

Evaluating the Impact of Changes to School-Level  
Alcohol Prevention Policies and Programs on Youth  
Binge Drinking: A Longitudinal Analysis of the  
Year 2 and Year 3 Data of the COMPASS Study

by

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## **Author's Declaration**

I hereby declare that I am the sole author of this thesis. This is a true copy of my thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

## Abstract

**Objective:** The purpose of this study was to investigate the effectiveness of alcohol prevention policies and programs implemented in a linked sample of Ontario COMPASS high schools in reducing youth binge drinking over time at both the population- and individual-levels.

**Methods:** This longitudinal study utilized the COMPASS Year 2 and 3 student- and school-level data obtained from the 16,491 linked students who had complete information for the binge drinking outcome measure as well as the relevant student-level covariates and who attended the same 77 Ontario high schools in both years. The COMPASS student-level questionnaire (Cq) was used to measure the relative student-level covariates as well as the binge drinking outcome measure. Binge drinking was measured using the question: “In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?” Students who indicated that they consumed 5 or more alcoholic drinks in one occasion either once a month or more frequently were classified as being current binge drinkers. Conversely, individuals who responded that they engaged in a similar pattern of alcohol consumption ranging from less than once a month to never were labelled as being non-current binge drinkers. School-level data regarding the changes in alcohol prevention policies and programs that occurred from Year 2 to Year 3 for this sample of schools was assessed using the Year 3 COMPASS School Policies and Practices (SPP) administrator questionnaire. Using this linked sample, a McNemar’s test was performed to see if there was any significant change in the prevalence of student binge drinking from Year 2 to Year 3. Difference-in-differences changes analyzed using a One-Way Analysis of Variance (ANOVA) and a longitudinal model analyzed using a Generalized Estimating Equation (GEE) were used to determine if changes in school-level alcohol prevention interventions between these two years were significantly associated with a change in the school-level prevalence of student binge drinking as well as with a change in individual student binge drinking behaviours, respectively, over time.

**Results:** At the population level, neither of the 19 specific alcohol prevention interventions ( $F = 1.00$ ,  $df_1 = 19$ ,  $df_2 = 3679$ ,  $p\text{-value} = 0.4631$ ) nor any of the 6 distinct intervention categories ( $F = 1.18$ ,  $df_1 = 6$ ,  $df_2 = 1553$ ,  $p\text{-value} = 0.3123$ ) were associated with a statistically significant relative reduction in the school-level prevalence of binge drinking from Year 2 to Year 3 when compared to the change observed in the pooled sample of control schools. Similarly, neither of the 19 specific alcohol prevention interventions ( $p\text{-value} = 0.6976$ ) nor any of the 6 distinct intervention categories ( $p\text{-value} = 0.5355$ ) were associated with a statistically significant increase or decrease in an average student’s risk of being a current binge drinker from Year 2 to Year 3 who attended an intervention school (or category) in comparison to the risk of a similar average student who attended one of the control schools while controlling for important student- and school-level covariates. As expected, the McNemar’s test showed that the proportion of current binge drinkers in the linked sample increased significantly over time as the cohort aged from 14.9% in Year 2 to 24.4% in Year 3 ( $p\text{-value} < .0001$ ).

**Implications and Conclusions:** Only 19 of the 77 Ontario high schools implemented new school-level alcohol prevention interventions between Year 2 and Year 3 with none of them being associated with a statistically significant decrease in binge drinking at the population or the individual level. However, a zero tolerance punishment policy and a student education program involving displays and pamphlets may have shown some potential for possibly having some public health impact on this behaviour at the individual level and should be further explored. Overall, the high school setting may not be the best place to intervene for this type of work and/or the current school-level alcohol prevention initiatives implemented in this province may be too simplistic in nature. Future research should evaluate the impact of more intricate programs that are only partially implemented within the high school environment as well as higher macro-level policies like increasing taxation on alcohol, increasing the minimum legal drinking age, and banning alcohol advertisements within Ontario as these may serve as more promising approaches for reducing youth binge drinking in this province. All of this is important since, unsurprisingly, the prevalence of binge drinking in this sample increased significantly over time as students aged. All in all, this is the first quasi-experimental longitudinal study to simultaneously evaluate the potential ability of multiple different high school-level alcohol prevention interventions to possibly reduce youth binge drinking in order to generate real-world evidence about this topic in Ontario.

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## **Chapter 1 – Introduction and overview**

Many Canadian youth binge drink and this behaviour is associated with numerous negative health outcomes such as road traffic accidents and suicide as well as the development of multiple chronic health problems later on in life (Miller et al., 2007; Karagulle et al., 2010; Jander et al., 2014). Both modifiable (i.e. marijuana use) and demographic (i.e. grade) individual factors as well as the school environment (i.e. school policies and programs) are associated with youth binge drinking (Leatherdale & Rynard, 2013; Leatherdale & Herciu, submitted). However, it may be more apt to target interventions at the school-level rather than the individual student-level as a means of high-risk alcohol consumption prevention as interventions that are designed to modify the school environment may have the potential for generating a larger population-level impact (Matson-Koffman et al., 2005). With binge drinking youth being more likely to continue practicing this behaviour later on in life, the high school environment may be a good place for trying to reduce and prevent binge drinking via alcohol prevention interventions given that the majority of youth are enrolled in high school where they feel like they receive the most education regarding alcohol's negative health effects (Han et al., 2014; Costello et al., 2012; Dick et al., 2011). Nevertheless, limited and unclear evidence exists regarding which specific types of interventions within the secondary school setting may be the most effective in reducing and preventing youth binge drinking (Costello et al., 2012; Leatherdale & Herciu, submitted). To clarify this, a longitudinal investigation of how changes in different school-level alcohol prevention policies and programs may impact student binge drinking was performed using data from the 16,491 students attending the 77 Ontario secondary schools who participated in Year 2 and Year 3 of the COMPASS study.

## **Chapter 2 – Literature review**

### **2.1 Recommended alcohol intake levels**

According to Canada's Low-Risk Alcohol Drinking Guidelines, in order to reduce the risk of experiencing injury and/or developing long-term health problems, it is recommended that women do not consume more than 10 drinks a week and no more than 2 drinks a day on most days (Butt et al., 2011). Similarly, it is recommended that men do not consume more than 15 drinks a week and no more than 3 drinks a day on most days; men should also not consume more than 4 drinks and women should not consume more than 3 drinks on one single occasion. These guidelines are in reference to one standard drink being equivalent to any one of the following: one 341 millilitre (ml) or 12 ounce (oz.) bottle of 5% alcohol beer, cider, or cooler; one 142 ml or 5 oz. glass of 12% alcohol wine; or one 43 ml or 1.5 oz. serving of 40% distilled alcohol (Butt et al., 2011). If the average person abides by these guidelines when consuming alcohol, he or she will usually experience no significant health effects. However, if individuals surpass such recommended drinking guidelines by binge drinking – where, in the last year, alcohol consumption may have reached or exceeded 4 standard drinks on one occasion for females and 5 for males –, they increase their risk of suffering an injury, experiencing harm, and/or developing chronic health problems later on in life (Centre for Addiction and Mental Health, 2008; Karagulle et al., 2010; Stolle, Sack & Thomasius, 2009; Jander et al., 2014).

### **2.2 Injury and harm as consequences of youth binge drinking**

It has been demonstrated that youth who binge drink are at an increased risk of suffering from many different types of injury and harm, some of which may be fatal. For instance, road traffic accidents due to drinking and driving or being a passenger of a driver who was found to be binge drinking is the main cause of death resulting from youth binge drinking (Stolle, Sack &

Thomasius, 2009). Likewise, suicide, attempted suicide, violence, being a victim of unwanted sexual activity, and other forms of injury are also some of the other short-term, acute health issues that can result from youth binge drinking (Stolle, Sack & Thomasius, 2009; Karagulle et al., 2010; Centers for Disease Control and Prevention, 2004; Cullen et al., 1999; Miller et al., 2007).

### **2.3 Binge drinking and chronic health problems in later life**

Youth binge drinking is also responsible for increasing the risk of developing one or more different chronic health conditions in later life such as alcohol-related fetal damage possibly resulting from binge drinking while pregnant during youth; infertility; neurotoxicity; brain damage and cognitive deficits; mood and personality disorders; oral, esophageal, larynx, and breast cancer-related morbidity and mortality; liver cirrhosis; heart disease; stroke; hypertension; high blood pressure; an increased risk for obtaining sexually transmitted diseases; and/or becoming overweight or obese (Stolle, Sack & Thomasius, 2009; Oesterle et al., 2004; Jander et al., 2014; Zeigler et al., 2005; Centers for Disease Control and Prevention, 2004; Cullen et al., 1999).

### **2.4 Prevalence of youth binge drinking in Ontario**

Although the prevalence of youth binge drinking has declined over time according to the Ontario Student Drug Use and Health Survey (OSDUHS), a large proportion of Ontario youth still engage in this behaviour which underlines the importance of reducing and preventing binge drinking among high school students (Centre for Addiction and Mental Health, 2013). Data from the 2013 wave of OSDUHS identified that the past year prevalence of binge drinking (having 5 or more alcoholic drinks in the past month) among those in grades 7-12 was 19.8% (CAMH, 2013). This was a significant decline compared to the past year prevalence of binge drinking

among this same age group that participated in the 1999 wave of OSDUHS which was 27.6%.

Despite a decline over time provincially, the rates of youth binge drinking in Ontario continue to remain high. According to the 2012-2013 self-reported COMPASS data, 22.9% of grade 9-12 students in Ontario were identified as being current binge drinkers (Leatherdale, 2015). This high prevalence of high school student binge drinking is significantly greater than that of middle school students where less than 5% of grade 7 students were classified as binge drinkers in 2011 according to OSDUHS (CAMH, 2013). Such numbers support the fact that the prevalence of binge drinking significantly increases with grade where there is a 326% increase in the prevalence of current binge drinking between grade 9 (8.6%) and 12 (36.7%) students according to the 2012-2013 COMPASS study results (Leatherdale & Rynard, 2013; Herciu et al., 2014; Leatherdale & Burkhalter, 2012; Leatherdale, 2015). These statistics clearly suggest that action must be taken to reduce the high prevalence of binge drinking in high school.

Youth who binge drink are also more likely to continue engaging in such a hazardous pattern of alcohol consumption later on in life (Wechsler et al., 1995; Dick et al., 2011; Englund et al., 2008; Pitkanen et al., 2005; McCarty et al., 2004; Oesterle et al., 2004; Guo et al., 2000). For instance, one study has shown that roughly 50% of males and one third of females who binge drank during adolescence also performed this behaviour in early adulthood in comparison to only 19% and 8% of their non-binge drinking adolescent counterparts, respectively (McCarty et al., 2004). Clearly, the current prevalence rates of this behaviour for youth are not on track to meet the Cancer 2020 target for Ontario where 98% of Ontarians are to practice safe alcohol consumption as proposed by the Centre for Addiction and Mental Health low-risk drinking guidelines (Canadian Cancer Society, 2006). Alcohol prevention efforts should therefore be

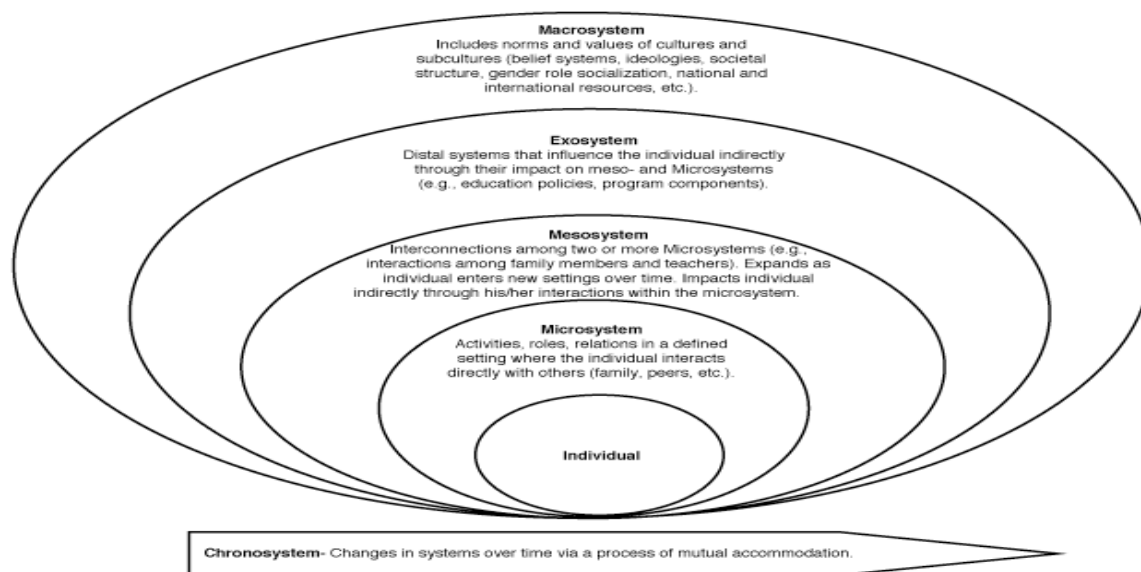
aimed at secondary school students given that this is the period where binge drinking starts to become a serious problem as well as a time when life-long behaviours begin to be formed.

## **2.5 Ecological models**

Using ecological models in youth binge drinking research can help to map out which factors should be taken into consideration as the most important influences affecting this behaviour. According to Bronfenbrenner's Ecological Model of Human Development (Figure 1), there are multiple levels of influence that affect, and which are affected by, human behaviour and development (Bronfenbrenner, 1977). These levels are: the individual level (i.e. one's age, gender, behaviours, perceptions, etc.), the microsystem (i.e. the relations that exist between a person and his or her immediate environment), the mesosystem (i.e. the interrelations between two or more major settings containing the person), the exosystem (i.e. an expansion of the mesosystem which does not contain the person but that includes other formal and informal social structures which immediately encompass the settings in which the person is found and therefore influence those settings), and the macrosystem (i.e. the overall cultural or subcultural institutional patterns – such as educational systems – which affect the expression of the micro-, meso-, and exosystems) (Bronfenbrenner, 1977; Bronfenbrenner, 1989). With respect to youth binge drinking, Kairouz & Adlaf (2003) have found that two levels which require special attention are individual student-level characteristics and characteristics of the school environment which are appropriate individual- and macro-level examples, respectively, of factors that may influence youth binge drinking. Some important individual student-level factors that may predict youth binge drinking are one's behaviours and perceptions associated with heavy drinking as well as one's age, gender, and ethnicity (Kairouz & Adlaf, 2003). At the school environment level, Kairouz & Adlaf (2003) suggested that an important factor affecting

student binge drinking is how tolerant a school is relative to student alcohol use via numerous factors that may include school-level policies and programs. Given that when both of these individual- and macro-levels were included in the model, in comparison to when only either one of the two were included, there was a significant increase in its fit justifies why both individual student-level characteristics as well as school-level policies and programs were examined as important and necessary factors for explaining high school youth binge drinking within this manuscript (Kairouz & Adlaf, 2003).

Figure 1: Bronfenbrenner's Ecological Model of Human Development adapted from Bronfenbrenner, 1989.



Reference: Bronfenbrenner, U. (1989). Ecological systems theory. *Annals of Child Development*, 6, 187-249.



## **2.6 Student-level factors affecting youth binge drinking in high school**

Individual-level factors and characteristics are important components of the ecological model which serve as key determinants of student binge drinking. These factors also have an influence on if and how the larger levels of the ecological model – such as the school environment – will shape one’s binge drinking behaviours. Previous research has determined that certain modifiable student behaviours and demographic characteristics may predict youth binge drinking behaviours.

### **2.6.1 Modifiable student behaviours**

There are a variety of different modifiable risk behaviours that have been determined to be associated with binge drinking among high school students. For example, binge drinking among high school students has been linked to being overweight or obese, being physically active, smoking tobacco, and using marijuana (Eichen et al., 2012; Oesterle et al., 2004; Rainey et al., 1996; McCaul et al., 2004; Wichstrom & Wichstrom, 2009; Herciu et al., 2014; Bedendo & Noto, 2015; Costello et al., 2012; Leatherdale & Ahmed, 2010; Feldman et al., 1999; Camenga et al., 2006; Field et al., 2002; Leatherdale, Hammond & Ahmed, 2008; Leatherdale & Burkhalter, 2012; Kirby & Barry, 2012). With the exception of being physically active, the co-occurrence of such behaviours alongside binge drinking amongst this population of high school students (Leatherdale & Rynard, 2013; Leatherdale, 2015; Costello et al., 2012) may further increase their risk of developing numerous different chronic diseases. As well, it is important to understand these associations between these behaviours and youth binge drinking given that alcohol prevention efforts may be able to also prevent some of these other unhealthy acts.

## **2.6.2 Demographic characteristics**

Aside from individual behaviours, it is important to acknowledge that there are also non-modifiable individual characteristics which are associated with youth binge drinking. Research has demonstrated that males are more likely than females to be current binge drinkers (Leatherdale & Rynard, 2013; Herciu et al., 2014; Leatherdale & Ahmed, 2010; Leatherdale, Hammond & Ahmed, 2008; Leatherdale, 2015; Costello et al., 2012; Hilarski, 2005; Kairouz & Adlaf, 2003). Furthermore, the prevalence of youth binge drinking has also been shown to increase with grade (Leatherdale & Rynard, 2013; Herciu et al., 2014; Leatherdale & Ahmed, 2010; Leatherdale, 2015; Leatherdale & Burkhalter, 2012; Coker & Borders, 2001; CAMH, 2013). High school students are also more likely to be current binge drinkers if they have more weekly spending money and/or if they are of White ethnicity (Herciu et al., 2014; Costello et al., 2012). Knowing the relationships between such personal features and binge drinking behaviours provides valuable information regarding how alcohol prevention efforts should be tailored around these non-modifiable characteristics in order for such interventions to achieve optimal effectiveness.

## **2.7 School-level factors affecting youth binge drinking in high school**

The high school environment is a good, but not ideal, setting for implementing youth alcohol prevention interventions by means of school-level policies and programs. One explanation for why this particular place may not serve as the perfect grounds to intervene in order to try and limit student binge drinking is because high school students do not frequently engage in this behaviour on school property (Centers for Disease Control and Prevention, 2009). Instead, youth enrolled in secondary school commonly state that the location where they most regularly binge drink is at another person's home (Centers for Disease Control and Prevention,

2009). Likewise, research also demonstrates that students who spend more evenings out with friends have a higher probability of binge drinking, with this behaviour being likely to occur off-school property such as at parties or other similar night-time social events (Patrick et al., 2013; Ramstedt et al., 2013).

Nevertheless, the school environment remains relevant to this context given that regardless of their socioeconomic status, all youth are allowed to attend high school. This results in a large majority of youth being enrolled in secondary school where roughly 90% of the youth population has access to this environment (Costello et al., 2012; Bauman & Phongsavan, 1999). With so many individuals being present within one environment for a significant period of time during the day, school-level alcohol prevention interventions may be able to target a large proportion of the high school student population. School-level policies and programs may have the potential to alter the rate of this behaviour especially given the existing link between student binge drinking and school-based alcohol prevention interventions (Costello et al., 2012; Leatherdale & Herciu, submitted; Poulin & Nicholson, 2005). As well, schools provide a natural setting for implementing and evaluating alcohol prevention interventions which allows for the development of practice based evidence in such real-world settings (Botvin & Griffin, 2007; Leatherdale et al., 2014).

The school environment also serves as a key binge drinking intervention site due to its ability to provide students with relevant alcohol prevention education. For example, students identify the school as the most common place for learning about the negative health effects associated with alcohol consumption (Han, Kim & Kim, 2014). For such reasons the school environment serves as a good place for drug refusal skills to be taught and for substance use norms to be corrected (Botvin & Griffin, 2007); the alcohol-related norms and harms that

students may learn in school have been found to be inversely related to the number of upper-year student drinkers (Kairouz & Adlaf, 2003). These educational interventions can be incorporated within the regular school curriculum given that many schools are required to provide drug education to their students (Botvin & Griffin, 2007).

Therefore, the high school environment offers an opportunity for alcohol prevention efforts to be enforced to students in order to try and reduce binge drinking behaviours. According to the literature, school-level policies and programs are important school-level environmental factors that affect youth binge drinking (Kairouz & Adlaf, 2003; Leatherdale & Herciu, submitted; Evans-Whipp et al., 2013; Griffin & Botvin, 2010; Gmel et al., 2012).

### **2.7.1 Current literature on high school alcohol prevention policies and programs**

#### Surveillance and punishment policies

Limited research exists on the effectiveness of high school alcohol prevention policies in reducing student binge drinking. As can be seen in Table 1, one study by Leatherdale & Herciu (submitted) evaluated the potential impact of high school alcohol prevention policies and programs implemented in Ontario COMPASS schools on binge drinking using the Year 1 and Year 2 longitudinal sample of students. During this time, two different schools implemented similar surveillance and punishment policies that included banning students caught under the influence of alcohol at school events from being able to enter such events and/or future events. Although for one of the schools a current binge drinking student at time 1 had a significantly lower likelihood of being a non-binge drinker at time 2 relative to a student who attended one of the control schools, results showed that such a significant difference was non-existent for the other school that implemented a similar policy (Leatherdale & Herciu, submitted). Furthermore, another study by Goldberg et al. (2007) investigated the ability of a random drug and alcohol

testing (DAT) intervention to reduce past month and past year illicit drug and alcohol use in high school athletes. For this surveillance and punishment policy, if a student was found to be consuming such substances, his or her parents would be notified and the student would be banned from continuing to participate in the respective athletic sport if he or she refused to receive counselling. At some of the follow-up time points, this intervention was associated with a significant decrease in students' past-year alcohol use with respect to the control schools (Goldberg et al., 2007).

### Counselling programs

Few studies have also explored the effectiveness of high school alcohol prevention programs. For instance, three different intervention schools implemented similar alcohol prevention programs that were based on addiction counselling for those with problematic alcohol use behaviours (Leatherdale & Herciu, submitted). As Table 1 illustrates, none of these interventions were found to be potentially effective in reducing or preventing individual student binge drinking behaviour, with such interventions actually appearing to possibly be associated with more student binge drinking relative to the control schools (Leatherdale & Herciu, submitted). Under this same type of intervention category, two other separate studies explored the ability of alcohol counselling programs rooted in motivational interviewing techniques to decrease alcohol use behaviours (Gmel et al., 2012; Mitchell et al., 2012). Although the brief group motivational interviewing techniques explored by Gmel et al. (2012) appeared to be ineffective in reducing heavy drinking, the brief motivational interviewing intervention assessed by Mitchell et al. (2012) appeared to be associated with a significant reduction in the frequency of drinking to intoxication among high school students.

### Programs with three or more different components

Moreover, the potential effectiveness of school-level alcohol prevention interventions involving more comprehensive programs that include three or more different components does not appear to be much clearer. One such multi-component program is the Schools Using Coordinated Community Efforts to Strengthen Students (SUCCESS) Project which consists of various interventions surrounding student education, counselling, and parental involvement (NCPC, 2009; Clark et al., 2010). A similar comprehensive program is Project Towards No Drug Abuse (TND) where students are also exposed to a variety of different educational, decision-making, social skills, and motivational development elements aimed towards reducing alcohol use behaviours (NCPC 2009; Griffin & Botvin, 2010; Gorman, 2014; Sussman et al., 2012). In a study conducted by Clark et al. (2010), it was revealed that there was no significant difference in the number of times that students drank until they got drunk in the past month between those attending SUCCESS intervention and those attending control alternative high schools. Although two separate studies explored the ability of Project TND to reduce student drunkenness, one showed a significant reduction in this measure while the other concluded that the program has mixed effects (Sussman et al., 2012; Gorman, 2014).

### Student education programs

Some literature also exists on high school-based alcohol prevention programs focused on student education. Two separate studies investigated the effectiveness of similar drug education interventions based on harm reduction, how to make good decisions regarding drug use, and improving knowledge about the harms and risks associated with substance use (Midford et al., 2012; Sloboda et al., 2009). In the study by Midford et al. (2012) it was revealed that junior high

school students who received such an intervention had a significantly lower likelihood of getting drunk relative to control students. Conversely, the opposite was found by Sloboda et al. (2009) where students who received this type of intervention in grade 7 and once again in grade 9 were significantly more likely to binge drink in grade 11 than students who were not exposed to this program. In a different investigation it was shown that junior secondary school students who perceived that they would receive alcohol education if they were found consuming alcohol, were exposed to an abstinence alcohol message, or were exposed to a harm minimization alcohol message at school experienced a significant reduction in the likelihood of student binge drinking one year later (Evans-Whipp et al., 2013).

#### Staff training and education programs

With respect to interventions focused on teaching and training school staff to administer alcohol prevention programs to high school students, two general types of interventions seem to be evaluated more commonly in the literature. The first kind involves trained school personnel delivering personality-targeted interventions to students whereas the second type consists of teachers learning about how they can reduce alcohol use among their students via educational interventions (Conrod et al., 2013; O’Leary-Barrett et al., 2010; Peleg et al., 2001; Strom et al., 2015). As shown in Table 1, although both staff-administered personality-targeted interventions generally showed potential in being able to effectively reduce binge drinking among students, only one of the two teacher-delivered educational programs was found to be associated with a positive effect on alcohol use relative to its control.

### Programs with two different components

A small proportion of the available scientific evidence appraising the ability of secondary school alcohol prevention approaches to impact student binge drinking has also focused on interventions that involve two different components. One such intervention is “Preventure” which utilizes motivational interviewing and cognitive behavioural therapy in order to reduce binge drinking among students with specific personality profiles; “Preventure” was not found to have a significant influence on student binge drinking in a study by Lammers et al. (2015). However, the “Resilient Families” intervention is a bi-component alcohol prevention method involving a social relationship curriculum as well as a parent education component that did significantly reduce the likelihood of students progressing towards a pattern of heavy alcohol consumption in Australian high school students (Toumbourou et al., 2013).



Table 1: Some high school-specific alcohol prevention policy and program interventions present within the literature and their suggested effectiveness based on the respective studies

<b>Type of Intervention</b>	<b>Description of Intervention</b>	<b>Target Grade (s)</b>	<b>Findings</b>	<b>Authors</b>
<i>Surveillance and punishment policy</i>	The school began conducting breathalyser tests at school events and students were required to pass these tests in order to be allowed to enter such events.	9-12	An intervention school current binge drinker in Y1 is significantly ( $p<0.1$ ) less likely to be a non-binge drinker in Y2 compared to a control school current binge drinker.	(Leatherdale & Herciu (submitted))
	A random drug and alcohol testing (DAT) intervention was implemented and directed towards high school athletes. Students testing positive for any use had their parents notified and would be banned from sports participation if they refused counselling.	9-12	No significant difference in past month illicit drug and alcohol use. However, intervention school athletes reported significantly less past year illicit drug and alcohol use relative to those in control schools at the second and third follow-up periods.	Goldberg et al., 2007
	The school banned students caught to be under the influence of alcohol at school events from attending future events.	9-12	No significant difference (at a p value of 0.1) in the likelihood of a current binge drinker in Y1 to be a non-binge drinker in Y2 between an intervention and control school student.	Leatherdale & Herciu (submitted)
	If one was found consuming alcohol at school, he or she would be expelled (based on student perceptions)	9	No significant change in the likelihood of student binge drinking (at 1 year follow-up)	Evans-Whipp et al., 2013
	If one was found consuming alcohol at school, the police would be called (based on student perceptions)	9	No significant change in the likelihood of student binge drinking (at 1 year follow-up)	Evans-Whipp et al., 2013
	If one was found consuming alcohol at school, he or she would be suspended (based on student perceptions)	9	No significant change in the likelihood of student binge drinking (at 1 year follow-up)	Evans-Whipp et al., 2013
<i>Student education programs</i>	The school began having a sequence of general information sessions and guest speakers during the school year.	9-12	An intervention school current binge drinker in Y1 is significantly ( $p<0.05$ ) more likely to be a non-binge drinker in Y2 compared to a control school current binge drinker.	(Leatherdale & Herciu (submitted))
	The school began having a sequence of general information sessions and one guest speaker from the local Public Health Unit.	9-12	An intervention school current binge drinker in Y1 is significantly ( $p<0.1$ ) less likely to be a non-binge drinker in Y2 compared to a control school current binge drinker.	Leatherdale & Herciu (submitted)
	Students found consuming alcohol at school would be instructed about its harms by a teacher (based on student perceptions)	8 <sup>a</sup>	Significant reduction in the likelihood of student binge drinking (at 1 year follow-up)	Evans-Whipp et al., 2013
	Students being exposed to an abstinence alcohol message (based on student perceptions)	8 <sup>a</sup>	Significant reduction in the likelihood of student binge drinking (at 1 year follow-up)	Evans-Whipp et al., 2013
	Students being exposed to a harm minimization alcohol message (based on student perceptions)	8 <sup>a</sup>	Significant reduction in the likelihood of student binge drinking (at 1 year follow-up)	Evans-Whipp et al., 2013
	A harm reduction focused drug education intervention addressing all drug use was conducted with alcohol receiving the greatest coverage.	8-9 <sup>a</sup>	Students who received the intervention were significantly less likely to consume alcohol and to get drunk in comparison to those in the control school.	Midford et al., 2012
	The universal school-based substance abuse prevention program, Take Charge of Your Life (TCYL) was delivered in 41 treatment schools and evaluated as a 5-year study.	7,9	A significantly greater number of intervention school 11 <sup>th</sup> grade students at follow-up reported higher past month drunkenness and past 14-day binge drinking than control students.	Sloboda et al., 2009
<i>Counselling programs</i>	The school had a mental health and addictions counsellor come in to school once a week.	9-12	An intervention school non-binge drinker in Y1 is significantly ( $p<0.05$ ) more likely to be a current binge drinker in Y2 compared to a control school non-binge drinker.	Leatherdale & Herciu (submitted)
	The school would refer at-risk students based on their alcohol use behaviours to alcohol addiction counselling	9-12	An intervention school current binge drinker in Y1 is significantly ( $p<0.1$ ) less likely to be a non-binge drinker in Y2 compared to a control school current binge drinker.	Leatherdale & Herciu (submitted)
	On-site mental health and addictions nurse which also links students with prevention services at the local PHU and hospital.	9-12	An intervention school non-binge drinker in Y1 is significantly ( $p<0.05$ ) more likely to be a current binge drinker in Y2 compared to a control school non-binge drinker.	Leatherdale & Herciu (submitted)

	Brief group motivational interviewing techniques for reducing heavy drinking for those considered to be at medium and high risk for heavy drinking	10-13	This type of intervention was shown to be ineffective in reducing heavy drinking for students at all levels of risk.	Gmel et al., 2012
	Behavioural Health Counselors (BHCs) delivered school-based screening, brief intervention, and referral to treatment programs	9-12	At the 6-month follow-up, students who received any of the interventions reported a significant reduction in the frequency of drinking to intoxication	Mitchell et al., 2012
<i>Staff training and education for staff-administered programs</i>	The Adventure trial was conducted where school staff were trained to provide brief personality-targeted interventions to students with high-risk profiles for alcohol use	9	This intervention had significant long-term effects on reducing binge drinking rates for high-risk youth and also reduced drinking rates in low-risk youth	Conrod et al., 2013
	Staff members were trained to administer teacher-delivered personality-targeted interventions	9	After 6 months, results showed statistically significantly lower binge-drinking rates for students who reported alcohol use at baseline	O'Leary-Barrett et al., 2010
	This was a 3 day staff-administered intervention which consisted of lectures and information sessions, life skills training, and student-parent activities	10	The rates of alcohol consumption did not change in the intervention group whereas these increased significantly in the control group at the one and two year post-intervention follow-up.	Peleg et al., 2001
	This teacher-delivered school-based alcohol prevention program used educational interventions centered on problem-based learning	8-9	At one-year follow-up, there was no significant difference between the intervention and control group in the frequency of monthly alcohol use.	Strom et al., 2015
<i>Two different intervention components</i>	A breathalyzer test was introduced at school events (entry into such events was dependent on passing this test). As well, a motivational speaker educated students about binge drinking.	9-12	No significant difference (at a p value of 0.1) in the likelihood of a current binge drinker/non-binge drinker in Y1 to be a non-binge drinker/current binge drinker in Y2 between an intervention and control school student.	Leatherdale & Herciu (submitted)
	The Resilient Families intervention involved students being exposed to a social relationship curriculum. As well, the students' parents were also provided with techniques to reduce alcohol abuse via parent education.	7-8 <sup>a</sup>	Students in the intervention schools experienced significant reductions in any lifetime use of alcohol as well as in the progression to frequent and heavy alcohol use relative to control school students.	Toumbourou et al., 2013
	"Preventure" is an intervention consisting of both motivational interviewing and cognitive behavioural therapy in order to try and reduce binge drinking in students with different, but specific, personality profiles.	8-10	The rates of student binge drinking were not significantly different between the intervention and control schools at one year follow-up.	Lammers et al., 2015
<i>Three or more different intervention components</i>	Project SUCCESS was implemented and consisted of drug prevention education, individual and group counselling, parent communication, and student referrals to community agencies.	9-12	No significant differences were observed between the intervention and control schools in terms of the number of occasions that alternative high school students drank to intoxication in the past 30 days	Clark et al., 2010
	Project TND was implemented and consisted of social, stress-coping, and decision-making skill development; drug education; and learning about how to have self-control and make good decisions	9-12	Mixed evidence exists overall regarding the ability of Project TND to reduce the prevalence of alcohol use or the prevalence of being drunk in students attending regular and/or continuation high schools	Gorman, 2014
	24 high schools were randomized to a standard care group, a TND classroom program only, or to a TND classroom program plus a motivational interviewing booster	9-12	After 1 year, both treatment groups showed significant reductions in past 30-day drunkenness with no significant differences between the two treatment groups	Sussman et al., 2012
	19 high schools were randomized to receive intervention 1 (student intervention involving educational lessons, school regulations, drug monitoring system, and parental involvement), 2 (parent intervention targeting parental rules for their children's alcohol use), or 3 (the combined student and the parent interventions).	9	After 10 months, the combined intervention significantly reduced heavy weekly drinking. After 22 months, the combined intervention did not have a statistically significant effect on heavy weekly drinking	Koning et al., 2009
Notes: <sup>a</sup> These studies were conducted in Victoria, Australia where secondary school consists of grades (years) 7-12.				

## 2.8 Research gaps

As illustrated in Table 1, the available research showing which high school-level alcohol prevention policies and programs may be able to potentially prevent or reduce student binge drinking is sparse. This is because the evaluation of alcohol prevention initiatives has largely been focused on the university and college settings with few studies assessing the impact of high school-based interventions (Foster, Neighbors & Pai, 2015; Wilson et al., 2016; Carey et al., 2007; Saltz et al., 2009; Turrisi et al., 2009). Out of the few existing studies that did focus on the high school environment, significant gaps are present in this limited body of evidence. For instance, mixed evidence exists regarding the effectiveness of alcohol prevention policies focused on surveillance and punishment, multi-component programs such as project TND, some comparable drug education programs, and teacher-administered educational programs in significantly impacting student binge drinking (Leatherdale & Herciu, submitted; Sussman et al., 2012; Gorman, 2014; Midford et al., 2012; Sloboda et al., 2009; Peleg et al., 2001; Strom et al., 2015). As well, the potential effectiveness of interventions like the surveillance and punishment DAT policy remains unclear as this policy was correlated with a significant reduction in past-year alcohol use at only the second and third of the four follow-up time points with respect to the control schools (Goldberg et al., 2007).

One other issue with the findings reported by these high school alcohol prevention intervention studies is that not all papers consistently investigated binge drinking per se as the outcome of interest with some having looked at the frequency of drinking to intoxication, getting drunk, or alcohol use in general (Mitchell et al., 2012; Midford et al., 2012; Peleg et al., 2001; Strom et al., 2015; Goldberg et al., 2007; Clark et al., 2010; Gorman, 2014; Sussman et al., 2012). Similarly, given that the risk of this behaviour is dependent on grade, it is also difficult to

interpret the possible success of such intervention methods since not all of the research has evaluated the effectiveness of such interventions on students present in the same grades. For example, the study by Gmel et al. (2012) included students in grades 10-13 whereas the one by Mitchell et al. (2012) looked at grade 9-12 students; similar discrepancies in the subjects' grades also exist in other studies investigating similar prevention programs (Midford et al., 2012; Sloboda et al., 2009; Peleg et al., 2001; Strom et al., 2015). As well, some of the research also looked at students who did not attend regular high schools or who were part of a certain type of student population with a specific risk for binge drinking (Clark et al., 2010; Gorman, 2014; Lammers et al., 2015).

Lastly, a large proportion of the papers listed in Table 1 conducted their evaluations using fairly small sample sizes meaning that the reliability of these results may be questionable given the reduced power of such studies (Goldberg et al., 2007; Midford et al., 2012; Gmel et al., 2012; Mitchell et al., 2012; O'Leary-Barrett et al., 2010; Peleg et al., 2001; Leatherdale & Herciu (submitted); Lammers et al., 2015; Clark et al., 2010). Similarly, many of these studies also investigated the potential effectiveness of such interventions under the artificial conditions of randomized controlled trials whose findings may differ if such initiatives were to be implemented within natural settings (Goldberg et al., 2007; Gmel et al., 2012; Conrod et al., 2013; O'Leary-Barrett et al., 2010; Peleg et al., 2001; Lammers et al., 2015; Clark et al., 2010; Sussman et al., 2012; Koning et al., 2009). As a result, this topic required further investigation in order to establish which high school-level alcohol prevention policies and/or programs may have real-world potential to be effective in reducing and/or preventing youth binge drinking.

## **Chapter 3 – Study rationale and research questions**

### **3.1 Study rationale**

With one in four Ontario high school students being identified as a current binge drinker, an alarmingly high number of youth are putting themselves at risk for being victims of injury and harm as well as developing numerous long-term health problems (Rehm et al., 2006; Stolle, Sack & Thomasius, 2009; Karagulle et al., 2010; Miller et al., 2007; Jander et al., 2014; Zeigler et al., 2005; Oesterle et al., 2004; Leatherdale, 2015). Nonetheless, the high school setting may be an appropriate place for implementing alcohol prevention efforts using policy- and program-specific interventions in order to try and mitigate this problem (Kairouz & Adlaf, 2003; Leatherdale et al., 2014; Costello et al., 2012; Leatherdale & Herciu, submitted; Botvin & Griffin, 2007).

The longitudinal quasi-experimental analysis of the Year 2 and Year 3 Ontario COMPASS study data contributed more practice-based evidence to the high school alcohol prevention literature and helped clarify which specific school-level alcohol prevention programs and policies may have potential to effectively reduce and/or prevent student binge drinking. The proposed study also addressed the previously mentioned gaps in the current research by simultaneously evaluating various different alcohol prevention interventions which have recently been implemented specifically within the Ontario high school environment. This investigation exclusively measured the outcome of binge drinking as this is the alcohol use behaviour associated with the most negative health effects; it did this in a sample of only grade 9-12 students attending regular high schools who were at all levels of risk for this behaviour. As all students in this sample were in the same grades and attended either private or public regular high schools, the interventions evaluated within this study can be more easily compared in terms of their potential effectiveness. Finally, with the inclusion of a significantly larger sample size

relative to the aforementioned studies, this investigation produced more reliable findings in this specific topic area.

### **3.2 Research questions**

This research primarily focused on the following questions related to the linked sample:

**Research Question 1:** Was there a significant change in the prevalence of binge drinking between Year 2 and Year 3 for the 9-12<sup>th</sup> grade students?

**Research Question 2:** Did changes in school-level alcohol prevention policies and programs between Year 2 and Year 3 lead to a significant change in the school-level prevalence of binge drinking over time for each school that experienced a change in its alcohol prevention interventions versus the combined sample of schools that did not?

**Research Question 3:** Did changes in school-level alcohol prevention policies and programs between Year 2 and Year 3 lead to a significant change in student binge drinking behaviours over time while adjusting for the effects of important student- and school-level covariates on binge drinking?

For reference, out of the 18,490 students who attended the same 77 Ontario secondary schools that participated in the study in both Year 2 and Year 3, 18,382 of those students answered the question “In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?” in both years and 16,491<sup>1</sup> of them had complete student-level data for both of these two years and therefore made up the linked, longitudinal sample used for this particular investigation.

### 3.3 Hypotheses

**Research Question 1 Hypothesis:** I expect the prevalence of current binge drinking to significantly increase from Year 2 to Year 3 among this linked sample of grade 9-12 students attending these respective 77 Ontario secondary schools of the COMPASS study. I hypothesize this because binge drinking increases with grade (and age) meaning that a student is more likely to be a current binge drinker in Year 3 than in Year 2 assuming that the student has moved up a grade between these two years (i.e. from grade 10 to grade 11) (Leatherdale & Rynard, 2013; Herciu et al., 2014; Leatherdale, 2015; Leatherdale & Burkhalter, 2012).

**Research Question 2 Hypothesis:** Between Year 2 and Year 3, I expect there to be a significantly greater relative decrease (or less of a relative increase) in the school-level prevalence of binge drinking for each school that experienced one or more changes in the following similar school-level alcohol prevention interventions relative to the combined sample of schools that did not: 2 different intervention changes involving a surveillance/punishment

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<sup>1</sup> 397 students who indicated that they have ever had 5 drinks of alcohol or more on one occasion in Year 2 but who also said that they have never had 5 drinks of alcohol or more on one occasion in Year 3 as well as 1,494 more students who did not have complete information in both years for the student-level covariates used (except for body mass index (BMI)) for the longitudinal analysis were removed from the sample of 18,382 students because their information was deemed to be unreliable or incomplete. This process yielded a final linked sample of 16,491 students.

policy and a student education program as well as a separate student education program involving a sequence of general information sessions and guest speakers. I expect this because this was also observed between Year 1 and Year 2 of the COMPASS Study for some of the schools that implemented such changes (Leatherdale & Herciu, submitted).

**Research Question 3 Hypothesis:** I hypothesize that some of the interventions identified in Research Question #2 will significantly reduce an individual student's propensity to binge drink at Year 3. For instance, if in Year 3 a school adopted a type of program where students were educated about this behaviour by being exposed to alcohol prevention messaging, then I suspect that this will significantly reduce the likelihood of binge drinking behaviours at the individual level at that school from Year 2 to Year 3 relative to the change seen in the control schools (Evans-Whipp et al., 2013). Similarly, if in Year 3 a school adopted a policy where individuals who were caught consuming alcohol at school would be suspended or expelled then, based on deterrence theory, I predict that this will also be associated with a significantly reduced likelihood of binge drinking behaviours at the individual level at that school from Year 2 to Year 3 relative to the change seen in the control schools (Evans-Whipp et al., 2013).



## Chapter 4 – Methodology

### 4.1 Host study – The COMPASS Study

The foundation for this project stemmed from the Canadian Institutes of Health Research (CIHR) funded COMPASS study, a prospective cohort study collecting hierarchical longitudinal data from a convenience sample of 89 secondary schools and the 50,000+ grade 9 to 12 students attending those schools in Ontario and Alberta (Leatherdale et al., 2014). Using quasi-experimental methods, COMPASS is the first to examine how ongoing changes in school policies, programs, and the built environment characteristics are related to multiple youth health behaviours and outcomes over time (Compass, 2014). The original cohort study was funded for 4 years (2012-2016) of data collection and program and policy evaluation. This study involved a longitudinal analysis of the Year 2 and Year 3 student- and school-level COMPASS data collected from a convenience sample of 77 Ontario high schools with a total of 16,491 students which had complete data for the outcome measure and relevant covariates in both the second and third year of the study.<sup>2</sup> More information regarding the COMPASS study is available in print (Leatherdale et al., 2014) or online ([www.compass.uwaterloo.ca](http://www.compass.uwaterloo.ca)).

### 4.2 Conceptual framework for COMPASS

The conceptual framework for COMPASS takes into account the needs of school stakeholders and researchers with this program being created to: allow local health and education systems to plan, tailor, and assess interventions; engage researchers in real-world studies that produce practice-based evidence from assessing natural experiments as interventions are

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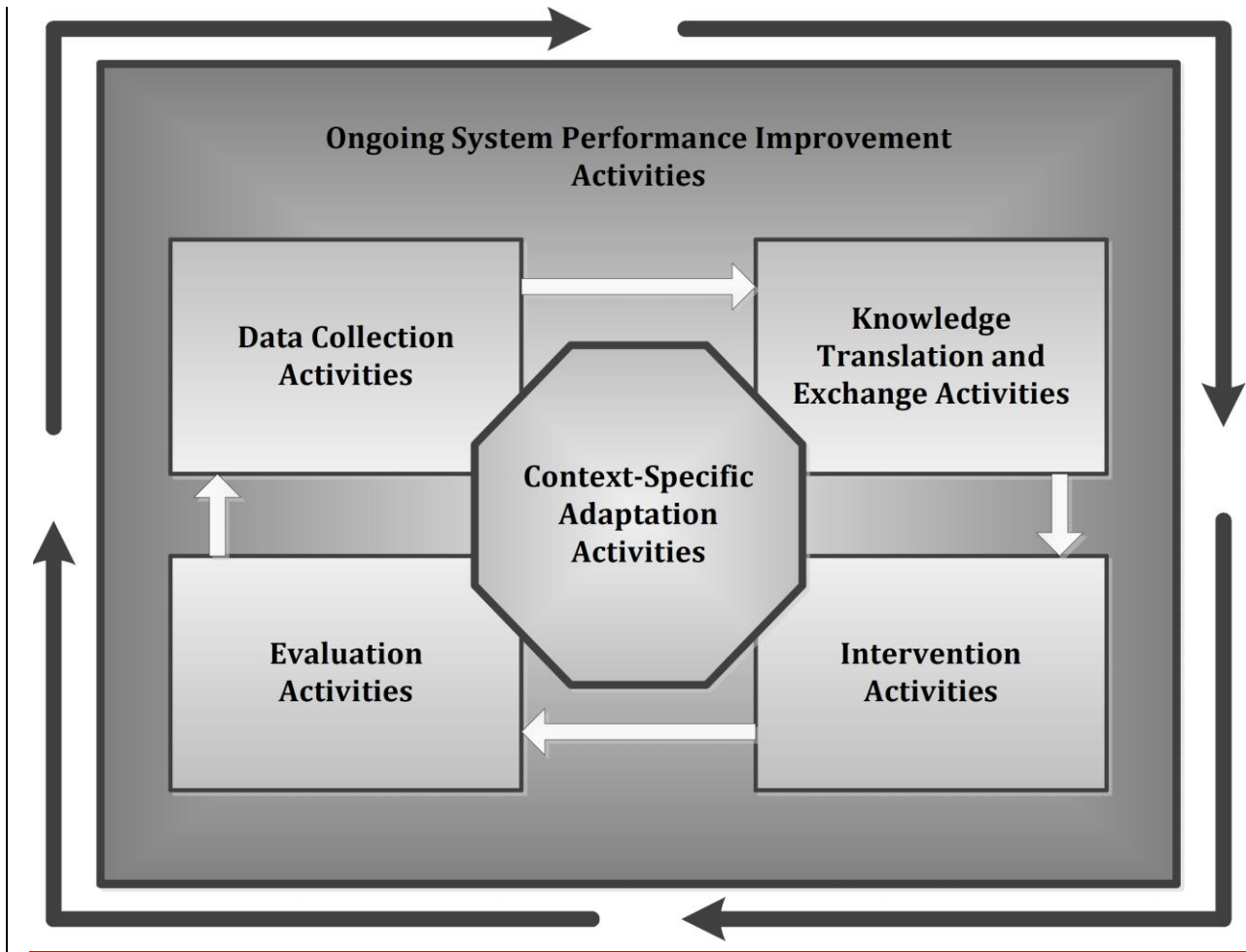
<sup>2</sup> The data from Years 2 and 3 were the most appropriate for this longitudinal analysis because (i) the Year 1 school sample size was lower than the intended target since only 43 Ontario secondary schools were included in that sample, and (ii) the Year 4 data has not yet been collected (Leatherdale, 2014). The larger data set from Year 2 and Year 3 allowed for a more reliable assessment (in terms of power) of the changes in school-level alcohol prevention interventions with the results being more generalizable in comparison to the results based on the Year 1 and Year 2 data. Data from only the Ontario secondary schools were used given the purpose of examining how different school-, and not provincial-level, alcohol policies and programs were associated with youth binge drinking behaviour.

implemented in schools and communities; and offer a platform to support and study the processes and structures that are necessary for effectively transferring and exchanging knowledge in school settings (Figure 2) (Leatherdale et al., 2014). Consistent with the concepts that are part of Systems Thinking, such goals are achieved through a continuous cycle that joins transdisciplinary research and practice (Leischow et al., 2008). COMPASS members include both researchers and practitioners who envision a future in which schools and communities are sustained by system models that enable them to identify the best opportunities to improve youth health, recognize effective and feasible intervention approaches, access timely intervention resources, and use a practical data collection and feedback platform to continuously guide, evaluate, refine, and learn from their work (Leatherdale et al., 2014).

Figure 2 – Conceptual Framework for the COMPASS Study<sup>3</sup>



<sup>3</sup> Reference: Leatherdale, S.T. (2016). Chapter 13: Shaping the direction of youth health with COMPASS: a research platform for evaluating natural experiments and generating practice-based evidence in school-based prevention. Population Health Intervention Research: Geographical Perspectives. Eds. Harrington, D., McLafferty, S., Elliot, S.. Ashgate Publishers, 2016.



## 4.3 COMPASS methods

### 4.3.1 School sampling

A purposeful sample of Ontario school boards were approached and asked if they wanted to participate in the COMPASS study (Leatherdale et al., 2014). School boards were eligible to participate only if they oversaw English-speaking secondary schools and allowed for active-information passive-consent parental permission protocols (Leatherdale et al., 2014). This type of permission protocol involved all of the students' parents being informed that their child(ren) would partake in the study and unless the parents would actively withdraw their child(ren) from

the data collection, it was assumed that the child(ren) was/were given consent to participate and was/were included in the study. This sort of consent has previously been established to be suitable in measuring youth health risk behaviours (Flicker & Guta, 2008; Rojas et al., 2008; White et al., 2004; Hollmann & McNamara, 1999).

#### **4.3.2 School recruitment – Year 2**

Eligible secondary schools were asked if they wanted to participate in the COMPASS study only if their respective school boards allowed them to do so and if their school boards had given the schools permission for active-information passive-consent (Compass, 2013; Leatherdale et al., 2014). Aside from having this type of parental permission protocols, schools were also required to contain students in grades 9 to 12 with over 100 students in each grade in order to be included in the study (Leatherdale et al., 2014). As an outcome of this procedure, a convenience sample of 79 Ontario secondary schools was recruited to be part of the Year 2 data. This number increased from 43 Ontario high schools in Year 1 (Leatherdale et al., 2014).

#### **4.3.3 School recruitment – Year 3**

This same procedure was also carried out in Year 3 where a total of 78 Ontario secondary schools made up that year's data with one Year 2 school having dropped out of the study. However, out of these 78 secondary schools, one of the schools was a first-year school which did not participate in Year 2. As a result, a total of 77 Year 3 schools which also participated in Year 2 were included in the longitudinal analysis for this study.

#### **4.3.4 Student recruitment**

Active-information passive-consent permission protocols were used to recruit eligible students from the recruited schools to participate in the study (Leatherdale et al., 2014). This entailed a COMPASS study information letter being sent to the parent(s) and/or guardian(s) of the eligible students, providing them with a description of the study protocols. This letter also provided the parent(s) and/or guardian(s) with both a phone number as well as an email address by which they could contact the COMPASS recruitment coordinator in the scenario that they did not want their child(ren) to participate in the study (Leatherdale et al., 2014). If a parent or guardian did not contact the COMPASS recruitment coordinator in order to withdraw his or her child(ren), that/those student(s) was/were considered eligible to be included within the study. However, aside from this, students were also able to decline to take part in or withdraw from the study at any point during this process or during the data collection (Leatherdale et al., 2014). This procedure was the same for both Year 2 and Year 3.

#### **4.3.5 Student sample – Year 2**

This procedure yielded a total of 52,529 total students enrolled in the 79 Ontario Year 2 participating secondary schools where 41,734 of these students took part in the study (participation rate of 79.5% with a 1.2% refusal rate and with other students not completing the survey either because they were absent on the day of administration or because they chose not to complete the survey during class time).

#### **4.3.6 Student sample – Year 3**

This same procedure was also carried out in Year 3 where a total of 49,773 students were enrolled in the 78 Ontario Year 3 participating secondary schools where 39,013 of these students took part in the study (participation rate of 78.4% with a 0.7% refusal rate and with other students not completing the survey either because they were absent on the day of administration or because they chose not to complete the survey during class time).

#### **4.3.7 Student sample – linkage between Year 2 and Year 3**

The overall longitudinal sample of 18,490 students was obtained by linking the Year 2 and Year 3 student responses using a unique, anonymous 6-digit alpha-numeric code that was created for each completed COMPASS student-level questionnaire ( $C_q$ ) (Qian et al., 2015). This was done using the responses to 5 specific questions that are found on the front cover of the  $C_q$  which are only designed for linkage purposes alongside the response to the question about the student's sex. The Year 2 and Year 3 codes for each student within each school were compared by record where if the code for a particular student's record in Year 2 matched the code for that same student's record in Year 3 on at least 5 out of the 6 digits, these two records were considered to be a match. If a student answered "No" to the question "Did you attend this school last year?" for the Year 3  $C_q$ , if the difference in a student's indicated grade between Year 2 and Year 3 was less than zero or greater than one, or if the difference in age was greater than two between Year 2 and Year 3 then that student was excluded from the linkage process (Qian et al., 2015). The fewer number of students that participated in the study in both years in comparison to the number of students that participated in the study in either Year 2 or Year 3 was due to a variety of factors. For instance, students in Year 2 were not linked if they did not complete the

Year 2 C<sub>q</sub> (i.e. because of spares and absenteeism on the scheduled C<sub>q</sub> data collection date or due to student or parental refusal), if they were grade 12 students graduating from the high school, if they were students transferring out to other high schools, or if the students dropped out of school in Year 3. Similarly, students in Year 3 were not linked if they did not complete the Year 3 C<sub>q</sub> (i.e. because of spares and absenteeism on the scheduled C<sub>q</sub> data collection date or due to student or parental refusal), if they were grade 9 students who were newly admitted into high school, or if they were students transferring in from other high schools (Qian et al., 2015). Although most grade 12 students did go on to graduate in Year 2 and most grade 9 students were not included in the final linked sample in Year 3 because they were not in high school in Year 2, some of these individuals (403 grade 12 students in Year 2 and 25 grade 9 students in Year 3) were still included in the linked sample if they failed to pass their respective grade in Year 2 and stayed behind another year in Year 3. This method for linking student data has been shown to be robust and to produce high linkage rates (Bredin & Leatherdale, 2013). Each student's data was linked to his or her respective school-level data from Year 2 to Year 3 using School ID (Bredin & Leatherdale, 2013; Qian et al., 2015). For more information regarding the linking process please refer to the manuscript titled "Assessing longitudinal data linkage results in the COMPASS study: Technical Report Series, Volume 3, Issue 4" (Qian et al., 2015) and to the paper titled "Methods for linking COMPASS student-level data over time" by Bredin and Leatherdale (2013).

After this linking process was complete, 108 students were removed from the linked sample of 18,490 because they did not answer the question "In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?" in both Year 2 and Year 3 of the study. Although the excluded sample of 108 students consisted of a significantly higher proportion of

current binge drinkers than that found in the sample of 18,382 students who did provide information for this outcome measure in both years (Qian et al., 2015), this bias was evenly distributed among the intervention and control schools; tables and calculations illustrating the distribution of this bias can be found in Appendix C. From this new linked sample of 18,382 individuals, 397 more students were excluded as their data was considered to be unreliable because they answered either “I did not have 5 or more drinks on one occasion in the last 12 months”, “less than once a month”, “once a month”, “2 to 3 times a month”, “once a week”, “2 to 5 times a week”, or “daily or almost daily” for this question in Year 2 and also answered “I have never done this” in Year 3. Similarly, 1,494 more students were excluded from this linked sample because they did not provide complete student-level information for all of the covariates used (except for body mass index (BMI)) in this longitudinal analysis in both years. Such modifications resulted in a final linked sample of 16,491 students that had complete student-level data and were included in the analyses for this project.

#### **4.4 Data sources**

This investigation used and analyzed both the student- and school-level information obtained from the Year 2 (2013-2014) and Year 3 (2014-2015) of the COMPASS study. The Year 2 and Year 3 COMPASS student-level questionnaires (Cq) were used to obtain information regarding student-level binge drinking and the Year 3 School Policies and Practices (SPP) administrator questionnaire was used to collect data regarding the different changes in school-level alcohol prevention policies and programs that may have occurred from Year 2 to Year 3. Student behavioural data from Year 2 was linked to that of Year 3 in order to assess how student binge drinking may have changed over this period of time.



#### **4.4.1 School-level data collection – School Policies and Practices (SPP) Questionnaire**

In order to measure the changes in the different types of school-level alcohol prevention policies and programs between Year 2 and Year 3 for the 77 Ontario schools, the COMPASS School Policies and Practices (SPP) administrator questionnaire was used. This annual questionnaire is to be filled out by the school staff member(s) who has/have the most knowledge regarding the respective school's policy and program environment (Leatherdale et al., 2014). For each of the behavioural categories measured by the COMPASS student-level questionnaire (Cq), the SPP gathers information regarding whether a school does or does not have relevant policies and programs related to that particular health behaviour and if any changes have occurred to such regulations from one year to another. The SPP has been designed after a similar, previously validated tool – the Healthy School Planner (Pan Canadian Joint Consortium for School Health, 2014) – however, the SPP has been adapted to cover a wider variety of school policies and programs while also being shorter in length relative to the Healthy School Planner tool (Leatherdale et al., 2014). During a school's student-level data collection, COMPASS staff also collected the completed SPP survey from each school as well as any other relevant documents (i.e. school policy handbook). The Year 1 SPP contains the baseline information regarding a particular school's policies, practices, environmental changes, or relationships whereas the Year 2 and Year 3 SPPs assess if, and what, changes have been made to such protocols since the previous year. A copy of the Year 3 SPP questionnaire can be found in Appendix B.

#### **4.4.2 Student-level data collection – COMPASS Student Questionnaire (Cq)**

The COMPASS student-level questionnaire (Cq) collects self-reported data related to obesity, sedentary behaviour, physical activity, healthy eating, tobacco use, alcohol use, marijuana use, bullying, academic outcomes, amount of sleep, and demographic factors (e.g., age, gender, income, and ethnicity) for each individual student using both scientific- and practice-based measures (Leatherdale et al., 2014). The Cq uses self-reported instead of objective measures due to the active-information passive-consent and the large-scale multiple school-based nature of the data collections. Cq items such as the ones measuring tobacco use, fruit and vegetable consumption, overweight and obesity, sedentary behaviour, and physical activity have been shown to be valid and reliable in measuring youth health behaviours (Leatherdale & Laxer, 2013; Wong, Leatherdale & Manske 2006; Wong et al., 2012; Leatherdale, Laxer & Faulkner, 2014). Measures used in the Cq are also consistent with those used in national surveillance tools or those used in current national public health guidelines (Elton-Marshall et al., 2011; Canadian Society for Exercise Physiology: Canadian Physical Activity Guidelines for Youth, 2013; Canadian Society for Exercise Physiology: Canadian Sedentary Behaviour Guidelines for Youth, 2013; Health Canada: Eating Well with Canada's Food Guide, 2014). The same Cq was used for both Year 2 and Year 3 data collections where the survey was completed by students during the 30-40 minute allotted class time on the day of their school's scheduled data collection. A copy of the COMPASS student-level questionnaire can be found in Appendix A.

## **4.5 Measures**

The data from the Year 2 and Year 3 COMPASS student-level questionnaire (Cq) was used to analyze the prevalence of current binge drinking for both Year 2 and Year 3 using measures that are consistent with previous research and national surveillance tools. In order to measure the changes in the different types of school-level alcohol prevention policies and programs within each school between Year 2 and Year 3, the Year 3 School Policies and Practices (SPP) administrator questionnaire data was used.

### **4.5.1 COMPASS binge drinking question**

The number of students defined as current binge drinkers was established for each of the 77 Ontario secondary schools in Year 2 and Year 3 using the COMPASS Student-level questionnaire (Cq) data. The question that was used to examine student-level current binge drinking within the Cq was consistent with a similar measure that was used in the 2010-2011 Youth Smoking Survey (YSS) (now currently called the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS)), a nationally representative school-based surveillance tool for youth health behaviours (Leatherdale et al., 2014; Leatherdale & Rynard, 2013; Elton-Marshall et al., 2011). This measure of student binge drinking used the question, “In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?” Based on the answer to this question, current binge drinking was treated as a dichotomous variable: a student was either classified as a current binge drinker or a non-current binge drinker. Students who answered that they consumed 5 or more alcoholic drinks in one sitting either ‘once a month’, ‘2 to 3 times a month’, ‘once a week’, ‘2 to 5 times a week’, or ‘daily’ were labelled as being current binge drinkers (coded as 1). Those students who answered ‘less than once a month’, ‘I did not have 5

or more drinks on one occasion in the last 12 months’, or ‘I have never done this’ were categorized as being non-current binge drinkers (coded as 0 and served as the reference group). This binge drinking measure was taken from CSTADS in order to remain consistent with the national student binge drinking estimates (Leatherdale & Rynard, 2013). However, some researchers state that consuming 5 or more drinks on one occasion is defined as binge drinking only for males whereas for females binge drinking can occur if only 4 or more drinks are consumed on one occasion (CAMH, 2008). Since the COMPASS measure for student binge drinking was designed to be consistent with the measure used for CSTADS, this measure is not gender-specific as it only examines if individuals consumed 5, not 4, drinks of alcohol or more on one occasion. Therefore, given the limitations of this measure used in the host study, only the binge drinking measure that looked at the consumption of 5 or more drinks of alcohol on one occasion was examined.

#### **4.5.2 School-level alcohol policies and programs measures**

The data collected using the Year 3 School Policies and Practices (SPP) administrator questionnaire was used to investigate if any school-level alcohol prevention policies and programs changed from Year 2 to Year 3 and what those changes entailed for the 77 Ontario schools that participated in the study’s second and third year. This was measured by asking administrators, “Have any changes been made since last school year? *Please provide details on a) whether past policies, practices, environment and relationships are still in place, and b) whether any new policies, practices, environment changes or relationships are planned or being implemented*” under the “Alcohol and Drug Use” section. For this question, respondents were supposed to answer either ‘Yes – If yes, please provide details’ or ‘No’ to multiple categories

including: ‘Policy Changes’, ‘Practice Changes’, ‘Environment or equipment Changes’, and ‘Changes with relationships with Public Health’. For each category the answers were coded as (Yes=1/No=2; if 1 + text, enter text listed; if 1 + no text, enter 88 (missing); if 2, enter 77 (valid skip)). If the school administrator indicated any sort of policy or program change(s) in the school’s alcohol prevention protocol within the Year 3 SPP, then that particular change(s) was recorded for each specific school with such schools being classified as intervention schools. Each intervention school was coded as unique with “1” representing the specific type of intervention change associated with intervention school 1, “2” representing the specific type of intervention change associated with intervention school 2, and so on (coded from 1 to 19). If no change(s) in such protocol was/were indicated in the Year 3 SPP for a particular school, then that respective school was labelled as a control school (coded as 0). This process resulted in 19 individual intervention schools<sup>4</sup> and 58 control schools collapsed into one group. Additionally, these 19 intervention schools were also grouped<sup>5</sup> into 6 different categories according to the general type of change experienced (each were coded from 1 to 6). For the Ontario schools that joined the study in Year 2 and also continued participating in Year 3, the same procedure took place with the only difference being that their Year 2 SPP<sup>6</sup> was analyzed instead of their Year 3 SPP. A table describing the different interventions that were added from Year 2 to Year 3 for each of the 19 intervention schools can be found in Appendix D.

To solidify this process, the COMPASS knowledge broker – a COMPASS team member who is in continuous contact with each school’s administrator – personally verified with each

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<sup>4</sup> 3 schools added different surveillance and punishment policies; 6 schools added different student education programs; 3 schools added different counselling programs; 2 schools added different staff training and education programs; 3 schools each added two different alcohol/drug prevention policies and/or programs; and 2 schools each added three different alcohol/drug prevention programs.

<sup>5</sup> Group 1 = surveillance and punishment policy changes; Group 2 = student education program changes; Group 3 = counselling program changes; Group 4 = staff training and education program changes; Group 5 = two different intervention changes in alcohol/drug prevention policies and/or programs; and Group 6 = three different intervention changes in alcohol/drug prevention programs.

<sup>6</sup> The Year 2 SPP asked the same question as the Year 3 SPP with respect to if any change(s) has been made in the school’s alcohol prevention protocol from the previous year.

school administrator if and what changes in alcohol prevention policies and/or programs occurred between Year 2 and Year 3 in order to ensure that the most current information was being used. The knowledge broker also obtained any other information from each school's respective administrator regarding the changes in alcohol prevention interventions that may have been missed or not indicated on the SPP. The information provided by this procedure was used in order to investigate what school-level alcohol prevention policies and/or programs changed between Year 2 and Year 3 in the 77 Ontario COMPASS schools and how this may have affected youth binge drinking in order to identify potentially effective school-level interventions that could possibly reduce and/or prevent this behaviour.

#### **4.5.3 Student-level measures**

Data regarding both demographic and behavioural student-level characteristics are collected by the COMPASS Student-level questionnaire (Cq). Consistent with Leatherdale & Rynard (2013) and with Leatherdale (2015), coding of the demographic and modifiable behavioural characteristics was as follows:

##### *Demographic characteristics:*

Gender: Participating students were asked, "Are you female or male?" Individuals who indicated that they were 'Female' were coded as "0" and served as the reference group whereas students who answered that they were 'Male' were coded as "1".

Grade: The students involved in completing the survey were asked, "What grade are you in?" These individuals selected answers ranging from 'Grade 9' to 'Grade 12'. The 'Grade 9' answer option served as the reference group for all of the models and was coded as "0". The 'Grade 10', 'Grade 11', and 'Grade 12' answer options were coded as "1", "2", and "3", respectively. Only

grade (not age) was considered in this analysis given the strong correlation between grade and age as well as the more relevant application of grade within the school setting.

Ethnicity: Participating students were asked “How would you describe yourself? (*Mark all that apply*)” Individuals were able to choose from the following response options: ‘White’, ‘Black’, ‘Asian’, ‘Aboriginal (First Nations, Métis, Inuit)’, ‘Latin American/Hispanic’, and/or ‘Other’.

Individual students who indicated that they were any ethnicity other than just ‘White’ or a mix of ethnicities other than just ‘White’ were coded as “0” and served as the reference group.

Contrastingly, individuals who indicated that they were only ‘White’ were coded as “1”.

Weekly spending money: Participating students were asked, “About how much money do you usually get each week to spend on yourself or to save? (*Remember to include all money from allowances and jobs like baby-sitting, delivering papers, etc.*)” The answer options included: ‘Zero’, ‘\$1 to \$5’, ‘\$6 to \$10’, ‘\$11 to \$20’, ‘\$21 to \$40’, ‘\$41 to \$100’, ‘\$More than \$100’, and ‘I do not know how much money I get each week’. This question was used as an alternative measure to estimate the student’s socioeconomic status. Consistent with previous research, the response categories for this question were collapsed into fewer categories (Leatherdale & Burkhalter, 2012; Elton-Marshall, Leatherdale & Burkhalter, 2012; Cole, Leatherdale & Burkhalter, 2013). The response option ‘Zero’ served as the reference group and was coded as “0”; ‘\$1 to \$5’, ‘\$6 to \$10’, and ‘\$11 to \$20’ were all coded as “1”; ‘\$21 to \$40’ and ‘\$41 to \$100’ were coded as “2”; ‘More than \$100’ was coded as “3”; and ‘I do not know how much money I get each week’ was coded as “missing”.

*Modifiable characteristics:*

Overweight and obesity: Participating students were asked, “How tall are you without your shoes on? (Please write your height in feet and inches OR in centimeters, and then fill in the

appropriate numbers for your height.)” and “How much do you weight without your shoes on? (Please write your weight in pounds OR in kilograms, and then fill in the appropriate numbers for your weight.)” (Leatherdale & Laxer, 2013). For the response options, students were able to indicate their appropriate height and weight number or to choose the response option “I don’t know” for each question. In order to measure overweight and obesity, the body mass index (BMI) measure was used which was based on the self-reported height and weight measurements and calculated using the equation:  $\text{kg/m}^2$ . Students’ BMIs were labelled as ‘normal’ (was coded as “0” and served as the reference group), ‘underweight’ (was coded as “1”), ‘overweight’ (was coded as “2”), or ‘obese’ (was coded as “3”) based on the World Health Organization cut offs (Leatherdale & Laxer, 2013). Given the high prevalence of missing BMI information in self-report studies among youth, students who had missing information regarding their height and/or their weight were still kept in the analysis and were labelled as ‘not stated’ (were coded as “4”) (Leatherdale, 2015; Arbour-Nicitopoulos, Falukner, & Leatherdale; 2010).

Physical activity: Consistent with Wong, Leatherdale & Manske (2006), moderate/vigorous physical activity (MVPA) was measured by asking participating students, “Mark how many minutes of HARD physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time” and “Mark how many minutes of MODERATE physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school evenings, and spare time. Do not include time spent doing hard physical activities.” With respect to what “HARD” and “MODERATE” physical activity entail, “HARD physical activities include jogging, team sports, fast dancing, jump-rope, and any other physical activities that increase your heart rate and make you breathe hard and sweat” and “MODERATE physical activities include



lower intensity activities such as walking, biking to school, and recreational swimming.” For each day of the week, the response options allowed students to indicate how much time they spent performing both “HARD” and “MODERATE” physical activity using a combination of 0, 1, 2, 3, or 4 hours and 0, 15, 30, or 45 minutes. Consistent with the Canadian physical activity guidelines for youth, students who indicated that they achieved less than 60 minutes of MVPA on one or more days of the past week were coded as “0”, serving as the reference group, and were classified as ‘not meeting the guidelines’ (CSEP, 2014). Individuals who indicated that they achieved 60 or more minutes of MVPA on each and every day of the past week were coded as “1” and were classified as ‘meeting the guidelines’.

Tobacco Use: Consistent with Wong et al. (2012), participating students were asked, “Have you ever smoked 100 or more whole cigarettes in your life? The two possible answers for this question included ‘Yes’ or ‘No’. Students were also asked, “On how many of the last 30 days did you smoke one or more cigarettes?” The possible answers for this question included: ‘None’, ‘1 day’, ‘2 to 3 days’, ‘4 to 5 days’, ‘6 to 10 days’, ‘11 to 20 days’, ‘21 to 29 days’, or ‘30 days (*every day*)’. Consistent with Leatherdale (2015), Leatherdale & Rynard (2013), and Elton-Marshall, Leatherdale & Burkhalter (2011), students who reported that they have never smoked 100 or more whole cigarettes in their life were classified as ‘never smokers’ and were coded as “0”, serving as the reference group. Individuals who had ever smoked 100 or more whole cigarettes in their life but who did not smoke one or more cigarettes in the last 30 days were labelled as ‘former smokers’ and were coded as “1”. Lastly, students who indicated that they have ever smoked 100 or more whole cigarettes in their life and who stated that they did smoke one or more cigarettes in the last 30 days were classified as ‘current smokers’ and were coded as “2”.

Marijuana Use: Participating students were asked, “In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash)” The response options for this question included: ‘I have never used marijuana’, ‘I have used marijuana but not in the last 12 months’, ‘Less than once a month’, ‘Once a month’, ‘2 or 3 times a month’, ‘Once a week’, ‘2 or 3 times a week’, ‘4 to 6 times a week’, or ‘Every day’. Consistent with Leatherdale (2015) and with Leatherdale & Rynard (2013), students who answered ‘I have never used marijuana’, ‘I have used marijuana but not in the last 12 months’, or ‘Less than once a month’ were identified as ‘non-current marijuana users’ and were coded as “0”, serving as the reference group. Those individuals who claimed that they used marijuana ‘Once a month’, ‘2 or 3 times a month’, ‘Once a week’, ‘2 or 3 times a week’, ‘4 to 6 times a week’, or ‘Every day’ were labelled as ‘current marijuana users’ and were coded as “1”.

#### **4.5.4 School-level descriptive measures**

To classify the *school location* for each participating school, the 2011 Canadian Census data was used (Statistics Canada, 2012). Schools that were classified as being ‘Only Rural’ must have been located in an area that had a population size less than 1,000 people or a population density that was less than 400 people per square kilometre. Schools that were classified as being ‘Small Urban’ must have been located in an area that had a population size between 1,000 and 29,000 people with a population density of at least 400 people per square kilometre. A school was considered to be ‘Medium Urban’ if it was situated in an area that had a population size between 30,000 to 99,000 people and a population density of at least 400 people per square kilometre. Finally, a school was considered to be ‘Large Urban’ if it was located in an area that had a population of 100,000 people or more and a population density of at least 400 people per

square kilometre. ‘Small Urban’ schools were coded as “0” and served as the reference group whereas ‘Medium Urban’, ‘Large Urban’, and ‘Only Rural’ were coded as “1”, “2”, and “3”, respectively.

In order to get an idea regarding the size of each particular school, *school enrolment* was used. ‘Small Schools’ were defined as those that had 500 students or less and were coded as “0”, serving as the reference group. ‘Medium Schools’ were defined as those that had anywhere from 501 to 1,000 students and were coded as “1” and ‘Large Schools’ were defined as those that had 1,001 students or more and were coded as “2”.

In order to compare private and public schools, a *school type* variable was used. ‘Public Schools’ were classified as those schools that received their funding from the Public school board or the Catholic school board and were coded as “0”, serving as the reference group. ‘Private Schools’ were defined as schools that had independent funding and were coded as “1”.

## 4.6 Data analysis

### 4.6.1 Data analysis for Research Question 1

In order to address this particular research question, a McNemar's test was used to determine if there was a significant change in the prevalence of binge drinking between these two years for this linked sample.

### 4.6.2 Data analysis for Research Question 2

Using the linked sample, difference-in-differences changes analyzed using a One-Way Analysis of Variance (ANOVA) were used in order to simultaneously investigate if there was a significant difference between the change in the school-level prevalence of binge drinking for each intervention school relative to the mean change in the school-level prevalence of binge drinking for the pooled sample of control schools over time (from Year 2 to Year 3). If the ANOVA results indicated that at least one of the schools experienced a significant change in its school-level prevalence of binge drinking from Year 2 to Year 3, then a Dunnett's test was performed to identify which specific intervention school(s) change(s) was/were significantly different than the change experienced by the (common) control schools. To illustrate this, the difference in the change of proportions was defined as:

$$\Delta P_{Diff}^{(i)} = \Delta P_i - \Delta P_C ,$$

where,  $\Delta P_i$  represented the change in proportion observed in the  $i^{\text{th}}$  intervention school such that  $\Delta P_i = P_i^{(at\ year\ 3)} - P_i^{(at\ year\ 2)}$ , with  $P_i^{(at\ year\ j)}$  represented the proportion of students who were classified as being current binge drinkers in the  $i^{\text{th}}$  intervention school at time  $j$  for  $j = 2,3$ ;

$\Delta P_C$  represented the pooled estimate for the change in proportion observed in the control schools.

In other words, if  $C$  represented the index set of control schools, then

$$\Delta P_C = \frac{\sum_{k \in C} w_k (P_k^{(at\ year\ 3)} - P_k^{(at\ year\ 2)})}{\sum_{k \in C} w_k},$$

where,  $P_k^{(at\ year\ j)}$  represented the proportion of students who were classified as being current binge drinkers in the  $k^{th}$  control school at time  $j$  for  $j=2,3$  and  $w_k$  was the  $k^{th}$  school's sampling weight.

Additionally, a similar type of analysis was conducted in a separate model where the 19 different intervention schools were compiled into 6 distinct intervention categories based on the similarity of initiatives implemented between Year 2 and Year 3. This was done to explore the potential ability of the different general types of intervention changes to have some impact on reducing the school-level prevalence of binge drinking over time. This yielded six intervention categories each coming from a larger sample size which provided increased power to determine if a general intervention type may have potential to be associated with a significant reduction in the school-level prevalence of binge drinking over time.

### **4.6.3 Data analysis for Research Question 3**

In order to answer this research question, a longitudinal model was used to explore if the changes in school-level alcohol prevention interventions that occurred between Year 2 and Year 3 were associated with a significant change in an average student's binge drinking behaviours. Given the three level (schools, students, and time) hierarchical structure of this longitudinal data, the Generalized Estimating Equation (GEE) method was used in order to account for the within-school and within-student associations.

For this model, the schools where no changes occurred between Year 2 and Year 3 in their alcohol prevention interventions were categorized as the control (i.e. referent) group. Relative Risk (RR) was used as a method of measuring the change in an intervention school student's probability of being a current binge drinker over time relative to a student from the control school. In our context, a  $RR < 1$  would imply that the probability of a student from an intervention school being a current binge drinker in Year 3 (relative to Year 2) is lower than that of a student from a control school. As a result, the following log binomial model

$$\log(\pi_{it}) = \alpha_0 + \mathbf{X}_{it}\boldsymbol{\alpha} + \mathbf{G}_i\boldsymbol{\beta}_1 + Year_t \boldsymbol{\beta}_2 + (\mathbf{G}_i \times Year_t) \boldsymbol{\gamma}$$

was used to estimate the RR where

$\mathbf{X}_{it}$  represents the set of student-level covariates such as gender, grade, etc.;

$\boldsymbol{\alpha}$  represents the effects of these covariates with  $Year_t = 1$  for Year 3 and 0 for Year 2;

$\mathbf{G}_i$  represents a matrix of indicators such that  $G_{ik} = 1$  if a student  $i$  is from the  $k^{th}$  intervention school for  $k = 1, \dots, 19$  and  $G_{ik} = 0$  if a student  $i$  is from a control school;

and the interaction effect  $\boldsymbol{\gamma} = (\gamma_1, \dots, \gamma_{19})'$  is the parameter of interest with  $\exp(\gamma_k)$

denoting the RR of a student  $i$  from the  $k^{th}$  intervention school relative to a student  $i$  from the control schools for  $k = 1, \dots, 19$  over time.

In the above model, the Intervention x Year effect (Intervention Impact) was of primary interest as this provided information regarding the effect that one or more changes in school-level alcohol prevention protocols in each individual intervention school had on the relative increase or decrease in the probability that an average student in that intervention school was a current binge drinker from Year 2 to Year 3 relative to a similar student who attended one of the control schools. This model simultaneously evaluated the potential effectiveness of each intervention change for each intervention school (in comparison to the control schools) in

reducing a student's binge drinking behaviours over time.

A similar type of analysis was also performed in a second model which compiled the 19 different intervention schools in the previous model into 6 different intervention categories based on the similarity of initiatives implemented between Year 2 and Year 3. In this model, the Intervention Impact was again of primary interest. This model simultaneously evaluated the potential effectiveness of each intervention type (in comparison to the control schools) in reducing a student's binge drinking behaviours over time.

According to the youth binge drinking literature, the following student- and school-level covariates were deemed to have a significant influence on this behaviour and were therefore included in the analyses of these longitudinal models in order to reduce the risk of confounding: gender, grade, ethnicity, weekly spending money, overweight and obesity status, moderate-to-vigorous physical activity, tobacco use, marijuana use, school location, school size, and school type. Both the Year 2 and Year 3 data were used for these covariates except for gender, ethnicity, school location, and school type where only their Year 2 values were used with the assumption that these would remain constant in Year 3. The PROC GENMOD procedure in SAS (9.4) was used to perform these GEE statistical analyses with schools being treated as a cluster and students as a sub-cluster of the schools. It was assumed that the within-school and within-student associations were the same for all schools.

## **4.7 Ethics**

The COMPASS study has received ethics approval from the University of Waterloo's Office of Research Ethics. The ethics approval has been extended for the data used by the current study and this occurred on October 7, 2013 and September 12, 2014 for the Year 2 and Year 3 datasets, respectively.



## Chapter 5 – Results

### 5.1 Descriptive results for student-level characteristics in Year 2

In Year 2, out of the linked sample of 16,491 students who had complete student-level information and attended the same 77 Ontario schools in both years, 53.6% self-identified as female and 46.4% self-identified as male (this is the same as in Year 3). In this same year, 39.0% self-identified as being in grade 9, 33.0% in grade 10, 25.9% in grade 11, and 2.1% in grade 12<sup>7</sup>. Furthermore, 85.1% (n=14,037) of these individuals were identified as non-current binge drinkers and 14.9% (n=2,454) were identified as current binge drinkers in Year 2.

#### 5.1.1 Descriptive results for students in Year 2 by gender

As can be seen in Table 2, it was observed that a greater proportion of males than females reported being in grade 9 whereas a greater proportion of females than males reported being in grade 10 and 11. A greater percentage of females than males also reported having \$21-100 of weekly spending money whereas a greater percentage of males than females reported having \$100+ of weekly spending money. When testing the association between binge drinking status and gender as well as between various student-level covariates and gender in Year 2, it was determined that grade (p-value <0.0001), weekly spending money (p-value <0.0001), overweight and obesity status (p-value <0.0001), moderate to vigorous physical activity (MVPA) (p-value <0.0001), tobacco use (p-value = 0.0004), and marijuana use (p-value = 0.0008) were significantly associated with gender. For more information regarding the Year 2 student-level descriptive statistics by gender, please refer to Table 2.

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<sup>7</sup> These are the individuals who stayed behind another year in Year 3 (i.e. for reasons such as failing a grade in Year 2).

Table 2: Descriptive statistics for the Ontario grade 9-12 students in the Year 2 (2013-2014) linked sample of the COMPASS Study by gender

		Females N=8836	Males N=7655	Total N=16491	Chi Square
Outcome Measure					
Binge Drinking	Non-current binge drinker	7551 (85.5%)	6486 (84.7%)	14037 (85.1%)	$\chi^2=1.7$ , df=1, p-value=0.1900
	Current binge drinker	1285 (14.5%)	1169 (15.3%)	2454 (14.9%)	
Demographic Characteristics					
Grade	9	3348 (37.9%)	3078 (40.2%)	6426 (39.0%)	$\chi^2=37.3^*$ , df=3, p-value<.0001
	10	2974 (33.7%)	2471 (32.3%)	5445 (33.0%)	
	11	2370 (26.8%)	1898 (24.8%)	4268 (25.9%)	
	12 <sup>a</sup>	144 (1.6%)	208 (2.7%)	352 (2.1%)	
Ethnicity	Other	1944 (22.0%)	1730 (22.6%)	3674 (22.3%)	$\chi^2=0.8$ , df=1, p-value=0.3568
	White	6892 (78.0%)	5925 (77.4%)	12817 (77.7%)	
Weekly Spending Money	\$0	1609 (18.2%)	1517 (19.8%)	3126 (19.0%)	$\chi^2=68.5^*$ , df=4, p-value<.0001
	\$1-20	3093 (35.0%)	2708 (35.4%)	5801 (35.2%)	
	\$21-100	2231 (25.3%)	1720 (22.5%)	3951 (24.0%)	
	\$100+	704 (8.0%)	828 (10.8%)	1532 (9.3%)	
	I don't know (8)	1199 (13.6%)	882 (11.5%)	2081 (12.6%)	
Modifiable Behaviours					
Overweight and Obesity (BMI)	Normal	5588 (63.2%)	4140 (54.1%)	9728 (59.0%)	$\chi^2=319.2^*$ , df=4, p-value<.0001
	Underweight	142 (1.6%)	122 (1.6%)	264 (1.6%)	
	Overweight	962 (10.9%)	1303 (17.0%)	2265 (13.7%)	
	Obese	316 (3.6%)	615 (8.0%)	931 (5.7%)	
	Not Stated	1828 (20.7%)	1475 (19.3%)	3303 (20.0%)	
MVPA	Did not meet the guidelines	5183 (58.7%)	3403 (44.5%)	8586 (52.1%)	$\chi^2=331.5^*$ , df=1, p-value<.0001
	Met the guidelines	3653 (41.3%)	4252 (55.6%)	7905 (47.9%)	
Tobacco Use	Never smoker	8637 (97.8%)	7417 (96.9%)	16054 (97.4%)	$\chi^2=15.7^*$ , df=2, p-value=0.0004
	Former smoker	40 (0.5%)	31 (0.4%)	71 (0.4%)	
	Current smoker	159 (1.8%)	207 (2.7%)	366 (2.2%)	
Marijuana Use	Non-current marijuana user	8095 (91.6%)	6898 (90.1%)	14993 (90.9%)	$\chi^2=11.2^*$ , df=1, p-value=0.0008
	Current marijuana user	741 (8.4%)	757 (9.9%)	1498 (9.1%)	
<p>Notes: * at a p-value of &lt; 0.05            MVPA = moderate to vigorous physical activity            BMI = body mass index  <sup>a</sup> These are the individuals who stayed behind another year in Year 3 (i.e. for reasons such as failing a grade in Year 2)</p>					

### **5.1.2 Descriptive results for students in Year 2 by binge drinking status**

Table 3 illustrates the student-level descriptive statistics by binge drinking status for the COMPASS linked sample in Year 2. From this, it can be seen that a greater proportion of students who were considered to be overweight were current binge drinkers than the proportion of students who were underweight or normal weight and who were current binge drinkers. It was also observed that a higher percentage of students who met the guidelines for moderate to vigorous physical activity (MVPA) were current binge drinkers than the percentage of those who did not meet the guidelines and who were current binge drinkers. A greater proportion of current smokers than former smokers were current binge drinkers and a greater proportion of former smokers than never smokers were current binge drinkers. Lastly, a much greater proportion of current marijuana users than non-current marijuana users were observed to be current binge drinkers. When testing the association between the various student-level covariates listed in Table 3 and binge drinking status in Year 2, it was determined that grade (p-value <0.0001), ethnicity (p-value <0.0001), weekly spending money (p-value <0.0001), overweight and obesity status (p-value = 0.0003), moderate to vigorous physical activity (MVPA) (p-value <0.0001), tobacco use (p-value <0.0001), and marijuana use (p-value <0.0001) were significantly associated with binge drinking status. For more information regarding the Year 2 student-level descriptive statistics by binge drinking status, please refer to Table 3.

Table 3: Descriptive statistics for the Ontario grade 9-12 students in the Year 2 (2013-2014) linked sample of the COMPASS Study by binge drinking status

		Non-Current Binge Drinker N=14037	Current Binge Drinker N=2454	Total N=16491	Chi Square
Demographic Characteristics					
Gender	Females	7551 (85.5%)	1285 (14.5%)	8836 (53.6%)	$\chi^2=1.7$ , df=1, p-value=0.1900
	Males	6486 (84.7%)	1169 (15.3%)	7655 (46.4%)	
Grade	9	5986 (93.2%)	440 (6.9%)	6426 (39.0%)	$\chi^2=720.3^*$ , df=3, p-value<.0001
	10	4589 (84.3%)	856 (15.7%)	5445 (33.0%)	
	11	3220 (75.5%)	1048 (24.6%)	4268 (25.9%)	
	12 <sup>a</sup>	242 (68.8%)	110 (31.3%)	352 (2.1%)	
Ethnicity	Other	3223 (87.7%)	451 (12.3%)	3674 (22.3%)	$\chi^2=25.3^*$ , df=1, p-value<.0001
	White	10814 (84.4%)	2003 (15.6%)	12817 (77.7%)	
Weekly Spending Money	\$0	2887 (92.4%)	239 (7.7%)	3126 (19.0%)	$\chi^2=695.0^*$ , df=4, p-value<.0001
	\$1-20	5168 (89.1%)	633 (10.9%)	5801 (35.2%)	
	\$21-100	3113 (78.8%)	838 (21.2%)	3951 (24.0%)	
	\$100+	1041 (68.0%)	491 (32.1%)	1532 (9.3%)	
	I don't know (8)	1828 (87.8%)	253 (12.2%)	2081 (12.6%)	
Modifiable Behaviours					
Overweight and Obesity (BMI)	Normal	8248 (84.8%)	1480 (15.2%)	9728 (59.0%)	$\chi^2=20.9^*$ , df=4, p-value=0.0003
	Underweight	235 (89.0%)	29 (11.0%)	264 (1.6%)	
	Overweight	1887 (83.3%)	378 (16.7%)	2265 (13.7%)	
	Obese	788 (84.6%)	143 (15.4%)	931 (5.7%)	
	Not Stated	2879 (87.2%)	424 (12.8%)	3303 (20.0%)	
MVPA	Did not meet the guidelines	7521 (87.6%)	1065 (12.4%)	8586 (52.1%)	$\chi^2=86.8^*$ , df=1, p-value<.0001
	Met the guidelines	6516 (82.4%)	1389 (17.6%)	7905 (47.9%)	
Tobacco Use	Never smoker	13880 (86.5%)	2174 (13.5%)	16054 (97.4%)	$\chi^2=875.1^*$ , df=2, p-value<.0001
	Former smoker	37 (52.1%)	34 (47.9%)	71 (0.4%)	
	Current smoker	120 (32.8%)	246 (67.2%)	366 (2.2%)	
Marijuana Use	Non-current marijuana user	13455 (89.7%)	1538 (10.3%)	14993 (90.9%)	$\chi^2=2784.6^*$ , df=1, p-value<.0001
	Current marijuana user	582 (38.9%)	916 (61.2%)	1498 (9.1%)	
Notes: * at a p-value of < 0.05 MVPA = moderate to vigorous physical activity BMI = body mass index. <sup>a</sup> These are the individuals who stayed behind another year in Year 3 (i.e. for reasons such as failing a grade in Year 2)					

## **5.2 Descriptive results for student-level characteristics in Year 3**

At this second time point, 0.1% of students self-identified as being in grade 9<sup>8</sup>, 38.9% in grade 10, 33.1% in grade 11, and 27.9% in grade 12. As well, 75.6% (n=12,463) of these individuals were considered to be non-current binge drinkers whereas 24.4% (n=4,028) were considered to be current binge drinkers in Year 3.

### **5.2.1 Descriptive results for students in Year 3 by gender**

As can be seen in Table 4, it was observed that a greater proportion of males than females reported being current binge drinkers in Year 3. In this same year, a greater proportion of males than females were in grade 10 whereas a greater proportion of females than males were in grade 11 and 12. With respect to ethnicity, a greater percentage of females than males reported being White. A greater percentage of females than males also reported having \$21-100 of weekly spending money whereas a greater percentage of males than females reported having \$100+ of weekly spending money in Year 3. When testing the association between binge drinking status and gender as well as between various student-level covariates and gender in Year 3, it was determined that binge drinking status (p-value <0.0001), grade (p-value = 0.0037), ethnicity (p-value = 0.0198), weekly spending money (p-value <0.0001), overweight and obesity status (p-value <0.0001), moderate to vigorous physical activity (MVPA) (p-value <0.0001), tobacco use (p-value <0.0001), and marijuana use (p-value <0.0001) were significantly associated with gender. For more information regarding the Year 3 student-level descriptive statistics by gender, please refer to Table 4.

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<sup>8</sup> These are the individuals who remained in the same grade in Year 3 as in Year 2 (i.e. for reasons such as failing a grade in Year 2).

Table 4: Descriptive statistics for the Ontario grade 9-12 students in the Year 3 (2014-2015) linked sample of the COMPASS Study by gender

		Females N=8841	Males N=7650	Total N=16491	Chi Square
Outcome Measure					
Binge Drinking	Non-current binge drinker	6849 (77.5%)	5614 (73.4%)	12463 (75.6%)	$\chi^2=37.0^*$ , df=1, p-value<.0001
	Current binge drinker	1992 (22.5%)	2036 (26.6%)	4028 (24.4%)	
Demographic Characteristics					
Grade	9 <sup>a</sup>	7 (0.1%)	15 (0.2%)	22 (0.1%)	$\chi^2=13.5^*$ , df=3, p-value=0.0037
	10	3349 (37.9%)	3071 (40.1%)	6420 (38.9%)	
	11	2982 (33.7%)	2469 (32.3%)	5451 (33.1%)	
	12	2503 (28.3%)	2095 (27.4%)	4598 (27.9%)	
Ethnicity	Other	1889 (21.4%)	1750 (22.9%)	3639 (22.1%)	$\chi^2=5.4^*$ , df=1, p-value=0.0198
	White	6952 (78.6%)	5900 (77.1%)	12852 (77.9%)	
Weekly Spending Money	\$0	1266 (14.3%)	1206 (15.8%)	2472 (15.0%)	$\chi^2=53.3^*$ , df=4, p-value<.0001
	\$1-20	2338 (26.4%)	2030 (26.5%)	4368 (26.5%)	
	\$21-100	2623 (29.7%)	2005 (26.2%)	4628 (28.1%)	
	\$100+	1636 (18.5%)	1669 (21.8%)	3305 (20.0%)	
	I don't know (8)	978 (11.1%)	740 (9.7%)	1718 (10.4%)	
Modifiable Behaviours					
Overweight and Obesity (BMI)	Normal	5724 (64.7%)	4238 (55.4%)	9962 (60.4%)	$\chi^2=321.7^*$ , df=4, p-value<.0001
	Underweight	90 (1.0%)	108 (1.4%)	198 (1.2%)	
	Overweight	1054 (11.9%)	1369 (17.9%)	2423 (14.7%)	
	Obese	385 (4.4%)	708 (9.3%)	1093 (6.6%)	
	Not Stated	1588 (18.0%)	1227 (16.0%)	2815 (17.1%)	
MVPA	Did not meet the guidelines	5380 (60.9%)	3466 (45.3%)	8846 (53.6%)	$\chi^2=398.6^*$ , df=1, p-value<.0001
	Met the guidelines	3461 (39.2%)	4184 (54.7%)	7645 (46.4%)	
Tobacco Use	Never smoker	8481 (95.9%)	7130 (93.2%)	15611 (94.7%)	$\chi^2=60.6^*$ , df=2, p-value<.0001
	Former smoker	54 (0.6%)	71 (0.9%)	125 (0.8%)	
	Current smoker	306 (3.5%)	449 (5.9%)	755 (4.6%)	
Marijuana Use	Non-current marijuana user	7712 (87.2%)	6328 (82.7%)	14040 (85.1%)	$\chi^2=66.0^*$ , df=1, p-value<.0001
	Current marijuana user	1129 (12.8%)	1322 (17.3%)	2451 (14.9%)	
<p>Notes: * at a p-value of &lt; 0.05            MVPA = moderate to vigorous physical activity            BMI = body mass index  <sup>a</sup> These are the individuals who remained in the same grade in Year 3 as in Year 2 (i.e. for reasons such as failing a grade in Year 2)</p>					

### 5.2.2 Descriptive results for students in Year 3 by binge drinking status

Table 5 illustrates the student-level descriptive statistics by binge drinking status for the COMPASS linked sample in Year 3. From this, it can be seen that a greater proportion of students who were considered to be overweight were current binge drinkers than the proportion of students who were underweight or who did not state their weight and who were current binge drinkers. It was also observed that a higher percentage of students who met the guidelines for moderate to vigorous physical activity (MVPA) were current binge drinkers than the percentage of those who did not meet the guidelines and who were current binge drinkers. A greater proportion of current smokers than former smokers were current binge drinkers and a greater proportion of former smokers than never smokers were current binge drinkers. Lastly, a much greater proportion of current marijuana users than non-current marijuana users were observed to be current binge drinkers. When testing the association between the various student-level covariates listed in Table 5 and binge drinking status in Year 3, it was determined that gender (p-value <0.0001), grade (p-value <0.0001), ethnicity (p-value <0.0001), weekly spending money (p-value <0.0001), overweight and obesity status (p-value <0.0001), moderate to vigorous physical activity (MVPA) (p-value <0.0001), tobacco use (p-value <0.0001), and marijuana use (p-value <0.0001) were significantly associated with binge drinking status. For more information regarding the Year 3 student-level descriptive statistics by binge drinking status, please refer to Table 5.

Table 5: Descriptive statistics for the Ontario grade 9-12 students in the Year 3 (2014-2015) linked sample of the COMPASS Study by binge drinking status

		Non-Current Binge Drinker N=12463	Current Binge Drinker N=4028	Total N=16491	Chi Square
<b>Demographic Characteristics</b>					
Gender	Females	6849 (77.5%)	1992 (22.5%)	8841 (53.6%)	$\chi^2=37.0^*$ , df=1, p-value<.0001
	Males	5614 (73.4%)	2036 (26.6%)	7650 (46.4%)	
Grade	9 <sup>a</sup>	19 (86.4%)	3 (13.6%)	22 (0.1%)	$\chi^2=386.2^*$ , df=3, p-value<.0001
	10	5319 (82.9%)	1101 (17.2%)	6420 (38.9%)	
	11	4059 (74.5%)	1392 (25.5%)	5451 (33.1%)	
Ethnicity	12	3066 (66.7%)	1532 (33.3%)	4598 (27.9%)	$\chi^2=46.4^*$ , df=1, p-value<.0001
	Other	2906 (79.9%)	733 (20.1%)	3639 (22.1%)	
Weekly Spending Money	White	9557 (74.4%)	3295 (25.6%)	12852 (77.9%)	$\chi^2=755.4^*$ , df=4, p-value<.0001
	\$0	2184 (88.4%)	288 (11.7%)	2472 (15.0%)	
	\$1-20	3612 (82.7%)	756 (17.3%)	4368 (26.5%)	
	\$21-100	3252 (70.3%)	1376 (29.7%)	4628 (28.1%)	
	\$100+	2048 (62.0%)	1257 (38.0%)	3305 (20.0%)	
	I don't know (8)	1367 (79.6%)	351 (20.4%)	1718 (10.4%)	
<b>Modifiable Behaviours</b>					
Overweight and Obesity (BMI)	Normal	7430 (74.6%)	2532 (25.4%)	9962 (60.4%)	$\chi^2=57.2^*$ , df=4, p-value<.0001
	Underweight	174 (87.9%)	24 (12.1%)	198 (1.2%)	
	Overweight	1795 (74.1%)	628 (25.9%)	2423 (14.7%)	
	Obese	809 (74.0%)	284 (26.0%)	1093 (6.6%)	
	Not Stated	2255 (80.1%)	560 (19.9%)	2815 (17.1%)	
MVPA	Did not meet the guidelines	7099 (80.3%)	1747 (19.8%)	8846 (53.6%)	$\chi^2=226.1^*$ , df=1, p-value<.0001
	Met the guidelines	5364 (70.2%)	2281 (29.8%)	7645 (46.4%)	
Tobacco Use	Never smoker	12212 (78.2%)	3399 (21.8%)	15611 (94.7%)	$\chi^2=1123.9^*$ , df=2, p-value<.0001
	Former smoker	49 (39.2%)	76 (60.8%)	125 (0.8%)	
	Current smoker	202 (26.8%)	553 (73.3%)	755 (4.6%)	
Marijuana Use	Non-current marijuana user	11605 (82.7%)	2435 (17.3%)	14040 (85.1%)	$\chi^2=2566.7^*$ , df=1, p-value<.0001
	Current marijuana user	858 (35.0%)	1593 (65.0%)	2451 (14.9%)	
Notes: * at a p-value of < 0.05 MVPA = moderate to vigorous physical activity BMI = body mass index <sup>a</sup> These are the individuals who remained in the same grade in Year 3 as in Year 2 (i.e. for reasons such as failing a grade in Year 2).					



### 5.3 Research Question 1: Change in the prevalence of binge drinking between Year 2 and Year 3 for the 9-12<sup>th</sup> grade students

As expected, the McNemar's test in Table 6 shows that, as the cohort aged, there was a significant increase in the proportion of current binge drinkers from Year 2 to Year 3 from 14.9% to 24.4%, respectively (p-value <.0001). As well, the proportion of current binge drinkers in Year 2 who became non-current binge drinkers in Year 3 (3.8%) was significantly smaller than the proportion of non-current binge drinkers in Year 2 who become current binge drinkers in Year 3 (13.3%) (p-value <.0001). This means that a non-current binge drinking high school student was considerably more likely to become a current binge drinker over time than a current binge drinking student was to become a non-current binge drinker over time.

Table 6: Current binge drinking status for the linked sample of Ontario grade 9-12 students in Year 2 (2013-2014) versus Year 3 (2014-2015) of the COMPASS Study

Binge Drinking	Year 3			McNemar's Test Statistic
	Year 2 Non-Current Binge Drinker	Year 2 Current Binge Drinker	Year 2 Total	
Non-Current Binge Drinker	11840 (71.8%)	2197 (13.3%)	14037 (85.1%)	S=878.5*, df=1, p-value<.0001
Current Binge Drinker	623 (3.8%)	1831 (11.1%)	2454 (14.9%)	
Total	12463 (75.6%)	4028 (24.4%)	16491	

Notes: \* at a p-value of < 0.05

## **5.4 Research Question 2: Difference-in-differences changes in the school-level prevalence of binge drinking from Year 2 to Year 3**

The ANOVA results indicate that none of the 19 intervention schools ( $F = 1.00$ ,  $df_1 = 19$ ,  $df_2 = 3679$ ,  $p\text{-value} = 0.4631$ ; see Table 7) and none of the 6 intervention categories ( $F = 1.18$ ,  $df_1 = 6$ ,  $df_2 = 1553$ ,  $p\text{-value} = 0.3123$ ; see Table 8) experienced a statistically significantly different change in the school-level prevalence of binge drinking relative to the mean change observed for the pooled sample of control schools over time (from Year 2 to Year 3).

Table 7: Difference-in-differences changes in the school-level prevalence of binge drinking for each intervention school relative to the pooled sample of control schools in the linked sample between Year 2 (2013-2014) and Year 3 (2014-2015) of the COMPASS Study

School	Year 2 School-level Prevalence (%) of Binge Drinking	Year 3 School-level Prevalence (%) of Binge Drinking	$\Delta P$ (%)	$\Delta P_{Diff}^{(i)}$ (%)	ANOVA
Control Schools					F=1.00, df1=19, df2=3679, p- value=0.4631
0	14.9	24.5	9.6	-	
Intervention Schools					
1	9.1	16.0	6.9	-2.7	
2	5.9	19.6	13.7	4.1	
3	11.6	27.9	16.3	6.7	
4	21.0	35.0	14.0	4.4	
5	19.2	24.4	5.2	-4.4	
6	6.4	11.0	4.6	-5.0	
7	1.2	4.2	3.0	-6.6	
8	10.2	18.5	8.3	-1.3	
9	18.6	22.6	4.0	-5.6	
10	24.9	41.5	16.6	7.0	
11	18.5	32.6	14.1	4.5	
12	20.7	36.4	15.7	6.1	
13	26.9	40.3	13.4	3.8	
14	27.5	35.0	7.5	-2.1	
15	22.9	31.4	8.5	-1.1	
16	12.0	20.3	8.3	-1.3	
17	14.7	21.8	7.1	-2.5	
18	15.7	27.9	12.2	2.6	
19	9.3	17.5	8.2	-1.4	
Notes: * at a p-value of <0.05 Intervention schools represented using numbers ranging from "1-19". The pooled sample of control schools (n=58) was represented using the school number "0".					

Table 8: Difference-in-differences changes in the school-level prevalence of binge drinking for each intervention category relative to the pooled sample of control schools in the linked sample between Year 2 (2013-2014) and Year 3 (2014-2015) of the COMPASS Study

School	Year 2 School-level Prevalence (%) of Binge Drinking	Year 3 School-level Prevalence (%) of Binge Drinking	$\Delta P$ (%)	$\Delta P_{Diff}^{(i)}$ (%)	ANOVA
Control Schools					F=1.18, df1=6, df2=1553, p-value=0.3123
0	14.9	24.5	9.6	-	
Intervention Categories					
1	8.4	18.6	10.2	0.6	
2	11.8	17.4	5.6	-4.0	
3	22.2	38.0	15.8	6.2	
4	27.4	36.3	8.9	-0.7	
5	14.2	21.9	7.7	-1.9	
6	13.2	23.8	10.6	1.0	
Notes: * at a p-value of <0.05 Intervention categories represented using numbers "1-6". The pooled sample of control schools (n=58) was represented using the school number "0".					

### **5.5 Research Question 3: Changes in student binge drinking behaviours in response to changes in school-level alcohol prevention interventions from Year 2 to Year 3**

The model-based relative risks (RR), 95% confidence intervals, and p-values associated with the Intervention Impacts (School  $\times$  Year interaction) for each of the 19 different alcohol prevention intervention schools (Model 1) as well as for these schools grouped by intervention type into 6 distinct categories (Model 2) are presented in Table 9.

For both Models 1 and 2, Table 9 shows that the risk of being a current binge drinker for an underweight (Model 1 and 2 p-value = 0.0014), overweight (Model 1 and 2, p-value = 0.0014), obese (Model 1 p-value = 0.0137; Model 2 p-value = 0.0130), or “no weight stated” student (Model 1 p-value = 0.0278; Model 2 p-value = 0.0273) was significantly greater than the risk of being a current binge drinker for a normal weight student while holding all other covariates fixed. Furthermore, the risk of being a current binge drinker for a physically active (meeting the weekly guidelines for moderate to vigorous physical activity (MVPA); Model 1 and 2, p-value = <.0001), former or current smoking (Model 1 and 2, p-value = <.0001), or current marijuana using (Model 1 and 2, p-value = <.0001) student was significantly greater than the risk of being a current binge drinker for a physically inactive (not meeting the weekly MVPA guidelines), non-current smoking, or non-current marijuana using student, respectively, while holding all other covariates fixed. In both Model 1 and 2, the risk of being a current binge drinker for a student who attended a large urban school was significantly smaller than the risk of being a current binge drinker for a student who attended a small urban school while holding all other covariates fixed (Model 1 and 2, p-value = <.0001). For Model 1, the risk of being a current binge drinker for a student who attended a medium urban school was significantly smaller than the risk of being a current binge drinker for a student who attended a small urban

school while holding all other covariates fixed (p-value = 0.0138); this significance was not observed in Model 2. With respect to school size, the risk of being a current binge drinker for a student who attended a medium (only for Model 2 (p-value = 0.0154)) or a large (for both Model 1 (p-value = 0.0001) and Model 2 (p-value <.0001)) school was significantly smaller than the risk of being a current binge drinker for a student who attended a small school in the same year while holding all other covariates fixed. For both models, the risk of being a current binge drinker for a student who attended a private school was significantly greater than the risk of being a current binge drinker for a student who attended a public school while holding all other covariates fixed (Model 1 and 2, p-value = <.0001).

As shown by Table 9, none of the Intervention Impact RRs were found to be statistically significant<sup>9</sup> for either Model 1 (p-value = 0.6976) or Model 2 (p-value = 0.5355).

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<sup>9</sup> at a p-value of <0.05

Table 9: Multi-level log binomial regression analyses evaluating the impact of 19 individual and 6 grouped school-specific alcohol prevention interventions implemented between Year 2 (2013-2014) and Year 3 (2014-2015) in the participating Ontario schools of the COMPASS Study on the relative risk of an average student being a current binge drinker from Year 2 to Year 3

Parameter	Model 1: Individual Interventions				Model 2: Grouped Interventions				
		95%CI				95%CI			
	RR	Lower	Upper	P-value	RR	Lower	Upper	P-value	
Intercept	0.03*	0.02	0.04	<0.0001	0.03*	0.02	0.04	<0.0001	
<b>Student-level covariates<sup>a</sup></b>									
Gender	Male	1.00	0.95	1.04	0.8929	1.00	0.96	1.04	0.9959
Grade	10	1.95*	1.78	2.14	<0.0001	1.95*	1.78	2.14	<0.0001
	11	2.53*	2.30	2.77	<0.0001	2.52*	2.29	2.76	<0.0001
	12	3.03*	2.73	3.36	<0.0001	3.01*	2.71	3.34	<0.0001
Ethnicity	White	1.21*	1.14	1.28	<0.0001	1.21*	1.14	1.28	<0.0001
Weekly Spending Money	\$1-20	1.37*	1.25	1.49	<0.0001	1.36*	1.25	1.48	<0.0001
	\$21-100	1.94*	1.78	2.11	<0.0001	1.94*	1.79	2.11	<0.0001
	\$100 or more	2.08*	1.91	2.27	<0.0001	2.08*	1.91	2.27	<0.0001
	I don't know	1.47*	1.32	1.62	<0.0001	1.47*	1.33	1.62	<0.0001
BMI	Underweight	1.46*	1.16	1.85	0.0014	1.46*	1.16	1.85	0.0014
	Overweight	1.47*	1.16	1.87	0.0014	1.48*	1.16	1.87	0.0014
	Obese	1.36*	1.07	1.74	0.0137	1.37*	1.07	1.75	0.0130
	Not Stated	1.31*	1.03	1.66	0.0278	1.31*	1.03	1.66	0.0273
MVPA	Met the Guidelines	1.30*	1.24	1.36	<0.0001	1.30*	1.24	1.36	<0.0001
Tobacco Use	Former Smoker	1.49*	1.26	1.76	<0.0001	1.50*	1.27	1.76	<0.0001
	Current Smoker	1.45*	1.35	1.56	<0.0001	1.46*	1.36	1.57	<0.0001
Marijuana Use	Current Marijuana User	3.33*	3.18	3.50	<0.0001	3.34*	3.19	3.51	<0.0001
<b>School-level covariates<sup>b</sup></b>									
School Location	Medium Urban	0.91*	0.84	0.98	0.0138	0.94	0.88	1.01	0.0880
	Large Urban	0.74*	0.69	0.80	<0.0001	0.76*	0.71	0.81	<0.0001
	Only Rural	1.13	0.97	1.33	0.1279	1.14	0.97	1.33	0.1166
School Size	Medium School	0.94	0.87	1.02	0.1157	0.92*	0.86	0.99	0.0154
	Large School	0.83*	0.76	0.91	0.0001	0.84*	0.77	0.91	<0.0001
School Type	Private School	1.48*	1.33	1.66	<0.0001	1.37*	1.24	1.52	<0.0001
Year	Year 3	1.00	0.95	1.05	0.9088	1.00	0.95	1.05	0.9069

<b>Intervention Impacts</b>								
<u>Surveillance and Punishment Policy</u>								
School 1	1.04	0.62	1.74	0.8771				
School 2	2.10	0.96	4.61	0.0642				
School 3	1.26	0.51	3.10	0.6104				
<u>Student Education Program</u>								
School 4	1.02	0.64	1.63	0.9210				
School 5	0.82	0.55	1.21	0.3173				
School 6	1.14	0.70	1.86	0.5916				
School 7	2.21	0.57	8.55	0.2493				
School 8	1.25	0.66	2.36	0.4916				
School 9	0.69	0.47	1.00	0.0511				
<u>Counselling Program</u>								
School 10	1.01	0.76	1.35	0.9433				
School 11	0.95	0.57	1.59	0.8552				
School 12	1.06	0.75	1.50	0.7482				
<u>Staff Training Program</u>								
School 13	0.82	0.49	1.38	0.4590				
School 14	0.80	0.59	1.09	0.1652				
<u>2 Different Interventions</u>								
School 15	0.95	0.54	1.65	0.8453				
School 16	1.04	0.76	1.44	0.8030				
School 17	1.00	0.74	1.36	0.9883				
<u>3 Different Interventions</u>								
School 18	1.00	0.73	1.38	0.9949				
School 19	1.23	0.74	2.04	0.4315				
<u>Group 1</u>								
Surveillance and Punishment Policy					1.32	0.90	1.94	0.1597
<u>Group 2</u>								
Student Education Programs					0.93	0.76	1.13	0.4574
<u>Group 3</u>								
Counselling Programs					1.02	0.83	1.25	0.8898
<u>Group 4</u>								
Staff Training/Education Programs					0.81	0.62	1.06	0.1229
<u>Group 5</u>								
2 Different Interventions					1.02	0.83	1.26	0.8487
<u>Group 6</u>								
3 Different Interventions					1.07	0.82	1.41	0.6076
Notes: * at a p-value of < 0.05 The Intervention Impacts indicated in this table were obtained while controlling for the respective Student- <sup>a</sup> and School-level <sup>b</sup> covariates.								



## **Chapter 6 – Discussion**

Unsurprisingly, the prevalence of youth binge drinking among this linked sample of Ontario COMPASS high school students significantly increased from Year 2 to Year 3 given that these individuals aged over time. Nonetheless, only a small number of Ontario high schools attempted to reduce the harmful use of this drug among students as 19 out of the 77 schools in this longitudinal sample implemented some sort of new school-level alcohol prevention intervention(s) between Year 2 and Year 3. Even when schools did intervene, it appeared that none of the 19 specific alcohol prevention programs or policies nor any of the 6 different general intervention types that were implemented were found to be statistically significantly associated with a reduction in youth binge drinking at either the population- or the individual-level. Regardless of these findings, this is the first quasi-experimental longitudinal study to monitor the binge drinking status of a large linked sample of students while also generating real-world evidence with respect to simultaneously evaluating the ability of multiple different high school-level alcohol prevention interventions to reduce youth binge drinking in Ontario.

### **6.1 Few alcohol prevention initiatives employed by Ontario COMPASS high schools**

Although a significant increase in the proportion of current binge drinkers was observed over time among these same Ontario COMPASS high school students as they aged from Year 2 to Year 3, only 19 of the 77 Ontario high schools in this linked sample enforced one or more new alcohol prevention policies or programs between these two years. A possible reason why only approximately 25% of these schools may have attempted to reduce the occurrence of this behaviour could be related to the fact that student binge drinking does not commonly occur on

school property. The school context may not be the best place for this sort of work given that underage high school students most often obtain and consume alcohol while present at private, off-school locations such as their or their peer's home as well as at larger private gatherings such as at house parties (Centres for Disease Control and Prevention, 2009; Patrick et al., 2013; Ramstedt et al., 2013; Wagoner et al., 2013). As a result, high schools may not consider binge drinking to be a behaviour of top priority with respect to school-based prevention in comparison to other negative health behaviours, such as smoking, that more commonly occur on school property (Cole, Leatherdale & Burkhalter, 2013). This means that, with respect to youth binge drinking prevention, it may be more appropriate for public health practitioners to implement and study provincial and national alcohol prevention policies at the more upstream end of the macro-level beyond the school context. Such an approach may serve as a more promising attempt in trying to reduce youth binge drinking in these off-school locations where alcohol is most commonly consumed.

National- and state-level initiatives such as having higher taxes on alcohol, increasing the minimum legal drinking age (MLDA) to 21 years, and/or banning alcohol advertisements have shown great potential in significantly reducing this behaviour among high school students over time in other locations (Carpenter et al., 2007; Grube & Nygaard, 2001; Green, Jason & Ganz, 2015; Elder et al., 2010; Saffer & Dave, 2006; Yanovitzky & Stryker, 2001) and could also achieve the same outcome within this province. Throughout the history of youth alcohol prevention, the interventions that have proven to be the most effective and associated with the greatest reduction in youth alcohol use and harmful drinking over time have been increasing the MLDA to 21 years and having higher taxes on alcohol (Carpenter et al., 2007; Grube & Nygaard, 2001). For instance, as has been done in the United States in the late 1970s and 1980s,

increasing the MLDA from 18 to 21 years has proven to be one of the major reasons for the significant reduction observed in underage heavy alcohol consumption among high school seniors (Carpenter et al., 2007; Green, Jason & Ganz, 2015). Since the Ontario MLDA is only at 19 years, enforcing such a policy within this province may also lead to a similar positive reduction in youth binge drinking. This is because of the strong evidence that exists linking a MLDA of 18 years with a significantly large increase in alcohol consumption and heavy episodic drinking among high school students in states that still had such a policy relative to the less harmful drinking patterns of similar students located in other states that had already implemented the more restrictive MLDA of 21 years (Carpenter et al., 2007).

Similarly, increasing the amount of tax being charged on alcohol sold in Ontario may also prove to be just as effective of an approach to reduce the high rates of binge drinking among this population given the significant association that exists between reduced alcohol consumption in underage populations and elevated alcohol taxes (Elder et al., 2010). As an example, increasing the price of alcohol by about 10% may reduce youth drinking by roughly the same percentage where a statistically significant and negative relationship has been shown to exist between the doubling of federal excise tax on beer in 1991 in the United States and the engagement in drinking behaviours by youth from 1976 to 2003 (Carpenter, 2007).

Another method that may help to decrease the number of youth who binge drink would be to reduce or to eliminate the sources that promote this act as a social norm in order to successfully prevent youth from intending to practice this behaviour. According to the theory of reasoned action, an immediate determinant of a volitional behaviour such as deciding whether or not to binge drink is one's intention to perform such an act (Johnston & White, 2003). A factor that has one of the strongest influences on a student's intention to binge drink is the effect of

group norm where students who strongly identify with a particular group that encourages alcohol use and binge drinking are more likely to want to engage in such a behaviour (Johnston & White, 2003; Livingstone & McCafferty, 2015; Huang et al., 2014; Teunissen et al., 2012; Yanovitzky & Stryker, 2001) and are less likely to benefit from substance use prevention initiatives (Valente et al., 2007). One potentially effective way of reducing this behaviour from becoming a group norm could be to ban the advertisement of alcohol-related content that is frequently part of social media websites, television, radio, newspapers, billboards, music festivals, sporting events, retail promotions, and brand-logoed items that are frequently used and accessed by underage individuals and which are partly responsible for fueling pro-drinking group attitudes (Moreno & Whitehill, 2014; Ellickson et al., 2005; Snyder et al., 2006; Anderson et al., 2009). Underage youth perceive the typical person that features in such alcohol advertisements as more favourable and also perceive alcohol use as more normative when they are being exposed to such ads than when they are not (Martino et al., 2016). Likewise, their intentions are likely to correspond with such norms given that one's intention to drink is associated with increased alcohol use and alcohol-related negative outcomes and therefore an increase in alcohol use and risky drinking in young populations has been linked with these individuals being exposed to such forms of alcohol advertising (Grazioli et al., 2015; Moreno & Whitehill, 2014; Ellickson et al., 2005; Snyder et al., 2006; Anderson et al., 2009). According to research conducted on the National Longitudinal Survey of Youth 1997 data set, a 28% reduction in alcohol advertising within a particular region may be able to reduce adolescent binge drinking by anywhere from 8 to 12 percent (Saffer & Dave, 2006). By also doing the same in Ontario, a similar positive outcome could also be achieved given that such a strategy could help reduce the spread of common misconceptions with respect to alcohol use patterns as understood by underage individuals and thereby contribute to a

reduction in youth alcohol abuse (Yanovitzky & Stryker, 2001). Youth alcohol prevention research in this province may benefit from more effective binge drinking prevention strategies if future studies would specifically evaluate the effectiveness of such policies implemented in Ontario.

## **6.2 Ineffectiveness of alcohol prevention interventions currently implemented by Ontario COMPASS high schools**

However, even though 19 different Ontario high schools still implemented some sort of alcohol prevention policies and/or programs between Year 2 and Year 3, none of these specific interventions nor any of the 6 different intervention categories investigated were associated with a statistically significant change in binge drinking at either the school- or individual-level. Such results are inconsistent with the hypotheses that were put forth prior to carrying out these analyses and with some previous research regarding the effectiveness of such similar types of interventions. Aside from the school context probably not being the ideal place for intervening in order to achieve maximal impact in regards to reducing youth binge drinking, the ineffectiveness of such interventions may also be partly attributed to the fact that Ontario schools are only implementing very simplistic interventions in an attempt to reduce this behaviour among youth. Two key components of an effective drug prevention plan are that it must be sufficiently comprehensive with respect to having many different types of intervention strategies and that it must also be multidisciplinary with respect to the settings and domains that it is delivered in (Nation et al., 2001), neither of which are contained by the interventions explored here. This means that school-based youth binge drinking prevention interventions in Ontario should be tailored to consist of a variety of different intervention components while also being delivered in

supplementary settings to the school environment in order to improve their effectiveness. A program that meets such criteria and which is recognized in the literature as generally being able to effectively reduce alcohol use and binge drinking in high school students is Project Northland (Perry et al., 2002; Stigler, Neusel & Perry, 2011). By using various multidisciplinary strategies at the school-level such as an education curriculum, a parental component, print media campaigns, and peer action teams all working towards reducing risky drinking among youth, the implementation of this type of an intervention in Ontario secondary schools may have potential to also achieve a similar, successful outcome with respect to student binge drinking. One of the crucial factors contributing to Project Northland's effectiveness may be its fifth component which involves the use of off-school community action teams to decrease student social and commercial access to alcohol in their respective districts (Perry et al., 2002). The use of such teams was associated with a significant reduction in student alcohol use and binge drinking by means of altering such individuals' alcohol use norms and intentions to drink. Future research should therefore study the effectiveness of more complex and multidisciplinary interventions like Project Northland (Perry et al., 2002; Stigler, Neusel & Perry, 2011) implemented in such Ontario high schools in order to evaluate if similar programs can also effectively reduce binge drinking among COMPASS students as it did in other high school populations. This would also be informative for understanding if there may be any value in continuing to implement, at least partially, alcohol prevention interventions within the Ontario high school environment.

## **6.2.1 Current school-level interventions with potential for having some public health impact at the individual level**

### Student education programs involving public health-designed displays and pamphlets

Although the findings of this investigation are in agreement with the possibility that alcohol prevention interventions may have a greater impact on youth binge drinking if implemented at the upper macro-levels above the school environment, Kairouz and Adlaf (2003) argue that the school context itself is still an important setting that has the potential to have some impact on alcohol prevention. With this being said, a couple of the school-level interventions explored in this analysis may demonstrate some potential for having a plausible public health effect on youth binge drinking at the individual level. For example, the p-value (0.0511) associated with the intervention for school 9 is very close to 0.05 which does not make a convincing case for or against this program being associated with a statistically significant effect on binge drinking. When coupling this with the confidence interval that is barely inclusive of 1 (0.47 to 1.00) which is associated with its relative risk that is well below 1 (a relative risk of 0.69), this intervention appears to be promising in regards to potentially being associated with a decrease in youth binge drinking at the individual level and is worth being further explored.

On top of this, other reasons also exist for why this type of intervention may have potential to have this sort of a protective impact on individual binge drinking which would correspond with the hypothesis stated at the beginning of this investigation regarding this type of intervention implemented by school 9. A similar type of student education program, where high school students reported that they were taught to say no to alcohol and/or to how to use alcohol safely via exposure to abstinence and harm minimization alcohol messages, to the one

implemented by school 9 appeared to be linked with a significant reduction in the likelihood of student binge drinking after one year in a separate study (Evans-Whipp et al., 2013). The mechanics of this type of an intervention may be one of the reasons supporting its potential of possibly being effective in reducing binge drinking at the individual level. Using public health-designed pamphlets and displays for educating students about this behaviour has the potential ability to provide such individuals with both written and visual alcohol prevention information. According to some cognitive psychological concepts such as the dual code theory, one is better able to understand, remember, and recall information that is presented using a combination of both text and illustrations (Whittingham et al., 2008). Given that most of the other student educational programs implemented by the different schools in this study most likely used verbal communication (i.e. schools 5-7 which had some sort of a guest speaker) as the predominant medium of presenting information, it is possible that the educational content incorporated within such interventions may not have been presented using these two forms of communication. This could be one of the possible reasons for why such interventions may not have shown as much potential for having a positive impact on student binge drinking behaviours as the intervention implemented by school 9.

#### Zero tolerance punishment policies

In a similar fashion, the intervention implemented by school 2 also appears to be promising with respect to possibly having some meaningful impact on student binge drinking behaviours given its p-value (0.0642) being close to 0.05, its confidence interval (0.96 to 4.61) barely including 1, and its relative risk estimate being more than twice as great as 1 (a relative risk of 2.10). These estimates may suggest that this intervention should be further explored as it



may have some potential for having a public health effect on youth binge drinking, one that could be associated with an increased risk of this behaviour at the individual level over time.

As well, other reasons also exist for why zero tolerance policies – which involve calling the police, suspending, and/or expelling students who are found to be possessing, using, or selling drugs or alcohol (Evans-Whipp et al., 2004; Skiba & Peterson, 1999) – may have the potential to achieve this sort of an effect which is inconsistent with the hypothesis previously stated but is consistent with some previous research (Evans-Whipp et al., 2013; Munro & Midford, 2001; Marlatt & Witkiewitz, 2002; Toumbourou et al., 2005; Skiba & Knesting, 2001; Evans-Whipp et al., 2004; Masterman & Kelly, 2003). One of the reasons for why this sort of an approach may not achieve its intended goal of preventing binge drinking may have to do with the fact that such a policy may detach a student from the school environment. Forcing a student who may be likely to binge drinking to not be in contact with the school setting may actually increase his or her risk of engaging in this behaviour given that attachment to one's school is strongly and negatively correlated with the risk of overconsumption of alcohol and other drugs (Evans-Whipp et al., 2004; McNeely, Nonnemaker & Blum, 2002; Munro and Midford, 2001). School engagement is a key factor associated with a reduction in such delinquent behaviour (Skiba & Knesting, 2001) potentially because participating in school-related pro-social activities may shield one from harmful drug use by keeping a student preoccupied with athletic, social, and other extracurricular activities as well as by encouraging him or her to meet the school's academic requirements (Munro and Midford, 2001; Toumbourou et al., 2005). Containing such binge drinking students within the school environment also allows for such individuals to potentially be exposed to school-based alcohol prevention programs and interventions that could have some positive effects on their binge drinking (Munro and Midford, 2001). By taking a

criminal- instead of a health prevention-based approach to dealing with this issue, students who are suspended (or expelled) for minor drug or alcohol related offences may not only receive none of these school-related benefits that could help prevent or reduce this behaviour, but these individuals may also be more likely to drop out of high school altogether (Skiba & Knesting, 2001); students who drop out of high school are usually at a significantly increased risk for engaging in drug abuse and binge drinking compared to individuals who remain in school (Townsend, Flisher & King, 2007).

Secondly, the potential ineffectiveness of zero tolerance policies may also be partially explained by the fact that the severity of punishment received by a particular student may not necessarily match the severity of the infraction that he or she committed. An academically sound, non-current binge drinking student who is expelled for having had only a sip of alcohol may feel like a victim of an unfair punishment. Aside from possibly affecting the academic potential of such an individual who is penalized with a similar punishment as another individual who brings a weapon to school (Skiba & Knesting, 2001), this student may also be more likely to rebel against such a rule whereby he or she may purposely engage in more serious substance use thereby potentially increasing his or her risk of binge drinking (Masterman & Kelly, 2003). With this policy placing the negative connotation on the act of drinking itself instead of on the amount of alcohol consumed and the negative health effects associated with this, a student may rationalize that consuming just a sip of alcohol is equivalent to consuming five or more drinks in one sitting given their equal punishment. With this rule promoting total abstinence from binge drinking, individuals who may realistically be able to reduce their alcohol consumption from a harmful to a less harmful amount (i.e. from 5 to 3 drinks in one sitting), as opposed to unrealistically stopping drinking completely, may be less inclined to want to seek assistance for

reducing these behaviours if they are given the sole choice of either abruptly and challengingly stopping any form of alcohol consumption or face being removed from the school context (Marlatt & Witkiewitz, 2002).

Despite these two interventions' potential for having some sort of a public health effect on youth binge drinking, no concrete recommendations can be made with respect to the effectiveness of these interventions based solely on this study as they did not demonstrate statistically significant proof for having a major impact on this behaviour. However, future research should further investigate the demonstrated potential of both of these alcohol prevention initiatives by implementing these in multiple different schools with similar characteristics given that in this study each of these interventions were implemented in only one school. This approach would allow for having a larger sample size and thus a greater power of determining if their promising effects could indeed be statistically significant.

### **6.2.2 Current school-level interventions lacking clear potential for having a public health impact at the population level**

At the school level, none of the interventions analyzed appeared to show sufficient promise with respect to potentially having a meaningful public health impact on youth binge drinking as no intervention was, nor showed the potential of being, significantly associated with a reduction in the prevalence of this behaviour over time relative to the change observed in the control schools. Aside from the reasons previously mentioned, some other possible explanations may exist for why such findings may have been observed which are in disagreement with the hypotheses previously stated and with some previous research. For instance, in the study by Leatherdale & Herciu (submitted), a significantly greater reduction in the school-level

prevalence of current binge drinking over time relative to the reduction observed in the control schools was found to be associated with a school which implemented a similar intervention to the one implemented by school 17 in this study that was also based on punishment and student education. The intervention implemented by school 17 may not have been associated with such a similar finding possibly because the educational component involved a police department workshop on drug and alcohol use whereas the educational component that was included in the similar intervention mentioned by the Leatherdale & Herciu (submitted) study involved a motivational speaker that provided key lessons and messages about alcohol use and its associated health issues as well as how to make responsible choices about drinking. Traditional educational programs delivered by police officers have proven to be ineffective and potentially be associated with higher binge drinking rates among students possibly due to their educational strategies that are based on scare tactics (Sloboda et al., 2009). Conversely, educational interventions similar to the one included in the dual component intervention mentioned in the Leatherdale & Herciu (submitted) study have been shown to be associated with a significantly reduced likelihood of binge drinking and getting drunk over time (Midford et al., 2012).

The punishment-focused strategy associated with school 17's second component of suspending alcohol and drug users while also providing them with reintegration strategies may also support this intervention's potential ineffectiveness as it has been shown that students may not experience a significant change in the likelihood of binge drinking over time if they perceive that they will be suspended if caught drinking at school (Evans-Whipp et al., 2013). Other interventions that were based on punishing students who were caught using alcohol by preventing them from participating in school sports if they refused to attend counselling (Goldberg et al., 2007) or from attending future school events (Leatherdale & Herciu, submitted)

have also shown to be associated with an insignificant effect on past month alcohol use or with a significant increase in the school-level prevalence of current binge drinking relative to the change observed in the control schools, respectively. Contrastingly, the second component of the intervention described in the Leatherdale & Herciu (submitted) study which involved punishing students who were caught being under the influence of alcohol by using breathalyzers at school events and thereby preventing them from entering those respective events may have also supported the intervention's potential effectiveness; using breathalyzers for this same purpose has also been shown to be associated with a greater reduction in the school-level prevalence of current binge drinking relative to the change observed in the control schools when implemented in a separate high school (Leatherdale & Herciu, submitted). Another possible reason for why this type of punishment may have demonstrated potential for possibly being effective is that, in both the school that had the dual component intervention as well as in the one that involved solely the breathalyzer program (Leatherdale & Herciu, submitted), the punishment received by the students for their actions was to be served immediately (i.e. not attending the respective event where the student was caught being under the influence of alcohol) instead of being served later on (i.e. possibly receiving a discretionary suspension depending on the type of alcohol-related infraction committed where the teacher or principal must first decide if and when the student is to be suspended (School Advocacy, 2006), having the time to decide whether or not to attend counselling before a decision is made if the student is to be removed from a school sports team (Goldberg et al., 2007), or not being able to attend future school events (Leatherdale & Herciu, submitted) which may all potentially represent delayed forms of punishment). Having to immediately serve a penalty may be associated with a more potentially effective intervention according to the contiguity of punishment concept which states that a punishment's effectiveness

with respect to reducing an undesirable behaviour decreases as the time interval between when the infraction is committed and when the penalty is served increases (Klein, 2013).

In the Leatherdale & Herciu (submitted) study, a separate student educational program which involved a sequence of general information sessions and guest speakers throughout the school year teaching students about the issues associated with heavy drinking and how to make smart choices with respect to alcohol use was associated with a significant decrease in the school-level prevalence of binge drinking relative to the change observed in the control schools. In this particular study, intervention school 5, 6, and 7 also implemented comparable student educational interventions to the one in the Leatherdale & Herciu (submitted) study, however, none of these initiatives were associated with a significant decrease in the school-level prevalence of binge drinking relative to the change observed in the control schools. One potential explanation for these differences could be that the student educational program in the Leatherdale & Herciu (submitted) study was a longer-lasting initiative relative to the ones implemented by the three intervention schools in this study. Based on the information indicated by each school's administrator, it appears that each of these three different interventions also included educators teaching students about the consequences associated with alcohol use and/or how to make responsible choices with respect to this drug. However, these were implemented as only one-time interventions instead of via multiple different sessions or guest speakers at numerous times throughout the year like the intervention in the Leatherdale & Herciu (submitted) paper. This principle of "sufficient dosage" of exposure to an intervention as a key component linked with a program's potential effectiveness is supported by Nation et al. (2003). In this review-of-reviews, the authors state that subjects must be exposed to multiple sessions of a program over a certain period of time in order for the participants to receive enough exposure

to the intervention for it to be potentially effective on the undesirable behaviour. This concept's key influence on an intervention's potential for being effective can also be witnessed when examining a similar education program that was implemented in a separate school in the Leatherdale & Herciu (submitted) study; this program also involved student exposure to multiple alcohol prevention information sessions and was also associated with a significant decrease in the school-level prevalence of binge drinking relative to the change observed in the control schools.

Given these results, it cannot be confidently recommended that any of the interventions investigated by this study be implemented in other schools with similar characteristics to the ones included in this sample in order to achieve a significant reduction in the school-level prevalence of binge drinking over time. Such a difference-in-differences model was used as a preliminary step to explore if any of these interventions showed potential for possibly having a meaningful effect on binge drinking at the population level. If any of these interventions were to have shown such potential, it would have been recommended for future research to further explore the impact of such interventions using a more complex model while also implementing these in more schools to see if, following these changes, such potential would still be present. After doing this, more concrete recommendations would be able to be made about the effectiveness of such interventions at the population level.

### **6.3 Student binge drinking patterns from Year 2 to Year 3 for the linked sample**

This longitudinal study has shown that the prevalence of binge drinking among the same students who remained at the same Ontario COMPASS high schools from Year 2 to Year 3 increased significantly over time as these individuals aged. As well, out of the students who were current binge drinkers in Year 2, a much larger proportion of them also remained current binge drinkers than became non-current binge drinkers in Year 3. This means that, in order to more efficiently decrease the proportion of students who binge drink over time, it may be important that youth be exposed to alcohol prevention interventions as early as possible before they begin binge drinking as it appears that once a high school student becomes a current binge drinker, he or she is fairly likely to continue to engage in this behaviour over time.

Such an increase in student binge drinking over time is consistent with what was expected prior to performing these analyses given that as a student becomes older, he or she is more likely to engage in this type of behaviour (Leatherdale & Rynard, 2013; Herciu et al., 2014; Leatherdale & Ahmed, 2010; Leatherdale, 2015; Leatherdale & Burkhalter, 2012; CAMH, 2013). This can also explain why the overall prevalence of current binge drinkers became greater with increasing grade given the strong correlation between age and grade. As this research has also demonstrated, with increasing grade students are also more likely to have more weekly spending money and thus may be more likely to binge drink (Herciu et al., 2014; Costello et al., 2012) by means of potentially having greater access and exposure to this drug. This makes sense given that with increasing grade a student may have more employment opportunities. With this having the potential of translating into more financial resources, students may have an easier time obtaining alcohol by potentially paying a social source that is able to legally purchase this drug (Wagoner et al., 2013). Similarly, this investigation has also shown that students are also



more likely to use tobacco and smoke marijuana (CAMH, 2013) as well as to be overweight or obese as they become older with such behaviours being associated with increased binge drinking which is also consistent with previous research (Herciu et al., 2014; Bedendo & Noto, 2015; Costello et al., 2012; Leatherdale & Ahmed, 2010; Leatherdale, Hammond & Ahmed, 2008; Leatherdale & Burkhalter, 2012).

With respect to gender, it was observed that males consisted of a greater proportion of current binge drinkers than females when classifying binge drinking as having 5 or more drinks in one sitting which is also consistent with previous research (Leatherdale & Rynard, 2013; Herciu et al., 2014; Leatherdale & Ahmed, 2010; Leatherdale, Hammond & Ahmed, 2008; Leatherdale, 2015; Costello et al., 2012; Hilarski, 2005; Kairouz & Adlaf, 2003). The difference in the prevalence of this behaviour among these two genders can potentially be explained by several factors. One possible reason for why males appear to binge drink more than females could be that, on average, males tend to engage in more risky behaviours when compared to females; for example, males are more likely than females to engage in other harmful health behaviours such as using tobacco and smoking marijuana (Herciu et al., 2014; Costello et al., 2012; Leatherdale & Ahmed, 2010; Leatherdale, Hammond & Ahmed, 2008; Leatherdale & Burkhalter, 2012). Furthermore, the differences in body structure and chemistry between the two genders may also play a role in why males appear to consume more alcohol than females. On average, women tend to absorb more alcohol than males while also taking a longer amount of time to metabolize the drug (Ashley et al., 1977); if both genders drink the same amount of alcohol, women will generally have a higher blood alcohol level while also experiencing alcohol's immediate effects much quicker and for longer periods of time than males (Ashley et al., 1977). As a result, this may translate into males having to consume larger amounts of alcohol

than females in order to feel the same effects of the drug.

With this being said, it may be valuable for future research to expand on both the length of this investigation as well as the number of binge drinking covariates measured. A longer longitudinal project analyzing three or more consecutive years of binge drinking data for these same individuals could help to understand in more detail how one's binge drinking status may change over longer periods of time. By measuring more factors that are believed to be associated with youth binge drinking, more knowledge on what other variables could further predispose such individuals to binge drink could be obtained which may also better inform prevention efforts. For example, given the strong influence of social and group norms on students' intentions to binge drink (Johnston & White, 2003; Livingstone & McCafferty, 2015; Huang et al., 2014; Teunissen et al., 2012; Yanovitzky & Stryker, 2001), such future research should also include measures for gathering data on students' opinions about their social group's binge drinking norms and if these encourage or discourage such an act. Future research should also use two separate measures for assessing the binge drinking status for males (5 or more drinks in one sitting) and females (4 or more drinks in one sitting) within the same study (Centre for Addiction and Mental Health, 2008). By doing so, the proportion of female binge drinkers would be able to be more accurately represented in order to confirm which gender has the greater proportion of current binge drinkers.

## 6.4 Study strengths

This investigation was the first to simultaneously evaluate the impact of multiple school-based alcohol prevention interventions on the binge drinking patterns of a large, linked sample of Ontario high school students using a longitudinal quasi-experimental study design. Such an approach helped generate real-world practice-based evidence regarding which youth binge drinking prevention interventions currently implemented within the Ontario high school environment may have potential to be effective in possibly reducing this behavior at the population and individual level. Although some previous research has also explored this behaviour in Ontario high school students, such studies were carried out using more simplistic cross-sectional designs while also not exploring the potential impact of multiple different school-level alcohol prevention interventions on binge drinking (Leatherdale & Rynard, 2013; Herciu et al., 2014; Leatherdale & Burkhalter, 2012; Leatherdale, 2015) or they used smaller linked samples (Leatherdale & Herciu, submitted). Most of the previous studies which evaluated the potential effectiveness of similar interventions only examined one initiative at a time and were not conducted within the Ontario context (Midford et al., 2012; Gmel et al., 2012; Mitchell et al., 2012; Conrod et al., 2013; O’Leary-Barrett et al., 2010; Strom et al., 2015; Toumbourou et al., 2013; Lammers et al., 2015; Clark et al., 2010; Gorman, 2014; Sussman et al., 2012) thereby making it more difficult to compare the potential success of such interventions due to the various differences existing between such studies (i.e. different samples, grades, reference groups, and/or locations).

The use of a large linked sample as part of a complete-case analysis (CCA) made it possible to assess the potential effectiveness of such alcohol prevention interventions by observing how the same individuals’ binge drinking status (or risk for binge drinking) changed

from before to after an intervention was implemented given that they all had outcome data at both points in time. The potential impact of these interventions may not have been evaluated as accurately if the sample also included the remaining students who indicated their binge drinking status at only one of the two years. This is because missing data techniques would have had to guess how these alcohol prevention interventions may have potentially affected the estimated binge drinking status of such individuals in order to obtain these missing data points. Likewise, the fact that this project used a quasi-experimental design along with a robust data set which consisted of a large, heterogeneous convenience sample with a low refusal rate also contributed towards accurately evaluating such interventions' real-world potential effectiveness.

The accuracy of this evaluation was further enhanced at the analysis level given that the model- instead of the empirical-based results were used for the Generalized Estimating Equation (GEE); the model-based results were more appropriate due to the sample's variability in school size as well as the fact that each of the 19 specific interventions were implemented and evaluated in 19 different schools. In comparison to the empirical-based parameter estimates, the model-based are more conservative given that they assume larger standard errors associated with each of the parameter estimates. By assuming larger standard errors, this results into larger p-values being generated for each of the estimates meaning that it is less likely for an intervention to be considered to have a significant effect. The more cautious model-based results reduce the likelihood of incorrectly claiming that an intervention may have a statistically significant impact on binge drinking when in reality this may not actually be the case. Overall, recommending an intervention that has demonstrated to be statistically significantly associated with reducing student binge drinking when a larger standard error is taken into account shows more concrete evidence that the intervention may actually be effective in reality than if this same intervention

was to show a similar result when a much smaller standard error was taken into consideration (i.e. for the empirical-based results).

By having a large sample of repeat observations over multiple time points, this study also served as a good surveillance tool for monitoring the change in binge drinking for the same Ontario COMPASS high school students over time. One feature that assisted this project in serving as a good surveillance tool was the use of a binge drinking measure that has also been previously used by nationally representative school-based surveillance instruments like the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS) for monitoring youth health behaviours (Leatherdale et al., 2014; Leatherdale & Rynard, 2013; Elton-Marshall et al., 2011). Such consistency in measuring youth binge drinking allows for inter-study comparisons in order to investigate how the binge drinking status of Ontario students compares to national estimates. Being able to make this comparison can help to inform researchers about where this province stands relative to the rest of the country with respect to the need for implementing effective youth alcohol prevention efforts.

All in all, having explored which school-level alcohol prevention interventions may have shown promise for potentially being associated with a reduction in youth binge drinking over time in Ontario, this study served as an important stepping stone prior to being able to pilot the initiatives that demonstrate such potential in more schools in order to begin generalizing a real evidence base regarding the effectiveness of such particular efforts.

## 6.5 Study limitations

Despite this investigation's numerous strengths, it is important to also acknowledge some of its limitations. Given the survey-based nature of the data collections at both the school and individual levels, this study was subjected to potential biases with respect to the report and/or recall of information. For the School Policies and Practices (SPP) administrator questionnaire, the survey's open-ended questions regarding the changes experienced in alcohol prevention interventions allowed for vague program and policy descriptions to be provided. As administrators may describe particular alcohol prevention initiatives implemented at their respective schools in different amounts of detail, misinterpretations regarding intervention complexity and/or fidelity of implementation may arise. However, the program and policy changes indicated in the SPP for each school were verified by the COMPASS knowledge brokers who ensured that the information provided by the school administrators was complete and up to date. Even so, such program and policy descriptions were sufficiently detailed in order for these analyses to be able to distinguish which kinds of interventions may or may not possibly be associated with student binge drinking. Similarly, it may also be safe to assume that the information provided by the school administrators closely represented the actual changes that occurred with respect to such interventions given that the SPP has been designed after a previously validated tool, the Healthy School Planner (Leatherdale et al., 2014).

At the student-level, incorrectly reporting information with respect to the outcome measure may have also been an issue given that it is difficult to accurately recall how much alcohol one had consumed in the past year. More significantly, since underage binge drinking is an illegal behaviour where one is not allowed to consume alcohol if he or she is under the age of 19 in Ontario (Royal Canadian Mounted Police, 2013), youth who are under the legal drinking

age are very likely to underreport this behaviour (Brenner, Billy & Grady, 2003). This limitation translates into current binge drinking rates among high school youth being higher than what was determined by this investigation as well as by previous studies that used similar measures. However, it has been demonstrated that this bias is reduced when students are asked to anonymously report their binge drinking status using surveys in comparison to when using other less confidential modes of data reporting (Brenner, Billy & Grady, 2003). Likewise, by using a quasi-experimental design, this bias likely affected students in intervention and control schools in a similar fashion while also remaining consistent over time and therefore it is unlikely that it had a significant effect on the observed differences in binge drinking between these two groups.

Another limitation which specifically pertains to the COMPASS student-level questionnaire (Cq) is that the binge drinking measure used was not gender specific. For this reason, the proportion of females being categorized as current binge drinkers may have been underestimated given that some researchers define female binge drinking as having 4, not 5, or more drinks in one sitting (Centre for Addiction and Mental Health, 2008). As a result, in reality, the binge drinking patterns of males and females may be more similar than what may be indicated by such studies that use the “5 or more drinks in one sitting” as the binge drinking cut-off for both genders. The Cq did not use two different gender-specific questions for measuring binge drinking given that this measure was taken from the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS) in order to be able to compare and contrast the binge drinking status of students attending this convenience sample of schools to the nationally representative binge drinking estimates obtained by CSTADS (Leatherdale & Rynard, 2013). Both a male- and a female-specific measure of current binge drinking should be included in the Cq in order to accurately measure female binge drinking as well as to verify if there is a significant difference

between the proportion of females classified as being current binge drinkers when using one of these cut-offs versus the other.

Although the Cq does measure some student-level covariates associated with youth binge drinking, it does not measure some of the most important influences affecting this behaviour like social norms and peer pressure (Johnston & White, 2003; Livingstone & McCafferty, 2015; Huang et al., 2014; Teunissen et al., 2012; Yanovitzky & Stryker, 2001). Nonetheless, this limitation is traded off for the short length of the study which allows a very large proportion of participants to complete the survey in a short period of time without losing interest thereby leading to the production of large amounts of good quality, reliable data.

Lastly, the actual population-level prevalence of binge drinking for each school included in this sample may be underestimated given that students who provided data for the binge drinking outcome measure for only one of the two years (i.e. because they just did not want to complete this question for whatever reason during the data collection in the other year or because they were absent) were not included in the linked sample. It has been shown that such a select group of individuals consists of a greater proportion of current binge drinkers than those students who are linked from one year to the next (Qian et al., 2015). Despite this, separate analyses illustrated in Appendix C reveal that, due to the quasi-experimental nature of this study, this bias is evenly distributed between the intervention and control groups meaning that the difference in binge drinking between these two groups is unlikely to be significantly affected by this bias.



## Chapter 7 – Conclusions

This study has shown that, in Ontario, few high schools tried to decrease the rates of youth binge drinking over time given that only 19 of the 77 COMPASS schools included in this linked sample had new school-level alcohol prevention policies or programs put into practice between Year 2 and Year 3. Even so, none of these 19 specific alcohol prevention interventions appeared to be associated with a statistically significant decrease in the population-level prevalence or the individual-level risk of this behaviour over time; such results held true even when these initiatives were grouped into 6 different general intervention types. Nevertheless, a zero tolerance punishment policy as well as a student education program using displays and pamphlets may have shown some potential for possibly having some public health impact on this behaviour at the individual level and should be further explored. Overall, these results suggest that such current school-level initiatives implemented in this province may be too simplistic in nature and/or the high school setting may not be the best place to intervene for achieving maximal impact with respect to this type of work. Future research on youth alcohol prevention in Ontario may want to focus on evaluating more complex, multidisciplinary programs that are only partially implemented within the high school environment. It may also be valuable for future research to assess the impact of higher macro-level policies like increasing taxation on alcohol, increasing the minimum legal drinking age to 21 years, and banning alcohol advertisements within the Ontario context as these may serve as more promising approaches for reducing youth binge drinking in this province. All of this is important given that the prevalence of youth binge drinking among this linked sample increased significantly from Year 2 to Year 3 which is not a surprise given that these individuals aged over time.

On the whole, this is the first quasi-experimental longitudinal study to monitor the binge

drinking status of a large linked sample of high school students over time while also simultaneously evaluating the potential ability of multiple different high school-level alcohol prevention interventions to reduce youth binge drinking in order to generate real-world evidence about this topic in Ontario.

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## About You

### 1. What grade are you in?

- Grade 9
- Grade 10
- Grade 11
- Grade 12

### 2. How old are you today?

- 13 years or younger
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years or older

### 3. Are you female or male?

- Female
- Male

### 4. How would you describe yourself? (Mark all that apply)

- White
- Black
- Asian
- Aboriginal (First Nations, Métis, Inuit)
- Latin American/Hispanic
- Other \_\_\_\_\_

### 5. About how much money do you usually get each week to spend on yourself or to save? (Remember to include all money from allowances and jobs like baby-sitting, delivering papers, etc.)

- Zero
- \$1 to \$5
- \$6 to \$10
- \$11 to \$20
- \$21 to \$40
- \$41 to \$100
- More than \$100
- I do not know how much money I get each week

### 6. How do you usually travel to and from school? (If you use two or more modes of travel, choose the one that you spend most time doing)

- | <u>To school</u>  | <u>From school</u>  |
|---|---|
| <input type="radio"/> By car (as a passenger)             | <input type="radio"/> By car (as a passenger)             |
| <input type="radio"/> By car (as a driver)                | <input type="radio"/> By car (as a driver)                |
| <input type="radio"/> By school bus                       | <input type="radio"/> By school bus                       |
| <input type="radio"/> By public bus, subway, or streetcar | <input type="radio"/> By public bus, subway, or streetcar |
| <input type="radio"/> By walking                          | <input type="radio"/> By walking                          |
| <input type="radio"/> By bicycling                        | <input type="radio"/> By bicycling                        |
| <input type="radio"/> Other _____                         | <input type="radio"/> Other _____                         |

### 7. Did you attend this school last year?

- Yes, I attended the same school last year
- No, I was at another school last year





## Physical Activity

**HARD** physical activities include jogging, team sports, fast dancing, jump-rope, and any other physical activities that increase your heart rate and make you breathe hard and sweat.

**MODERATE** physical activities include lower intensity activities such as walking, biking to school, and recreational swimming.

11. Mark how many minutes of **HARD** physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time.

	Hours					Minutes			
Monday	0	1	2	3	4	0	15	30	45
Tuesday	0	1	2	3	4	0	15	30	45
Wednesday	0	1	2	3	4	0	15	30	45
Thursday	0	1	2	3	4	0	15	30	45
Friday	0	1	2	3	4	0	15	30	45
Saturday	0	1	2	3	4	0	15	30	45
Sunday	0	1	2	3	4	0	15	30	45

For example: If you did 45 minutes of **hard** physical activity on Monday, you will need to fill in the 0 hour circle and the 45 minute circle, as shown below:

	Hours					Minutes				
Monday	●	0	1	2	3	4	0	15	30	●

12. Mark how many minutes of **MODERATE** physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time. Do not include time spent doing **hard** physical activities.

	Hours					Minutes			
Monday	0	1	2	3	4	0	15	30	45
Tuesday	0	1	2	3	4	0	15	30	45
Wednesday	0	1	2	3	4	0	15	30	45
Thursday	0	1	2	3	4	0	15	30	45
Friday	0	1	2	3	4	0	15	30	45
Saturday	0	1	2	3	4	0	15	30	45
Sunday	0	1	2	3	4	0	15	30	45

For example: If you did 1 hour and 30 minutes of **moderate** physical activity on Monday, you will need to fill in the 1 hour circle and the 30 minute circle, as shown below:

	Hours					Minutes			
Monday	0	●	2	3	4	0	15	●	45

13. Were the last 7 days a typical week in terms of the amount of physical activity that you usually do?

- Yes  
 No, I was more active in the last 7 days  
 No, I was less active in the last 7 days

14. Your closest friends are the friends you like to spend the most time with. How many of your closest friends are physically active?

- None  
 1 friend  
 2 friends  
 3 friends  
 4 friends  
 5 or more friends

15. Are you taking a physical education class at school this year?

- Yes, I am taking one this term  
 Yes, I will be taking one or have taken one this school year, but not this term.  
 No, I am not taking a physical education class at school this year



## Healthy Eating

24. If you do not eat breakfast every day, why do you skip breakfast? (Mark all that apply)

- I eat breakfast every day
- I don't have time for breakfast
- The bus comes too early
- I sleep in
- I'm not hungry in the morning
- I feel sick when I eat breakfast
- I'm trying to lose weight
- There is nothing to eat at home
- Other \_\_\_\_\_

25. In a *usual* school week (Monday to Friday), on how many days do you do the following?

None    1 day    2 days    3 days    4 days    5 days

	None	1 day	2 days	3 days	4 days	5 days
a) Eat breakfast	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b) Eat breakfast provided to you as part of a school program	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c) Eat lunch at school - lunch packed and brought <u>from home</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) Eat lunch at school - lunch <u>purchased in the cafeteria</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e) Eat lunch purchased at a fast food place or restaurant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f) Eat snacks purchased from a vending machine <u>in your school</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g) Eat snacks purchased from a vending machine, corner store, snack bar, or canteen <u>off school property</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h) Drink sugar-sweetened beverages (soda pop, Kool-Aid, Gatorade, etc.) <u>Do not include diet/sugar-free drinks</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
i) Drink high-energy drinks (Red Bull, Monster, Rock Star, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
j) Drink coffee or tea <u>with sugar</u> (include cappuccino, frappuccino, iced-tea, iced-coffees, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
k) Drink coffee or tea <u>without sugar</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

26. On a *usual* weekend (Saturday and Sunday), on how many days do you do the following?

None    1 day    2 days

	None	1 day	2 days
a) Eat breakfast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b) Eat lunch	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c) Eat foods purchased at a fast food place or restaurant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) Eat snacks purchased from a vending machine, corner store, snack bar, or canteen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e) Drink sugar-sweetened beverages (soda pop, Kool-Aid, Gatorade, etc.) <u>Do not include diet/sugar-free drinks</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f) Drink high energy drinks (Red Bull, Monster, Rock Star, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g) Drink coffee or tea <u>with sugar</u> (include cappuccino, frappuccino, iced-tea, iced-coffees, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h) Drink coffee or tea <u>without sugar</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

27. YESTERDAY, from the time you woke up until the time you went to bed, how many **servings** of meats and alternatives did you have? One 'Food Guide' **serving** of meat and alternatives includes cooked fish, chicken, beef, pork, or game meat, eggs, nuts or seeds, peanut butter or nut butters, legumes (beans), and tofu.

- None
- 1 serving
- 2 servings
- 3 servings
- 4 servings
- 5 or more servings

**Canada's Food Guide Serving Sizes of Meats and Alternatives**



28. YESTERDAY, from the time you woke up until the time you went to bed, how many **servings** of vegetables and fruits did you have? One 'Food Guide' **serving** of vegetables and fruit includes pieces of fresh vegetable or fruit, salad or raw leafy greens, cooked leafy green vegetables, dried or canned or frozen fruit, and 100% fruit or vegetable juice.

- None
- 1 serving
- 2 servings
- 3 servings
- 4 servings
- 5 servings
- 6 servings
- 7 servings
- 8 servings
- 9 or more servings

**Canada's Food Guide Serving Sizes of Vegetables and Fruits**



29. YESTERDAY, from the time you woke up until the time you went to bed, how many **servings** of milk and alternatives did you have? One 'Food Guide' **serving** of milk or milk alternatives includes milk, fortified soy beverage, reconstituted powdered milk, canned (evaporated) milk, yogurt or kefir (another type of cultured milk product), and cheese.

- None
- 1 serving
- 2 servings
- 3 servings
- 4 servings
- 5 servings
- 6 or more servings

**Canada's Food Guide Serving Sizes of Milk and Alternatives**



30. YESTERDAY, from the time you woke up until the time you went to bed, how many **servings** of grain products did you have? One 'Food Guide' **serving** of grain products includes bread, bagels, flatbread such as tortilla, pita, cooked rice or pasta, and cold cereal.

- None
- 1 serving
- 2 servings
- 3 servings
- 4 servings
- 5 servings
- 6 servings
- 7 servings
- 8 servings
- 9 or more servings

**Canada's Food Guide Serving Sizes of Grain Products**



Food photos source: Canada's Food Guide, Health Canada, 2011. Reproduced with the permission of the Minister of Health, 2011.



39. Have you ever smoked every day for at least 7 days in a row?

- Yes
- No

40. On how many of the last 30 days did you smoke one or more cigarettes?

- None
- 1 day
- 2 to 3 days
- 4 to 5 days
- 6 to 10 days
- 11 to 20 days
- 21 to 29 days
- 30 days (every day)

41. Thinking back over the last 30 days, on the days that you smoked, how many cigarettes did you usually smoke each day?

- None
- A few puffs to one whole cigarette
- 2 to 3 cigarettes
- 4 to 5 cigarettes
- 6 to 10 cigarettes
- 11 to 20 cigarettes
- 21 to 29 cigarettes
- 30 or more cigarettes

42. Your closest friends are the friends you like to spend the most time with. How many of your closest friends smoke cigarettes?

- None
- 1 friend
- 2 friends
- 3 friends
- 4 friends
- 5 or more friends

43. Have you ever tried to quit smoking cigarettes?

- I have never smoked
- I have only smoked a few times
- I have never tried to quit
- I have tried to quit once
- I have tried to quit 2 or 3 times
- I have tried to quit 4 or 5 times
- I have tried to quit 6 or more times

44. In the last 30 days, did you use any of the following? (Mark all that apply)

- Pipe tobacco
- Cigarillos or little cigars (plain or flavoured)
- Cigars (not including cigarillos or little cigars, plain or flavoured)
- Roll-your-own cigarettes (tobacco only)
- Loose tobacco mixed with marijuana
- E-cigarettes (electronic cigarettes that look like cigarettes/cigars, but produce vapour instead of smoke)
- Smokeless tobacco (chewing tobacco, pinch, snuff, or snus)
- Nicotine patches, nicotine gum, nicotine lozenges, or nicotine inhalers
- Hookah (water-pipe) to smoke tobacco
- Hookah (water-pipe) to smoke herbal sheesha/shisha
- Blunt wraps (a sheet or tube made of tobacco used to roll cigarette tobacco)
- I have not used any of these things in the last 30 days





## Your School and You

52. How strongly do you agree or disagree with each of the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
a) I feel close to people at my school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b) I feel I am part of my school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c) I am happy to be at my school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) I feel the teachers at my school treat me fairly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e) I feel safe in my school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f) Getting good grades is important to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

53. In the last 30 days, in what ways were you bullied by other students? (Mark all that apply)

- I have not been bullied in the last 30 days
- Physical attacks (e.g., getting beaten up, pushed, or kicked)
- Verbal attacks (e.g., getting teased, threatened, or having rumours spread about you)
- Cyber-attacks (e.g., being sent mean text messages or having rumours spread about you on the internet)
- Had someone steal from you or damage your things

54. In the last 30 days, how often have you been bullied by other students?

- I have not been bullied by other students in the last 30 days
- Less than once a week
- About once a week
- 2 or 3 times a week
- Daily or almost daily

55. In the last 30 days, in what ways did you bully other students? (Mark all that apply)

- I did not bully other students in the last 30 days
- Physical attacks (e.g., beat up, pushed, or kicked them)
- Verbal attacks (e.g., teased, threatened, or spread rumours about them)
- Cyber-attacks (e.g., sent mean text messages or spread rumours about them on the internet)
- Stole from them or damaged their things

56. In the last 30 days, how often have you taken part in bullying other students?

- I did not bully other students in the last 30 days
- Less than once a week
- About once a week
- 2 or 3 times a week
- Daily or almost daily

57. How supportive is your school of the following?

	Very supportive	Supportive	Unsupportive	Very unsupportive
a) Making sure there are opportunities for students to be physically active	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b) Making sure students have access to healthy foods and drinks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c) Making sure no one is bullied at school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) Giving students the support they need to resist or quit tobacco	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e) Giving students the support they need to resist or quit drugs and/or alcohol	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

58. What academic level was your current or most recent Math course?

- Applied
- Academic
- Other \_\_\_\_\_



## Appendix B: Year 3 School Policies and Practices Administrator Questionnaire

### School Policies and Practices Year 3 Cardinal Catholic SS

Please provide as much detail as possible in this chart. We have provided a summary of what was reported in the School Policy and Practices Questionnaire and follow-up interview completed at your school last year. This information will aid the COMPASS team with investigating the impact of your school's changes in policies, practices or environmental factors on student health related behaviour.

Behaviour	2012-13 Summaries	2013-14 Changes	Have any changes been made since last school year? <i>Please provide details on a) whether past policies, practices, environment and relationships are still in place, and b) whether any new policies, practices, environment changes or relationships are planned or being implemented.</i>		
Healthy Eating	<p><i>Is unhealthy eating among students a problem at your school?</i></p> <ul style="list-style-type: none"> <li>- Yes</li> </ul>	<ul style="list-style-type: none"> <li>- yes, still a problem</li> </ul>	<p><i>Is unhealthy eating among students a problem at your school this year?</i></p> <p><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>		
	<p><b>Policies:</b></p> <ul style="list-style-type: none"> <li>- No written policies concerning healthy eating</li> </ul>	<ul style="list-style-type: none"> <li>- Yes, under regulation from M of E, PPM 150</li> </ul>	<p>Policy Changes</p> <p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>	<p>If yes, please provide details</p>	
	<p><b>Practices:</b></p> <ul style="list-style-type: none"> <li>- The school has a free breakfast program available to all students 3 days per week</li> <li>- The school offers cooking class and media literacy on special topics related to healthy eating (e.g. body image, eating disorders)</li> <li>- School offers Foods classes to help students understand nutrition</li> <li>- In the past year school staff have not received any training, conference or presentations for nutrition or for promoting positive body image</li> <li>- There are no clear guidelines to refer students with a suspected eating disorder to the appropriate health professional or community agency</li> </ul>	<ul style="list-style-type: none"> <li>- Fuel after school program from the public health nurse - physical activity for girls</li> </ul>	<p>Practices Changes</p> <p><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>	<p><i>(If yes, please provide details)</i></p> <p>1) Guest Speaker - health, nutrition and fitness, body image</p> <p>2) Guest Trainer for our workout/fitness studio</p>	
	<p><b>Environment/Equipment:</b></p> <ul style="list-style-type: none"> <li>- School has a cafeteria and vending machines that are operated by a food service company</li> <li>- School has other vending machines and a snack bar/tuck shop that is operated by the school</li> </ul>	<ul style="list-style-type: none"> <li>- No change</li> </ul>	<p>Environment or equipment Changes</p> <p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>	<p>If yes, please provide details</p>	

	<b>Public Health:</b> <ul style="list-style-type: none"> <li>- Public Health has provided information/resources/programs on healthy eating</li> <li>- RETHINK your drink program with Public Health</li> <li>- Public Health always initiates contact with the school</li> </ul>	<ul style="list-style-type: none"> <li>- No change</li> </ul>	Changes with relationships with Public Health: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes, please provide details • Health fair now keeps regular hours here at the school • more access/visits to classrooms • attend PAC meeting • participated in our Wellness Fair
<b>Behaviour</b>	<b>2012-13 Summaries</b>	<b>2013-14 Changes</b>	<b>Have any changes been made since last school year?</b> Please provide details on a) whether past policies, practices, environment and relationships are still in place, and b) whether any new policies, practices, environment changes or relationships are planned or being implemented	
	<b>Is physical inactivity among students a problem at your school?</b> <ul style="list-style-type: none"> <li>- unknown</li> </ul>	<ul style="list-style-type: none"> <li>- unknown</li> </ul>	<b>Is physical inactivity among students a problem at your school your school this year?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No	
	<b>Policies:</b> <ul style="list-style-type: none"> <li>- No written policies concerning physical activity</li> </ul>	<ul style="list-style-type: none"> <li>- No change</li> </ul>	<b>Policy Changes</b> <input type="checkbox"/> Yes <input type="checkbox"/> No	Please provide details on a) whether past policies are still in place, and b) whether new policies are planned or being implemented
<b>Physical Activity</b>	<b>Practices:</b> <ul style="list-style-type: none"> <li>- The majority of students do not have access to indoor physical activity areas during non-instructional time, but do have access to outdoor facilities on school grounds</li> <li>- Sometimes students have access to physical activity equipment such as soccer balls and basketballs during non-instructional times</li> <li>- The school does not offer intramural physical activity programs</li> <li>- The school has a dance club</li> <li>- The school has interschool or varsity programs. Last year there were 20 teams</li> <li>- The school participated in a Walk-a-thon for Cancer and Juvenile Diabetes</li> </ul>	<ul style="list-style-type: none"> <li>- There are times during the school year where intramural activities in the gym occur.</li> </ul>	<b>Practices Changes</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If yes, please provide details

	<b>Environments &amp; Equipment:</b> <ul style="list-style-type: none"> <li>School has change rooms available for use before and after physical activity. The girls' change room has privacy stalls, but the boys' does not. Both change rooms have showers. There are no lockers in the change rooms</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	Environment or equipment Changes <input type="radio"/> Yes <input checked="" type="radio"/> No	If yes, please provide details
	<b>Public Health:</b>	<ul style="list-style-type: none"> <li>No change</li> </ul>	Changes with relationships with Public Health: <input checked="" type="radio"/> Yes <input type="radio"/> No	If yes, please provide details - more access - added smoking cessation program
<b>Behaviour</b>	<b>2012-13 Summaries</b>	<b>2013-14 Changes</b>	<b>Have any changes been made since last school year?</b> <i>Please provide details on a) whether past policies, practices, environment and relationships are still in place, and b) whether any new policies, practices, environment changes or relationships are planned or being implemented</i>	
	<b>Is tobacco use among students a problem at your school?</b> <ul style="list-style-type: none"> <li>no</li> </ul>	<ul style="list-style-type: none"> <li>no change</li> </ul>	<b>Is tobacco use among students a problem at your school this year?</b> <input checked="" type="radio"/> Yes <input type="radio"/> No	
<b>Tobacco Use</b>	<b>Policies:</b> <ul style="list-style-type: none"> <li>Tobacco use is prohibited within specific distance of the school, in private vehicles parked at school and at sponsored events off of school grounds. These policies include smokeless tobacco.</li> <li>violation of this policy will result in an automatic suspension.</li> <li>Even during school dances there is still not to be any smoking on school property - any student found smoking on school property will be asked to leave the dance.</li> <li>Students always adhere to the school's written</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	Policy Changes <input checked="" type="radio"/> Yes <input type="radio"/> No	Please provide details on a) whether past policies are still in place, and b) whether new policies are planned or being implemented  Adding smoking cessation/support group

	<p>policies</p> <ul style="list-style-type: none"> <li>Students are not permitted to wear or carry apparel or paraphernalia with tobacco company names or logos on them</li> </ul>			
	<p><b>Practices:</b></p> <ul style="list-style-type: none"> <li>There is an area off of school grounds within view of the school where students smoke</li> <li>Students caught smoking on school grounds are referred to a counsellor, their parents are contacted, the students is encouraged but not required to participate in an assistance, education, or cessation program, the substance is confiscated and the student is suspended from school. Sanctions get stronger with subsequent violations.</li> <li>Tobacco prevention program with public health, but no cessation programs are available</li> <li>In the last year school staff have not received any training, conference, workshops or presentations surrounding tobacco use</li> <li>Atrium set up to send awareness to the students mostly related to smoking</li> </ul>	<ul style="list-style-type: none"> <li>Refer to 91 reasons to be tobacco free.</li> <li>Diversion program</li> </ul>	<p>Practices Changes</p> <p><input type="radio"/> Yes</p> <p><input checked="" type="radio"/> No</p>	<p>If yes, please provide details</p>
	<p><b>Environments &amp; Equipment:</b></p>		<p>Environment or equipment Changes</p> <p><input type="radio"/> Yes</p> <p><input checked="" type="radio"/> No</p>	<p>If yes, please provide details</p>
	<p><b>Public Health:</b></p> <ul style="list-style-type: none"> <li>Public Health has provided information/resources/programs on tobacco use specifically on tobacco prevention</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<p>Changes with relationships with Public Health:</p> <p><input type="radio"/> Yes</p> <p><input checked="" type="radio"/> No</p>	<p>If yes, please provide details</p>

	Environments & Equipment:		Environment or equipment Changes - Yes ✓ No	If yes, please provide details
	Public Health:		Changes with relationships with Public Health: - Yes ✓ No	If yes, please provide details
<b>Behaviour</b>	<b>2012-13 Summaries</b>	<b>2013-14 Changes</b>	<b>Have any changes been made since last school year?</b> <i>Please provide details on a) whether past policies, practices, environment and relationships are still in place, and b) whether any new policies, practices, environment changes or relationships are planned or being implemented</i>	
	<i>Is bullying a problem at your school?</i> - yes	- Yes	<i>Is bullying a problem at your school this year?</i> - Yes ✓ No	
<b>Bullying</b>	<b>Policies:</b> - Incidents of intimidation, harassment, threats and physical violence and/or the possession of a weapon, whether on Cardinal Carter property or elsewhere will be considered as very serious. - Violations may result in suspensions up to 20 days and/or expulsion - Bullying will not be accepted on school property, at school-related activities, on school buses, or in any other circumstances (eg. online) where engaging in bullying will have a negative impact on the school climate - Bystanders witnessing bullying that do not intervene will also be punished	- No change	<b>Policy Changes</b> - Yes ✓ No	Please provide details on a) whether past policies are still in place, and b) whether new policies are planned or being implemented
	<b>Practices:</b> - School has the BRAD bullying program through the Ontario Provincial Police	- No change	<b>Practices Changes</b> - Yes ✓ No	If yes, please provide details

Behaviour	2012-13 Summaries	2013-14 Changes	Have any changes been made since last school year? Please provide details on a) whether past policies, practices, environment and relationships are still in place, and b) whether any new policies, practices, environment changes or relationships are planned or being implemented	
	<p>Are alcohol and drug use among students a problem at your school?</p> <p>Alcohol: no Drug Use: yes</p>	<ul style="list-style-type: none"> <li>Alcohol: no</li> <li>Drugs: yes</li> </ul>	<p>Are alcohol and drug use among students a problem at your school this year?</p> <p>Alcohol use:      Drug use:</p> <p><input type="radio"/> Yes                  <input checked="" type="radio"/> Yes</p> <p><input checked="" type="radio"/> No                    <input type="radio"/> No</p>	
	<p>Policies:</p> <ul style="list-style-type: none"> <li>Students found in possession or under the influence of alcohol /drugs will be suspended and may require police involvement. Additional infractions can result in expulsion</li> <li>Students always adhere to the school's written policies</li> <li>Students are not permitted to wear or carry apparel or paraphernalia with alcohol or drug company names or logos on them</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<p>Policy Changes</p> <p><input checked="" type="radio"/> Yes</p> <p><input type="radio"/> No</p>	<p>Please provide details on a) whether past policies are still in place, and b) whether new policies are planned or being implemented</p> <p>• Keamington Hospital now offer more programs - Addiction, Gambling etc.</p> <p>• New Beginnings - Substance Abuse Counselling.</p> <p>Using both of these agencies more</p>
Alcohol & Drug Use	<p>Practices:</p> <ul style="list-style-type: none"> <li>Students caught using alcohol or drugs on school grounds are referred to a counsellor, their parents are contacted, the students is encouraged but not required to participate in an assistance, education, or cessation program, the substance is confiscated and the student is suspended from school. The police are also alerted. Sanctions get stronger with subsequent violations.</li> <li>In the last year school staff have not received any training, conference, workshops or presentations surrounding alcohol or drug use</li> <li>No alcohol use prevention programs offered at the school</li> <li>Drug use prevention program is offered at the school, suspension re-entry counselling</li> <li>OPP officer comes in to talk about marijuana</li> </ul>	<ul style="list-style-type: none"> <li>No change</li> </ul>	<p>Practices Changes</p> <p><input type="radio"/> Yes</p> <p><input checked="" type="radio"/> No</p>	<p>If yes, please provide details</p>



	Environments & equipment:	• No change	Environment or equipment Changes <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes, please provide details added a 'Suggestion Box' in hallway; students are using it on a daily basis.
	Public Health:	• No change	Changes with relationships with Public Health: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes, please provide details • Health nurse now has regular hours here; more contact w/ students & staff
<b>Behaviour</b>	<b>2012-13 Summaries</b>	<b>2013-14 Changes</b>	<b>Have any changes been made since last school year?</b> Please provide details on a) whether past policies, practices, environment and relationships are still in place, and b) whether any new policies, practices, environment changes or relationships are planned or being implemented	
	Policies:	• No change	Policy Changes <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Please provide details on a) whether past policies are still in place, and b) whether new policies are planned or being implemented
	Practices:	• No change	Practices Changes <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes, please provide details Sherk Complex offered fitness membership free to all our Gr 9's.
<b>Sedentary Behaviour</b>	Environments & Equipment:	• No change	Environment or equipment Changes <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If yes, please provide details
	Public Health:	• Fuel program	Changes with relationships with Public Health: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If yes, please provide details
	• Fuel program (added)			

2012-13 Response	2013-14 Response	2014-15 Response
<p>Please rank these school/health-related issues in terms of importance to your school from 1 to 10 (1= highest priority...10=lowest priority.):</p> <p>a. Tobacco Use b. Alcohol and other Drug Use c. Healthy Eating d. Physical Activity e. Bullying/Violence f. Mental Health g. Sexual Health h. Sun safety/tanning beds i. Obesity/overweight/healthy weight j. Sedentary behaviours/screen-time</p> <p><i>*this section was not completed, but a note beside said "I would say that bullying/mental health is a top priority however all of these are parallel priorities"</i></p>	<p>Please rank these school/health-related issues in terms of importance to your school from 1 to 10 (1= highest priority...10=lowest priority.):</p> <p>a. Tobacco Use 1 b. Alcohol and other Drug Use 1 c. Healthy Eating 1 d. Physical Activity 5 e. Bullying/Violence 1 f. Mental Health 1 g. Sexual Health 2 h. Sun safety/tanning beds 2 i. Obesity/overweight/healthy weight 2 j. Sedentary behaviours/screen-time 2</p> <p><input type="checkbox"/> Same priority ranking as last year</p> <p>If physical activity and healthy eating are top priorities is it because obesity, overweight and/or healthy weight are problems at your school?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>	<p>Please rank these school/health-related issues in terms of importance to your school from 1 to 10 (1= highest priority...10=lowest priority.):</p> <p>a. Tobacco Use 1 b. Alcohol and other Drug Use 2 c. Healthy Eating 3 d. Physical Activity 5 e. Bullying/Violence 1 f. Mental Health 1 g. Sexual Health 7 h. Sun safety/tanning beds 7 i. Obesity/overweight/healthy weight 5 j. Sedentary behaviours/screen-time 5</p> <p><input type="checkbox"/> Same priority ranking as last year</p> <p>If physical activity and healthy eating are top priorities is it because obesity, overweight and/or healthy weight are problems at your school?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>

Please select the interschool or varsity programs involving physical activity that are/will be offered to students at your school during this school year.

Sport/Game	Junior Girl's	Senior Girl's	Junior Boy's	Senior Boy's
Soccer	●	●	●	●
Cross country running	●	●	●	●
Tennis	●	●	●	●
Basketball	●	●	●	●
Football	●	●	●	●
Field hockey	○	○	○	○
Ice Hockey	●	●	●	●
Volleyball	○	●	●	●
Wrestling	●	●	●	●
Swimming	○	○	○	○
Cliffing	○	○	○	○
Alpine Skiing	○	○	○	○
Cross-Country Skiing	○	○	○	○

## Appendix C: Binge drinking in students who reported the outcome in both years versus those who reported the outcome in only one year (linked sample)

Students who gave no response in Year 2 and who reported being current binge drinkers in Year 3

Frequency	Table of interv by drop1			
Row Pct	interv	drop1		
		0	1	Total
	0	14663	<b>20</b>	14683
		99.86	<b>0.14</b>	
	1	3800	<b>7</b>	3807
		99.82	<b>0.18</b>	
	Total	18463	<b>27</b>	18490

### Statistics for Table of interv by drop1

Statistic	DF	Value	Prob
Chi-Square	1	0.4709	<b><u>0.4926</u></b>
Likelihood Ratio Chi-Square	1	0.4446	0.5049
Continuity Adj. Chi-Square	1	0.2008	0.6541
Mantel-Haenszel Chi-Square	1	0.4709	0.4926
Phi Coefficient		0.0050	
Contingency Coefficient		0.0050	
Cramer's V		0.0050	

### Fisher's Exact Test

Cell (1,1) Frequency (F)	14663
Left-sided Pr <= F	0.8247
Right-sided Pr >= F	0.3139

Fisher's Exact Test

Table Probability (P) 0.1386  
 Two-sided Pr <= P 0.4773

Students who reported being current binge drinkers in Year 2 and who gave no response in Year 3

Frequency Row Pct	Table of interv by drop2			
	interv	drop2		
		0	1	Total
0	14675	8	14683	
	99.95	<b>0.05</b>		
1	3807	0	3807	
	100.00	<b>0.00</b>		
Total	18482	8	18490	

Statistics for Table of interv by drop2

Statistic	DF	Value	Prob
Chi-Square	1	2.0751	<b><u>0.1497</u></b>
Likelihood Ratio Chi-Square	1	3.6895	0.0548
Continuity Adj. Chi-Square	1	1.0065	0.3157
Mantel-Haenszel Chi-Square	1	2.0750	0.1497
Phi Coefficient		-0.0106	
Contingency Coefficient		0.0106	
Cramer's V		-0.0106	

WARNING: 25% of the cells have expected counts less than 5. Chi-Square may not be a valid test.

Fisher's Exact Test

Fisher's Exact Test

Cell (1,1) Frequency (F)	14675
Left-sided Pr <= F	0.1581
Right-sided Pr >= F	1.0000
Table Probability (P)	0.1581
Two-sided Pr <= P	0.3742

Students who gave no response in Year 2 and who reported being non-current binge drinkers in Year 3

The FREQ Procedure

Frequency Row Pct	Table of interv by drop1			
	interv	drop1		
		0	2	Total
0	14660	<b>23</b>	14683	
	99.84	<b>0.16</b>		
1	3803	<b>4</b>	3807	
	99.89	<b>0.11</b>		
Total	18463	<b>27</b>	18490	

Statistics for Table of interv by drop1

Statistic	DF	Value	Prob
Chi-Square	1	0.5515	<b>0.4577</b>
Likelihood Ratio Chi-Square	1	0.5966	0.4399
Continuity Adj. Chi-Square	1	0.2545	0.6139
Mantel-Haenszel Chi-Square	1	0.5515	0.4577
Phi Coefficient		-0.0055	
Contingency Coefficient		0.0055	

Statistic	DF	Value	Prob
Cramer's V		-0.0055	

Fisher's Exact Test

Cell (1,1) Frequency (F)	14660
Left-sided Pr <= F	0.3204
Right-sided Pr >= F	0.8367
Table Probability (P)	0.1571
Two-sided Pr <= P	0.6344

Students who reported being non-current binge drinkers in Year 2 and who gave no response in Year 3

Frequency Row Pct	Table of interv by drop2			
	interv	drop2		
		0	2	Total
0	14648	<b>35</b>	14683	
	99.76	<b>0.24</b>		
1	3796	<b>11</b>	3807	
	99.71	<b>0.29</b>		
Total	18444	<b>46</b>	18490	

Statistics for Table of interv by drop2

Statistic	DF	Value	Prob
Chi-Square	1	0.3115	<b><u>0.5767</u></b>
Likelihood Ratio Chi-Square	1	0.3002	0.5838
Continuity Adj. Chi-Square	1	0.1411	0.7072
Mantel-Haenszel Chi-Square	1	0.3115	0.5767

Statistic	DF	Value	Prob
Phi Coefficient		0.0041	
Contingency Coefficient		0.0041	
Cramer's V		0.0041	

Fisher's Exact Test

Cell (1,1) Frequency (F)	14648
Left-sided Pr <= F	0.7754
Right-sided Pr >= F	0.3424
Table Probability (P)	0.1179
Two-sided Pr <= P	0.5840

Sample Size = 18490

The FREQ Procedure

Frequency	Table of A5DRNKC1_2013 by A5DRNKC1_2014			
	A5DRNKC1_2013	A5DRNKC1_2014		Total
		0	1	
0	13301	2384		15685
1	772	1925		<b>2697</b>
Total	14073	<b>4309</b>		18382

Statistics for Table of A5DRNKC1\_2013 by A5DRNKC1\_2014

McNemar's Test

Statistic (S)	823.3663
DF	1
Asymptotic Pr > S	<.0001
Exact Pr >= S	<.0001

### Simple Kappa Coefficient

Kappa	0.4503
ASE	0.0081
95% Lower Conf Limit	0.4345
95% Upper Conf Limit	0.4661

Sample Size = 18382

Those who answered the binge drinking question in both years = 18,382:

Y2 current binge drinkers = 2697 binge / 18382 total sample = **14.67%** binge drinkers in Y2

Y3 current binge drinkers = 4309 binge / 18382 total sample = **23.44%** binge drinkers in Y3

Those who answered the binge drinking question in only one of the two years (18,490 – 18,382) = 108

#### DROP 1

No response Y2/Binge Y3 = **27**

No response Y2/Non-Binge Y3 = 27

#### DROP 2

No response Y3/Binge Y2 = **8**

No response Y3/Non-Binge Y2 = 46

**35/108 = 32.41%** binge drinkers in dropped sample

Therefore, there are significantly more binge drinkers present in the sample that did not indicate their binge drinking status in both years (108) than there are in the sample that did indicate their binge drinking status in both years (18,382) for either Year 2 or Year 3. However, this bias (i.e. higher proportion of binge drinkers in the sample of 108 students than the proportion of binge drinkers in the sample of 18,382 for either Year 2 or Year 3) is not significantly different between Intervention and Control schools and therefore affects these two groups in a similar fashion. As a result, any differences that are seen in student binge drinking between the intervention and control schools would probably not be attributed to this bias.



## Appendix D: Intervention changes that occurred from Year 2 to Year 3 for each of the 19 Ontario intervention schools in the COMPASS linked sample

Table 10: School-specific alcohol prevention interventions that were implemented in the 19 different intervention schools in the linked sample between Year 2 (2013-2014) and Year 3 (2014-2015) of the COMPASS Study (Ontario, Canada)

Description of the Intervention	
<i>Surveillance and punishment policies</i>	
School 1	The school administrators are actively cracking down on drug use or suspected drug use by taking a proactive approach to the drug problem. The staff is doing this by calling parents when they suspect that a student is high, searching bags, etc.
School 2	Last June the board initiated a “zero” tolerance policy aligned with OSAID in particular response to a tragic accident at grad time.
School 3	Progressive discipline depending on severity.
<i>Student education programs</i>	
School 4	The school is involved in a "mock crash" planned with the community first responders with the focus being on distracted driving and drugs.
School 5	The school has a ‘Kiards’ counsellor from the health department and religion department come in to discuss making responsible choices.
School 6	The school has a public health nurse attend the parent council meeting and also give a presentation to the school.
School 7	The school has MADD Canada coming in for an assembly on Friday, September 19 <sup>th</sup> .
School 8	The school offers team meetings and information on community supports for alcohol and drug use. The school also has a mixer contest with the Durham Regional Police.
School 9	Public Health provides the school with displays and pamphlets.
<i>Counselling programs</i>	
School 10	A mental health and addictions counselor comes in 1 day a week at the school as part of a partnership through the PE Health curriculum.
School 11	Students may be sent to a temporary alternative program called ‘ABLE’ to get counselling on drugs and alcohol and work on their academics as well.
School 12	The program ‘Choices for Change’ is in the school 2 days a week and provides alcohol prevention programs. This program is provided by the PHN.
<i>Staff training and education programs</i>	
School 13	Lanark County OPP officers provided a short in-service training session for staff related to recognizing drug use amongst students. Some members of staff have attended substance use focused training sessions. The school is also

	represented at the local Municipal Drug Strategy Committee.
School 14	All school staff were presented to by Treaty 3 Police and drug enforcement officer constable Ashley Gebbs. The presentation talked about awareness and how to help in prevention.
<i>Two different intervention changes</i>	
School 15	<p>1. Student Success Team monitors and refers students to the mental health and addictions nurse. One office assistant has been identified as the "Intervention Assistant" (used to be attendance secretary) and is on the SST, monitors the guidance area, and books appointments with Guidance and mental health and addictions nurse (triage support and coordination).</p> <p>2. Four students are preparing to perform a safety presentation to gr. 7 and 8 students. These four students are on the prevention pillar committee along with the Northwest Health Unit.</p>
School 16	<p>1. "Drive 4 Life" program is offered to the school each year by Public Health in partnership with the city police. This program is a drug and alcohol awareness event for grade 11 students and the school participates in it every year.</p> <p>2. The school has a MADD presentation offered to grade 11 classes in the spring.</p>
School 17	<p>1. The school has a police department workshop.</p> <p>2. The school has a policy on suspending students for drugs/alcohol but also has re-integration strategies.</p>
<i>Three different intervention changes</i>	
School 18	<p>1. The school has a drug and alcohol addiction specialist who is available to speak with individual students.</p> <p>2. The school offers presentations regarding drug and alcohol abuse to gr 11/12 students. This includes a large forum as well as individual classes.</p> <p>3. Counselling is available as a follow-up to such presentations.</p>
School 19	<p>1. Leamington Hospital now offers more programs with respect to addiction, gambling, etc. within the school.</p> <p>2. "New Beginnings" substance abuse counselling is offered at the school.</p> <p>3. The health nurse now has regular hours at the school and is in more contact with students.</p>
<p>Notes: Control Schools (n=58) reported no changes to their school-based alcohol prevention policies and/or programs between Year 2 and Year 3 and were pooled into one group</p>	