Dieting and Health-Related Behaviours Among Adolescent Girls: A Longitudinal Analysis of Data From a School-Based 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 the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Objective: Dieting to lose weight is extremely common among adolescents, especially girls, and is driven by multiple factors, including individual traits and societal standards regarding body weight and shape. Dieting is associated with poor diet quality, overweight and obesity, and increased risk of eating disorders. Also, according to the amassed cross-sectional and longitudinal research, dieting adolescent girls are more likely to engage in smoking, binge drinking, and breakfast-skipping than non-dieting girls. However, despite literature documenting these bivariate associations, we know little about whether there is a causal link between dieting to lose weight and these behaviours among Canadian adolescent girls. Further, there has been little research considering clustering of multiple risky behaviours with dieting.

Methods: Using longitudinal data (2012-2014) from COMPASS, a school-based study conducted in Ontario (N=3,386), we prospectively explored associations between dieting to lose weight and clusters of health-compromising behaviours among adolescent girls. Dieting was defined as an intentional change in behaviour to achieve weight loss. Longitudinal, multilevel logistic regression models were used to investigate the relationship between dieting and each of smoking, binge drinking, breakfast-skipping, and clusters of these behaviours.

Results: Over half of girls reported dieting to lose weight (54%) and a similar proportion (61%) self-reported heights and weights corresponding with a healthy BMI (61%). Over 80% of girls classified as dieters at baseline also reported dieting 2 years later. Girls who engaged in dieting at baseline were at a significantly elevated risk of smoking, binge drinking, and breakfast-skipping (OR=1.3 to 1.4) by follow-up than non-dieters. Dieting was also associated with engaging in combinations of these behaviours, with the highest risk for engagement in patterns of binge drinking/breakfast-skipping (OR=1.6) and smoking/binge drinking/breakfast-skipping (OR=1.6). Girls who dieted at baseline were also more likely to engage in a greater number of risky behaviours than non-dieters, regardless of what the actual behaviours were.

Conclusion: Dieting is a persistent and pervasive behaviour among adolescent girls, with implications for engagement in other risky behaviours. The theoretical mechanisms underlying the observed clustering are complex, but these findings suggest the need for comprehensive interventions that use a systems lens to consider the array of relevant factors, and their interactions, among this population. Strategies that target a single behaviour may represent missed opportunities to address shared risk factors and may have unintended consequences for other behaviours. These findings are particularly salient given the dominant focus within health promotion on weight loss and maintenance as part of a war on obesity.

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Chapter 1

Introduction and Overview

According to measured anthropometric data from the 2007-2009 Canadian Health Measures Survey (CHMS), 10.5% of Canadians aged 12 to 17 were obese (1); yet, despite the growing concern over rates of obesity among Canadian youth, the Canadian Paediatric Society discourages dieting to lose weight among this age group (2). Nonetheless, dieting to lose weight is an extremely common practice among Canadian adolescents (3–5), especially girls (6,7), and is driven by multiple factors, including individual traits and societal standards for body weight and shape (6,8). Dieting is associated with several negative health outcomes and a greater risk of engaging in other harmful health-related behaviours (9–11).

Health-compromising, “risky” behaviours, including dieting, tend to cluster and co-occur in adolescence (12,13). The underlying mechanisms for the co-occurrence of health-related behaviours are currently debated (14). Systems science approaches, which work with the complexity of multiple drivers underlying health issues by observing them as both independent and part of a whole system (15), may assist researchers in unraveling the complexity that drives this clustering and inform comprehensive policy and program interventions to promote health by addressing underlying risk factors. However, to further investigate complex social systems, we must first establish the foundational, linear relationships between the co-occurrence and temporality of multiple behaviours to better understand the workings of how the system operates (16,17). Although research has demonstrated a positive association between dieting to lose weight among adolescent girls with each of smoking (8,18,19), binge drinking (7,19,20), and breakfast-skipping (4,10,21) independently, these associations have not been established in a longitudinal Canadian study.

This study aimed to investigate each of these relationships among Canadian adolescent girls, so that further research may investigate the potential role of dieting in the complex web of adolescent health behaviour through a systems perspective. This empirical foundation is critical to the development of comprehensive prevention initiatives that effectively target multiple health-compromising behaviours among adolescents.

Chapter 2

Literature Review

2.1 Dieting to Lose Weight

Dieting is broadly defined as an intentional change in behaviour to achieve weight loss (22,23). However, this loose definition for dieting has been applied differently across health research, as observed dieting behaviours vary significantly and occur on a spectrum (2). On one end of the spectrum, dieting to lose weight may be exhibited through the adoption of "healthful" behaviours, such as engaging in increased amounts of physical activity, eating more fruits and vegetables, and limiting less healthy foods as a means to lose weight (9,24). At the other end of the spectrum, unhealthful dieting behaviours may include meal-skipping, fasting, self-induced vomiting, laxative abuse, and diuretic abuse (3,9,25). Additionally, dieting may occur intermittently or may persist over time (4,26); engaging in unhealthful dieting behaviours over an extended period of time is often referred to as disordered eating (3,4).

Dieting to lose weight is much more prevalent among girls and women than it is among boys and men, as the construct of dieting significantly differs by gender (27). Briefly, women often strive to diet to lose weight and aspire to achieve a thin body ideal, while males typically strive to lose fat mass, build muscle mass, and alter their body shape to attain a muscular body ideal (28,29). These standards are influenced by media-fuelled societal "body ideals" (29). The construct of dieting in itself, and how we define it as an intentional striving to lose weight, is shaped by the societal standards of body appearance and shape that *women* are led to believe is the "ideal" (30); consequently, women are more likely to engage in this behaviour. Although attempts to lose weight have been observed in adolescent males in North American studies (7,9,31), dieting to lose weight is still more common among girls.

2.1.1 Prevalence of Dieting among Adolescent Girls

In 2004, approximately 30% of a sample of girls aged 10 to 14 in Southern Ontario reported dieting to lose weight (4). Many studies conducted among samples of North American adolescent girls report similar findings, with prevalences of self-reported dieting ranging from one quarter (3,10,32) to one half (5,7) of all girls surveyed. Although intention to lose weight is dynamic and may fluctuate over time among this population and across samples (4), cross-sectional Canadian data have demonstrated that, at any given time, 1 in 5 adolescent girls report being “on a diet” (3). Furthermore, in one American-based study on adolescent dieting and weight-control behaviours, nearly 57% of adolescent girls reported engaging in “unhealthful” or extreme dieting behaviours in the previous year (9). Although both healthful and unhealthful forms of dieting have been observed more frequently in certain subsets of adolescent girls, such as those who are overweight and obese (33) and in later adolescent stages (34), both forms of dieting are highly prevalent among this population in general and are associated with a range of negative health effects.

2.1.2 Determinants of Dieting

In a review conducted by Littleton and Ollendick (8), research on adolescents’ dieting and disordered eating behaviours has highlighted risk factors at the individual, intra-personal, familial, and societal levels.

Individually, body dissatisfaction and negative body image are associated with a greater risk of engaging in dieting behaviours among adolescent girls in North America (4,19,35). Body image is broadly defined as the mental representation of one’s own body, influenced by a variety of factors, including body dissatisfaction (6). Adolescents who have a body mass index (BMI) that is classified as overweight or obese are more likely to be dissatisfied with their bodies and have a negative body image than adolescents who are in a healthy or normal weight range (33,35,36). Greater media consumption, particularly the watching of television and music

videos, is also associated with a higher risk of negative body image in this population (37–40), and recent research has highlighted the potential association between social media usage and dieting (41). Additionally, girls who often present negative emotionality and personality disturbances; experience early puberty; possess generally low self-esteem; and have a stronger internalization of the thin ideal are at an elevated risk of dieting to lose weight (8).

Body image (and as a result, dieting) can also be influenced by intra-personal encounters, including the collective body image of the friendship group or clique to which an adolescent belongs (42–44) and experiencing body-based harassment, bullying, and teasing in the school and home environments (35,45–47). Negative familial influence is also a salient risk factor for dieting, as cross-sectional and longitudinal studies have shown positive associations between mothers' dieting and/or weight management practices and girls' eventual dieting habits (47–49).

Broader societal factors strongly influence risk of dieting. The previously described thin ideal for women is highly present in mainstream media sources and is significantly associated with dieting and its related factors (50,51). As previously mentioned, this places adolescent girls at a greater risk of engaging in dieting behaviours than boys (3,10,52). Girls and women are significantly more likely than boys and men to have negative body image and body dissatisfaction, and this trend is observed across the lifespan, from preadolescence through adulthood (53). Furthermore, although it was once presumed that White adolescent girls were more likely to engage in dieting to lose weight, research from the United States has demonstrated similar rates of dieting among Hispanic and African American adolescents (54,55), suggesting vulnerability across different racial and ethnic groups.

2.1.3 Dieting and Nutrition, Body Weight and Health

Dieting to lose weight among adolescent girls is associated with negative implications for health. In a cross-sectional study among Canadian adolescents in Ontario and Alberta, Woodruff et al. (10) found that dieting youth had an overall lower dietary quality score than non-dieting youth. This trend has also been observed in a larger American sample (21), in which dieting adolescents consumed lower intakes of calcium and fruits and vegetables and higher intakes of highly-processed fast foods and sugar-sweetened beverages than non-dieting adolescents. Longitudinal studies suggest that eating behaviours developed in adolescence may track into adulthood (56–58), and this increased risk of poor diet among dieting girls may thus have implications for nutrition-related chronic disease development in adulthood.

Dieting among adolescent girls is also associated with an increased risk of weight gain and overweight/obesity in later adolescence and early adulthood. Project EAT II (Eating Among Teens) was a longitudinal study conducted in Minnesota middle and secondary schools over a five-year period from 1999 to 2004 (11). In this study, researchers found that adolescent girls who used healthful and unhealthful forms of dieting, as previously defined, at baseline were significantly more likely to have increased BMI at follow-up (five years later) than non-dieting girls (5,9). Stice et al. found a similar trend in a longitudinal study of American girls aged 11-15 (59). This demonstrated association between dieting and weight gain is worrisome since overweight and obese adolescents are at an increased risk of remaining overweight and obese into adulthood (60). Obesity in adulthood is linked to several negative health outcomes, including an increased incidence of type II diabetes, certain types of cancers, cardiovascular disease, asthma, and osteoarthritis (1).

Additionally, results from Project EAT indicated that adolescent girls who reported dieting were significantly more likely to develop an eating disorder within five years than girls who did not diet (9). Eating disorders are psychiatric illnesses characterized by a “serious disturbance in eating behaviour” (61) and include Anorexia Nervosa, Bulimia Nervosa, Binge-

Eating Disorder, and Other Specified Feeding or Eating Disorder (62). In an Australian study of 14-15 year old adolescents, girls who engaged in strict dieting practices were nearly 18 times more likely to develop an eating disorder within six months than non-dieters (63). Although these longitudinal studies have not been replicated among Canadian adolescent girls, the similarity in rates of dieting to lose weight among Canadian and American youth (4,5) raise concerns about the implications for the development of disordered eating among Canadians as well. Researchers have suggested that dieting to lose weight, as a common risk factor for both eating disorders and obesity, may be an under-emphasized component of comprehensive prevention and interventions targeting these conditions (64–66). Dieting as a potential link between obesity and eating disorders may potentially reflect its role in a more complex web of other health-related behaviours.

2.2 Complexity of Youth Health Behaviours

Health-related behaviours have been shown to co-occur as patterned clusters in adolescents (12,13,67,68). These clusters of multiple behaviours are complex and continue into adulthood (12). Although health-improving behaviours (e.g. meeting physical activity recommendations, adequate intake of fruits and vegetables) also tend to co-occur among adolescents (68,69), the focus of research thus far has primarily been on the co-occurrence of health-compromising and “risky” behaviour clusters in this population (12,70).

Cross-sectional studies have demonstrated the clustering of several health-related behaviour patterns, including smoking/binge drinking/risky sexual behaviours (12,13) and illicit substance use/smoking/unhealthy diet (71,72). Hale and Viner (14) highlight the paradox of health throughout adolescence, in which youth are becoming stronger, fitter, and smarter, yet are increasing their risk of mortality and morbidity from the period of childhood through the engagement of risky health-compromising behaviours.

Although there is strong evidence for co-occurrence of these behaviours, which allows us to determine that there are established clusters (12,73–75), the underlying mechanisms that motivate the engagement in multiple behaviours are still being investigated and debated. Some research has focused on the role of a “single syndrome” of behavioural risk among adolescents engaging in these behaviours (14,74,76,77). This theory is derived from cross-sectional data that highlight associations between risky health-compromising behaviours and common underlying factors that arise during adolescence, including depressive symptoms, low school achievement, poor connection with family, and low school connectedness (76,77). Alternatively, others have posited the “gateway” model, proposing that adolescents who engage in one risky health-compromising behaviour (e.g., smoking, binge drinking) have greater exposure to and opportunity to engage in other risky behaviours (e.g., unprotected sexual intercourse, illicit drug use) (74,78,79). Finally, some researchers have investigated the role of trade-offs in engaging

in multiple health-related behaviours (80–82). In a qualitative study among adolescents in Northern England (80), adolescents reported balancing their healthy and unhealthy behaviours to reach a self-regulated equilibrium. For example, if they engaged in a health-compromising behaviour (e.g., smoking), they would attempt to "balance" it with a more health-oriented behaviour (e.g., exercising), despite their knowledge that the risky behaviour will negatively impact their health. In this pattern of trading off behaviours, youth may engage in multiple health-compromising behaviours with the assumption that their health-promoting behaviours have an offsetting effect.

2.2.1 Applying a Systems Lens to Prevention

Complex, systems-based approaches to chronic disease prevention are becoming more prevalent (83,84), particularly in regards to obesity (15,85–88). Briefly, a systems perspective considers drivers and risk factors for health as both independent and part of a whole, interdependent system (15). Systems approaches to health allow researchers to observe the multiple, complex drivers of health issues through a transdisciplinary lens (16,84). In viewing a system as a whole entity, researchers can more accurately predict how interventions at one point can affect drivers at another point and create unanticipated consequences within the entire system (16,87). To enable conceptualization of the complex relationships that exist in the system as a whole, the linear, dyadic relationship between each pair of related factors must first be established (15,16).

Systems approaches may be valuable in understanding the clustering of health-compromising behaviours observed among youth. This clustering has made the period of adolescence a target for preventative policies and interventions (14,67). However, few systems-based, comprehensive prevention programs targeting multiple health-compromising behaviours have been evaluated (75,89). In Canada, prevention programming is conducted within a hierarchical setting, where policies can be implemented at the national, provincial, regional, and

local (school-based) levels, and programming typically remains segregated by health concern (90).

In particular, school policies and interventions have been designed and implemented to reduce the risks of several health behaviours, including dieting to lose weight (91), smoking (92,93), binge drinking (94), and breakfast-skipping (95) independently. Few studies have investigated the co-occurrence or established clustering of health-compromising behaviours among Canadian adolescents (90), and there is a concerning lack of research that considers the role that gender may play in school-based prevention programming (55,91,96), despite the demonstrated difference between adolescent boys and girls in health behaviours (e.g., dieting patterns (4,27)). Again, the lack of comprehensive prevention programming may be the result of very few studies examining co-occurrence in this population.

In cross-sectional studies, the health-related behaviours of smoking, binge drinking, and breakfast-skipping have been shown to cluster in adolescent girls (7,18,97); smoking is associated with each of binge drinking and breakfast-skipping, and binge drinking is associated with breakfast-skipping. Dieting to lose weight has been linked to each of these behaviours individually in cross-sectional and longitudinal studies (8,98,99); however, no known study has included dieting to lose weight among a multiple-behaviour cluster in a Canadian sample. The establishment of linear, binary relationships between two behaviours or drivers of health is a necessary foundation for observing and preventing complex adolescent health behaviours through a systems lens (16,17,83).

2.3 Dieting-Related and Other Risky Behaviours among Female Youth

In addition to poor diet quality, obesity, and eating disorders, dieting among adolescent girls is associated with an increased risk of engaging in several health-compromising behaviours (9–11). This section will focus on the dyadic relationships between dieting to lose weight and each of smoking, binge drinking, and breakfast-skipping, which are all associated with various health consequences (94,100–102) and have demonstrated associations with dieting among this population.

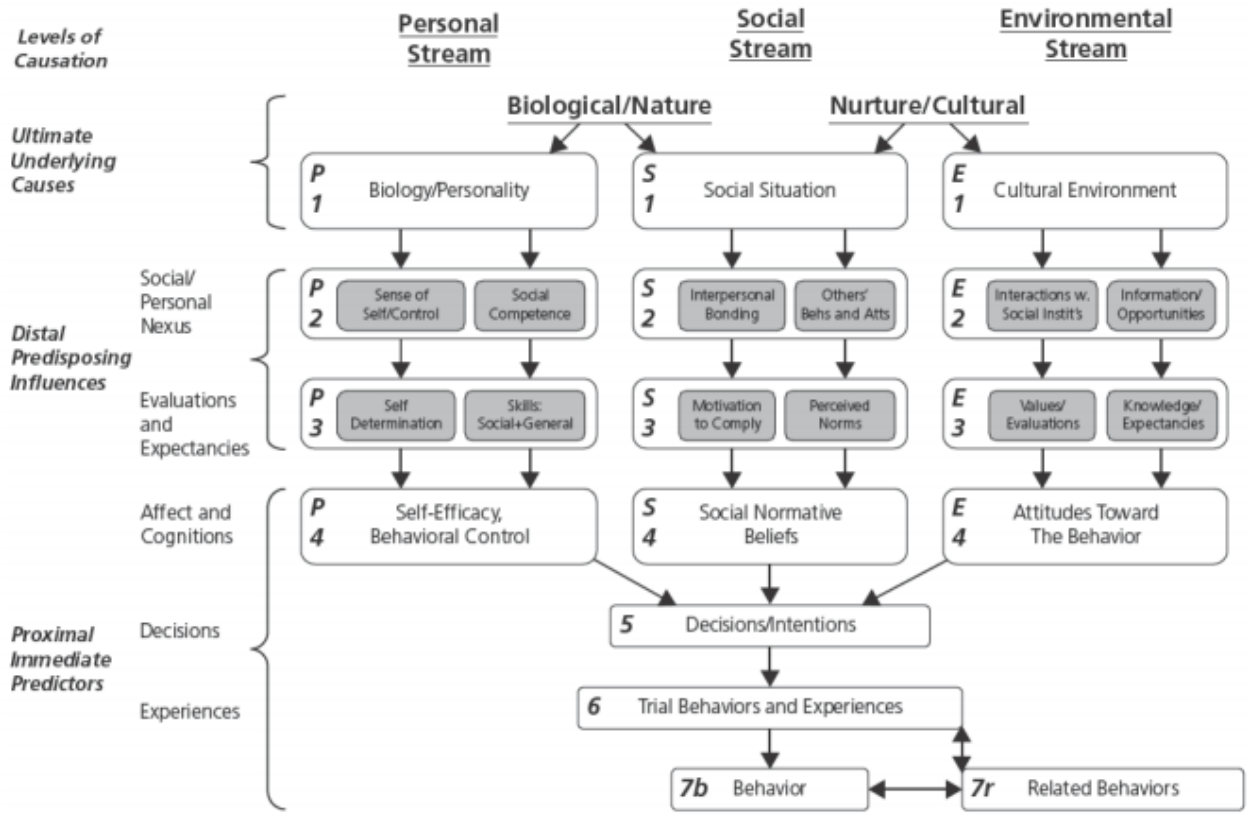
2.3.1 Smoking

Many adolescent smokers perceive that smoking is an effective tool for appetite suppression, weight control, and weight loss (103,104). In a longitudinal study among American adolescents in grades 7 through 10, trying to lose weight, eating disorder symptoms, and constant thoughts about weight at baseline significantly predicted smoking initiation in girls one year later (18). Additional prospective studies among American youth have yielded similar results (26,105). Results from cross-sectional studies have demonstrated that adolescents who think smoking is effective for weight loss and control are more likely to smoke than those who do not (103,104,106). Although overweight and obese adolescents are more likely to engage in dieting to lose weight (33,36), the research on whether or not there is a positive association between weight and smoking status among adolescent girls is mixed (107–109).

Dieting and weight perception may play a significant role in the complex web of risk factors that contribute to smoking initiation among adolescent girls. According to the frequently used Theory of Triadic Influence (TTI; Figure 1), smoking behaviour in adolescents can be predicted through the personal, social, and environmental streams (110,111). Briefly, the theory hypothesizes that distal (value- and control-oriented) and proximal (expectancy- and evaluation-driven) influences in each of these streams may influence smoking initiation among youth (110).

Effective interventions, then, try to make as many changes as possible in all three domains and on both proximal and distal factors (111). However, some influences, such as dieting to lose weight, may influence the likelihood of smoking initiation through multiple streams. For example, it may be hypothesized that the expectancy that smoking will assist in weight loss (personal and proximal) may be driven by media influences that reinforce this expectancy (social and distal). Dieting, then, is not a sole contributor to the initiation of smoking among adolescent girls, but may be a component in the grander, more complicated set of risk factors.

Figure 1: Theory of Triadic Influence (111)



Since nearly 88% of first cigarette usage occurs before the age of 18 (100), early intervention among this population can help reduce the future burden of smoking-related health outcomes (101). There is an established body of literature on adolescent smoking initiation,

cessation, and behaviours (108), which has contributed to the development of strategies that have led to a reduction in adolescent smoking rates in Canada. According to the 2012-2013 Youth Smoking Survey, 5.9% of girls in grades 10-12 were current smokers, compared to 8.7% in 2010-2011 (112,113). The majority of evidence detailing the relationship between dieting to lose weight and smoking in this population was published prior to 2005, however, and it is not known whether smoking remains a potential strategy utilized by girls for weight maintenance or weight loss. Although there has been a demonstrated stigmatization of and growing social unacceptability towards smoking (114), rates of dieting among American adolescents, and particularly overweight girls, have remained nearly the same from 1999 to 2010 (115). Considering the stable rates of dieting and declining rates of smoking among adolescent girls, we do not know the extent to which these two behaviours co-occur in girls, whether they remain associated, and if so, what makes girls particularly vulnerable.

2.3.2 Binge-Drinking

It is estimated that 27 to 38% of Canadian adolescents are alcohol users (101,116). Rates of alcohol use vary across gender and age, with the highest rates among older adolescent males (101). Binge drinking, defined as four or more drinks on one occasion for girls and women by the Centers for Disease Control and Prevention (117), is also very common, with an estimated 25% of Canadian adolescent girls engaging in this behaviour in the previous month (116,118). Among girls, binge drinking is associated with increased risks of: smoking cigarettes, using other illicit drugs, attempting or committing suicide, being in a motor vehicle accident, poor school performance, unprotected sexual intercourse, and developing alcohol disorders later in life (119–122).

Adolescent girls who engage in dieting to lose weight are more likely to use alcohol than non-dieters (7,19,20,98,123,124). This association is less established in the literature than that between dieting and smoking, and there are no known Canadian longitudinal studies

investigating this relationship. Longitudinal American data suggest that adolescent girls who diet at baseline are significantly more likely to binge drink at follow-up than non-dieters (18,40). There is also research that investigates and supports the relationship between dieting and binge drinking among college and university-aged women (123,125–127) and between eating disorder/bulimic symptomatology and binge drinking in clinical and sub-clinical populations (123,126,128,129).

Cross-sectional results from Project EAT indicate that dieting adolescent girls are significantly more likely to use alcohol (at least a few times in the past year) than non-dieting girls. There also appears to be an interaction with body weight in that non-overweight dieters are at a greater risk (odds ratio 1.70) of alcohol use than overweight dieters (odds ratio 1.60) (7). In other cross-sectional studies, however, overweight adolescent girls were more likely to engage in binge drinking (defined in these studies as 5 or more drinks on one occasion) than normal weight girls, regardless of their dieting status (130,131). Associations between dieting and alcohol use also differ in relation to the types of dieting strategies used. Extreme or unhealthful dieting behaviours (e.g., fasting, self-induced vomiting) are stronger correlates (132) and predictors (18) of binge drinking than are more healthful (e.g., moderate physical activity, reducing fast food intake) dieting behaviours. Furthermore, the relationship between dieting and alcohol use may even begin earlier than adolescence, particularly among children and youth who are more at-risk of alcohol use through other alcohol-related factors (e.g., parental drinking, lack of school bonding) (131). Two longitudinal studies in the United States found that girls who dieted at ages 10 and 11 were 1.34 to 1.7 times more likely to use alcohol at ages 14 and 15 than their non-dieting peers (123,124).

Among adolescent girls, the relationship between smoking and dieting to lose weight is presumably driven by the perception that smoking allows for appetite suppression and weight control (103,104); however, the pathways between dieting and binge drinking are not as clear. One popular theory involves the concept of dietary restraint, which assumes that purposeful

restriction of caloric intake leads to reduced reception to and control over satiety cues that can be overridden by disinhibition in certain contexts (133). Polivy and Herman theorized that dieters would drink larger quantities of alcohol when they are exposed to it because they did not have control over their satiety cues, which were further numbed by the disinhibiting effect of the alcohol itself (134). Among young adult and college/university-aged women, dietary restraint is associated with alcohol use and binge drinking (126), and several studies among this population have identified a pattern of caloric restriction prior to alcohol consumption for purposes of weight loss/maintenance and maximizing the effect of consumed alcohol (80,82,135,136). However, this theory has not been comprehensively investigated among adolescents. The TTI has also been applied to alcohol use and binge drinking among adolescent populations (94). As with smoking, the personal (e.g. self-efficacy in resisting peer pressure), social (normative beliefs about teenage alcohol consumption), and environmental (availability and portrayals of alcohol in stores and media) streams can each influence the likelihood of binge drinking among adolescent girls (Figure 1).

2.3.3 Breakfast-Skipping

Breakfast-skipping is also common among Canadian adolescent girls. Longitudinal studies suggest that breakfast consumption decreases with age among female American youth from childhood to early adolescence (137). In one study of young adolescents in Southern Ontario, nearly 27% of girls reported habitually skipping breakfast on an eating behaviour questionnaire (10,138). Another study conducted with Southern Ontario secondary school students found that only 36% of girls in the sample ate breakfast daily (139). Breakfast-skipping is associated with several negative consequences based on cross-sectional data, including poorer dietary quality (10,97,138,140–142) and low rates of physical activity (36,97,139). Longitudinal data suggest that breakfast skipping is linked to poor academic performance (141,143,144) and overweight/obesity (36,102,141). Analyses of the American National

Longitudinal Study of Adolescent Health found that regular breakfast consumption in adolescence predicted regular breakfast consumption in young adulthood, and that frequent breakfast consumption reduced the risk of overweight and obesity at follow-up (102).

Similarly to smoking and binge drinking, dieting to lose weight and weight concerns among adolescent girls are associated with an increased risk of breakfast-skipping (5,10,36,97,145,146). In Project EAT II, adolescent girls who dieted at baseline were significantly more likely to engage in breakfast-skipping five years later than non-dieters (5). American girls who were trying to lose weight in another sample were 1.22 to 1.40 times more likely to not eat breakfast than their non-dieting peers (146). Among dieting adolescents, meal-skipping is commonly used as a method of weight loss and weight control, and breakfast-skipping seems most common (3,4). Similarly to smoking, the perceived benefit of engaging in breakfast-skipping as a means to an end (weight loss) prompts youth to continuously engage in skipping meals (3), despite its increased risk of associated health consequences.

2.4 Summary

Dieting to lose weight is an extremely common practice among Canadian adolescent girls, and is associated with poor diet quality, overweight and obesity, and increased risk of eating disorders. Also, according to the amassed cross-sectional and longitudinal research, dieting adolescent girls are more likely to engage in smoking, binge drinking, and breakfast-skipping than non-dieting girls. However, despite the body of literature that that has identified these bivariate associations and their patterns of co-occurrence, we know very little about whether there is a causal link between dieting to lose weight and these behaviours among Canadian adolescent girls. This dyadic, linear knowledge is needed to allow for systems approaches that account for the complexity of risky behaviours among youth. The clustering of negative health behaviours among adolescents has been well-documented, and an understanding of how behaviours interact among youth is essential for prevention programming and policy development.

Chapter 3

Study Rationale and Research Questions

3.1 Study Rationale

To inform systems-based and comprehensive approaches to chronic disease prevention, there is a need to better elucidate the hypothesized linear relationships between health behaviours. Such approaches are needed to allow a greater appreciation of the complexity of health behaviour patterns that may increase chronic disease risk among Canadians.

Among adolescent girls, dieting to lose weight has been independently associated with each of smoking, binge-drinking, and breakfast-skipping; however, there is a lack of Canadian longitudinal research, particularly in the past decade, which demonstrates the potential causal relation of dieting to each of and pairs of these behaviours in a single, large sample. Additionally, there is a growing focus on comprehensive chronic disease prevention in the school system and the development of policies and interventions for school-aged youth. As previously noted, the implementation of youth health promotion initiatives in Canada flows in a unique, contextual national-provincial-municipal framework. Knowledge of the dyadic relationships between dieting and each of these health-compromising behaviours among adolescent girls will provide a foundation for further research on how they are interrelated, which is important for developing more comprehensive chronic disease programs and policies that target this population.

3.2 Research Questions

1. At baseline (Year 1), do rates of smoking, binge drinking, and frequent breakfast-skipping differ between dieting and non-dieting adolescent girls after controlling for grade, ethnicity, BMI, and the school they are attending? To what extent do these behaviours co-occur?
2. When compared to girls who are not trying to lose weight, are girls who are trying to lose weight at baseline (Year 1) more likely to be smokers by Year 3 after controlling for grade, ethnicity, BMI, and the school they are attending?
3. When compared to girls who are not trying to lose weight, are girls who are trying to lose weight at baseline (Year 1) more likely to be binge drinkers by Year 3 after controlling for grade, ethnicity, BMI, and the school they are attending?
4. When compared to girls who are not trying to lose weight, are girls who are trying to lose weight at baseline (Year 1) more likely to engage in frequent breakfast-skipping by Year 3 after controlling for grade, ethnicity, BMI, and the school they are attending?
5. When compared to girls who are not trying to lose weight, are girls who are trying to lose weight at baseline (Year 1) more likely to engage in multiple risky behaviours by Year 3 after controlling for grade, ethnicity, BMI, and the school they are attending?

Chapter 4

Methods

4.1 Study Design

Cross-sectional and longitudinal analyses were conducted using data from the Cohort study on Obesity, Marijuana use, Physical activity, Alcohol use, Smoking and Sedentary behaviour (COMPASS). COMPASS is a prospective cohort study which began data collection in 2012 and provides opportunities to examine associations among a range of health behaviours (147). COMPASS includes a convenience sample of secondary schools in Ontario and Alberta and the grade 9 through 12 students who attend them. Measures include school- and student-level factors related to obesity/overweight status, dietary intake, marijuana usage, binge drinking, tobacco, bullying, physical activity and sedentary behaviours, and academic achievement (148). Further details on the COMPASS study design and methods can be found elsewhere and are briefly summarized below (147,148). The study has received ethics approval from the University of Waterloo, Office of Research Ethics.

4.2 COMPASS Study

4.2.1 School sampling and recruitment

Recruitment for COMPASS flows through school boards, secondary schools, and then students. School boards eligible for inclusion are those that include students in grades 9 through 12, are primarily English-speaking, have an enrollment of 100 students or more per grade level, have standard school/classroom settings, and permit use of active-information passive-consent protocols (detailed below). Once a school board meets the inclusion criteria and agrees to allow schools to participate in the study, researchers approach administrators at each of the schools, who decide whether or not they would like to have students in their school invited to participate (149).

Data collection for COMPASS occurs annually, with each school year corresponding to a wave. In Year 1 (2012/2013) of COMPASS, data were collected from 43 schools and over 24,000 secondary school students in Ontario. In Year 2 (2013/2014), an additional 36 schools in Ontario and 11 schools in Alberta were added to the sample (147). In Year 3 (2014/2015), all schools included in Years 1 and 2 were approached. Data are currently available for Years 1, 2, and 3.

4.2.2 Student recruitment

Active-information passive-consent parental permission protocols were used to recruit students into the COMPASS study (150). Parents of children in the participating schools received a letter detailing the study and were invited to call or email the COMPASS recruitment coordinator to remove their child from the study. If a parent did not withdraw his or her child from the study, then the child was deemed eligible and approached to participate on the day of data collection. During the consent process and data collection, an eligible student was allowed to withdraw from the study.

4.2.3 Student-level data collection

Data are collected through self-reported surveys, completed during class time, on several health measures and outcomes, as well as demographic information such as age, sex (male/female), race/ethnicity, grade, and proxy measures of socioeconomic status. The COMPASS student questionnaire can be found in Appendix A. COMPASS inquires about whether students are male or female, which is typically reflective of sex, rather than gender (151,152). Although an individual's sex may not align with their self-identified gender (151), the two constructs are interrelated, and self-identified females are referred to as "girls" in this study.

4.2.4 Analytic sample

This study made use of data from Years 1 (baseline) and 3 (follow up), using data from only those students for whom there are observations at both time points. In studies that use repeated measures, such as COMPASS, it is important to consider the impact of intermittently or completely missing data on the study results (153,154). Previous research has consistently highlighted the relationship between youth study participation and a series of health-compromising behaviours (150,155,156). Although COMPASS employs active-information passive-consent protocols to curtail participant dropout and non-response (150), it remains important to investigate the potential impact of missing data, which may bias results by underestimating youth engagement in health-compromising behaviours (156).

In Year 1 of COMPASS, 80.2% of eligible students participated in the study, totalling 23,280, 11,485 of whom were female (90). Among the girls, 6,232 were in grades 9 or 10 at baseline and eligible to participate in the data collection at Year 3.

In Year 3, eligible girls for the sample for the current analyses were in grades 11 or 12. Data were available for 3,436 (55%) of these girls. COMPASS does not collect information on reasons for student dropout, which could include dropping out of school or relocating to another school. Additionally, 15-20% of secondary school students in COMPASS do not complete the

student questionnaire because of absenteeism or having a spare class period (157), which likely explains some of the participant dropout. Prior to analyses, a check was conducted to assess whether any girls in grades 11 or 12 at year 3 were repeating grade 12, to ensure that there was consistency across grade among girls; this did not apply to any of the girls in the sample.

In this study, girls who participated in Years 1 and 3, but not Year 2, were considered to be missing data intermittently. Statistical methods for longitudinal data may be sensitive to information missing at certain time points (153), and as previously noted, missing data among youth on the aforementioned health-compromising behaviours may be indicative of patterned behaviour and intentionally not participating in the study.

The longitudinal analyses (further detailed below) used generalized estimating equations (GEE). GEE models assume that data are missing completely at random (158), and that any non -response or -participation is entirely random and not associated with the nature of the survey or the study; therefore, the underlying assumption is that COMPASS intended to measure some participants at two time points and others at three time points, and that non-participation has nothing to do with the nature of the information being collected. This essentially biases the sample, in that it does not recognize the inherent difference that may exist between girls who participate in all three years and those who do not. Approximately one-fifth (21%) of the sample is missing data at Year 2 for reasons that are unknown to the researchers; since GEEs do not assume or impose a specific variance structure on a model, they will not treat the lack of data at Year 2 as impacting the relationship between Years 1 and 3. In this study, the correlation matrix (relationship between observations) was *a priori* specified as unstructured, so that the GEE would not impose a structured working matrix on data from girls that may be missing. This does not ascertain that a participant's reported behaviors at Year 1 will impact their engagement in that same behaviour or other behaviours at Year 3, and allows for unbiased observation of the relationship between participants' reported information at different time points.

Conversely, including only participants with data in all three years of the survey would have resulted in a smaller sample size (N = 2,704). In this situation, the sample may also be inherently biased, because a segment of the sample who may have intentionally not participated and who would be at a higher risk of engaging in the outcome variables of interest would be excluded. To determine this possibility, sensitivity analyses were conducted to investigate whether there was an association between missing data at Year 2 and each of dieting, BMI, smoking, binge drinking, and breakfast-skipping at Years 1 (baseline) and 3 (follow-up; see Appendix B). Although skipping a year of the study was not significantly associated with dieting at either time point, it was associated with BMI status at Year 3, smoking at Year 1, and binge drinking and breakfast-skipping at both time points.

These results demonstrate a potentially complex relationship between participating at Year 2 and each of our behaviours of interest. In choosing an analytic sample where all subjects who provided data for Years 1 and 3 are included, the potential biasing of the sample by excluding girls who may be at a greater risk for engaging in the outcome behaviours (see Appendix B) is avoided. As a result, all subjects who provided data for Years 1 and 3 were included in the analytic sample (N = 3,386), despite their participation at Year 2.

4.3 Measures

4.3.1 Dieting to lose weight

Dieting to lose weight, the primary explanatory variable, was based on a single question on the student questionnaire that has been used in previous research (159). Students were asked: “Which of the following are you trying to do about your weight?”, to which they could respond “Lose weight”, “Gain weight”, “Stay the same weight”, or “I am not trying to do anything about my weight”. This variable was dichotomized into two categories: “Trying to lose weight” (girls who selected the first response; coded as 1) and “Not trying to lose weight” (girls who select the second, third, or fourth responses; coded as 0). As was noted, dieting is a complex construct, which can vary significantly in severity and persistence (2,21,23). The use of a single item likely does not fully encapsulate the wide range of behaviours that girls classified as dieters are undertaking (e.g., some girls may be using healthful behaviours, while others are using unhealthful behaviours). However, the use of this variable was based on the aforementioned definition of dieting as an intentional change in behaviour to achieve weight loss (22). Additionally, studies using data from other health surveys, including the National Health and Nutrition Examination Survey (NHANES) and the Youth Risk Behavior Survey, also use this single item to identify subjects who are dieting (160,161). Thus, this measure was used as a proxy to identify girls who are dieting.

4.3.2 Health-compromising behaviours

Smoking status was operationalized using two separate measures. Respondents were asked “Have you ever smoked 100 or more whole cigarettes in your life?” and could respond with: “Yes” or “No”. They were also asked “On how many of the last 30 days did you smoke one or more cigarettes?”, and could respond with: “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)”. Consistent with previous

research conducted using data from COMPASS (90,118), girls were coded as current smokers (1) if they indicated ever smoking 100 cigarettes in their life and smoked one or more cigarettes in the past 30 days. Students who did not meet these criteria were coded as non-smokers (0). Using this item, a previous validation study indicated strong agreement (r = 0.90) between self-reported smoking and biomarker measurement (162).

Binge drinking was measured with the item: “In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?” and students could respond with “I have never done this”, “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”. Again, consistent with previous COMPASS analyses (90,118), girls were coded as current binge drinkers (1) if they indicated drinking 5 drinks of alcohol or more once a month or more frequently. Students who did not meet this criterion were coded as not being current binge drinkers (0). This may have been a conservative estimate of binge drinking among this population, as binge drinking in girls and women is defined as 4 or more drinks on one occasion by the Centers for Disease Control and Prevention (117).

Breakfast-skipping was operationalized using two separate measures. Respondents were asked: “In a *usual* school week (Monday to Friday), on how many days do you do the following?” and for “Eat breakfast” could respond with “None”, “1 day”, “2 days”, “3 days”, “4 days”, or “5 days”. They were also asked: “On a *usual* weekend (Saturday or Sunday), on how many days do you usually do the following?” and for “Eat breakfast” could respond with “None”, “1 day”, or “2 days”. It is possible that students who participate in school- or community-based breakfast programs may consume breakfast more often during the school week, when breakfast is provided, than on weekends if they are from a low-income household (163). To investigate whether there was a significant difference between weekday and weekend breakfast consumption among the sample, chi-square analyses were used (see Appendix C). At baseline (Year 1), breakfast consumption during the week was significantly associated with breakfast

consumption on weekend days ($p < .0001$). Girls who reported not eating breakfast at all on the weekend ate breakfast 0 (49%), 1 (11%), and 2 (10%) days of the week. Most girls who consumed breakfast 4 and 5 days of the school week also consumed breakfast on Saturday and Sunday (73% and 85%, respectively). Since these two behaviours are significantly associated, a single variable was used to encompass breakfast-skipping patterns. The responses from each of the weekday and weekend items were summed to create a new variable representing “Days breakfast eaten”, which was subtracted from 7 (days in a week) to create a new variable indicating “Days breakfast not eaten”. Girls were then coded as breakfast-skippers (1) if they reported not eating breakfast 2 or more days a week, or not breakfast-skippers (0) if they reported not eating breakfast 0 or 1 days a week, consistent with previous research (164).

4.3.4 Additional measures

Grade was measured with the item: “What grade are you in?”. Students were able to select from the following options: “Grade 9”, “Grade 10”, “Grade 11”, “Grade 12”.

Ethnicity was measured with the item: “How would you describe yourself? (Mark all that apply)”. Students were able to select one or more of the following responses: “White”, “Black”, “Asian”, “Aboriginal (First Nations, Métis, Inuit)”, “Latin American/Hispanic”, “Other”. The vast majority of this sample identified as White (73.4%; see Table 1). Since each of the other designated ethnic groups (Black, Asian, Aboriginal, Hispanic, and Other) had very few subjects in each of them (Table 1), ethnicity could not be included as a categorical variable in regression models without resulting in a Hessian Matrix error (165). Briefly, this occurs when there is an estimated value of zero along the diagonal of a variance matrix. For example, a regression model with ethnicity as one of several predictor variables and smoking as the outcome may not be able to solve because there were zero subjects who identified as both Asian ethnicity and being a smoker. Given this distribution in the sample, the ethnicity variable was thus

dichotomized as White and non-White. Although this may limit further investigation by ethnic group, it is common practice in analyses using national data sources (166–168).

Table 1: Descriptive statistics for race/ethnicity among adolescent girls in Year 1 of the COMPASS study (N = 3,386)

Race/Ethnicity	Total	Percent of Sample
White	**2487**	**73.4**
Non-White	**892**	**26.3**
Black	153	4.5
Asian	250	7.4
Aboriginal	127	3.8
Hispanic	105	3.1
Other	257	7.6
Not stated	**7**	**0.3**

BMI was a variable derived from self-reported height and weight. Respondents 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 weigh without your shoes on? (Please write your weight in pounds OR in kilograms, and then fill in the appropriate numbers for your weight.)”, to which they could respond with “I don’t know”. BMI was then calculated with the equation kilograms divided by metres squared (kg/m^2), and classified according to the World Health Organization’s categories of underweight (< 18.50; coded as 1), normal range (18.50 - 24.99; coded as 2), overweight (≥ 25.00; coded as 3), and obese (≥ 30.00; coded as 4) (169). A fifth variable, for weight and/or height not reported, was coded as 5, or “missing BMI”, as non-response to height and weight measures among the target population may indicate a particular pattern of non-response (170). The test-retest reliability (ICC = 0.95) and concurrent validity (ICC = 0.84) of this measure in COMPASS have been shown to be substantial (171).

The school a student attends was represented by a unique identifier that has been designated for each individual participating school. This was included as a cluster within the regression modelling to account for study design, which involved the clustering of students within schools (147).

Chapter 5

Statistical Analyses

All data analyses were performed using the statistical package SAS version 9.4. Data from Years 1 and 3 were linked to conduct the longitudinal regression analyses, following the same students from baseline to follow-up, and duplicate data points from errors in the linkage process were removed.

5.1 Cross-Sectional Analyses

To answer Research Question 1, descriptive statistics (frequency counts) were run to determine the prevalence of each of the outcome measures among dieting and non-dieting adolescent girls separately at baseline (Year 1). Additionally, new variables were created for combinations of each of the response variables (e.g., smoking and binge-drinking, smoking and breakfast-skipping) to determine prevalence of behaviour co-occurrence among dieting and non-dieting girls. Generalized logistic regression models were used to determine if rates of smoking, binge drinking and breakfast-skipping were significantly different between dieting and non-dieting girls at baseline, controlling for the covariates of grade, ethnicity, and BMI. In the regression models, subjects' individual responses were considered as a nested cluster within their school.

5.2 Longitudinal Analyses

To answer Research Questions 2, 3, 4, and 5, several separate longitudinal logistic regression models were conducted. Longitudinal analyses allow researchers to observe changes in health behaviour over time, and how risk factor occurrence (e.g. dieting to lose weight) can temporally predict the occurrence or co-occurrence of other risk factors (e.g., smoking, smoking and binge drinking) (90). Although the feature of temporality in longitudinal studies cannot solely indicate causality between the predictor and outcome variable(s) (172), determining a temporal order among variables may assist in the sequencing of prevention initiatives among youth (124).

5.2.1 Modelling approach

A generalized estimating equation (GEE) modelling approach was used, drawing upon data from Years 1 to 3. Briefly, GEEs are used to estimate the influence of factors on binary model outcomes (e.g., non-smoker or current smoker) longitudinally (154). GEEs are an extension of generalized linear models, which estimate regression parameters in models that may not have a normal error distribution (153,154). A GEE modelling approach was used because the overall objective is to observe population-level averages among adolescent girls in the sample who are dieting or non-dieting, indifferent of how grouped data are structured or clustered (153,173). This differs from the commonly-used alternative, generalized linear mixed models (GLMM), which observe the weighted average of each cluster model over a period of time, rather than population-averaged effects (174).

GEEs can also account for variance outside of the predetermined covariates in a predictive model, over repeated measures (153,173), which makes them a robust tool for modelling data that are not complete.

5.2.2 Conducted analyses

The conducted longitudinal analyses are summarized in Table 2. In all of the models, each subject's responses were considered as a nested cluster within their school, to account for differences that may exist across schools. The intra-class correlation was calculated for each of the outcome variables; 10.9%, 5.3%, and 2.3% of the variability in smoking, binge drinking, and breakfast-skipping, respectively, in Year 3 of this study was accounted for by school.

Table 2: Summary of longitudinal GEE models for Research Questions 2-5

Research Question	Outcome variable	Predictor variable	Covariates
2	*Smoking* (0 = non-smoker, 1 = current smoker) at Year 3	*Dieting* (0 = not trying to lose weight, 1 = trying to lose weight) at baseline	*Grade, ethnicity, BMI*
3	*Binge drinking* (0 = not a current binge drinker, 1 = current binge drinker) at Year 3	*Dieting* (0 = not trying to lose weight, 1 = trying to lose weight) at baseline	*Grade, ethnicity, BMI*
4	*Breakfast-skipping* (0 = not a breakfast-skipper, 1 = breakfast-skipper) at Year 3	*Dieting* (0 = not trying to lose weight, 1 = trying to lose weight) at baseline	*Grade, ethnicity, BMI*
5	*Smoking and binge drinking* (0 = not a smoker and binge drinker, 1 = smoker and binge drinker) at Year 3	*Dieting* (0 = not trying to lose weight, 1 = trying to lose weight) at baseline	*Grade, ethnicity, BMI*
	Smoking and breakfast-skipping (0 = not a smoker and breakfast-skipper, 1 = smoker and breakfast-skipper) at Year 3	*Dieting* (0 = not trying to lose weight, 1 = trying to lose weight) at baseline	*Grade, ethnicity, BMI*
	Binge drinking and breakfast-skipping (0 = not a binge drinker and breakfast-skipper, 1 = binge drinker and breakfast-skipper) at Year 3	*Dieting* (0 = not trying to lose weight, 1 = trying to lose weight) at baseline	*Grade, ethnicity, BMI*
	Smoking and binge drinking and breakfast-skipping (0 = not a smoker and binge drinker and breakfast-skipper, 1 = smoker and binge drinker and breakfast-skipper) at Year 3	*Dieting* (0 = not trying to lose weight, 1 = trying to lose weight) at baseline	*Grade, ethnicity, BMI*

Grade was included as a covariate in each of the models, as dieting and each of smoking, binge-drinking, and breakfast-skipping are more prevalent in older adolescent girls (38,39,63,70,100), and grade is typically indicative of age. In using grade, rather than age, the results may be easier to translate to school administrators and policy-makers. Year (1, 2, and 3) was also included in each model to account for the passage of time, to ensure that the model is considering and controlling for the increased likelihood of engaging in each of these behaviours as girls age. There are slight differences in dieting prevalence and behaviour across girls from different racial and ethnic backgrounds (54,55), and so ethnicity was also included as a covariate. BMI was included, since overweight and obese adolescent girls are more likely to engage in dieting than normal weight girls (35,36), and as previously noted, may be more at risk in engaging in each of the health-compromising behaviours of interest.

Research Question 2 investigated whether adolescent girls who are trying to lose weight at baseline (Year 1) were more likely to be smokers by Year 3 when compared to non-dieting girls. The outcome variable was smoking, dichotomized as 0 (non-smoker) or 1 (current smoker) at Year 3. The predictor variable was dieting status (0 = not dieting to lose weight, 1 = dieting to lose weight) at Year 1. The model also included the covariates of grade, ethnicity, and BMI.

Research Question 3 investigated whether adolescent girls who are trying to lose weight at baseline (Year 1) were more likely to be current binge drinkers by Year 3 when compared to non-dieting girls. The outcome variable was binge drinking, dichotomized as 0 (not a current binge drinker) or 1 (current binge drinker) at Year 3. The predictor variable was dieting status (0 = not dieting to lose weight, 1 = dieting to lose weight) at Year 1. The model also featured the aforementioned covariates.

Research Question 4 investigated whether adolescent girls who were trying to lose weight at baseline (Year 1) were more likely to be breakfast-skippers by Year 3 when compared to non-dieting girls. The outcome variable was breakfast-skipping, dichotomized as 0 (not a breakfast-skipper) or 1 (breakfast-skipper) at Year 3. The predictor variable was dieting status

(0 = not dieting to lose weight, 1 = dieting to lose weight) at Year 1. The model included the same covariates.

Research Question 5 investigated whether adolescent girls who were trying to lose weight at baseline (Year 1) were more likely to engage in multiple behaviours by Year 3 when compared to non-dieting girls. Based on the results of the cross-sectional analyses in Research Question 1, it was concluded that a reasonable number of girls were participating in combinations of multiple behaviours (smoking and binge drinking; smoking and breakfast-skipping; binge drinking and breakfast-skipping; and smoking, binge drinking, and breakfast-skipping; see Chapter 6.1) in Year 1, and that these behaviours would also likely be present among a sufficient proportion of the population by Year 3. As a result, separate longitudinal GEE analyses were conducted with each combination of behaviours as the outcome, dichotomized as 0 (not partaking in both or all three behaviours) or 1 (partaking in both or all three behaviours), at Year 3. Each model also included the same covariates.

Finally, additional exploratory analyses were conducted to investigate the cross-sectional and prospective relationship between dieting and the number of behaviours girls were engaged in, irrespective of the behaviours themselves. An outcome variable was created to count the number of health-compromising behaviours girls were engaged in at Year 3 (range 0 to 3). A longitudinal GEE regression, using the Poisson distribution, was conducted using the same covariates.

Chapter 6

Results

6.1 Descriptive Statistics

In this study's sample of 3,386 girls at baseline (Year 1), 73.4% self-identified as White and nearly 54% were in grade 9. The majority of the girls reported a height and weight that would classify them as having a 'healthy weight' (BMI 18.5 to 24.9; 61.0%), followed by overweight (BMI 25 to 29.9; 10.0%), obese (BMI > 30; 2.6%), and underweight (BMI < 18.5; 1.3%). One quarter of girls (25.1%, N = 851) did not self-report their height and/or weight. Overall, 56.7% of girls (N = 1,948) reporting trying to lose weight at Year 1. Although dieting at Year 1 was not associated with ethnicity or grade, it was significantly associated with BMI classification (see Table 3).

6.1.1 Prevalence of outcome behaviours and their co-occurrence at baseline

In Year 1, 3.4% of girls were current smokers, 11.0% were current binge drinkers, and 51.1% were frequent breakfast-skippers. A smaller proportion of the sample engaged in multiple behaviours at Year 1: 1.7% were smokers and binge drinkers (N = 59), 2.7% smokers and breakfast-skippers (N = 90), 7.1% binge drinkers and breakfast-skippers (N = 240), and 1.3% reported engaging in all three (N = 44). At Year 1, less than 1% of the sample did not report their smoking (N = 17) or binge drinking (N = 23) status, and 2% did not provide sufficient information for their breakfast-skipping patterns to be classified (N = 69).

6.1.2 Relationship between dieting and each outcome behaviour at baseline

In Year 1, dieting to lose weight was significantly associated with each of smoking, binge drinking, and breakfast-skipping ($p < 0.05$, see Table 3). Approximately two-thirds of all girls who engaged in each of these behaviours also reported trying to lose weight.

Table 3: Descriptive statistics for adolescent girls in Year 1 of the COMPASS study by dieting status (N=3,386)

		Dieting Status		**Chi-Square (χ^2)**
Parameter		*Dieter (%)*	*Non-Dieter (%)*	
Grade	9	1051 (56.8)	799 (43.2)	3.41
	10	897 (58.1)	639 (41.9)	
Ethnicity	White	1426 (57.3)	1061 (42.7)	4.81
	Non-White	516 (58.2)	371 (41.8)	
BMI	Underweight	8 (17.8)	37 (82.2)	**245.40****
	Healthy weight	1037 (50.2)	1028 (49.8)	
	Overweight	296 (88.1)	40 (11.9)	
	Obese	79 (88.8)	10 (11.2)	
	Not stated	528 (62.0)	323 (38.0)	
Smoking	Yes	79 (68.1)	37 (31.9)	**5.50***
	No	1869 (57.2)	1401 (42.8)	
Binge Drinking	Yes	257 (69.1)	115 (30.9)	**22.90****
	No	1687 (56.1)	1321 (43.9)	
Breakfast-skipping	Yes	1105 (63.8)	626 (36.2)	**58.71****
	No	815 (50.7)	792 (49.3)	

*p-value of < 0.05, **p-value of < 0.001

6.2 Results of Cross-Sectional Analyses

Cross-sectional analyses were conducted using baseline data from the linked sample of girls from Years 1 to 3, controlling for the school a subject attends as a repeated-subject cluster (see Chapter 5.2.2).

6.2.1 Research question 1: Multilevel regression model results for relationship between dieting and each outcome behaviour at baseline

Table 4 shows the results of several cross-sectional multilevel logistic regression models. After controlling for covariates, in Year 1, dieting to lose weight was not significantly associated with smoking status (OR = 1.48, $p = 0.07$). Girls with obesity were nearly 3 times more likely (OR = 2.98, $p < 0.05$) to be smokers than girls who self-reported heights and weights consistent with the healthy BMI range.

Dieting girls were significantly more likely to engage in binge drinking at baseline than their non-dieting peers (OR = 1.87, $p < 0.001$). Self-identifying as non-White was a protective factor in binge drinking status (OR = 0.58, $p < 0.05$). Girls who reported heights and weights corresponding to the BMI categories of underweight, overweight, and obese were not more likely to engage in binge drinking, but those who did not report these variables were significantly less likely to be binge drinkers than girls who reported a healthy weight (OR = 0.65, $p < 0.05$).

Finally, dieting girls were at a greater risk of frequently skipping breakfast than girls who were not trying to lose weight (OR = 1.61, $p < 0.001$). Breakfast-skipping did not differ by grade or ethnicity, but girls who self-reported heights and weights consistent with BMIs in the obese category (OR = 1.50) or who did not report their height and/or weight (OR = 1.59) were significantly more likely to skip breakfast than healthy weight girls.

Table 4: Multilevel logistic regression models investigating factors associated with health-compromising behaviours among adolescent girls in the COMPASS study (N=3,386)

		Adjusted Odds Ratio[1] (95% CI)		
Parameter		*Smoking*	*Binge Drinking*	*Breakfast-skipping*
Dieting	No	1.00	1.00	1.00
	Yes	1.48 (0.97, 2.25)	**1.87 (1.55, 2.28)****	**1.61 (1.36, 1.89)****
Grade	9	1.00	1.00	1.00
	10	1.02 (0.99, 1.05)	1.04 (0.95, 1.13)	0.97 (0.93, 1.02)
Ethnicity	White	1.00	1.00	1.00
	Non-white	0.76 (0.44, 1.30)	**0.58 (0.41, 0.81)***	1.04 (0.90, 1.22)
BMI	Healthy weight	1.00	1.00	1.00
	Underweight	2.69 (0.83, 8.73)	0.19 (0.03, 1.36)	0.86 (0.49, 1.52)
	Overweight	1.50 (0.92, 2.44)	0.70 (0.47, 1.05)	1.28 (1.00, 1.65)
	Obese	**2.98 (1.31, 6.81)***	0.59 (0.29, 1.19)	**1.50 (1.02, 2.21)***
	Not stated	1.21 (0.72, 8.73)	**0.65 (0.48, 0.88)***	**1.59 (1.30, 1.94)****

[1] Odds ratio controlling for all other parameters in the table
**p*-value of < 0.05, ***p*-value of < 0.001

6.2.2 Research question 1: Relationship between dieting and each co-occurring behaviour pattern at baseline

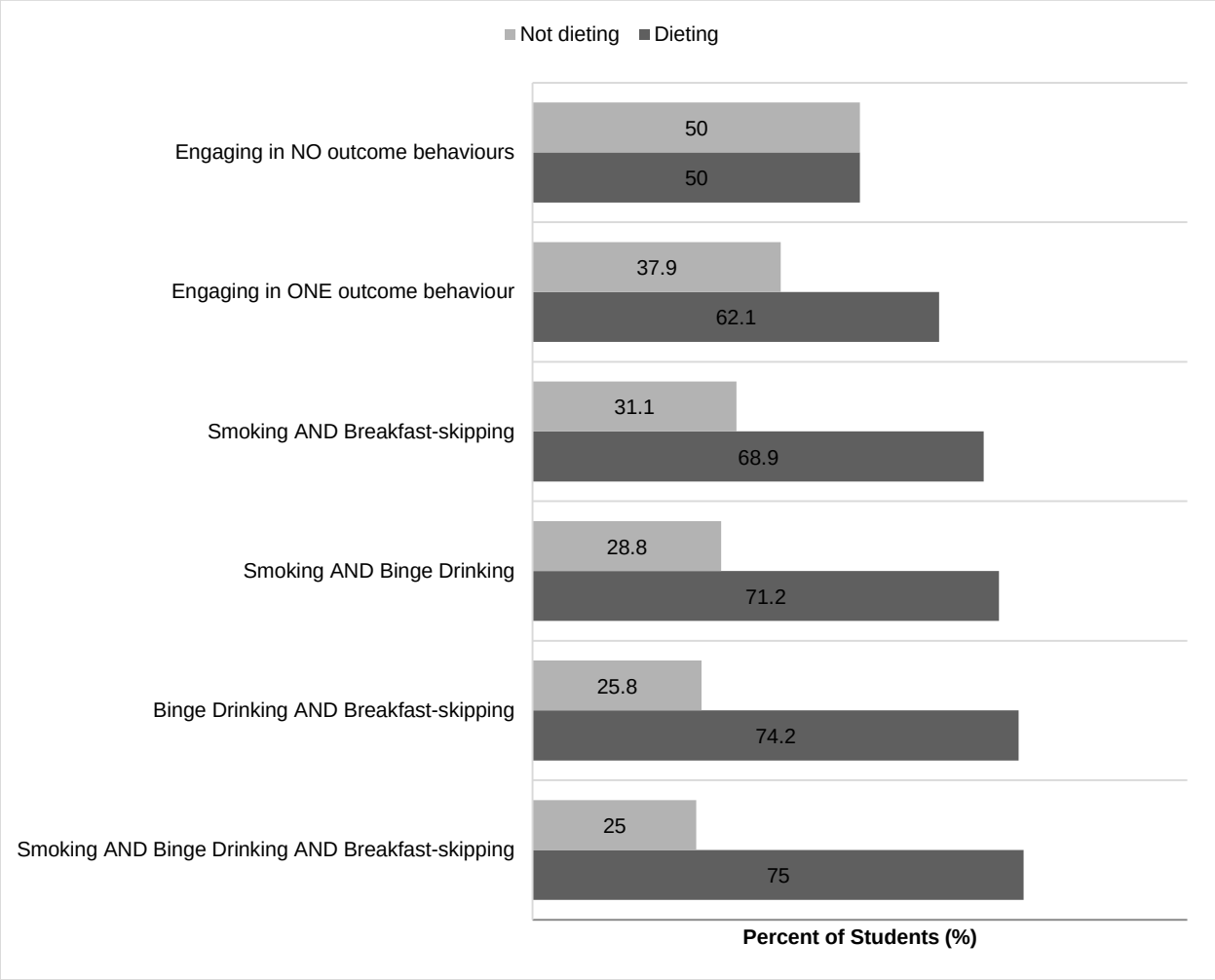
Dieting was significantly associated with each pattern of multiple, co-occurring behaviours at Year 1 ($p < 0.05$, see Table 5). As Figure 2 demonstrates, among each sample of girls who engaged in multiple behaviours, the proportion of girls who reported trying to lose weight was always larger than the proportion who did not (e.g., the majority of girls who were current smokers and binge drinkers were also trying to lose weight). The co-occurrence of binge drinking and breakfast-skipping was most closely associated with dieting ($\chi^2 = 29.26$, $p < 0.001$), and three quarters of girls who engaged in this behaviour pattern were also trying to lose weight.

Table 5: Descriptive statistics for co-occurring behaviours among adolescent girls in Year 1 of the COMPASS study by dieting status (N=3,386)

		Dieting Status		**Chi-Square (χ^2)**
Parameter		Dieter (%)	Non-Dieter (%)	
Engaging in only a single behaviour	Yes	972 (62.1)	594 (37.9)	**24.56****
	No	976 (53.6)	844 (46.4)	
Smoking and Binge Drinking	Yes	42 (71.2)	17 (28.8)	**4.58***
	No	1906 (57.3)	1421 (42.7)	
Smoking and Breakfast-skipping	Yes	62 (68.9)	28 (31.1)	**4.88***
	No	1886 (57.2)	1410 (42.8)	
Binge Drinking and Breakfast-skipping	Yes	178 (74.2)	62 (25.8)	**29.26****
	No	1770 (56.3)	1376 (43.7)	
Smoking and Binge Drinking and Breakfast-skipping	Yes	33 (75.0)	11 (25.0)	**5.57***
	No	1915 (57.3)	1427 (42.7)	

**p*-value of < 0.05, ***p*-value of < 0.001

Figure 2: Prevalence of dieting among adolescent girls in the COMPASS study who are engaging in no, single, or multiple co-occurring health-compromising behaviours at Year 1 (N=3,386)



6.3 Results of Longitudinal Analyses

To investigate research questions 2 to 5, longitudinal analyses were conducted using data from the linked sample of girls from Years 1 to 3, controlling for each subject and the school they attend as a repeated-subject cluster (see Chapter 5.2.2).

One-fifth of girls reporting dieting at Year 1 and not dieting at Year 3, and under one-third went from identifying as non-dieters to dieters (Table 6). Differences in the prevalence rates of dieting and each outcome behaviour are displayed in Figure 3. Descriptive statistics for the sample in Year 3, stratified by dieting status, are displayed in Tables 7 and 8. Similar to baseline, less than 1% of the sample did not report their smoking or binge drinking status and 1.7% did not report their breakfast-skipping patterns at follow-up.

Table 6: Descriptive statistics for changes in dieting status from Years 1 to 3 among adolescent girls in the COMPASS study (N=3,334)

	Dieting Status (Year 3)		
Dieting Status (Year 1)	Dieter (%)	Non-Dieter (%)	**Total**
Dieter (%)	1527 (79.5)	**393 (20.5)**	1920
Non-Dieter (%)	**412 (29.1)**	1002 (70.9)	1414
Total	1939	1395	3334

Figure 3: Prevalence of dieting and individual outcome behaviours among adolescent girls in the COMPASS study Years 1 and 3 (N=3,386)

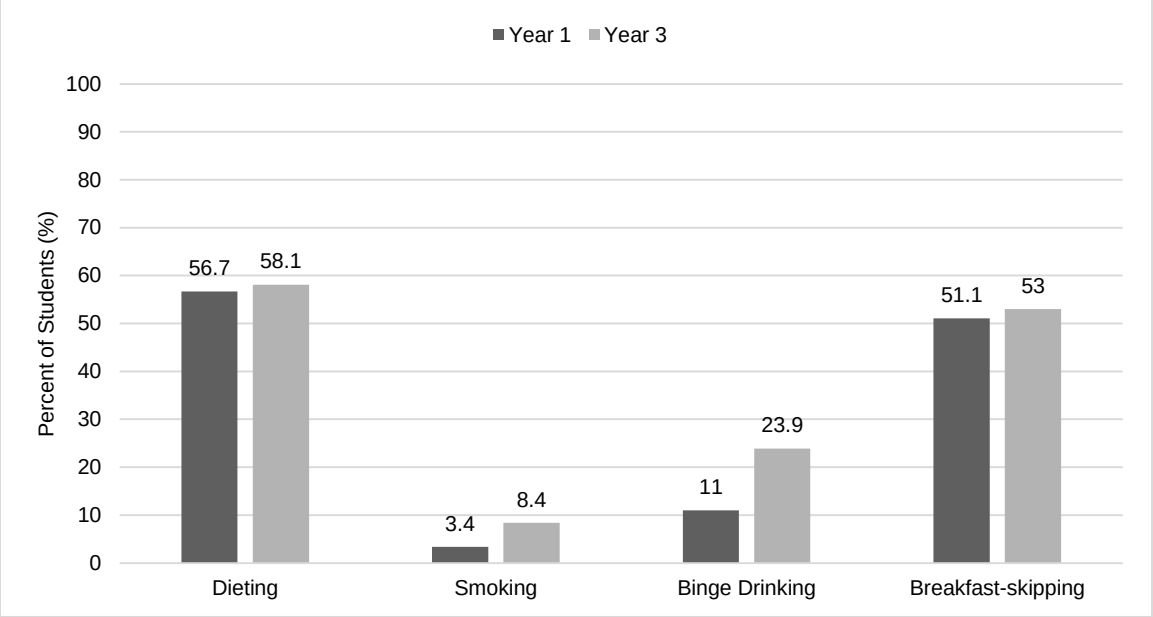


Table 7: Descriptive statistics for adolescent girls in Year 3 of the COMPASS study by dieting status (N=3,386)

		Dieting Status		**Chi-Square (χ^2)**
Parameter		*Dieter (%)*	*Non-Dieter (%)*	
Grade	11	1069 (57.5)	790 (42.5)	0.72
	12	896 (59.0)	624 (41.1)	
Ethnicity	White	1463 (57.4)	1085 (42.6)	2.29
	Non-White	496 (60.4)	325 (39.6)	
BMI	Underweight	5 (17.2)	24 (82.8)	**227.26****
	Healthy weight	1148 (51.1)	1100 (48.9)	
	Overweight	321 (83.2)	65 (16.8)	
	Obese	124 (89.2)	15 (10.8)	
	Not stated	368 (63.5)	212 (36.5)	
Smoking	Yes	182 (63.9)	103 (36.1)	**4.20***
	No	1784 (57.6)	1313 (42.4)	
Binge Drinking	Yes	529 (65.4)	280 (34.6)	**23.07****
	No	1435 (55.8)	1135 (44.2)	
Breakfast-skipping	Yes	1117 (62.2)	679 (37.8)	**25.41****
	No	836 (53.6)	724 (46.4)	

**p*-value of < 0.05, ***p*-value of < 0.001

Table 8: Descriptive statistics for co-occurring behaviours among adolescent girls in Year 3 of the COMPASS study by dieting status (N=3,386)

		Dieting Status		**Chi-Square (χ^2)**
Parameter		Dieter (%)	Non-Dieter (%)	
Engaging in only a single behaviour	Yes	907 (60.2)	600 (39.8)	**4.71***
	No	1059 (56.5)	816 (43.5)	
Smoking and Binge Drinking	Yes	118 (63.1)	69 (36.9)	2.01
	No	1848 (57.8)	1347 (42.2)	
Smoking and Breakfast-skipping	Yes	146 (65.5)	77 (34.5)	**5.28***
	No	1820 (57.6)	1339 (42.4)	
Binge Drinking and Breakfast-skipping	Yes	340 (68.1)	159 (31.9)	**24.07****
	No	1626 (56.4)	1257 (43.6)	
Smoking and Binge Drinking and Breakfast-skipping	Yes	96 (65.3)	51 (34.7)	3.25
	No	1870 (57.8)	1365 (42.2)	

**p*-value of < 0.05, ***p*-value of < 0.001

6.3.1 Research question 2: Prospective relationship between dieting and smoking

Dieting in Year 1 was a significant predictor of smoking at Year 3; girls who were dieting were 1.33 times more likely to be current smokers two years later than girls who were not dieting ($p < 0.05$; Table 9). Girls who were in grade 10 in Year 1 were at a slightly elevated risk of being smokers in Year 3 compared to girls in grade 9 (OR = 1.02, $p < 0.05$). Ethnicity and BMI at baseline were not significantly associated with smoking status in Year 3.

Table 9: Longitudinal, multilevel logistic regression models investigating factors associated with individual health-compromising behaviours among adolescent girls in the COMPASS study (N=3,386)

		Adjusted Odds Ratio[1] (95% CI)		
Parameter		*Smoking, Year 3*	*Binge Drinking, Year 3*	*Breakfast-skipping, Year 3*
Dieting, Year 1	No	1.00	1.00	1.00
	Yes	**1.33 (1.09, 1.61)***	**1.44 (1.28, 1.63)****	**1.28 (1.18, 1.40)****
Grade, Year 1	9	1.00	1.00	1.00
	10	**1.02 (1.01, 1.05)***	1.02 (1.00, 1.04)	0.99 (0.97, 1.01)
Ethnicity, Year 1	White	1.00	1.00	1.00
	Non-white	0.98 (0.77, 1.24)	**0.80 (0.68, 0.93)***	**1.12 (1.00, 1.26)***
BMI, Year 1	Healthy weight	1.00	1.00	1.00
	Underweight	1.30 (0.61, 2.74)	0.77 (0.44, 1.33)	0.88 (0.63, 1.23)
	Overweight	1.11 (0.84, 1.45)	0.92 (0.77, 1.10)	**1.22 (1.07, 1.38)***
	Obese	1.31 (0.86, 1.99)	0.94 (0.70, 1.27)	1.12 (0.90, 1.39)
	Not stated	1.11 (0.90, 1.39)	**0.86 (0.75, 0.99)***	**1.23 (1.12, 1.36)****

[1] Odds ratio controlling for all other parameters in the table
*p-value of < 0.05, **p-value of < 0.001

6.3.2 Research question 3: Prospective relationship between dieting and binge drinking

Girls who dieted at Year 1 were roughly 1.4 times more likely to engage in binge drinking by Year 3 than girls who were not dieting ($p < 0.001$; Table 9). Although grade was not a predictor of binge drinking, non-White girls were at a significantly lower risk of becoming binge drinkers (OR = 0.80, $p < 0.05$), controlling for the other covariates in the model. Those girls who did not report their weights and/or heights were less likely than their healthy weight peers to become binge drinkers (OR = 0.86, $p < 0.05$).

6.3.3 Research question 4: Prospective relationship between dieting and breakfast-skipping

Dieters in Year 1 were significantly more likely to engage in frequent breakfast-skipping at Year 3 than their non-dieting peers (OR = 1.28, $p < 0.001$; Table 9). Furthermore, this risk was significantly higher among non-White girls, who were 1.12 times more likely to be breakfast-skippers by follow-up ($p < 0.05$). Girls who reported a height and weight indicating an overweight BMI status and those who did not report their weight/height at baseline were at a greater risk of breakfast-skipping at follow-up than girls who were a healthy weight (OR = 1.22 and 1.33, respectively). This increased-risk relationship between BMI and breakfast-skipping, controlling for the other covariates, did not exist among girls who were underweight (OR = 0.88, $p = 0.49$) and obese (OR = 1.12, $p = 0.31$).

6.3.4 Research question 5: Prospective relationship between dieting and smoking/binge drinking

Girls who dieted at Year 1 were significantly more likely to engage in smoking and binge drinking at Year 3 than their non-dieting peers (OR = 1.39, $p < 0.05$; Table 10). There was no significant difference of engaging in these behaviours across ethnicity or BMI status. However, girls who were in grade 10 at baseline were at a slightly elevated risk of being smokers and binge drinkers by follow-up than girls who were in grade 9 (OR = 1.03, $p < 0.05$).

Table 10: Longitudinal, multilevel logistic regression models investigating factors associated with co-occurring health-compromising behaviours among adolescent girls in the COMPASS study (N=3,386)

		Adjusted Odds Ratio[1] (95% CI)			
Parameter		*Smoking **and** Binge drinking, Year 3*	*Smoking **and** Breakfast-skipping, Year 3*	*Binge drinking **and** Breakfast-skipping, Year 3*	*Smoking **and** Binge drinking **and** Breakfast-skipping, Year 3*
Dieting, Year 1	No	1.00	1.00	1.00	1.00
	Yes	**1.39 (1.08, 1.80)***	**1.41 (1.13, 1.76)***	**1.64 (1.41, 1.91)****	**1.60 (1.19, 2.14)***
Grade, Year 1	9	1.00	1.00	1.00	1.00
	10	**1.03 (1.01, 1.05)***	**1.03 (1.00, 1.05)***	**1.02 (1.01, 1.04)***	**1.03 (1.01, 1.06)***
Ethnicity, Year 1	White	1.00	1.00	1.00	1.00
	Non-white	0.96 (0.71, 1.29)	0.98 (0.75, 1.28)	0.89 (0.74, 1.06)	0.90 (0.64, 1.26)
BMI, Year 1	Healthy weight	1.00	1.00	1.00	1.00
	Underweight	1.07 (0.36, 3.17)	1.06 (0.41, 2.72)	0.79 (0.39, 1.63)	0.94 (0.24, 3.70)
	Overweight	1.03 (0.72, 1.47)	1.28 (0.95, 1.71)	1.00 (0.81, 1.24)	1.17 (0.79, 1.73)
	Obese	0.96 (0.52, 1.75)	1.43 (0.90, 2.26)	0.91 (0.63, 1.32)	1.00 (0.51, 1.96)
	Not stated	1.11 (0.83, 1.47)	1.12 (0.88, 1.44)	1.02 (0.86, 1.21)	1.11 (0.80, 1.55)

[1] Odds ratio controlling for all other parameters in the table
*p-value of < 0.05, **p-value of < 0.001

6.3.5 Research question 5: Prospective relationship between dieting and smoking/breakfast-skipping

Controlling for grade, ethnicity, and BMI, dieting in Year 1 was a significant predictor of engaging in smoking and breakfast-skipping at Year 3 (OR = 1.41, $p < 0.05$). Girls in grade 10 at baseline were at a slightly elevated risk of engaging in both behaviours by follow-up (OR = 1.03, $p < 0.05$). The remaining covariates were not significant predictors of these behaviours in the predictive model.

6.3.5 Research question 5: Prospective relationship between dieting and binge drinking/breakfast-skipping

Dieting in Year 1 was also a significant predictor of engaging in binge drinking and breakfast-skipping at Year 3 (OR = 1.64, $p < 0.001$). Girls who were in grade 10 at baseline were at a slightly elevated risk of engaging in both of these behaviours by follow-up than girls who were in grade 9 (OR = 1.02, $p < 0.05$).

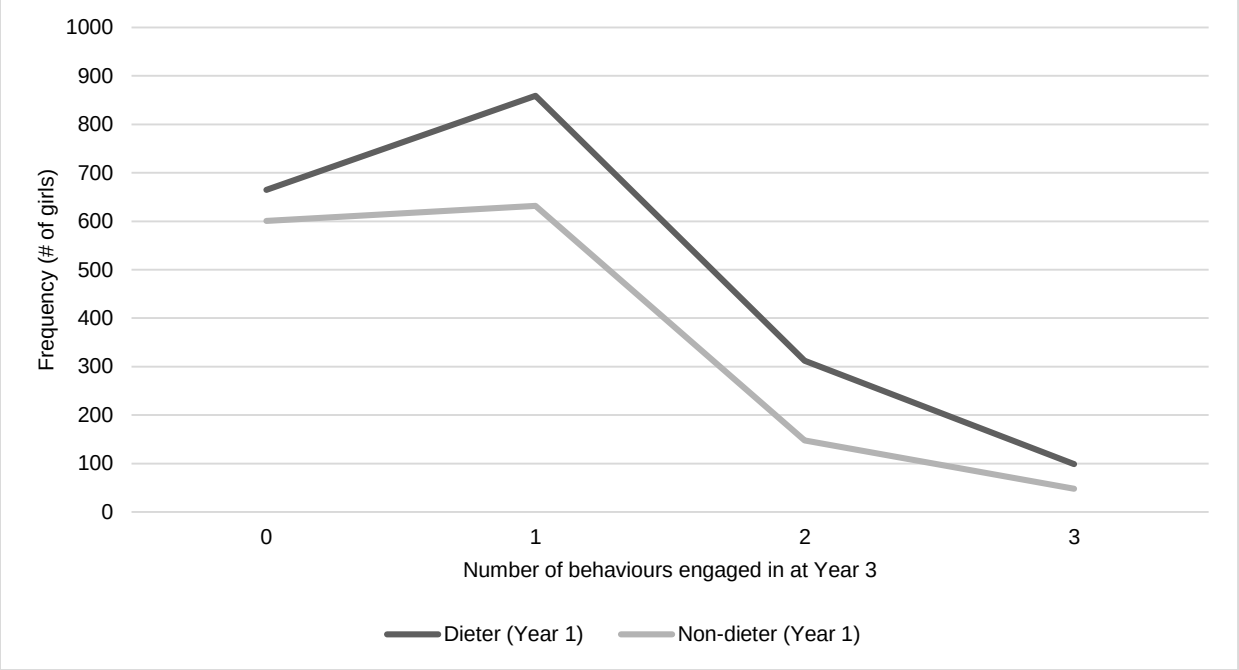
6.3.6 Research question 5: Prospective relationship between dieting and smoking/binge drinking/breakfast-skipping

Compared to non-dieters, girls who dieted in Year 1 were roughly 1.6 times more likely to engage in all three of smoking, binge drinking, and breakfast-skipping by Year 3 ($p < 0.05$). BMI and ethnicity were not significant predictors of this behaviour pattern, but girls who were in grade 10 at baseline were at a significantly slightly elevated risk (OR = 1.03, $p < 0.05$).

6.3.7 Additional Analyses: Relationship between dieting and the number of behaviours engaged in

Girls who dieted in Year 1 were significantly more likely to engage in a greater number of health-compromising behaviours by Year 3 than non-dieters (OR = 1.30, 95% CI [1.23-1.37], $p < 0.0001$; see Figure 4). There was no significant difference in risk by grade or ethnicity. Girls who did not report their height and/or weight were at a slightly elevated risk of engaging in more behaviours than girls who reported a healthy weight BMI (OR = 1.11, 95% CI [1.05-1.17], $p < 0.01$).

Figure 4: Total health-compromising behaviours that girls in the COMPASS study are engaged in at Year 3, separated by dieting status at Year 1 (N=3,386)



Chapter 7

Discussion

7.1 Dieting and Risky, Health-Compromising Behaviours

A large body of research indicates that dieting to lose weight is an extremely common phenomenon among adolescent girls, with various implications for health and well-being (9–11,59,63). However, data are lacking in the Canadian context, particularly concerning the co-occurrence of dieting with other risky health-compromising behaviours. This study sheds light on the pervasiveness of dieting among Canadian adolescent girls and the persistence of this behaviour over a two-year period, as well as associations between dieting at baseline and other risky behaviours. Almost six in ten girls were dieting at baseline and 80% of these dieters reported engaging in this behaviour 2 years later. Further, dieting was cross-sectionally and longitudinally associated with other risky behaviours, as well as clusters of those behaviours. This is of concern given the current health-related policy context in which a “war on obesity” is being waged, with little consideration of how pressures to attain a healthy weight may promote increased dieting among vulnerable populations, such as adolescent girls (66,175–178).

The prevalence rates for each behaviour increased from baseline to follow-up. A very small proportion of girls were classified as current smokers at baseline, and dieting was not associated with this behaviour cross-sectionally. However, girls with obesity were nearly 3 times as likely to be current smokers than girls with a healthy weight (though the confidence interval for this estimated level of risk was fairly large (CI 95% [1.31-6.81], likely due to the small number of girls who were classified as current smokers at baseline). In the longitudinal analysis, girls who reported dieting at baseline were 1.3 times more likely to be smokers at follow-up. Similar to the longitudinal patterns observed with smoking, over two times as many girls were binge drinkers at follow-up than baseline. Girls who reported dieting at baseline were 1.4 times

more likely to be binge drinkers by follow-up than non-dieters. Unlike the trends observed in smoking and binge drinking, the proportion of girls engaged in breakfast-skipping by follow-up was similar to that of baseline. Research does suggest that breakfast consumption decreases over time among girls, with rates that begin to fall before girls even reach secondary school (137), and that adolescent consumption tracks into young adulthood (102). Thus, patterns of breakfast-skipping may be established prior to girls' enrollment in grade 9 and are maintained into later adolescence. However, similar to smoking and binge drinking, dieting at baseline did significantly predict engagement in breakfast-skipping by follow-up, consistent with previous research (5,10,146).

Similar to what was observed for each behaviour individually, the prevalence rates for clusters of behaviours increased from baseline to follow-up, with the rates of some clusters (binge drinking/breakfast-skipping) growing more than others (smoking/binge drinking/breakfast-skipping). Additionally, the proportion of girls dieting among each cluster was always greater than the proportion of girls who were not, and the number of dieters is nearly even to the number of non-dieters among girls engaging in none of the other behaviours. Thus, dieting to lose weight was not solely clustered with each of these behaviours because it happens to occur so often among this population, but because it occurs more frequently as girls engage in more health-compromising, risky behaviours. Girls who dieted at baseline were also more likely to engage in a *greater number* of risky behaviours than non-dieters, regardless of what the actual behaviours were. To the author's knowledge, this is a novel finding, because although previous research has identified that dieting predicts each of the aforementioned behaviours individually, it was not known to what extent dieting clustered among multiple risky behaviours.

7.2 Theories and Mechanisms Underlying Behavioural Clusters

As summarized in Chapter 2.2, the reasons that youth engage in multiple health-compromising behaviours are debated (13,14). In the context of this study's findings, we may be able to conceptualize how dieting and each of the demonstrated behavioural clusters fit into existing theoretical models for risky behaviour co-occurrence. The first, most transparent explanation for why dieting may be associated with and predict the onset of engaging in multiple risky behaviours is that girls practice these other behaviours in conjunction to assist in their goal of achieving weight loss. Evidence suggests that girls who perceive smoking as an effective tool for weight loss are more likely to smoke than girls who do not (103,104,106) and that meal- and breakfast-skipping may also be used to encourage weight loss (3,4); as a result, girls would engage in both behaviours to increase their perceived chances of losing weight. This framework, however, may oversimplify the contributors to engagement in each of these behaviours, which are also regulated and influenced by other individual, intrapersonal, familial, and broader social factors; for example, girls are not likely to engage in smoking for the sole purpose of losing weight, because smoking is influenced by a wide array of other factors at the aforementioned levels (110). Additionally, this theory fails to build upon the demonstrated association between dieting to lose weight and binge drinking, which has not been shown to serve as a tool for weight loss among this population but does cluster with the other behaviours.

The theory of dietary restraint (134), which has been used to inform clinical treatment for eating disorders and weight-related concerns, has been applied to weight management and binge drinking (this is often colloquially referred to as "drunkorexia", which may be an inappropriate and inconsistent label for this cluster of behaviours (179)). This pattern of caloric restriction prior to alcohol consumption serves the purposes of reducing calorie intake to lose/maintain weight and maximizing the perceived effects of consumed alcohol (81,135,136,179). A previously published study using cross-sectional data from COMPASS

found that, among girls, breakfast-skipping significantly predicted binge drinking and was associated with dieting to lose weight (180). This theorized mechanism, through which girls may be restricting breakfast intake to serve the purposes of weight loss and binge drinking without worry of calories, fits in with prior literature on health behaviour trading-off among youth (80,81) and this study's finding that, compared to non-dieters, dieting girls were at the highest risk of engaging in this behavioural cluster. At the individual psychosocial level, it may help to explain a subclinical disordered eating/weight management phenomena among this population (179), and may contribute to binge drinking prevention initiatives by elucidating a risk factor for alcohol use and breakfast-skipping. However, although this behavioural pattern has been demonstrated among college- and university-aged women, its onset among adolescent girls has not been explained within a framework of broader contextual factors, such as how it may interrelate with smoking to sustain weight loss or how the use of policies/programs that provide breakfast to youth may be affected by the planned consumption of alcohol at a later time.

The TTI (Figure 1) has been applied to explain smoking and alcohol use among adolescents (110,111). Its use of a combined, socioecological framework to explain the distal and proximal influences on the personal, social, and environmental streams allows for a systematic view of the complexity underlying health issues. Effective interventions, then, try to target and achieve changes in all three domains and on both proximal and distal factors (111). In the context of this study, it builds upon the simplistic interpretation of dieting to lose weight as a sole catalyst for engagement in behaviours, such as binge drinking, by placing the desire to lose weight within expectancy- and value-based orientations for risky behaviour initiation. It may also serve as a foundation for the previously noted pattern of caloric restriction prior to alcohol consumption, by highlighting how personal beliefs about this form of weight loss/maximum alcohol effect are influenced by broader environmental stimuli (e.g., alcohol-promoting youth culture and media) and may interrelate with the initiation of smoking behaviours. However, the TTI's strength in its consideration of the multiple levels of contributors to the engagement of

risky behaviours among youth also leads to unexplainable complexity, which makes it difficult to comprehensively prevent behaviours through a single intervention or health promotion effort (68,111) or predict how an intervention may affect the prevalence/onset of other behaviours and their clustering.

Systems-based complexity approaches may provide an additional layer to the usefulness of the TTI in its application to the clustering of risky, health-compromising behaviours among girls. Although the authors of the TTI outline its use of feedback loops within and across the personal, social, and environmental streams (110), it does fall short of considering the dynamic complexity of the system underlying youth health behaviours (181). According to complex systems theories, systems are counterintuitive, constantly changing, adaptive, nonlinear, and self-organizing (17,182). Although it may appear that girls' dieting and weight management patterns are predictive of behaviours that assist in the goal of weight loss, these relationships and the risk for engaging in zero, one, two, or three other behaviours are mediated by an ever-changing system that encapsulates factors at every level. For example, as previously noted, young girls' smoking rates have significantly decreased over the past three decades as dieting rates have remained stable; smoking is a more stigmatized behaviour than it once was (114), and obesity and the emphasis on achieving a "healthy weight" has grown in the past thirty years (15,85,86). However, this study found that the association between these two constructs remains intact. Systems theories highlight the problematic paradigm of policies and interventions promoting weight loss to achieve health (175), which may serve as a tool to explain why obesity-related policies may actually promote the assumption that girls need to lose weight intentionally, which may be aided by the perceived appetite-suppressing effect of tobacco. The anticipation that all factors in a system are interrelated and dependent on one another and the system as a whole allows for the prediction of policy resistance and the conceptualization of how behaviours may cluster.

7.3 Prior Research on Interrelationships Among Behaviours

Previous research investigating the prospective association between smoking and dieting has found that girls who dieted at baseline were 1.9 to 2.1 times more likely to be smokers by one and two year follow-ups than non-dieters (18,26,105). As previously noted, these studies' data were collected in the 1990s, when rates of smoking among youth were significantly higher than they are today (114). Since smoking prevalence among Canadian adolescent girls seems to be decreasing (112,113), this may explain the lowered risk of becoming a smoker among dieters that is demonstrated in this study. However, this evidence does suggest that a prospective relationship between trying to lose weight and smoking does still exist, and this has significant implications for public health prevention initiatives that aim to prevent/curb rates of smoking among this population. Previous research on the relationship between weight and smoking status among adolescent girls has been mixed (107–109), with little evidence suggesting an established, temporal relationship between the two health-related outcomes. In this study, the relationship between dieting and smoking seems more salient than that between weight and smoking, as baseline weight was not a significant predictor of smoking status at follow-up.

The prevalence of binge drinking in the sample increased from 11% to 24% from baseline to follow-up. This aligns with other Canadian studies that estimate one quarter of adolescent girls have engaged in binge drinking in the previous month (116,118). In the present study, girls who dieted at baseline were 1.4 times more likely to be binge drinkers than non-dieters; although this prospective association has not been found in a Canadian sample, this finding is consistent with studies among American sample that estimate this risk is between 1.3 to 1.7 times (123,124).

Approximately half of the adolescent girls at baseline and follow-up were classified as breakfast-skippers, and nearly two-thirds of these girls also reported dieting. Previous research

conducted among Southern Ontarian girls found that nearly a quarter of girls reported skipping breakfast on a single 24-hour recall and nutrition behaviour questionnaire (10,138). The higher rates of dieting among girls in this study compared to other studies (10,138,139) are concerning, considering the wide range of negative health- and academic-related consequences associated with the behaviour among this population (10,36,97,102,138,139,141). Contrary to the results of the cross-sectional model, girls who were classified as obese were not at a significantly elevated risk of breakfast-skipping in the prospective model, but girls who were overweight were at an elevated risk. This finding does not correspond with past research, particularly since there is no evidence suggesting that girls who are overweight would be more prone to skipping breakfast than girls who are obese.

7.4 Factors Associated with Dieting and Other Risky Behaviours

This study also sheds light on the complexity of dieting to lose weight in relation to other factors, such as weight perception. Discordance among weight status, perception, and management patterns have been demonstrated in prior research among young women (183,184). In the present study, over half (57%) of the girls reported dieting to lose weight, despite the fact that nearly the same proportion (61%) reported heights and weights corresponding with a healthy weight based on their BMI. This finding appears consistent with the previously summarized literature demonstrating high prevalences of dieting among girls regardless of self-reported weight status (3,4,7). The extent of discord may be misestimated, however, since many of the girls in the sample may have under-reported their weight, as is common among this population (185). For reference, measured data from the 2007-2009 CHMS indicate that 8% of Canadian girls aged 12 to 17 were classified as obese (1), versus the 3% of girls who reported heights and weights corresponding to obesity in this study.

Although many girls who reported heights and weights consistent with a healthy weight also reported dieting to lose weight, prevalences of dieting were even higher among girls in the overweight or obese categories. At baseline, nine in ten girls who were overweight and obese were dieting, compared to half of girls who self-reported healthy weights and just under one in five girls who were underweight. Crow et al. (7) and Barker et al. (33) reported similar patterns among girls falling into different BMI categories, but found that only 73% of girls with a self-reported BMI higher than 24 (overweight) reporting trying to lose weight, compared to 88% in this study. Boutelle et al. (36) found even lower rates of dieting among youth across BMI categories (36% of girls who were not overweight and 55% of girls who were obese). In these studies, dieting was similarly operationalized as reports of trying to lose weight in the previous year. These studies were conducted using data from American samples between 2002 and 2006, and the higher prevalence rates of dieting among girls who report being overweight/obese

in this study may reflect an increase in self-reported dieting among adolescent girls. However, the lack of longitudinal data on Canadian populations makes it difficult to confirm this hypothesis.

As in other research (2,23), there was some movement out of dieting over time, indicating that engagement in dieting to lose weight among some girls may fluctuate over time. One fifth of girls who reported dieting at baseline did not identify as dieters two years later, but nearly a third of non-dieters in Year 1 identified as dieters in Year 3. As previously mentioned, dieting to lose weight may be temporal (4), but the majority of girls remained dieters (80%) throughout the observed period.

These analyses also uncovered other factors associated with clusters of risky behaviours, including grade, race/ethnicity, and self-reported/missing BMI. The risk of engaging in any of the risky behaviour clusters was slightly elevated among girls who were in grade 10 at baseline, which is consistent with previous literature highlighting an increased risk in engaging in each of these behaviours as adolescents age (38,39,63,70,100).

There were no observed differences in dieting by race/ethnicity (White/non-White) in this sample. Approximately 57% and 58% of White and non-White girls reported trying to lose weight, which is reflective of the overall sample. Much of the existing research demonstrating differing patterns of dieting across racial and ethnic groups has been conducted in the United States (54,55,186), where health disparities between White and non-White youth are greater than they are in Canada (187). Additionally, much of the research on race/ethnicity and dieting has investigated weight loss attempt patterns among separate minority groups (186), which could not be done in this study because of the dichotomized variable representing this construct. As a result, we may not have been able to capture potentially significant associations between dieting and self-identifying as part of a particular racial/ethnic group.

Girls who reported being non-White were significantly less likely to engage in binge drinking than their White peers, which aligns with previous research conducted among this

population (188). Across the predictive models of clusters, there were no significant differences based on race/ethnicity and BMI (except in the behavioural count analyses, in which girls who did not report their height/weight were at a very slightly elevated risk), which differs from the individual-behaviour predictive models. When the outcome behaviour of interest is an existing cluster, dieting seems to account for most of the models' predictive variability, and is the most significant predictor of engaging in each behavioural cluster. Dieting to lose weight, then, precedes and clusters with each existing cluster of risky, health-compromising behaviours among girls across schools, race/ethnicity, and BMI category.

One quarter of the girls in the sample did not report their height/weight. Girls with missing BMI values may reresent a unique grouping; since adolescent girls are typically aware of their actual height and weight (192), it is likely that non-reporting among this population is intentional. Multiple studies have investigated the relationship between motivated non-reporting of height/weight and a series of health-related behaviours, including academic achievement, body image and satisfaction, and levels of physical activity (170,193,194). Although we cannot determine the reasons for why they may not have reported their height/weight, we can hypothesize that these girls may be overweight/obese. In a previously submitted manuscript (195) investigating girls in Year 2 of COMPASS, we found that the prevalence of dieting among girls with missing BMI data was similar to that of girls who were overweight, and that fewer girls expressed perceiving themselves as "about the right weight" than girls who were in the healthy weight BMI category.

Girls who did not report their height and/or weight were also significantly less likely to binge drink. Although other studies using COMPASS data have found a similarly lower risk of binge drinking among girls who did not report their height/weight (180), there is no known research investigating the possible mechanisms through which these girls may be less inclined to binge drink than their healthy weight peers, particularly when non-response to this item is typically associated with other health-compromising behaviours. Girls who do not report their

height and/or weight are likely heterogeneous in several facets, since non-response to a particular item does not correspond to a single demographic/behavioural profile; however, considering their increased risk for the aforementioned health-related behaviours, and particularly poor body image (194), there may be an unknown mechanism through which they are at a decreased risk of binge drinking.

Girls who did not report their height/weight, similarly to girls who were overweight and obese, were significantly more likely to skip breakfast than their healthy weight peers. To the author's knowledge, there is no known research investigating the association between non-response to measures of height/weight and breakfast consumption patterns, but these results may suggest that non-reporters may have more in common with girls who self-report heights and weights corresponding to obesity when it comes to breakfast-skipping, possibly as a method for weight control and/or weight loss.

7.5 Study Limitations

This study's use of secondary data presents several limitations. COMPASS does not collect student data from a nationally representative sample, which limits the generalizability of the study's findings across all Canadian girls, as Ontario school boards (and as a result, schools and students) were purposefully selected and recruited into Year 1 of the study (149). Additionally, the sample was predominantly White (73.4%), and the impact of race/ethnicity in the regression models was interpreted through a dichotomized variable (White and non-White). As previously noted, this division of sample populations by ethnicity is common in analyses using national data sources (166–168); however, the results may not be completely reflective of the experiences of girls who belong to specific non-White racial/ethnic groups (e.g., Black or Aboriginal) and may report dieting, weight status, and engagement in other behaviours differently (54,55). Also, the COMPASS student questionnaire asks participants whether they identify as male or female, terms used to identify sex, rather than gender (151,152). By assuming that participants who identify as female also identify as girls/women, this study may unintentionally include participants whose self-identified sex is female but gender identity is not girl/woman (151). Further research investigating the relationships between the construct of dieting and other health-related behaviours should consider the unique roles of racial/ethnic and gender identity in the engagement of co-occurring risky behaviours among this population.

GEE regression models that use cluster-specific models (e.g., accounting for the study design of collecting data in different schools) to make population-level assumptions may be affected by insufficient sample sizes (196), despite the typical robustness of these models. As a result, when making population-averaged assumptions, these models may under- or over-estimate the degree of association between parameters if there are too few or no observations in a particular cluster. One of the models, which revealed that at baseline, dieting was not

associated with smoking at Year 1, may have suffered from this issue, since a very small fraction of the sample were current smokers at baseline.

Furthermore, COMPASS study data were collected through self-report measures, which may not accurately capture girls' heights, weights, and engagement in the behaviours of interest. Firstly, as previously detailed in Chapter 4.3.1, the use of a single item to determine and classify dieting status is limiting. The complexity of dieting, including its duration, associated methods, and severity (2), cannot be fully observed when using a single item (23). This measure, then, could only be used as a proxy to identify girls who are intentionally trying to lose weight, as has been done in previous studies (160,161), and could not distinguish between thos using healthy and/or unhealthy weight loss behaviours. This may have resulted in an underestimation of the associations between dieting and each of the outcome behaviours, as girls who engaged in less extreme forms of dieting were classified with those engaged in more severe weight loss methods.

The use of self-report measures may not accurately reflect girls' BMI status and engagement in risky behaviours. Adolescent girls often under-report their weight (185,197), and given the noted discrepancy between this sample's prevalence of obesity and that of objective CHMS data, this is also likely in this study. A previous study using subsets of the COMPASS sample found that self-reported and objectively-measured height and weight data were not significantly different (ICC = 0.84) (171), but the possible impacts of social desirability biases and body dissatisfaction among this population on misreporting height and/or weight (185) must be considered. Data on height/weight were also missing for a quarter of the girls at Year 1; although this constrained the investigation of relationships between self-reported BMI and each of the outcome variables of interest, demonstrated patterns of behaviour among girls in this heterogeneous group may be indicative of unique behavioural clusters that should be explored in future research. Self-report measures for each of the outcome behaviours (smoking, binge drinking, and breakfast-skipping) and their previous validity/usage in other studies, detailed in

Chapter 4.3.2, may also be subject to similar reporting biases among adolescent girls in this sample. Rates of non-response for each of these outcome measures were low (Chapters 6.1.1 and 6.3).

An additional limitation of this study is the longitudinal design and resulting missing data. As formerly detailed in Chapter 4.2.4, data were available for just over half of the girls from Year 1 who would have been eligible to participate in Year 3. Although we cannot ascertain the true reasons behind the participant dropout, which may include switching schools, absenteeism, or having a spare class period, we may be missing data from girls who missed school and are at a greater risk of engaging in more risky behaviours (155,156). This may have resulted in an under-estimation of the association between dieting and these other behaviours. Further, data are missing for one-fifth of the sample at Year 2, and GEE analyses cannot distinguish whether these data are missing completely at random. Exploratory sensitivity analyses found that these girls differed from participants who had data available on all three time points on a variety of behaviours, and so their treatment in the study as having only two time-points may under-estimate the association between dieting and other behaviours. However, the decision to include these girls in the study was made to avoid eliminating a significant portion of girls who may have been at greater risk of engaging in each of the outcome behaviours in Year 3.

Finally, by design, this study did not consider the possible role of the school and broader socio-environmental context on engagement in risky health-compromising behaviours. The intra-class correlations for each of the outcome variables highlighted the variability that could be accounted for at the school level (10.9% for smoking, 5.3% for binge drinking, 2.3% for breakfast-skipping). Although the focus of this study was on investigating the relationship between and clustering of dieting with other healthy-compromising, risky behaviours, future research should consider the potential role of the broader school environment (e.g., programming and resources, policies) on the uptake of multiple behaviours among adolescent girls.

7.6 Study Strengths

The present study had several strengths. Firstly, many of the survey questions and measures used to assess the outcome behaviours of interest had been previously validated (Chapter 4.3.2). Despite the limitations of self-reported data, as previously described, the measures used to assess each of smoking, binge drinking, and breakfast-skipping have been previously validated and/or used in prior research, which allows for comparison of this sample's results with those of other studies.

Secondly, the longitudinal design of this study contributes significant knowledge to this area of research. Longitudinal analyses allow for conceptualizing how behaviours and risk factors can predict the occurrence of risky behaviours and their clusters by establishing their temporality (118,172). Although previous work has investigated how dieting may predict the onset of each of these behaviours individually, no known work has examined how dieting may predict engagement in established clusters of multiple risky behaviours. Furthermore, the established relationship of dieting preceding the other behaviours with which it clusters allows for opportunities to sequence prevention initiatives among youth more carefully (124).

Thirdly, this study's use of GEE modelling allowed for the observation of population-level averages over repeated measures (153,154). Despite the limitation of intermittently missing data among a portion of the girls in the sample, which is common in longitudinal research (157), GEEs are robust in their modelling of incomplete data (173,174) because they do not impose a variance structure on the data and can account for variance outside of pre-determined covariates.

Finally, this study makes use of a novel systems framework to investigate how dieting clusters with and predicts the onset of other risky behaviours. Although the co-occurrence of health-compromising behaviours among adolescents is being emphasized as an area of significance in chronic disease prevention in Canada (90), little work has been done to

conceptualize how these behaviours, their drivers, and risk factors for chronic disease connect with one another through a systems perspective.

7.7 Implications for Future Research

The results from the present study demonstrate some implications for future research. Future research in the area should investigate systems approaches to prevention at the school level, which is mostly siloed and segregated by health issue (91–95,118). Few multi-component intervention programs have been effectively evaluated, and to the author's knowledge, there is no research evaluating the effectiveness of school-based policies or programs targeting more than two health-compromising behaviours at once. Although it was outside the scope of this project, future research in this area should also consider the role/impact of school-level policies and programs on behavioural clustering. Furthermore, the use of a systems approach may be supplemented by the use of systems-based analytic approaches, such as agent-based modelling (ABM) and system dynamic causal loop diagramming (17,84,88,181,198). These methods of analysis allow for thorough investigations of policies prior to their implementation, including the prediction of possible unanticipated consequences and tailoring prevention efforts to include risk factors for multiple behaviours (17,181).

In an observational analysis of health-related behaviours in three international samples, Lippke et al. found evidence for persistent health-promoting behavioural clustering among adults in addition to established health-risk clustering (68). Future research may benefit from including health-promoting behaviours in a systems framework, as changes to policies that aim to promote health (e.g., teaching parents about the risks associated with obesity) may actually hinder health-promoting behaviours (parents incorrectly relay these messages to their children, resulting in decreased body satisfaction (199)).

Finally, this study's use of a gender lens to explore how risky health behaviours cluster with dieting among adolescent girls may provide a foundation for future research focused on how these behaviours coalesce in boys and non-binary gender-identifying youth. Research has shown that the body ideals of boys differ significantly from that of girls', and that they often use

alternative forms of weight management to achieve this (28,31,35), which may have a different impact on how their forms of weight management cluster with the behaviours of interest in this study.

7.8 Implications for Policy and Practice

Overall, the complexity of using a systems approach to frame the clustering of behaviours among adolescent girls may be difficult to translate into practice, considering the vast multitude of dynamic, ever-changing factors that compose a system (17,110,181). However, a recognition that behaviours are inter-related has implications for school-based prevention programming, which can aim to be comprehensive and consider the role that dieting may play in the prevention of other health-compromising behaviours. Multi-component programming may benefit from this study's conclusion that dieting significantly predicts the initiation of smoking, binge drinking, and breakfast-skipping among girls. Dieting prevention initiatives should not only be added as a supplement to existing initiatives targeting the prevention of the aforementioned behaviours, but should also be sequenced before girls begin to engage in weight management practices. Research suggests that dieting among girls begins as early as 6 to 8 years old (2,4), and so targeted prevention among this population should commence before the onset of weight management-related behaviours. Comprehensive programming that addresses multiple risk factors may also be more cost-effective for schools, as their implementation would involve fewer resources and effort from teachers and staff than separate programming for each health-related issue.

This is especially pertinent given the current dominant focus on obesity prevention and the promotion of healthy weights in public health and school-based health promotion initiatives (85,86,175,200). Obesity prevention policies and programming efforts to reduce weight in the population, such as BMI report cards in the United States and the Healthy Kids Community Challenge in Ontario, that do not address psychosocial contributors to weight may unintentionally promote dieting and weight loss among girls (64,66,201,202) and result in an increased risk of the associated health consequences that occur as a result of dieting, including eventual weight gain (5,8,24), an example of policy resistance. Prevention programming that

includes a weight and/or dieting component should also be gender-focused, considering the impact that gender may have on the clustering of dieting with other health-compromising behaviours among youth.

Finally, given the pervasiveness of dieting among the population, interventions to clarify messaging around body weight and to enhance body image among adolescent girls is critical to stem the negative implications that may occur across the lifecycle.

Chapter 8

Conclusion

Over half of Canadian adolescent girls are dieting to lose weight. This is associated with several negative health consequences, as well as an increased likelihood of engaging in multiple risky, health-compromising behaviours. These behaviours, which often begin and develop during the period of adolescence, tend to track into adulthood and increase chronic disease risk. In using a systems science complexity lens to investigate how dieting and other risky behaviours are inter-related among adolescent girls, we may be able to develop more comprehensive, multi-faceted prevention programs and policies that effectively improve overall health among youth. This is especially pertinent in our current health research context, where obesity prevention initiatives encourage youth to focus on achieving healthy weights, with little regard for the unanticipated consequences that are associated with intentional weight loss. The present study provides a foundation of evidence for future research to investigate how these risky behaviours co-occur among girls and the overall complex system of drivers that contribute to youth health.

References

1. Public Health Agency of Canada. Obesity in Canada [Internet]. 2011. Available from: http://www.phac-aspc.gc.ca/hp-ps/hl-mvs/oic-oac/index-eng.php
2. Findlay S. Dieting in adolescence. Paediatr Child Health. 2004;9(7):487–91.
3. Jones JM, Bennett S, Olmsted MP, Lawson ML, Rodin G. Disordered eating attitudes and behaviours in teenaged girls: A school-based study. Can Med Assoc J. 2001;165(5):547–52.
4. McVey G, Tweed S, Blackmore E. Dieting among preadolescent and young adolescent females. Can Med Assoc J. 2004;170(10):1559–61.
5. Neumark-Sztainer D, Wall M, Haines J, Story M, Eisenberg ME. Why does dieting predict weight gain in adolescents? Findings from Project EAT-II: a 5-year longitudinal study. J Am Diet Assoc. 2007;107(3):448–55.
6. Slade PD. What is body image? Behav Res Ther. 1994;32(5):497–502.
7. Crow S, Eisenberg ME, Story M, Neumark-Sztainer D. Psychosocial and behavioral correlates of dieting among overweight and non-overweight adolescents. J Adolesc Heal. 2006;38(5):569–74.
8. Littleton HL, Ollendick T. Negative body image and disordered eating behavior in children and adolescents: what places youth at risk and how can these problems be prevented? Clin Child Fam Psychol Rev. 2003;6(1):51–66.
9. Neumark-Sztainer D, Wall M, Guo J, Story M, Haines J, Eisenberg ME. Obesity, disordered eating, and eating disorders in a longitudinal study of adolescents. J Am Diet Assocation. 2006;106(4):559–68.
10. Woodruff SJ, Hanning RM, Lambraki I, Storey KE, McCargar L. Healthy Eating Index-C is compromised among adolescents with body weight concerns, weight loss dieting, and meal skipping. Body Image. 2008;5(4):404–8.

11. University of Minnesota. Project EAT [Internet]. 2016. Available from: http://www.sphresearch.umn.edu/epi/project-eat/
12. Spring B, Moller AC, Coons MJ. Multiple health behaviours: Overview and implications. J Public Health (Bangkok). 2012;34(Suppl. 1):i3–10.
13. Kipping RR, Campbell RM, MacArthur GJ, Gunnell DJ, Hickman M. Multiple risk behaviour in adolescence. Eur J Public Health. 2012;25(Suppl. 1):44–9.
14. Hale DR, Viner RM. Policy responses to multiple risk behaviours in adolescents. J Public Health (Bangkok). 2012;34(Suppl. 1):i11–9.
15. Johnston LM, Matteson CL, Finegood DT. Systems science and obesity policy: A novel framework for analyzing and rethinking population-level planning. Am J Public Health. 2014;104(7):1270–8.
16. Meadows D. Thinking in Systems: A Primer. Chelsea Green Publishing. Vermont, US: Chelsea Green Publishing; 2008.
17. Sterman JD. Learning from evidence in a complex world. Am J Public Heal. 2006;96(3):505–14.
18. French S, Perry C, Leon G, Fulkerson J. Weight concerns, dieting behavior, and smoking initiation among adolescents: a prospective study. Am J Public Health. 1994;84(11):1818–20.
19. French S, Story M, Downes B, Resnick M, Blum R. Frequent dieting among adolescents: psychosocial and health behavior correlates. Am J Public Health. 1995;85(5):695–701.
20. Pirkle EC, Richter L. Personality, attitudinal and behavioral risk profiles of young female binge drinkers and smokers. J Adolesc Heal. 2006;38(1):44–54.
21. Larson NI, Neumark-Sztainer D, Story M. Weight Control Behaviors and Dietary Intake among Adolescents and Young Adults: Longitudinal Findings from Project EAT. J Am Diet Assoc. 2009;109(11):1869–77.
22. Schur EA, Sanders M, Steiner H. Body dissatisfaction and dieting in young children. Int J

Eat Disord. 2000;27(1):74–82.

23. Neumark-Sztainer D, Jeffery RW, French SA. Self-reported dieting: How should we ask? What does it mean? Associations between dieting and reported energy intake. Int J Eat Disord. 1997;22(4):437–49.

24. Neumark-Sztainer D, Story M, Hannan P, Perry C, Irving L. Weight-related concerns and behaviors among overweight and nonoverweight adolescents: implications for preventing weight-related disorders. Arch Pediatr Adolesc Med. 2002;156(2):171–8.

25. Field AE, Austin SB, Taylor CB, Malspeis S, Rosner B, Rockett HR, et al. Relation between dieting and weight change among preadolescents and adolescents. Pediatrics. 2003;112(4):900–6.

26. Maldonado-Molina MM, Komro KA, Prado G. Prospective association between dieting and smoking initiation among adolescents. Am J Heal Promot. 2007;22(1):25–32.

27. McCabe MP, Ricciardelli LA. Sociocultural influences on body image and body changes among adolescent boys and girls. J Soc Psychol. 2003;143(1):5–26.

28. Smolak L, Stein JA. The relationship of drive for muscularity to sociocultural factors, self-esteem, physical attributes gender role, and social comparison in middle school boys. Body Image. 2006;3(2):121–9.

29. Kostanski M, Fisher A, Gullone E. Current conceptualisation of body image dissatisfaction: Have we got it wrong? J Child Psychol Psychiatry Allied Discip. 2004;45(7):1317–25.

30. Fikkan JL, Rothblum ED. Is Fat a Feminist Issue? Exploring the Gendered Nature of Weight Bias. Sex Roles. 2012;66(9-10):575–92.

31. McCabe MP, Ricciardelli LA. Body image dissatisfaction among males across the lifespan: a review of past literature. J Psychosom Res. 2004;56(6):675–85.

32. Boyce W. Young People in Canada: Their Health and Well-being [Internet]. Health Canada. Health Canada; 2004. Available from: http://www.phac-aspc.gc.ca/hp-ps/dca-

dea/publications/hbsc-2004/index-eng.php

33. Barker M, Robinson S, Wilman C, Barker DJ. Behaviour, body composition and diet in adolescent girls. Appetite. 2000;35(2):161–70.

34. Lam CB, McHale SM. Developmental patterns and family predictors of adolescent weight concerns: A replication and extension. Int J Eat Disord. 2012;45(4):524–30.

35. Barker ET, Galambos NL. Body Dissatisfaction of Early Adolescent Girls and Boys: Risk and Resource Factors. J Early Adolesc. 2003;23(2):141–65.

36. Boutelle K, Neumark-Sztainer D, Story M, Resnick M. Weight control behaviors among obese, overweight, and nonoverweight adolescents. J Pediatr Psychol. 2002;27(6):531–40.

37. Grabe S, Ward LM, Hyde JS. The role of the media in body image concerns among women: a meta-analysis of experimental and correlational studies. Psychol Bull. 2008;134(3):460–76.

38. Bell BT, Dittmar H. Does Media Type Matter? The Role of Identification in Adolescent Girls' Media Consumption and the Impact of Different Thin-Ideal Media on Body Image. Sex Roles. 2011;65(7):478–90.

39. Morris A, Katzman D. The impact of the media on eating disorders in children and adolescents. Paediatr Child Heal. 2003;8(5):287.

40. Field AE, Camargo CA, Taylor CB, Berkey CS, Roberts SB, Colditz GA. Peer, parent, and media influences on the development of weight concerns and frequent dieting among preadolescent and adolescent girls and boys. Pediatrics. 2001;107(1):54–60.

41. Santarossa S. #SocialMedia: Exploring the Associations of Social Networking Sites and Body Image, Self-Esteem, Disordered Eating and/or Eating Disorders and the Impact of a Media Literacy Intervention. University of Windsor; 2015.

42. Jones DC, Vigfusdottir TH, Lee Y. Body Image and the Appearance Culture Among Adolescent Girls and Boys: An Examination of Friend Conversations, Peer Criticism,

Appearance Magazines, and the Internalization of Appearance Ideals. J Adolesc Res. 2004;19(3):323–39.

43. Hutchinson DM, Rapee RM. Do friends share similar body image and eating problems? The role of social networks and peer influences in early adolescence. Behav Res Ther. 2007;45(7):1557–77.

44. Paxton SJ, Schutz HK, Wertheim EH, Muir SL. Friendship clique and peer influences on body image concerns, dietary restraint, extreme weight-loss behaviors, and binge eating in adolescent girls. J Abnorm Psychol. 1999;108(2):255–66.

45. Neumark-Sztainer D, Falkner N, Story M, Perry C, Hannan PJ, Mulert S. Weight-teasing among adolescents: correlations with weight status and disordered eating behaviors. Int J Obes Relat Metab Disord. 2002;26(1):123–31.

46. van den Berg P, Wertheim EH, Thompson JK, Paxton SJ. Development of body image, eating disturbance, and general psychological functioning in adolescent females: a replication using covariance structure modeling in an Australian sample. Int J Eat Disord. 2002 Jul;32(1):46–51.

47. Neumark-Sztainer D, Bauer KW, Friend S, Hannan PJ, Story M, Berge JM. Family Weight Talk and Dieting: How Much Do They Matter for Body Dissatisfaction and Disordered Eating Behaviors in Adolescent Girls? J Adolesc Heal. 2010;47(3):270–6.

48. Byely L, Archibald AB, Graber J, Brooks-Gunn J. A prospective study of familial and social influences on girls' body image and dieting. Int J Eat Disord. John Wiley & Sons, Inc.; 2000;28(2):155–64.

49. Edmunds H, Hill AJ. Dieting and the family context of eating in young adolescent children. Int J Eat Disord. John Wiley & Sons, Inc.; 1999;25(4):435–40.

50. Knobloch-Westerwick S, Crane J. A Losing Battle: Effects of Prolonged Exposure to Thin-Ideal Images on Dieting and Body Satisfaction. Communic Res. 2012;39(1):79–102.

51. Stice E, Spangler D, Agras SW. Exposure to Media-Portrayed Thin-Ideal Images

Adversely Affects Vulnerable Girls: A Longitudinal Experiment. J Soc Clin Psychol. 2001;20(3):270–88.

52. Al Sabbah H, Vereecken C a, Elgar FJ, Nansel T, Aasvee K, Abdeen Z, et al. Body weight dissatisfaction and communication with parents among adolescents in 24 countries: international cross-sectional survey. BMC Public Health. 2009;9:52–62.

53. Tiggemann M, Lynch JE. Body image across the life span in adult women: The role of self-objectification. Dev Psychol. 2001;37(2):243–53.

54. Field AE, Aneja P, Austin SB, Shrier LA, de Moor C, Gordon-Larsen P. Race and Gender Differences in the Association of Dieting and Gains in BMI among Young Adults. Obesity. 2007;15(2):456–64.

55. Croll J, Neumark-Sztainer D, Story M, Ireland M. Prevalence and risk and protective factors related to disordered eating behaviors among adolescents: relationship to gender and ethnicity. J Adolesc Health. 2002 Aug;31(2):166–75.

56. te Velde SJ, Twisk JWR, Brug J. Tracking of fruit and vegetable consumption from adolescence into adulthood and its longitudinal association with overweight. Br J Nutr. 2007;98(2):431–8.

57. Mikkilä V, Räsänen L, Raitakari OT, Pietinen P, Viikari J. Consistent dietary patterns identified from childhood to adulthood: the cardiovascular risk in Young Finns Study. Br J Nutr. 2005;93(6):923–31.

58. Lake AA, Mathers JC, Rugg-Gunn AJ, Adamson AJ. Longitudinal change in food habits between adolescence (11-12 years) and adulthood (32-33 years): The ASH30 study. J Public Health (Bangkok). 2006;28(1):10–6.

59. Stice E, Presnell K, Shaw H, Rohde P. Psychological and behavioral risk factors for obesity onset in adolescent girls: a prospective study. J Consult Clin Psychol. 2005;73(2):195–202.

60. Roberts KC, Shields M, de Groh M, Aziz A, Gilbert J-A. Overweight and obesity in

children and adolescents: results from the 2009 to 2011 Canadian Health Measures Survey. Heal reports. 2012 Sep;23(3):37–41.

61. Public Health Agency of Canada. The Human Face of Mental Health and Mental Illness in Canada 2006 [Internet]. 2006 [cited 2016 Mar 4]. Available from: http://www.phac-aspc.gc.ca/publicat/human-humain06/pdf/human_face_e.pdf

62. NEDIC (National Eating Disorder Information Centre). Clinical Definitions [Internet]. 2014. Available from: http://nedic.ca/clinical-definitions

63. Patton GC, Selzer R, Coffey C, Carlin JB, Wolfe R. Onset of adolescent eating disorders: population based cohort study over 3 years. BMJ. 1999 Mar 20;318(7186):765–8.

64. Urquhart C, Mihalynuk T. Disordered eating in women: Implications for the obesity pandemic. Can J Diet Pract Res. 2011;72(1):e115–25.

65. Neumark-Sztainer D. Preventing Obesity and Eating Disorders in Adolescents: What Can Health Care Providers Do? J Adolesc Heal. 2009;44(3):206–13.

66. Bacon L, Aphramor L. Weight science: Evaluating the evidence for a paradigm shift. Nutr J. 2011;10(1):9.

67. Viner R, Macfarlane A. Health promotion. BMJ. 2005;330(7490):527–9.

68. Lippke S, Nigg CR, Maddock JE. Health-Promoting and Health-Risk Behaviors: Theory-Driven Analyses of Multiple Health Behavior Change in Three International Samples. Int J Behav Med. Springer US; 2012 Mar 14;19(1):1–13.

69. Ansari W El, Stock C, John J, Deeny P, Phillips C, Snelgrove S, et al. Health promoting behaviours and lifestyle characteristics of students at seven universities in the UK. TL - 19. Cent Eur J Public Health. 2011;19 VN - r(4):197–204.

70. Jackson CA, Henderson M, Frank JW, Haw SJ. An overview of prevention of multiple risk behaviour in adolescence and young adulthood. J Public Health (Bangkok). 2012;34(Suppl. 1):i31–40.

71. DuRant RH, Smith J a, Kreiter SR, Krowchuk DP. The relationship between early age of

onset of initial substance use and engaging in multiple health risk behaviors among young adolescents. Arch Pediatr Adolesc Med. 1999;153(3):286–91.

72. Ellickson PL, Tucker JS, Klein DJ. High-risk behaviors associated with early smoking: Results from a 5-year follow-up. J Adolesc Heal. 2001;28(6):465–73.

73. Busch V, Van Stel HF, Schrijvers AJP, de Leeuw JRJ. Clustering of health-related behaviors, health outcomes and demographics in Dutch adolescents: a cross-sectional study. BMC Public Health. 2013;13(1):1118.

74. Biglan A, Brennan PA, Foster SL, Holder HD. Helping adolescents at risk. (2004). London, UK: The Guildford Press; 2004.

75. Canadian Institute for Health Information. Improving the Health of Young Canadians [Internet]. Canadian Institute for Health Information. Ottawa: Canadian Institute for Health Information; 2005. Available from: http://secure.cihi.ca/cihiweb/products/IHYC05_webRepENG.pdf

76. Jessor R, Turbin MS, Costa FM. Protective factors in adolescent health behavior. J Pers Soc Psychol. 1998;75(3):788–800.

77. Zweig JM, Phillips SD, Lindberg LD. Predicting adolescent profiles of risk: Looking beyond demographics. J Adolesc Heal. 2002;31(4):343–53.

78. Patton GC, Coffey C, Carlin JB, Sawyer SM, Lynskey M. Reverse gateways? Frequent cannabis use as a predictor of tobacco initiation and nicotine dependence. Addiction. 2005;100(10):1518–25.

79. Wagner FA, Anthony JC. Into the world of illegal drug use: Exposure opportunity and other mechanisms linking the use of alcohol, tobacco, marijuana, and cocaine. Am J Epidemiol. 2002;155(10):918–25.

80. Giles EL, Brennan M. Trading between healthy food, alcohol and physical activity behaviours. BMC Public Health. 2014;14(1):1231.

81. Swinburn B, Egger G. The runaway weight gain train: too many accelerators, not enough

brakes. Br Med J. 2004;329(7468):736–9.

82. Burke SC, Cremeens J, Vail-Smith K, Woolsey CL. Drunkorexia: Calorie Restriction Prior to Alcohol Consumption among College Freshman. J Alcohol Drug Educ. 2010;54(2):17–35.

83. Roux AVD. Complex systems thinking and current impasses in health disparities research. Am J Public Health. 2011;101(9):1627–34.

84. Green LW. Public health asks of systems science: To advance our evidence-based practice, can you help us get more practice-based evidence? Am J Public Health. 2006;96(3):406–9.

85. Kirk SFL, Penney TL. The Role of Health Systems in Obesity Management and Prevention: Problems and Paradigm Shifts. Curr Obes Rep. 2013;2(4):315–9.

86. Freedhoff Y, Sharma AM, Kirk SFL, Vallis M, Poirier P, Ball GDC, et al. Realistic first steps for effectively managing obesity in Canada. Clin Obes. 2012;2(3-4):78–82.

87. Butland B, Jebb S, Kopelman P, McPherson K, Thomas S, Mardell J, et al. Foresight Tackling Obesities: Future Choices – Project report. Gov Off Sci. Government Office for Science United Kingdom; 2007;1–161.

88. Finegood DT, Merth TDN, Rutter H. Implications of the foresight obesity system map for solutions to childhood obesity. Obesity (Silver Spring). 2010;18(Suppl. 1):S13–6.

89. Public Health Agency of Canada. Creating Healthy Transitions [Internet]. Ottawa, ON: Public Health Agency of Canada; 2011. Available from: http://www.phac-aspc.gc.ca/cphorsphc-respcacsp/2011/cphorsphc-respcacsp-07-eng.php

90. Leatherdale ST. An examination of the co-occurrence of modifiable risk factors associated with chronic disease among youth in the COMPASS study. Cancer Causes Control. 2015;26(4):519–28.

91. Robertson L, Thomson D. “BE” ing a certain way: Seeking body image in Canadian health and physical education curriculum policies. Can J Educ. 2012;35(2):334–54.

92. Reitsma AH, Manske S. Smoking in Ontario schools: Does policy make a difference? Can J Public Heal. 2004;95(3):214–8.

93. Sabiston CM, Lovato CY, Ahmed R, Pullman AW, Hadd V, Campbell HS, et al. School smoking policy characteristics and individual perceptions of the school tobacco context: Are they linked to students' smoking status? J Youth Adolesc. 2009;38(10):1374–87.

94. Komro KA, Stigler MH, Perry CL. Comprehensive approaches to prevent adolescent drinking and related problems. Recent Dev Alcohol. 2005;17:207–24.

95. Browning HF, Laxer RE, Janssen I. Food and eating environments: In Canadian schools. Can J Diet Pract Res. 2013;74(4):160–6.

96. Wilson GS, Pritchard ME, Revalee B. Individual differences in adolescent health symptoms: The effects of gender and coping. J Adolesc. 2005;28(3):369–79.

97. Vereecken C, Dupuy M, Rasmussen M, Kelly C, Nansel TR, Al Sabbah H, et al. Breakfast consumption and its socio-demographic and lifestyle correlates in schoolchildren in 41 countries participating in the HBSC study. Int J Public Health. 2009 Sep;54 Suppl 2:180–90.

98. Pisetsky EM, Chao YM, Dierker LC, May AM, Striegel-Moore RH. Disordered eating and substance use in high-school students: Results from the youth risk behavior surveillance system. Int J Eat Disord. 2008;41(5):464–70.

99. Neumark-Sztainer D, Wall M, Larson NI, Eisenberg ME, Loth K. Dieting and disordered eating behaviors from adolescence to young adulthood: Findings from a 10-year longitudinal study. J Am Diet Assoc. 2011;111(7):1004–11.

100. U.S. Department of Health and Human Services. Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General, 2012. Atlanta, GA; 2012.

101. Leatherdale ST, Burkhalter R. The substance use profile of Canadian youth: Exploring the prevalence of alcohol, drug and tobacco use by gender and grade. Addict Behav. 2012;37(3):318–22.

102. Merten MJ, Williams AL, Shriver LH. Breakfast consumption in adolescence and young adulthood: parental presence, community context, and obesity. J Am Diet Assoc. 2009 Aug;109(8):1384–91.

103. Weekley CK, Klesges RC, Reylea G. Smoking as a weight-control strategy and its relationship to smoking status. Addict Behav. 1992;17(3):259–71.

104. Camp DE, Klesges RC, Relyea G. The relationship between body weight concerns and adolescent smoking. Health Psychol. 1993;12(1):24–32.

105. Austin SB, Gortmaker SL. Dieting and smoking initiation in early adolescent girls and boys: A prospective study. Am J Public Health. 2001;91(3):446–50.

106. Cachelin FM, Weiss JW, Garbanati JA. Dieting and its relationship to smoking, acculturation, and family environment in Asian and Hispanic adolescents. Eat Disord. 2003;11(1):51–61.

107. Strauss RS, Mir HM. Smoking and weight loss attempts in overweight and normal-weight adolescents. Int J Obes Relat Metab Disord. 2001;25(9):1381–5.

108. Potter BK, Pederson LL, Chan SSH, Aubut J-AL, Koval JJ. Does a relationship exist between body weight, concerns about weight, and smoking among adolescents? An integration of the literature with an emphasis on gender. Nicotine Tob Res. 2004;6(3):397–425.

109. Parkes SA, Saewyc EM, Cox DN, MacKay LJ. Relationship Between Body Image and Stimulant Use Among Canadian Adolescents. J Adolesc Heal. 2008;43(6):616–8.

110. Flay B. Understanding environmental, situational and intrapersonal risk and protective factors for youth tobacco use: the Theory of Triadic Influence. Nicotine Tob Res. 1999;Suppl. 2:569–70.

111. Flay B, Snyder F, Petraitis J. The Theory of Triadic Influence. In: Diclemente R, Crosby R, Kegler M, editors. Emerging Theories in Health Promotion Practice and Research. Second. San Francisco, CA: Jossey-Bass; 2009. p. 451–510.

112. Health Canada. Youth Smoking Survey: Table 2. Smoking status, by sex and grouped grades, Canada, 2010-11 [Internet]. 2012. Available from: http://hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_survey-sondage_2010-2011/table-eng.php
113. Health Canada. Youth Smoking Survey: Table 2. Smoking status, by sex and grouped grades, Canada, 2012-2013 [Internet]. 2014. Available from: http://healthycanadians.gc.ca/publications/healthy-living-vie-saine/youth-smoking-survey-tables-2012-2013-tableaux-enquete-jeunes-tabagisme/index-eng.php
114. Graham H. Smoking, Stigma and Social Class. J Soc Policy. 2012;41(1):83–99.
115. Loth K, Wall M, Larson N, Neumark-Sztainer D. Disordered eating and psychological well-being in overweight and nonoverweight adolescents: Secular trends from 1999 to 2010. Int J Eat Disord. 2015;48(3):323–7.
116. Herciu AC, Cole A, Laxer RE, Leatherdale ST. A Cross-sectional Study Examining Factors Associated with Youth Binge Drinking in the COMPASS Study: Year 1 Data. J Alcohol Drug Depend. 2014;02(04):2–4.
117. Centers for Disease Control and Prevention. Alcohol and Public Health: Binge Drinking [Internet]. 2015. Available from: http://www.cdc.gov/alcohol/fact-sheets/binge-drinking.htm
118. Leatherdale ST, Rynard V. A cross-sectional examination of modifiable risk factors for chronic disease among a nationally representative sample of youth: are Canadian students graduating high school with a failing grade for health? BMC Public Health. 2013;13(1):569.
119. Hotton T, Haans D. Alcohol and drug use in early adolescence. Heal Reports. 2004;15(3):9–19.
120. DeWit DJ, Adlaf EM, Offord DR, Ogborne AC. Age at first alcohol use: a risk factor for the development of alcohol disorders. Am J Psychiatry. 2000;157(5):745–50.
121. Miller JW, Naimi TS, Brewer RD, Jones SE. Binge drinking and associated health risk

behaviors among high school students. Pediatrics. 2007;119(1):76–85.

122. Baskin-Sommers A, Sommers I. The co-occurrence of substance use and high-risk behaviors. J Adolesc Heal. 2006;38(5):609–11.

123. Krahn D, Piper D, King M, Olson L, Kurth C, Moberg DP. Dieting in sixth grade predicts alcohol use in ninth grade. J Subst Abuse. 1996;8(3):293–301.

124. Field AE, Austin SB, Frazier AL, Gillman MW, Camargo CA, Colditz GA. Smoking, getting drunk, and engaging in bulimic behaviors: in which order are the behaviors adopted? J Am Acad Child Adolesc Psychiatry. 2002 Jul;41(7):846–53.

125. Saules KK, Pomerleau CS, Snedecor SM, Mehringer AM, Shadle MB, Kurth C, et al. Relationship of onset of cigarette smoking during college to alcohol use, dieting concerns, and depressed mood: results from the Young Women's Health Survey. Addict Behav. 2004 Jul;29(5):893–9.

126. Stewart SH, Baker JM, Boland FJ, Angelopoulos M, Mcpherson P, Barton S. Relations Between Dietary Restraint and Patterns of Alcohol Use in Young Adult Women. Psychol Addict Behav. 2000;14(1):77–82.

127. Vogeltanz-Holm ND, Wonderlich SA, Lewis BA, Wilsnack SC, Harris TR, Wilsnack RW, et al. Longitudinal predictors of binge eating, intense dieting, and weight concerns in a national sample of women. Behav Ther. 2000;31(2):221–35.

128. Gadalla T, Piran N. Co-occurrence of eating disorders and alcohol use disorders in women: a meta analysis. Arch Womens Ment Health. 2007;10(4):133–40.

129. Krug I, Treasure J, Anderluh M, Bellodi L, Cellini E, di Bernardo M, et al. Present and lifetime comorbidity of tobacco, alcohol and drug use in eating disorders: a European multicenter study. Drug Alcohol Depend. 2008 Sep 1;97(1-2):169–79.

130. Eichen DM, Conner BT, Daly BP, Fauber RL. Weight Perception, Substance Use, and Disordered Eating Behaviors: Comparing Normal Weight and Overweight High-School Students. J Youth Adolesc. 2012;41(1):1–13.

131. Pasch KE, Perry CL, Stigler MH, Komro KA. Sixth grade students who use alcohol: do we need primary prevention programs for “tweens”? Heal Educ Behav. 2009;36(4):673–95.

132. Brown CS, Kola-Palmer S, Dhingra K. Gender differences and correlates of extreme dieting behaviours in US adolescents. J Health Psychol. 2015;20(5):569–79.

133. Herman CP, Mack D. Restrained and unrestrained eating. J Pers. 1975 Dec;43(4):647–60.

134. Polivy J, Herman CP. Dieting and binging. A causal analysis. Am Psychol. 1985;40(2):193–201.

135. Luce KH, Crowther JH, Leahey T, Buchholz LJ. Do restrained eaters restrict their caloric intake prior to drinking alcohol? Eat Behav. 2013 Aug;14(3):361–5.

136. Osborne VA, Sher KJ, Winograd RP. Disordered eating patterns and alcohol misuse in college students: Evidence for “drunkorexia”? Compr Psychiatry. 2011;52(6):E12.

137. Lytle LA, Seifert S, Greenstein J, McGovern P. How do children’s eating patterns and food choices change over time? Results from a cohort study. Am J Health Promot. 14(4):222–8.

138. Woodruff SJ, Hanning RM, McGoldrick K, Brown KS. Healthy eating index-C is positively associated with family dinner frequency among students in grades 6-8 from Southern Ontario, Canada. Eur J Clin Nutr. 2010 May;64(5):454–60.

139. Cohen B, Evers S, Manske S, Bercovitz K, Edward HG. Smoking, physical activity and breakfast consumption among secondary school students in a Southwestern Ontario community. Can J Public Heal. 2003;94(1):41–4.

140. Woodruff SJ, Hanning RM. Effect of meal enviroment on diet quality rating. Can J Diet Pract Res. 2009;70(3):118–24.

141. Rampersaud GC, Pereira MA, Girard BL, Adams J, Metzl JD. Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. J Am Diet Assoc. 2005;105(5):743–60.

142. Storey K, Hanning R, Lambraki I, Driezen P, Fraser S, McCargar L. Determinants of diet quality among Canadian adolescents. Can J Diet Pract Res. 2009;70(2):58–65.
143. Lien L. Is breakfast consumption related to mental distress and academic performance in adolescents? Public Health Nutr. 2007;10(4):422–8.
144. Adolphus K, Lawton CL, Dye L. The effects of breakfast on behavior and academic performance in children and adolescents. Front Hum Neurosci. 2013;7:425.
145. Neumark-Sztainer D, Wall M, Story M, Standish AR. Dieting and unhealthy weight control behaviors during adolescence: associations with 10-year changes in body mass index. J Adolesc Health. 2012 Jan;50(1):80–6.
146. Zullig K, Ubbes VA, Pyle J, Valois RF. Self-Reported Weight Perceptions, Dieting Behavior, and Breakfast Eating Among High School Adolescents. J Sch Health. 2006 Mar;76(3):87–92.
147. Leatherdale ST, Brown KS, Carson V, Childs R, Dubin J, Elliott SJ, et al. The COMPASS study: a longitudinal hierarchical research platform for evaluating natural experiments related to changes in school-level programs, policies and built environment resources. BMC Public Health. 2014;14(1):331.
148. Leatherdale ST. The COMPASS Study [Internet]. 2015. Available from: https://uwaterloo.ca/compass-system/compass-system-projects/compass-study
149. Thompson-Haile A, Leatherdale ST. School board and school recruitment procedures. Compass Tech Rep Ser. 2013;1(3).
150. Thompson-Haile A, Bredin C, Leatherdale ST. Rationale for using active-information passive-consent permission protocol in COMPASS. Compass Tech Rep Ser. 2013;1(6).
151. West C, Zimmerman DH. Doing Gender. Gend Soc. 1987 Jun 1;1(2):125–51.
152. Canadian Institutes of Health Research. Sex, Gender and Health Research Guide: A Tool for CIHR Applicants [Internet]. 2015 [cited 2016 May 10]. Available from: http://www.cihr-irsc.gc.ca/e/32019.html

153. Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. Biometrika. 1986;73(1):13–22.

154. Zeger SL, Liang KY. Longitudinal data analysis for discrete and continuous outcomes. Biometrics. 1986 Mar;42(1):121–30.

155. Frissell KC, McCarthy DM, D'Amico EJ, Metrik J, Ellingstad TP, Brown SA. Impact of consent procedures on reported levels of adolescent alcohol use. Psychol Addict Behav. 2004 Dec;18(4):307–15.

156. Courser MW, Shamblen SR, Lavrakas PJ, Collins D, Ditterline P. The impact of active consent procedures on nonresponse and nonresponse error in youth survey data: evidence from a new experiment. Eval Rev. 2009 Aug;33(4):370–95.

157. Qian W, Battista K, Bredin C, Brown KS, Leatherdale ST. Assessing longitudinal data linkage results in the COMPASS study. Compass Tech Rep Ser. 2015;3(4).

158. Paik MC. The Generalized Estimating Equation Approach When Data Are Not Missing Completely at Random. J Am Stat Assoc. 1997 Dec;92(440):1320–9.

159. Leatherdale ST, Wong SL, Manske SR, Colditz GA. Susceptibility to smoking and its association with physical activity, BMI, and weight concerns among youth. Nicotine Tob Res. 2008;10(3):499–505.

160. Johnson JL, Eaton DK, Pederson LL, Lowry R. Associations of Trying to Lose Weight, Weight Control Behaviors, and Current Cigarette Use Among US High School Students. J Sch Health. 2009 Aug;79(8):355–60.

161. Yaemsiri S, Slining M, Agarwal S. Perceived weight status, overweight diagnosis, and weight control among US adults: the NHANES 2003–2008 Study. Int J Obes. 2010;35(10):1063–70.

162. Wong SL, Shields M, Leatherdale ST, Malaison E, Hammond D. Assessment of validity of self-reported smoking status. Heal reports. 2012;23(1):47–53.

163. Hanson KL, Olson CM. School Meals Participation and Weekday Dietary Quality Were

Associated after Controlling for Weekend Eating among U.S. School Children Aged 6 to 17 Years. J Nutr. 2013 May 1;143(5):714–21.

164. Tapper K, Murphy S, Lynch R, Clark R, Moore GF, Moore L. Development of a scale to measure 9–11-year-olds' attitudes towards breakfast. Eur J Clin Nutr. Nature Publishing Group; 2008 Apr 21;62(4):511–8.

165. Wothke W. Nonpositive definite matrices in structural modeling. In: Bollen KA, Long JS, editors. Testing structural equation models. Newbury Park, CA: Sage; 1993. p. 256–93.

166. Matheson FI, White HL, Moineddin R, Dunn JR, Glazier RH. Drinking in context: the influence of gender and neighbourhood deprivation on alcohol consumption. J Epidemiol Community Heal. 2012 Jun 1;66(6):e4–e4.

167. Matheson FI, LaFreniere MC, White HL, Moineddin R, Dunn JR, Glazier RH. Influence of neighborhood deprivation, gender and ethno-racial origin on smoking behavior of Canadian youth. Prev Med (Baltim). 2011;52(5):376–80.

168. Klarenbach S, Padwal R, Chuck A, Jacobs P. Population-Based Analysis of Obesity and Workforce Participation. Obesity. 2006 May;14(5):920–7.

169. World Health Organization. Global Database on Body Mass Index: BMI Classification [Internet]. 2015. Available from: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html

170. Arbour-Nicitopoulos KP, Faulkner GE, Leatherdale ST. Learning from Non-Reported Data: Interpreting Missing Body Mass Index Values in Young Children. Meas Phys Educ Exerc Sci. 2010;14(4):241–51.

171. Leatherdale ST, Laxer RE. Reliability and validity of the weight status and dietary intake measures in the COMPASS questionnaire: are the self-reported measures of body mass index (BMI) and Canada's food guide servings robust? Int J Behav Nutr Phys Act. 2013;10(1):42.

172. Höfler M. The Bradford Hill considerations on causality: a counterfactual perspective. Emerg Themes Epidemiol. 2005;2(1):11.

173. Hardin JW, Hilbe JM. Generalized Estimating Equations. Second Edi. Boca Raton, US: CRC Press; 2013.
174. Hubbard AE, Ahern J, Fleischer NL, Laan M Van der, Lippman SA, Jewell N, et al. To GEE or Not to GEE. Epidemiology. 2010 Jul;21(4):467–74.
175. Penney TL, Kirk SFL. The Health at Every Size paradigm and obesity: Missing empirical evidence may help push the reframing obesity debate forward. Am J Public Health. 2015;105(5):e38–42.
176. Frederick DA, Saguy AC, Gruys K. Culture, health, and bigotry: How exposure to cultural accounts of fatness shape attitudes about health risk, health policies, and weight-based prejudice. Soc Sci Med. 2015;
177. Bombak A. Obesity, health at every size, and public health policy. Am J Public Health. 2014;104(2).
178. Bacon L. Health at Every Size: The Surprising Truth About Your Weight. Dallas, TX: BenBella Books; 2010.
179. Piazza-Gardner AK, Barry AE. Appropriate terminology for the alcohol, eating, and physical activity relationship. J Am Coll Health. 2013;61(5):311–3.
180. Patte KA, Leatherdale ST. A cross-sectional analysis examining the association between dieting behaviours and alcohol use among secondary school students in the COMPASS study. J Public Health (Oxf). 2016 May 10;
181. Hassmiller Lich K, Frerichs L, Fishbein D, Bobashev G, Pentz MA. Translating research into prevention of high-risk behaviors in the presence of complex systems: definitions and systems frameworks. Transl Behav Med. 2016 Mar;6(1):17–31.
182. Midgley G. Systemic intervention for public health. Am J Public Health. 2006 Mar;96(3):466–72.
183. Malinauskas BM, Raedeke TD, Aeby VG, Smith JL, Dallas MB. Dieting practices, weight perceptions, and body composition: A comparison of normal weight, overweight, and

obese college females. Nutr J. 2006;5(11).

184. Strauss RS. Self-reported Weight Status and Dieting in a Cross-sectional Sample of Young Adolescents. Arch Pediatr Adolesc Med. 1999 Jul 1;153(7):741–7.

185. Sherry B, Jefferds ME, Grummer-Strawn LM. Accuracy of adolescent self-report of height and weight in assessing overweight status: a literature review. Arch Pediatr Adolesc Med. 2007 Dec;161(12):1154–61.

186. Story M, French SA, Resnick MD, Blum RW. Ethnic/racial and socioeconomic differences in dieting behaviors and body image perceptions in adolescents. Int J Eat Disord. Wiley Subscription Services, Inc., A Wiley Company; 1995 Sep;18(2):173–9.

187. Willson AE. `Fundamental Causes' of Health Disparities: A Comparative Analysis of Canada and the United States. Int Sociol. 2009 Jan 1;24(1):93–113.

188. Thomson M, Spence JC, Raine K, Laing L. The association of television viewing with snacking behavior and body weight of young adults. Am J Heal Promot. 2008;22(5):329–35.

189. Ortega RM, Requejo AM, López-Sobaler AM, Quintas ME, Andrés P, Redondo MR, et al. Difference in the breakfast habits of overweight/obese and normal weight schoolchildren. Int J Vitam Nutr Res Int Zeitschrift für Vitamin- und Ernährungsforschung J Int Vitaminol Nutr. 1998;68(2):125–32.

190. O'Dea JA, Caputi P. Association between socioeconomic status, weight, age and gender, and the body image and weight control practices of 6- to 19-year-old children and adolescents. Health Educ Res. 2001 Oct;16(5):521–32.

191. Rashidi A, Mohammadpour-Ahranjani B, Karandish M, Vafa M-R, Hajifaraji M, Ansari F, et al. Obese and female adolescents skip breakfast more than their non-obese and male peers. Cent Eur J Med. 2007;2(4):481–7.

192. Himes JH, Faricy A. Validity and reliability of self-reported stature and weight of US adolescents. Am J Hum Biol. 13(2):255–60.

193. Tiggemann M. Nonreporting of body mass index: a research note on the interpretation of missing data. Int J Eat Disord. 2006 May;39(4):346–9.

194. Fonseca H, de Matos MG, Guerra A, Gomes-Pedro J. Emotional, behavioural and social correlates of missing values for BMI. Arch Dis Child. 2009 Feb;94(2):104–9.

195. Raffoul A, Leatherdale ST, Kirkpatrick SI. Weight management, weight perception, and health-compromising behaviours among adolescent girls in the COMPASS study. Manuscript submitted for publication. 2016.

196. Teerenstra S, Lu B, Preisser JS, van Achterberg T, Borm GF. Sample size considerations for GEE analyses of three-level cluster randomized trials. Biometrics. 2010 Dec;66(4):1230–7.

197. Conner Gorber S, Tremblay M, Moher D, Gorber B. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. Obes Rev. Blackwell Publishing Ltd; 2007 Jul;8(4):307–26.

198. Lich KH, Ginexi EM, Osgood ND, Mabry PL. A call to address complexity in prevention science research. Prev Sci. 2013 Jun;14(3):279–89.

199. Thomas SL, Olds T, Pettigrew S, Randle M, Lewis S. “Don’t eat that, you'll get fat!” Exploring how parents and children conceptualise and frame messages about the causes and consequences of obesity. Soc Sci Med. 2014;119:114–22.

200. Kirk SFL, Price SL, Penney TL, Rehman L, Lyons RF, Piccinini-Vallis H, et al. Blame, Shame, and Lack of Support: A Multilevel Study on Obesity Management. Qual Health Res. 2014;24(6):790–800.

201. Evans EW, Sonneville KR. BMI report cards: will they pass or fail in the fight against pediatric obesity? Curr Opin Pediatr. 2009 Aug;21(4):431–6.

202. Ontario Ministry of Health and Long-Term Care. Learn about the Healthy Kids Community Challenge – part of Ontario’s Healthy Kids Strategy [Internet]. 2016. Available from: http://www.health.gov.on.ca/en/public/programs/healthykids/hkcc.aspx

Appendix A

COMPASS Student Questionnaire

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 <u>each week</u> 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 <u>usually</u> travel to and from school?

<u>To school</u>	<u>From school</u>
○ By car (as a passenger)	○ By car (as a passenger)
○ By car (as a driver)	○ By car (as a driver)
○ By school bus	○ By school bus
○ By public bus	○ By public bus
○ By walking	○ By walking
○ By bicycling	○ By bicycling
○ By subway or streetcar	○ By subway or streetcar
○ Other_____	○ Other_____

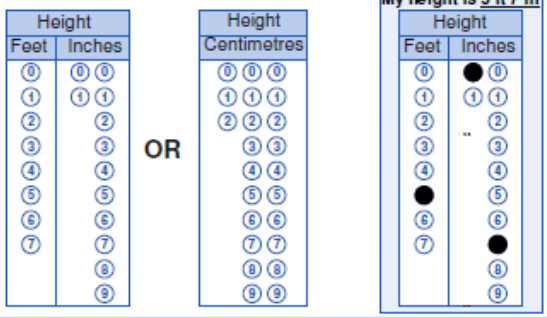
7. How tall are you without your shoes on? (Please write your height in feet and inches **OR** in centimetres, and then fill in the appropriate numbers for your height.)

○ I do not know how tall I am

"My height is ____feet ____ inches"

OR

"My height is _____centimetres"



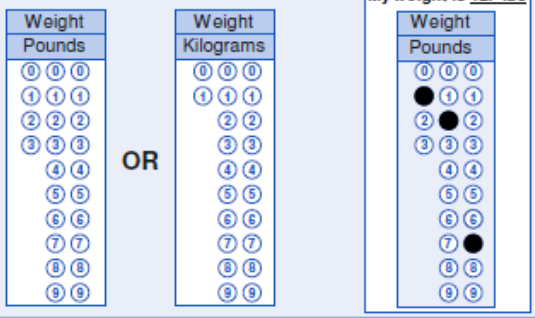
8. How much do you weigh without your shoes on? (Please write your weight in pounds **OR** in kilograms, and then fill in the appropriate numbers for your weight.)

○ I do not know how much I weigh

"My weight is _____pounds"

OR

"My weight is _____kilograms"



9. How much time per day do you *usually* spend doing the following activities?

For example: If you spend about 3 hours watching TV each day, you will need to fill in the 3 hour circle, and the 0 minute circle as shown below:

	Hours	Minutes
a) Watching/streaming TV shows or movies	0 1 2 3 4 5 6 7 8 9	0 15 30 45
b) Playing video/computer games	0 1 2 3 4 5 6 7 8 9	0 15 30 45
c) Doing homework	0 1 2 3 4 5 6 7 8 9	0 15 30 45
d) Talking on the phone	0 1 2 3 4 5 6 7 8 9	0 15 30 45
e) Surfing the internet	0 1 2 3 4 5 6 7 8 9	0 15 30 45
f) Texting, messaging, emailing **(note: 50 texts = 30 minutes)**	0 1 2 3 4 5 6 7 8 9	0 15 30 45
g) Sleeping	0 1 2 3 4 5 6 7 8 9	0 15 30 45

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

15. Do you participate in before-school, noon hour, or after-school physical activities organized by your school? *(e.g., intramurals, non-competitive clubs)*

- ○ Yes
- ○ No
- ○ None offered at my school

16. Do you participate in competitive school sports teams that compete against other schools? *(e.g., junior varsity or varsity sports)*

- ○ Yes
- ○ No
- ○ None offered at my school

17. Do you participate in league or team sports outside of school?

- ○ Yes
- ○ No
- ○ There are none available where I live

18. On how many days in the last 7 days did you do exercises to strengthen or tone your muscles? *(e.g., push-ups, sit-ups, or weight-training)*

- ○ 0 days
- ○ 1 day
- ○ 2 days
- ○ 3 days
- ○ 4 days
- ○ 5 days
- ○ 6 days
- ○ 7 days

19. How do you describe your weight?

- ○ Very underweight
- ○ Slightly underweight
- ○ About the right weight
- ○ Slightly overweight
- ○ Very overweight

20. Which of the following are you trying to do about your weight?

- ○ **Lose** weight
- ○ **Gain** weight
- ○ **Stay** the same weight
- ○ I am **not trying to do anything** about my weight

21. How much do your parents, step-parents, or guardians encourage you to be physically active?

- ○ Strongly encourage
- ○ Encourage
- ○ Do not encourage or discourage
- ○ Discourage
- ○ Strongly discourage

22. How much do your parents, step-parents, or guardians support you in being physically active? *(e.g., driving you to team games, buying you sporting equipment)*

- ○ Very supportive
- ○ Supportive
- ○ Unsupportive
- ○ Very unsupportive

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

Healthy Eating

23. 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 _____

24. 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
a) Eat breakfast	○	○	○	○	○	○
b) Eat breakfast provided to you **as part of a school program**	○	○	○	○	○	○
c) Eat lunch at school - lunch packed and brought from home	○	○	○	○	○	○
d) Eat lunch at school - lunch purchased in the cafeteria	○	○	○	○	○	○
e) Eat lunch purchased at a fast food place or restaurant	○	○	○	○	○	○
f) Eat snacks purchased from a vending machine **in your school**	○	○	○	○	○	○
g) Eat snacks purchased from a vending machine, corner store, snack bar, or canteen **off school property**	○	○	○	○	○	○
h) Drink sugar-sweetened beverages (soda pop, Kool-Aid, Gatorade, etc.) Do not include diet/sugar-free drinks	○	○	○	○	○	○
i) Drink high-energy drinks (Red Bull, Monster, Rock Star, etc.)	○	○	○	○	○	○
j) Drink coffee or tea **with sugar** (include cappuccino, frappuccino, iced-tea, iced-coffees, etc.)	○	○	○	○	○	○
k) Drink coffee or tea **without sugar**	○	○	○	○	○	○

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

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

Your Experience with Smoking

30. Have you ever tried cigarette smoking, even just a few puffs?

- ○ Yes
- ○ No

31. How old were you when you first tried smoking cigarettes, even just a few puffs?

- ○ I have never done this
- ○ I do not know

- ○ 8 years or younger
- ○ 9 years
- ○ 10 years
- ○ 11 years
- ○ 12 years
- ○ 13 years
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years or older

32. Do you think in the future you might try smoking cigarettes?

- ○ Definitely yes
- ○ Probably yes
- ○ Probably not
- ○ Definitely not

33. If one of your best friends was to offer you a cigarette, would you smoke it?

- ○ Definitely yes
- ○ Probably yes
- ○ Probably not
- ○ Definitely not

34. At any time during the next year do you think you will smoke a cigarette?

- ○ Definitely yes
- ○ Probably yes
- ○ Probably not
- ○ Definitely not

35. Do you think it would be difficult or easy for you to get cigarettes if you wanted to smoke?

- ○ Difficult
- ○ Easy
- ○ I do not know

36. Have you ever smoked a whole cigarette?

- ○ Yes
- ○ No

37. Have you ever smoked 100 or more whole cigarettes in your life?

- ○ Yes
- ○ No

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

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

- ○ Yes
- ○ No

39. 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)*

40. 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

41. 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

42. 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

43. 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
- ○ Bidis (little flavoured cigarettes that are hand-rolled in leaves and tied at the ends with string)
- ○ 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

Alcohol and Marijuana Use

*Please remember that we will keep your answers **completely confidential**.*

A DRINK means: 1 regular sized bottle, can, or draft of beer; 1 glass of wine; 1 bottle of cooler; 1 shot of liquor (rum, whiskey, etc); or 1 mixed drink (1 shot of liquor with pop, juice, energy drink).

44. In the last 12 months, how often did you have a drink of alcohol that was more than just a sip?

- ○ I have never drunk alcohol
- ○ I did not drink alcohol in the last 12 months
- ○ I have only had a sip of alcohol

- ○ 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
- ○ Every day

45. How old were you when you first had a drink of alcohol that was more than just a sip?

- ○ I have never drunk alcohol
- ○ I have only had a sip of alcohol
- ○ I do not know

- ○ 8 years or younger
- ○ 9 years
- ○ 10 years
- ○ 11 years
- ○ 12 years
- ○ 13 years
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years or older

46. In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?

- ○ I have never done this
- ○ 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
- ○ Daily or almost daily

47. In the last 12 months, have you had <u>alcohol</u> mixed or pre-mixed with an energy drink such as Red Bull, Rock Star, Monster, or another brand?

- ○ I have never done this
- ○ I did not do this in the last 12 months
- ○ Yes
- ○ I do not know

48. In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash)

- ○ 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
- ○ Every day

49. How old were you when you first used marijuana or cannabis?

- ○ I have never used marijuana
- ○ I do not know

- ○ 8 years or younger
- ○ 9 years
- ○ 10 years
- ○ 11 years
- ○ 12 years
- ○ 13 years
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years or older

50. Do you think it would be difficult or easy for you to get marijuana if you wanted some?

- ○ Difficult
- ○ Easy
- ○ I do not know

○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

Appendix B

Table 11: Associations between participation at Year 2 and various parameters at Years 1 and 3 among adolescent girls in the COMPASS study (N=3,386)

		Participation in Year 2		**Chi-Square (χ^2)**
Parameter		*Yes (%)*	*No (%)*	
Dieting at Year 1	Yes	1523 (78.2)	425 (21.8)	0.75
	No	1142 (79.4)	296 (20.6)	
Dieting at Year 3	Yes	1541 (78.4)	425 (21.6)	0.36
	No	1122 (79.2)	294 (20.8)	
BMI at Year 1	Underweight	34 (73.9)	12 (26.1)	5.18
	Healthy weight	1660 (79.8)	533 (20.3)	
	Overweight	253 (74.9)	85 (25.1)	
	Obese	70 (78.7)	19 (21.3)	
	Not stated	674 (78.0)	190 (22.0)	
BMI at Year 3	Underweight	20 (69.0)	9 (31.0)	**14.17***
	Healthy weight	1816 (80.2)	448 (19.8)	
	Overweight	282 (72.7)	106 (27.3)	
	Obese	111 (79.9)	28 (20.1)	
	Not stated	457 (77.1)	136 (22.9)	
Smoking at Year 1	Yes	79 (68.1)	37 (31.9)	**8.06***
	No	2612 (79.1)	691 (20.9)	
Smoking at Year 3	Yes	214 (74.6)	73 (25.4)	3.20
	No	2472 (79.1)	654 (20.9)	
Binge drinking at Year 1	Yes	264 (70.8)	109 (29.2)	**15.54****
	No	2421 (79.6)	619 (20.4)	

Binge drinking at Year 3	Yes	605 (74.2)	210 (25.8)	**12.55 ****
	No	2076 (80.1)	517 (19.9)	
Breakfast-skipping at Year 1	Yes	1327 (76.1)	417 (23.9)	**15.84****
	No	1326 (81.7)	297 (18.3)	
Breakfast-skipping at Year 3	Yes	1388 (76.9)	418 (23.1)	**8.66***
	No	1271 (81.0)	298 (19.0)	

**p*-value of < 0.05, ***p*-value of < 0.001

Appendix C

Table 12: Relationship between weekday and weekend breakfast consumption among adolescent girls in Year 1 of the COMPASS study (N=3,386)

		Days ate breakfast on the weekend			**Chi-Square (χ^2)**
		0	*1*	*2*	
Days ate breakfast during the school week	*0*	123	166	245	**1095.87****
	1	34	100	200	
	2	16	81	250	
	3	23	79	311	
	4	14	47	197	
	5	55	157	1269	

*p-value of < 0.05, **p-value of < 0.001