

UNHEALTHY WEIGHT CONTROL BEHAVIORS AMONG HIGH SCHOOL STUDENTS

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2011

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This dissertation is dedicated, with deepest love and appreciation, to my parents—without their support, this accomplishment would not have been possible.

ACKNOWLEDGMENTS

I thank my committee members, Drs. William W. Chen, Jiunn-Jye Sheu, R. Morgan Pigg, Jr., Delores C.S. James, and I-Chan Huang, for their patience, encouragement, and unwavering support. I appreciate each person for his/her unique gifts and special talents. I am grateful for the attention shown to me, time devoted to me, and sage advice shared with me.

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ABSTRACT OF DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
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December 2011

Chair: William W. Chen

Major: Health and Human Performance

Weight control has become a major health concern nationwide. Adolescents often practice weight control behaviors using both healthy and unhealthy approaches. The present work utilized Youth Risk Behavior Survey (YRBS) data to estimate the trends of Healthy Weight Control Behaviors (HWCB) and Unhealthy Weight Control Behaviors (UWCB), identify the predictive factors of UWCB, and explore the relationship between UWCB and selected health risk behaviors.

Results showed: 1) The prevalence rates of UWCB decreased and the prevalence rates of HWCB increased in a significant linear trend from 1999 to 2009. The subgroup analyses (by sex, grade, race/ethnicity, Body Image Distortion (BID) also demonstrated similar trends in both UWCB and HWCB. 2) UWCB is significantly associated with the following risk factors: currently trying to lose weight (vs. not trying); being American Indian/Alaska Native (vs. White) or multiple race/ethnicity (vs. White); nonoverweight but having body image distortion (BID) (vs. nonoverweight and no BID); eating the recommended amount of vegetables (vs. not eating the recommended amount); being female (vs. male); drinking sugar-sweetened beverage daily (vs. not drinking sugar-sweetened beverage daily); and being not vigorous in physical activity

(vs. vigorous physical activity). 3) UWCB was significantly associated with substance use, suicidal behavior, and been bullied among female adolescents while male adolescents demonstrated significant associations in alcohol and tobacco use, multiple sexual partners, suicidal behaviors, physical and sexual violence, and been bullied.

Findings suggested a moderate portion of high school students engaged in UWCB, and several demographic, psychological, lifestyle factors, and several health risk behaviors. Moreover, male adolescents with UWCB tended to engage in more health risk behaviors than females. Design of intervention programs accounting for the aforementioned risk factors is suggested to help reduce adolescent's risk of UWCB.

CHAPTER 1 INTRODUCTION AND LITERATURE REVIEW

General Introduction

The prevalence of obesity has been more than doubled in the past 3 decades (Y. Wang & Beydoun, 2007). Recent data from 2007-2008 National Health and Nutrition Examination Survey (NHANES) indicated that 33.8% of American adults were obese and 68% were overweight or obese (Flegal, Carroll, Ogden, & Curtin, 2010). Among adolescents aged 12-19 years old, 18% had age-specific BMI greater than 95th percentile, which is considered obese, and 34% had age-specific Body Mass Index (BMI) greater than 85th percentile, which is considered overweight (Ogden & Flegal, 2010; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Such trends, if persist, can cause enormous life lost and economic costs.

To prevent weight gain, people tend to engage in different weight control practices. Although many adolescents use healthy strategies, unhealthy or extreme weight control strategies, such as fasting, using diet pills/powders/liquids, vomiting, or taking laxatives, are also common among adolescents (Eaton et al., 2010). Unhealthy Weight Control Behaviors (UWCB), such as the aforementioned ones (Eisenberg, Neumark-Sztainer, Story, & Perry, 2005; Haines, Neumark-Sztainer, Perry, Hannan, & Levine, 2006; D. Neumark-Sztainer, Wall, Story, & Perry, 2003), predict the onset of more severe disordered eating behaviors and eating disorders, including anorexia nervosa, bulimia nervosa, and binge eating disorder, as well as depression and other medical and psychosocial morbidity (Fonseca, Matos, Guerra, & Pedro, 2009).

According to the 2009 Youth Risk Behavioral Surveillance System (YRBSS), 59% of female and 31% of male students in grades 9–12 reported trying to lose weight. By looking into each unhealthy behaviors, in 2009, 11% of high school students did not eat for 24 or more hours, 5% had taken diet pills, powders, or liquids without a doctor's advice, and 4% had vomited or

taken laxatives to lose weight or to keep from gaining weight during the 30 days before the survey (Eaton et al., 2010). Contrary to the projected weight loss, particularly during adolescence, dieting has been shown to predict weight gain over time (Fonseca et al., 2009) (D. Neumark-Sztainer, Wall, Story, & Sherwood, 2009). In addition, adolescents who practiced UWCB have approximately 3 times greater risk for being overweight and 6 times higher risk for uncontrollable binge eating 5 years later (D. Neumark-Sztainer et al., 2006). (D. Neumark-Sztainer et al., 2006)

Gender difference may also play a role in the weight control related problems. Many studies had identified the gender difference in body image, weight concern, and weight control behaviors. Girls engaged in more bulimic symptoms than boys; particularly among overweight girls (McCabe & Ricciardelli, 2009). About 40% of overweight girls and 20% of overweight boys engaged in at least one of the disordered eating behaviors (binge eating and / or extreme weight control) (D. R. Neumark-Sztainer et al., 2007). However, past research has not evaluated the racial/ethnic differences of weight control behaviors among adolescents.

Studies further identified that dissatisfaction with body size is correlated with eating disorders, ineffective dieting, low self-esteem, depression, and high-risk behaviors among adolescent girls (Liechty, 2010). In addition, dissatisfaction with body size contributes to Body Image Distortion (BID), the perceived discrepancy between their current and ideal body among both men and women (Liechty, 2010). Common strategies utilized as a result of dissatisfaction with body size include dieting and exercise (Heywood & McCabe, 2006).

Additionally, weight-body concerns were found to have a strong correlation with UWCB (D. Neumark-Sztainer et al., 2003; D. R. Neumark-Sztainer et al., 2007). Regardless of body weight, dieting practices were prevalent among female students (Malinauskas, Raedeke, Aeby,

Smith, & Dallas, 2006). Researchers indicated that this may be caused by the fact that girls reported relatively more weight and shape problems and concerns than boys (Smolak & Levine, 2001). Moreover, studies have suggested that female students with an inflated body weight perception were significantly more likely to engage in UWCB and report depressive symptoms than were female students with an accurate body weight perception (Harring, Montgomery, & Hardin, 2010; Rahman & Berenson, 2010).

Despite the physical and psychological effects on adolescents, preliminary studies showed that UWCB is associated with other risk behaviors such as illicit drug use, tobacco use, binge drinking, (Haley, Hedberg, & Leman, 2010), physical and sexual dating violence against adolescent girls (Silverman, Raj, Mucci, & Hathaway, 2001), and suicidal ideation (Haley et al., 2010; Kim, Cho, Cho, & Lim, 2009). However, such associations were mostly based on small samples and have not been well established from a national representative data.

To monitor health-risk behaviors among youth and young adults, the Centers for Disease Control and Prevention (CDC) established the nation's biennial epidemiologic surveillance system in 1991. The Youth Risk Behavior Surveillance System (YRBSS) monitors the prevalence of obesity and asthma as well as the six categories of priority high-risk behaviors, including behaviors that contribute to unintentional injuries and violence, tobacco use, alcohol and other drug use, sexual behaviors, unhealthy dietary behaviors, and physical inactivity. The YRBSS surveys students in grades 9-12 from nationally sampled schools across the United States, thus providing the most representative data for youth health practices. The Youth Risk Behavior Survey (YRBS) has been given biennially since 1999. Each official brief descriptive statistics were reported in the year following the survey. The data collected by the YRBSS is an

important source of information in the area of unhealthy weight control behaviors and were used to analyze trends, associate risk behaviors, and identify predictors in this study.

Overweight and Obesity among Adolescents in the United States

The most frequently cited data on obesity prevalence rates over time in the U.S. came from the results of the National Health and Nutrition Examination Survey (NHANES). The National Center for Health Statistics (NCHS) periodically collects measured heights and weights in representative samples of adults, adolescents, and children in the U.S. NHANES I in 1971-74 indicated nearly 6% of adolescents were overweight (Catenacci, Hill, & Wyatt, 2009). The trend of overweight among adolescents has been increasing since NHANES I. Although no statistically significant linear trends were found over the time periods, the most recent NHANES data uncover the fact that the rate of overweight adolescents had reached 34% in the 2007-2008 survey (Ogden et al., 2010). These results demonstrated a six-fold increase over the past 30 years. In addition, the NHANES data also suggested the prevalence of obesity increased from 5% to 18% during the same period among adolescents (Ogden & Carroll, 2010).

Being overweight or obese has life-long health impacts, including heart disease, stroke, hypertension, diabetes, and various forms of cancer. Research estimated that up to 80% of overweight or obese children are likely to remain obese as adults (Guo & Chumlea, 1999). Moreover, obese adolescents were 16 times more likely to develop severe obesity, which can lead to severe health consequences, in their young adulthood than normal-weight or overweight adolescents (The, Suchindran, North, Popkin, & Gordon-Larsen, 2010). While the rates of overweight and obese increased over the years, overweight and obese adolescents were found to engage themselves more in weight control behaviors, both healthy and unhealthy than their non-overweight peers (Fonseca et al., 2009).

Healthy Weight Control Behaviors (HWCB)

Weight loss practice was found prevalent among adolescents. According to 2009 YRBS data, 44.4% of adolescents were trying to lose weight. Overall, the prevalence of weight control practice was higher among female (59.3%) than male (30.5%) students (Eaton et al., 2010). The majority of the weight control behaviors, which are typically viewed as health promoting acts, included decreased fat intake and increased physical activity (D. Neumark-Sztainer, 1999). Nationally, the American Dietetic Association supported it since late 1980s and stated that the achievement and maintenance of optimal weight through sound eating practices and adequate exercise are an essential health promotion strategy (Position of the American Dietetic Association: Optimal weight as a health promotion strategy.1989). In addition, the traditional medical models promote the use of healthy weight loss methods, such as increased physical activity and moderate modifications in the types and amounts of food consumed (D. Neumark-Sztainer, 1999).

Engaging in healthy weight control behaviors to lose body weight can help to gain significant health benefits. Research reported that moderate weight control behaviors such as increased fruit and vegetable intake, a lowered fat intake, and increased physical activity can benefit adolescents in maintaining ideal weight, reducing the risk of becoming obese, as well as improving fitness (Adam, Westenhofer, Rudolphi, & Kraaibeek, 2009; Dae et al., 2002).

Healthy weight control behaviors are lifestyle interventions, which include physical activity, nutrition education, and behavior therapy, and result in extended effectiveness of weight control. For example, a lifestyle intervention, which included nutrition education, physical and exercise intervention, psychological intervention, parents education, and medical lessons, was conducted in 129 centers specialized in pediatric obesity care in Germany. This study recruited 21,784 overweight children and adolescents aged from 2 to 20. Results demonstrated a long-term

effectiveness in weight control among overweight children and adolescents after 6 months intervention and at a 2-year follow-up (Reinehr et al., 2009). Another randomized treatment study with 10-year follow-up was conducted to identify the variables associated with long-term weight control among overweight children aged 6-12 years old. The basic treatment for all groups included weekly meetings for 8-12 weeks and monthly meetings lasting for 6-12 months from the start of the program. Results showed significant treatment effects in all groups. Particularly, the aerobic exercise and lifestyle intervention groups demonstrated the most significant reduction in overweight proportion among obese children after 10 years of follow-up. Moreover, the lifestyle physical activity intervention combined with diet showed the superior decrease in overweight proportion when compared to structured aerobic exercise or calisthenics alone (Epstein, Valoski, Wing, & McCurley, 1994).

Physical activity contributes to many positive benefits in weight control, especially in long-term effectiveness. Fulton and colleagues reviewed the weight loss treatment and weight gain prevention studies conducted among adolescents and suggested that treatment of uncomplicated childhood obesity should reinforce healthy eating and physical activity behaviors to achieve weight loss without adverse effects on growth. In addition, lifestyle exercise programs, which incorporate unstructured physical activity or activity that is deliberately to increase the physical activity in an individual's daily regimen had been shown to produce the best and consistent long term results (Fulton, McGuire, Caspersen, & Dietz, 2001). On the other hand, decreases in sedentary behavior had also been shown to facilitate weight loss among children and adolescents because they have substituted active behavior and thereby lowered the food intake (K. N. Boutelle, Libbey, Neumark-Sztainer, & Story, 2009; Epstein et al., 1995; Epstein, Roemmich, Paluch, & Raynor, 2005).

The other core component of standard behavior weight loss interventions involves dietary prescription to produce a healthy, calorie-reduced diet. In order to determine whether adolescent eating behaviors, such as intake of fruit, vegetable, snack foods, and reduced-calorie snack foods, are associated with BMI change over the course of weight loss program, researchers recruited 72 adolescents aged 13-16 years old to participate in a 16-week weight loss trial. Results identified male adolescents who had higher initial frequency of vegetable intake, increased frequency of fruit intake, and reduced-calorie snack foods accounted for 43% of the variance in BMI reduction. Therefore, researchers suggested early changes in eating habits, including increased frequency of vegetable and fruit intake can promote greater BMI reduction among adolescents (C. N. Hart et al., 2010).

In summary, the recommended weight control methods among adolescents should include lifestyle modification of modest eating and physical activity as well as decreases in sedentary behaviors and early initiation of increased frequency of vegetable and fruit intake to maintain long-term weight control outcomes.

Unhealthy Weight Control Behaviors (UWCB)

The concerns of overweight and obesity among adolescents had been shown to promote the use of healthy weight control behaviors such as decreasing fat intake, increasing fruit and vegetable consumption, and increasing physical activity (D. Neumark-Sztainer, Story, & French, 1996). But, in the meantime, the Unhealthy Weight Control Behaviors (UWCB), such as fasting, taking diet pills or laxatives, or inducing vomiting, (Centers for Disease Control and Prevention (CDC), 2010b)(Centers for Disease Control and Prevention (CDC), 2010b) remained very common among adolescents (Centers for Disease Control and Prevention (CDC), 2010b). The first UWCB study examined CDC's 1999 YRBS data and indicated that among adolescents trying to lose weight or stay the same weight, 62% of females and 41% of males combined

exercise with a reduced fat and calorie diet, while 32% of females and 17% of males also practiced UWCB (Lowry, Galuska, Fulton, Wechsler, & Kann, 2002).

With a closer look at the YRBS results concerning the UWCB among adolescents in the U.S., the most recent YRBS report indicated that 10.6% of adolescents fasted, i.e. did not eat for 24 or more hours to lose weight or to keep from gaining weight during the 30 days before the survey. The prevalence of fasting was higher among female (14.5%) than male (6.9%) (Eaton et al., 2010). The Morbidity and Mortality Weekly Report (MMWR) stated that the prevalence rates of fasting increased during 1999-2001 (12.6% to 13.5%) and then decreased during 2001-2009 (13.5% to 10.6%). In addition, 5% of students had taken diet pills, powders, or liquids without a doctor's advice to lose weight or to keep from gaining weight during the 30 days before the survey. The prevalence was higher among female (6.3%) than male (3.8%) students, especially among White females (7%) and Hispanic females (6.9%). The prevalence of taking diet pills exhibited similar trends as fasting—increased during 1999-2001 (7.6% to 9.2%) and then decreased during 2001-2009 (9.2% to 5.0%). The other unhealthy weight control practice is vomiting or taking laxatives. Four percents of high school students in the U.S. had vomited or taken laxatives to lose weight or to keep from gaining weight during the 30 days before the survey. The prevalence rate was higher among Hispanic females (6.9%) when compared with other ethnic groups. Trends of vomited or taken laxatives increased during 1995-2003 (4.8% to 6.0%) and then decreased during 2003-2009 (6.0% to 4.0%) (Eaton et al., 2010).

Although MMWR has indicated the overall trends of decrease for these three UWCB in recent years, the detailed trends of UWCB and healthy weight control behaviors grouped by gender, ethnicity, or weight perception remain unavailable.

Health Consequences of UWCB

In order to lose weight, adolescents engaged in all kinds of weight control behaviors. As a result, weight control behaviors have become increasingly widespread among adolescents, especially females. They do so not only to achieve ideal thinness but also due to the bombardment of messages and images of so-called beauty from the media. When adolescents take the shortcut by engaging themselves in UWCB, potential dire outcomes can exacerbate the health conditions both physiologically and psychologically.

One of the major consequences of UWCB for adolescents is long-term weight gain and increased risk for obesity later in life (Stice, Cameron, Killen, Hayward, & Taylor, 1999). Research showed that adolescents who reported dieting and other weight loss efforts, either healthy or unhealthy, were more likely to gain weight than those who did not report these efforts. The same study also revealed that UWCB is also predictive of greater weight gain over 3 years (Daee et al., 2002). Similarly, a 5-year longitudinal study examining overweight adolescents identified UWCB as a major risk factor for disordered eating and suggested weight gain over time (D. Neumark-Sztainer et al., 2006; D. Neumark-Sztainer et al., 2009).

A study examined the biomedical consequences of severely obese outpatients on a very low calorie diet and suggested dieting resulted in significant short-term improvements in health, such as body weight, systolic and diastolic blood pressure, triglycerides, and cholesterol. However, only a small percentage (less than 25%) of individuals actually maintained their lowered weight over substantial time periods (K. E. Hart & Warriner, 2005). Moreover, dieting without exercise was found to be associated with an increased risk of eating disorders later among youth. (Patton, Selzer, Coffey, Carlin, & Wolfe, 1999)

In addition, UWCB can impact adolescent's psychological health, particularly during a time of rapid physical, psychological, and social development (Daee et al., 2002). Adolescents who

were engaged in UWCB exhibited the most negative patterns of psychosocial and health behaviors. Neumark-Sztainer's study showed the associations between UWCB and other problem behaviors, such as alcohol or marijuana use, school delinquency, unprotected sex, and suicide attempts (D. Neumark-Sztainer et al., 1996). Additionally, it was reported that the more serious danger about UWCB is the subsequent development of eating disorders, including anorexia nervosa, bulimia nervosa, and binge eating (Daee et al., 2002). A large sample study also suggested that adolescents who reported binge / purge to lose weight were less likely to report sense of purpose, self-esteem, personal power, and positive view of personal future (French et al., 2001). Similarly, a study suggested dieting tends to co-occur with measures of diminished emotional well-being, such as low self-esteem, body dissatisfaction, and depressive symptoms, regardless of weight status (Crow, Eisenberg, Story, & Neumark-Sztainer, 2006). Furthermore, researches showed that an individual's cognitive functioning may be negatively affected by UWCB (Mathias & Kent, 1998) (D. Neumark-Sztainer et al., 1996; D. Neumark-Sztainer, Story, French, & Resnick, 1997) (D. Neumark-Sztainer et al., 1996; D. Neumark-Sztainer, Story, French, & Resnick, 1997).

In regards to the major physiologic consequences of UWCB among adolescents, diet pills take the center stage. A clinical study showed diet pills can only produce limited effectiveness to palliation of overweight and obesity {{593 Bray,G.A. 2009}}, but the side-effects may jeopardize adolescents' health. The acute side-effects of taking diet pills can cause problems in the cardiovascular system (arrhythmias, hypertension, and myocardial ischemia) and the central nervous system (tremulousness, insomnia, psychosis, and seizures). Researchers identified cardiac valvular lesions and pulmonary hypertension after long-term use of diet pills, which

contain fenfluramine and dexfenfluramine (Dae et al., 2002). Due to health complications, these diet pills had been withdrawn from clinical use since 1997 (Bray, 2009) (Bray, 2009).

Other health consequences of UWCB included fatigue, dizziness, lack of energy, sore throat, abdominal pain, constipation, loss of dental enamel, and pancreatitis (Pritts & Susman, 2003). These medical complications may be irreversible and may simultaneously cause growth retardation, structural brain changes, and pubertal delay or arrest (Golden et al., 2003).

To summarize, UWCB may help to control body weight in short-term. However, adolescents who engaged in UWCB would eventually gain weight overtime. In addition, UWCB can jeopardize adolescent's health both physiologically and psychologically. Further studies are warranted to identify predictive factors to help developing prevention and intervention programs.

Predictive Factors of UWCB

Research efforts have contributed to identify the predictive factors to explain why adolescents engage in UWCB. Selected factors related to UWCB have been shown to include gender, race/ethnicity, overweight status, weight concern, body image distortion, sedentary behaviors, dietary behaviors, and physical activities. These predictive factors from the literature are summarized below.

Gender, Race/Ethnicity, and Overweight Status

Recent studies highlighted the importance of gender differences in understanding and predicting adolescent weight control behaviors. In fact, most of the studies concerning weight related issues examined the gender differences. This indicates researcher's support on gender's role in weight loss. Among the studies, female adolescents reported more frequent engagement in both healthy and unhealthy weight control behaviors (Fonseca et al., 2009). In addition, studies examined the nature of UWCB among overweight and normal weight adolescents indicated that girls engaged in more bulimic symptoms than boys; particularly among overweight

girls (K. Boutelle, Neumark-Sztainer, Story, & Resnick, 2002; Crow et al., 2006; McCabe & Ricciardelli, 2009). Study indicated that although female adolescents tend to have lower overweight prevalence than male adolescents, they are more likely to engage in UWCB (Lowry et al., 2002). Because females were more likely to engage in weight control behaviors, some studies purposely recruited females only. Although statistically significant gender differences were observed, with females significantly more likely than men to report fasting and vomiting, but effect sizes (“Number Needed to Treat”) were found to be small at 4% (Striegel-Moore et al., 2009). Gender’s influences over UWCB are notably worthwhile for further investigation.

After years of intensive studies and efforts in weight control interventions, the prevalence of overweight, obese, and UWCB among high school youth did not decrease significantly. Ethnic differences were considered as a confounding variable by many health professionals. A regional study in Oregon using 2005 YRBS questionnaire found that American Indian and Hispanic girls had higher prevalence rates of UWCB when compared with non-Hispanics Caucasians (Haley et al., 2010). Another regional study in Massachusetts revealed the lowest prevalence of UWCB among Caucasian youth and Asian youth, while Hawaiian/Pacific Islander and American Indian/Alaskan Native youth exhibited the highest prevalence (Silverman et al., 2001). A national survey targeting American Indian- Alaska Native adolescents also revealed UWCB were common among American Indian adolescent with 27% reported self-induced vomiting at some time to try to lose weight and 11% reported using diet pills (Story et al., 1994). Additionally, the odds of UWCB reached 10 times higher among female students who belong to these two aforementioned high-prevalence groups when compared to White females (Austin et al., 2011). Further studies using the national representative data to explore the ethnic differences are suggested.

Many studies also identified overweight status as a major factor related to UWCB among adolescents. Studies have suggested that overweight youth are more likely to engage in weight-control behaviors, both healthy and unhealthy than their non-overweight peers (Austin et al., 2011; Fonseca et al., 2009; Foti & Lowry, 2010). In addition, a cross-sectional study consisting of a statewide representative sample of 7th -11th grade public school students in Connecticut suggested overweight adolescents use more unhealthy weight management strategies and avoid the healthier strategies, such as increased physical activity or healthier eating (K. Boutelle et al., 2002). Another cross-sectional study, which aimed to explore the perception of body size among overweight adolescents and to determine whether they consider it necessary to adjust weight and adopt healthier life habits, revealed overweight adolescents are eager to lose weight, and more likely to choose unhealthy methods (Chen, Fan, Jane, & Wu, 2009).

Weight Perception, Body Image Distortion, and Weight Loss Intention

Weight perception represents an important predictor of diet and weight management behaviors especially for those who perceived overweight (Cheung, Ip, Lam, & Bibby, 2007). As shown in the literature, individuals who perceived their body as ‘fat’ tended to engage in weight control behaviors in both health and unhealthy methods (Fonseca et al., 2009). Progressively, the UWCB prevalence increased from those who perceived themselves as ‘thin’, to those who perceived themselves as being ‘the right size’ and those who perceived themselves as ‘fat’ (Fonseca et al., 2009). Furthermore, weight-body concern has been shown to significantly correlate to UWCB (D. Neumark-Sztainer et al., 2003), especially those who see themselves as overweight or underweight (Cook, MacPherson, & Langille, 2007).

Based on the YRBS reports, although the prevalence of overweight increased from 1999 to 2007, the prevalence of perceived overweight did not change among US high school students. In fact, the prevalence of perceived overweight decreased among non-overweight adolescents (Foti

& Lowry, 2010). While these results could suggest positive implications for reducing UWCB, the relationship between weight misperception and UWCB remains unclear. For example, a study examining 2003 YRBS data to explore the prevalence of misperceptions and weight control behavior among normal weight adolescents revealed that a significant portion of normal weight adolescents who misperceived themselves as overweight engaged in UWCB (Talamayan, Springer, Kelder, Gorospe, & Joye, 2006). In addition, results from the National Longitudinal Study of Adolescent Health indicated girls with Body Image Distortion (BID), which refers to a discrepancy between perceived and actual weight status, exhibited 4.3 times greater odds of extreme weight loss behaviors (e.g., vomiting, laxatives, diet pills) and 2.3 times higher odds of dieting to control weight 1 year later (Liechty, 2010).

A study aimed to explore the relationships between weight misperception and weight control behaviors, especially UWCB among women, suggested normal-weight females with misperception of their body weight were more likely to report healthy and unhealthy weight-reduction behaviors compared with normal-weight females who perceived themselves normal weight (Rahman & Berenson, 2010). In addition, studies explored the gender difference on weight misperception and UWCB among adolescents indicated that female students with an inflated body weight perception were significantly more likely to engage in UWCB and to report depressive symptoms than were female students with an accurate body weight perception (Cheung et al., 2007; Harring et al., 2010). The influences of body weight distortion over UWCB were reported statistically significant. However, how the direction of misconception, by the actual weight status and perceived weight status, is associated with UWCB prevalence remains unclear. Whether a dose-response relationship exists is of interest to investigate.

Weight loss intention can be an important factor determining the selection of weight control behavior whether healthy or unhealthy. A large sample study suggested UWCB was significantly higher among those not dieting but thinking they should (Fonseca et al., 2009).

Sedentary Behaviors, Physical Activity, and Dietary Behaviors

Physical activity creates many positive benefits for children and adolescents, and provides an opportunity for play activity and pleasure. Physical activity not only facilitates the development of motor skills and increases energy expenditure (Batch, 2005), but also provides more effective and long-term weight control results. Physical activity also has been shown to affect body composition favorably during weight loss by preserving or increasing lean mass while promoting fat loss (Fulton et al., 2001). Numerous studies indicated that the combination of proper nutrition and regular physical activity is the most effective intervention for weight loss and maintenance of weight loss (Rippe & Hess, 1998).

These studies focused mainly on the predictors of UWCB such as, gender, overweight status, and BID as well as the benefits of physical activity on weight control practices. Very limited research investigated the relationship among UWCB, sedentary behavior, and physical activity. While the limited research on this topic persists, a recent longitudinal study suggested that moderate-to-vigorous physical activity was a protective factor against UWCB among adolescents while sedentary behaviors such as, watching TV, using computer, and reading or doing homework did not show significant association (D. R. Neumark-Sztainer et al., 2007). In addition, study has shown overweight adolescents were less likely to engage in vigorous physical activity and more likely to engage in UWCB than non-overweight youths (K. Boutelle et al., 2002)

In regard to dietary behaviors, more healthy food choices can usually help to prevent UWCB. However, the 1999 YRBS data showed that, among male adolescents, the consumption

of greater than 5 servings/day of fruits and vegetables was associated with engaging in fasting for weight control, while female adolescents who consumed the same amount of fruits and vegetables were more likely to use exercise, diet, fasting, vomiting, and laxatives for weight control (Lowry et al., 2002).

A school-based, multi-component intervention, which included one hour of physical activity and the provision of a low-fat, nutrient-dense snack at individual level, designed to reduce the engagement in UWCB among elementary schoolchildren suggested significant improvement of confidence to impact weigh-teasing norms. However, the prevalence of UWCB remained the same in the intervention group while the control group showed decreased prevalence (Haines et al., 2006). How dietary behavior intervention interacts with other psychosocial factors and how it relates to UWCB remains unclear and demands further investigation.

In sum, the relationships between UWCB and sedentary behavior, physical activity, and dietary behavior still remain tentative especially without a national representative data; thus warrant further studies.

Associations between UWCB and Other Risk Behaviors

Health risk behaviors usually link with each other. As Dr. DiClemente suggested, practitioners and researchers should attempt to address multiple behaviors, not merely one health habit at a time, and consider contextual and environmental factors necessary to understand the big picture and more effectively influence health behaviors (Werch, Ames, Moore, Thombs, & Hart, 2009). While the health consequences of UWCB may not cause immediate life threatening dangers, studies have suggested that UWCB can lead to more complicated ailments, such as eating disorders, anorexia nervosa, and bulimia nervosa. In addition, UWCB has been reported to associate with a cluster of risk behaviors, including alcohol, tobacco, and illicit drug use, sexual risk behaviors, and suicide ideation/attempts. Researchers suggested that adolescents who engage

in UWCB are more likely to engage in a range of other health-compromising behaviors, including suicide attempts, delinquency, tobacco, alcohol, and marijuana use, unprotected sexual intercourse, and multiple sexual partners (D. Neumark-Sztainer et al., 1996). The related literature of the selected risk behaviors under investigation are reviewed as following.

Alcohol, Tobacco, or Drug Use

Alcohol, tobacco, and drug use are frequently associated with each other. This review of literature found it difficult to separate their associations with UWCB by individual substances. UWCB among adolescents was found to correlate with cigarette smoking, appearance concerns, (Cance, Ashley, & Penne, 2005; Croll, Neumark-Sztainer, Story, & Ireland, 2002; French et al., 2001)(Cance, Ashley, & Penne, 2005; Croll et al., 2002; French et al., 2001) and alcohol use (Croll et al., 2002). Researchers examined UWCB and found them associated with alcohol consumption among adolescents (Cance et al., 2005; Croll et al., 2002; French et al., 2001; Haley et al., 2010). Underage alcohol drinking, especially heavy drinking, was associated with numerous negative consequences, such as drunk driving, acute impairment, violence, poor school performance, and suicide (National Research Council (US) and Institute of Medicine (US) Committee on Developing a Strategy to Reduce and Prevent Underage Drinking, 2004). The majority of the inter-connected web of risk behaviors were reported by researchers with smaller sample size studies. Hence , more in-depth investigations are warranted.

In addition to alcohol, tobacco use is also associated with UWCB among adolescents. Researchers pointed out the fact that some students smoked cigarettes as a method of weight control (Johnson, Eaton, Pederson, & Lowry, 2009), especially among female adolescents (Lowry et al., 2002). The literature also showed the increased likelihood of UWCB among smokers. In terms of risk, adolescent smokers were significantly more likely to engage in UWCB (Strauss & Mir, 2001), with odds ratio approximately 2 times higher when compared with those

who did not smoke (Johnson et al., 2009). More specifically, adolescents who smoked currently or in the past were more likely than nonsmokers to report purging (vomiting, laxatives, diuretics) (Breitkopf & Berenson, 2004)

In regard to the relationship between UWCB and drug use among adolescents, those who engaged in UWCB reported more health compromising behaviors such as substance use in the past year (McGuire et al., 2002). The YRBS 2003 report suggested juvenile delinquents, which include illicit drug use, were more likely than non-delinquents to engage in UWCB to lose weight or to keep from gaining weight (Ho, Kingree, & Thompson, 2006). In addition, adolescent females who had used laxatives or vomited to lose weight in the past year were more likely than those who had not used substances during the past year, including ecstasy, inhalants, nonmedical psychotherapeutics, marijuana, cigarettes, and alcohol (Cance et al., 2005). Girls who reported the use of illicit drugs or tobacco were four times more likely to report UWCB than non-users. Among both sexes, UWCB was found significantly associated with all substance use behaviors including illicit drug use, tobacco use, and binge drinking (Haley et al., 2010). On the other hand, from the prevention standpoint, adolescents who reported abstinence from alcohol, drug, or sex were less likely to report binge eating or purging (French et al., 2001).

Suicidal Ideation and Suicidal Attempt

Suicide was the third leading cause of death among youth ages 15-19 years in 2010. A prior suicide attempt was one of the most significant risk factors for a fatal adolescent suicide attempt (Centers for Disease Control and Prevention (CDC), 2010b). Adolescents who engaged in UWCB are more likely to report a history of physical and sexual abuse, and suicide attempts in the past year (McGuire et al., 2002). In addition, the adolescents engaging in multiple UWCB showed greater risk of having suicidal thoughts (Kim et al., 2009). In terms of their risk, adolescents with suicidal ideation exhibited 3 times higher odds engaging in UWCB when

compared with their counterparts (Haley et al., 2010). As discussed previously, female adolescents were more likely to engage UWCB. Those female adolescents who engaged in UWCB exhibit 4.2 times higher odds of suicidal thoughts, 2.9 times higher odds of suicide planning, and 3.4 times higher odds of suicide attempts than their counterparts (Cook et al., 2007).

Sexual Risk Behaviors

Early initiation of sexual intercourse was associated with having a greater number of lifetime sexual partners. In addition, adolescents who initiate sexual intercourse early were less likely to use contraception and were at higher risk of unexpected pregnancy (Centers for Disease Control and Prevention (CDC), 2010b). Recent estimates suggested that while representing 25% of the ever sexually active population, young people aged 15-24 acquired nearly half of all new STDs (Weinstock, Berman, & Cates, 2004). There are significant relationships between UWCB and sex related behaviors. For example, researchers suggested that female adolescents who engaged in UWCB were more likely to report being sexually active (McGuire et al., 2002). Data from 1997 and 1999 Massachusetts Youth Risk Behavior Surveys indicated that physical and sexual dating violence against adolescent girls is associated with increased risk of UWCB (Silverman et al., 2001). Quantitatively speaking, the adolescent girls who engaged in UWCB exhibited 1.6 times higher odds of ever having had vaginal intercourse compared with the girls who did not engaged in UWCB (Cook et al., 2007). When examined the relationships between UWCB and sexual behaviors from the prevention perspectives, researchers suggested that values related to abstinence from alcohol and sex appear to be protective against unhealthy eating behaviors and may reflect a general resilience that buffers against a broad range of health risk behaviors (French et al., 2001).

The above reviewed literature based on researcher initiated studies with relatively smaller sample sizes showed preliminary evidences of the association between UWCB and other selected risk behaviors. These findings support the aggregation of risk behaviors among adolescents. However, the strength of association varies from study to study. While some studies examined the complete definition of UWCB, some others examined UWCB sub-behaviors separately. The use of the nationally representative YRBS data in this study can provide greater statistical power to examine the detailed association between UWCB and other selected risk behaviors.

Description of the Youth Risk Behavior Survey (YRBS)

The Division of Adolescent and School Health of the Centers for Disease Control and Prevention established this biennial epidemiologic Youth Risk Behavior Surveillance System (YRBSS) in 1991 to monitor health-risk behaviors among youth and young adults at national, state, and local levels. The YRBSS surveys students in grades 9-12 from scientifically sampled schools across the United States, thus provides the most representative data for youth health practices. CDC designed YRBSS to determine the prevalence of health-risk behaviors among high school students, to assess whether these behaviors increase, decrease, or stay the same over time, and to examine the co-occurrence of health-risk behaviors. YRBSS focuses almost exclusively on health-risk behaviors, rather than the determinants of these behaviors (e.g., knowledge, attitudes, beliefs, and so on). In addition, YRBSS is designed not only to provide comparable national, state, and local data as well as comparable data among subpopulations of youth (e.g., racial/ethnic groups), but also to monitor progress toward achieving the national health objectives for 2000 and 2010 along with other program indicators (Brener et al., 2004).

The Youth Risk Behavior Survey (YRBS) is the major component of the YRBSS. It contains six categories of priority high-risk behaviors that contribute substantially to the leading causes of death, disability, and social problems among youth and adults in the United States.

These six categories include: 1) behaviors that contribute to unintentional injuries and violence; 2) tobacco use; 3) alcohol and other drug use; 4) sexual behaviors that contribute to unintended pregnancy and sexually transmitted diseases (STDs), including human immunodeficiency virus (HIV) infection; 5) unhealthy dietary behaviors; and 6) physical inactivity, plus overweight and asthma (Centers for Disease Control and Prevention (CDC), 2010a).

Population and Sampling

The national school-based YRBS was conducted by CDC since 1991 biennially using a similar three-stage cluster sampling design to obtain a nationally representative sample of high school students in the United States. The target population consisted of all public and private school students in grades 9 to 12 in the 50 states and District of Columbia. This study retrieved only the data since 1999 because YRBS from 1991 to 1997 did not include UWCB related questions. In the years 1999, 2001, 2003, 2005, 2007, and 2009, school response rate were 77%, 75%, 81%, 78%, 81%, and 81%, respectively; student response rate were 86%, 83%, 83%, 86%, 84%, and 88%, respectively; overall response rate were 66%, 63%, 67%, 67%, 68%, and 71%, respectively; and sample size were 15,349, 13,601, 15,214, 13,917, 14,041, and 16,410, respectively (Eaton et al., 2006; Eaton et al., 2008; Eaton et al., 2010; Grunbaum et al., 2002; Grunbaum et al., 2004; Kann et al., 2000).

Three-stage cluster sampling design

The national YRBS used a three-stage cluster sampling design to produce a representative sample of 9th through 12th grade students in the United States. In the first stage, the Primary Sampling Units (PSUs), consisting of large counties or groups of smaller adjacent counties selected from 16 strata formed according to the degree of urbanization and the relative percentages of Black and Hispanic students in the PSU. The PSUs were selected with probability proportional to the total school enrollment in the PSU. In the second stage of sampling, schools

were selected with probability proportional to school enrollment size. Schools with substantial numbers of Black and Hispanic students were sampled at relatively higher rates than were other schools. The final stage of sampling comprised of random selection from each chosen school and grade level 1 or 2 intact classes of either a required subject (e.g., English or social studies) or a required period (e.g., homeroom or second period). All students in sampled classes were eligible to participate. Schools, classes, and students that refused to participate were not replaced.

Weighting

A weighting factor based on student gender, race/ethnicity, and grade was applied to each record to adjust for student non-response and for oversampling of Black and Hispanic students. Final overall weights were scaled so that the weighted count of students equaled the total sample size and the weighted proportions of students in each grade matched national population projections. Therefore, weighted estimates are representative of all students in grades 9-12 attending public and private schools in the United States.

Instrumentation

A questionnaire containing approximately 88 items (the exact number varied by survey year) was administered in the classroom by trained data collectors each survey year. Before survey administration, local parental permission procedures were followed. Students completed the self-administered questionnaire during one class period and recorded their responses directly on a computer-scannable booklet or answer sheet. An institution review board at the CDC reviewed and approved the YRBS.

Validity and Reliability of YRBS

The available literature indicated CDC had conducted a test-retest reliability study out of the 1999 version of national YRBS in 2000. The questionnaire was administered to a convenience sample of 4,619 high school students. The questionnaire was administered on two

occasions, approximately 2 weeks apart. Approximately one of five items (22%) had significantly different prevalence estimates for the first and second times that the questionnaire was administered. Ten items (14%) had both kappas less than 61% and significantly different time-1 and time-2 prevalence estimates, indicating that the reliability of these items may be questionable. Certain items (e.g., an item related to injury during physical activity) have been revised or deleted from later versions of the questionnaire (Brener et al., 2004).

In 2000, CDC also conducted a study to assess the validity of the two YRBS questions regarding self-reported height and weight. In that study, 2,965 high school students completed the 1999 version of the YRBS questionnaire on two occasions approximately 2 weeks apart. After completing the questionnaire, the students were weighed and had their height measured. Self-reported height, weight, and BMI calculated from these values were substantially reliable, but on average, students in the study overreported their height by 2.7 inches and underreported their weight by 3.5 pounds. These results indicate YRBSS may potentially underestimate the prevalence of overweight in adolescent populations (Brener et al., 2004).

The CDC had conducted a review of existing empirical literature to assess cognitive and situational factors that might affect the validity of adolescent self-reporting of behaviors measured by the YRBS questionnaire in 2003. Results suggested although self-reports of risk behaviors are affected by cognitive and situational factors, these factors do not threaten the validity of self-reports of each type of behavior equally (Brener et al., 2004).

Although no existing literature suggested high validity of current YRBS questionnaire, a logical consistency edits mechanism was used to improve the validity. The majority of the edit criteria compare two questions at a time to ensure logical consistency. If responses from two questions conflict logically, both questions are set to blank. For example, If students who

responded they have never tried cigarette smoking, even one or two puffs and then responded a certain age to the other question asking “How old were you when you smoked a whole cigarette for the first time?”, both questions are set to missing data. However, data from demographic questions are not set to missing in this case (Centers for Disease Control and Prevention (CDC), 2010a). Another mechanism to ensure the data quality was subverting records. If a student answers 20 or less questions or answers with b, c, d, e, f, g, or h 15 or more times in a row, all values except the demographic variables are set to missing (Centers for Disease Control and Prevention (CDC), 2010a).

Quality Control Procedures

All hypothesis testings were performed on weighted data using IBM SPSS Statistics 19. The 1999-2009 YRBS data sets, instructional menus, YRBS biennial reports, and questionnaires were downloaded from the Centers for Disease Control and Prevention, Division of Adolescent and School Health, Youth Risk Behavior Surveillance System’s website. To avoid misunderstanding and errors during data processing, descriptive statistical procedures were performed and the results were compared with Youth Online, the web-based inquiry system provided by YRBSS (<http://apps.nccd.cdc.gov/youthonline/App/Default.aspx>). Youth Online allows users to filter and sort data on the basis of race/ethnicity, sex, grade, or survey collection site, create customized tables and graphs, and perform statistical tests by site and health topic. The results inquired from Youth Online were compared with the descriptive statistics produced from the downloaded data sets. Inconsistent results, if any, were reviewed. In such incident, the data sets and descriptive statistical procedures were examined and corrected to ensure the quality of data and future analysis for this study.

Advantages and Disadvantages of Secondary Data Analysis

Secondary data analysis is “any further analysis of an existing data set which presents interpretations, conclusions or knowledge additional to, or different from, those presented in the first report on an inquiry and its main results”. Given the huge human and financial investment in data collection by funders, investigators, and subjects, it seems reasonable if not imperative, ethically speaking, to make the maximum use possible of research data (Clarke & Cossette, 2000).

The choice of primary or secondary data need not be an either/or question. Research methodologist suggested scientists to select data that are appropriate to the research question being studied and the resources available to the researchers. Several advantages were detailed in the literature (Boslaugh, 2007). The first advantage of working with secondary data is economy in terms of money and time. Because someone else already collected the data, the researchers do not have to devote resources to this phase of research. In addition, the data are already collected, cleaned and stored in electronic format, thus the researchers can spend the bulk of their time analyzing the data.

The second major advantage of using secondary data is the breadth of data available. Few researchers would have the resources to collect data from a representative sample of adolescents in every state in the U.S., let alone repeat this data collection process in every other year. However, the federal government conducts numerous surveys on that scale.

The third major advantage in using secondary data is that often the data collection process is informed by expertise and professionalism that may not available to smaller research projects. For instance, many of the federal health surveys use a complex sampling design and system of weighting that allows the researchers to compute population based estimates of health conditions and behaviors; thus obtains greater generalizability. To take another example, data collection for

many federal data sets is often performed by staff members who specialize in that task and who may have years of experience working on a particular survey.

In Addition, secondary data analysis affords the researchers the opportunity to explore variables of interest and study sub-samples such as gender, race/ethnicity, grade, of the original group using a variety of statistical techniques. Lastly, when longitudinal data or data collected with same questions repeated annually or at regular intervals are available, researchers may track trends and patterns of health status and health behaviors in the population across time (Clarke & Cossette, 2000).

One major disadvantage when using secondary data is inherent in its nature. Because the data were not collected to answer the researcher's specific research questions, particular information that the researcher would like to have may not have been collected (Boslaugh, 2007). The second major disadvantage of using secondary data is that because the researcher did not participate in the planning and execution of the data collection process, he or she does not know exactly how it was done. More to the point, the researcher does not know how well it was done and therefore how seriously the data are affected by problems such as low response rate or respondent misunderstanding of specific survey questions (Boslaugh, 2007). However, this disadvantage could be overcome by closely examining the data available in the original document or literature.

Delimitations

The study employed secondary data analysis, which is inherent in the nature of the original survey. Because of this restriction, the research questions were confined within the original scope. Some possible factors reported in the literature as the outcomes of researcher initiated studies, such as body image, body dissatisfaction, peer influence (Hutchinson & Rapee, 2007), and frequent reading of magazines articles about dieting/weight loss and weight-control

behavior(van den Berg, Neumark-Sztainer, Hannan, & Haines, 2007), cannot be included because these factors were not covered by YRBS (van den Berg et al., 2007)(van den Berg et al., 2007). In order to adjust data to become nationally representative, CDC's YRBSS administrative team had decided to give a weight based on student sex, race/ethnicity, and grade level to each record to adjust for school and student nonresponse and oversampling of African American and Hispanic students. The overall weights were scaled so that the weighted count of students equals the total sample size, and the weighted proportions of students in each grade match the national population proportions. Thus the data are deemed representative of students in grades 9-12 in public and private schools in the United States (Centers for Disease Control and Prevention (CDC), 2010a).

YRBS data sets have multiple limitations. First, all YRBS data are self-reported, and the extent of under-reporting or over-reporting of behaviors may not be determined, although that the data retain acceptable quality (Brener et al., 2004). Second, data apply only to adolescents who attend school and therefore, are not representative of all persons in this age group. Third, YRBSS is designed to produce information to help assess the effect of broad national, state, and local policies and programs. It was not designed to evaluate the effectiveness of specific interventions. Fourth, YRBSS only addresses behaviors that contribute to the leading causes of morbidity and mortality among youth and adults.

Statement of Purpose

The Centers for Disease Control and Prevention's *Morbidity and Mortality Weekly Report (MMWR)* had briefly illustrated some trends of UWCB. For example, the most recent YRBS data indicated that 10.6% of adolescents fasted, i.e. did not eat for 24 or more hours, to lose weight or to keep from gaining weight during the 30 days before the survey. In addition, the prevalence of fasting was higher among female (14.5%) than male (6.9%) (Eaton et al., 2010). However, no

further analysis except descriptive statistics was done to date. More sophisticated analyses, including bivariate and multivariate analyses, to describe detailed trends of UWCB over the past 10 years, its risk factors, and its association with other risk behaviors were lacking. This type of information would be very helpful when designing prevention and control program specifically related to the health problems associated with UWCB. The findings from these analyses can reflect more accurate and comprehensive trends to raise the awareness of UWCB among the general public, school teachers and counselors, and the health professionals. While several studies using partial YRBSS data or researcher initiated surveys had identified some preventive and risk factors for UWCB, analyzing a more thorough, comprehensive, and nationally representative data brings much greater benefits and allows for more accurate scientific discovery with national generalizability.

Significance

Unhealthy Weight Control Behaviors (UWCB) could predict the onset of more severe disordered eating behaviors and eating disorders, including anorexia nervosa, bulimia nervosa, and binge eating disorder, as well as depression and other medical and psychosocial morbidity(Fonseca et al., 2009). Eating disorders are widely recognized sources of morbidity among adolescents. Although not meeting the Diagnostics and Statistical Manual of Mental Disorders fourth edition (DSM-IV) diagnostic criteria for eating disorders, many adolescents engaged in extreme weight loss practice(Croll et al., 2002). Such practice included prolonged fasting, vomiting, and use of unprescribed weight loss medications.

Study indicated that these unhealthy behaviors may not be immediately life-threatening, but they can lead to electrolyte imbalance and other physical manifestations, may progress to frank anorexia or bulimia, and often are associated with other health risk behaviors (Haley et al., 2010). A longitudinal study suggested female adolescents who engaged in moderate dieting were

five times more likely to develop an eating disorder than nondieters, and female adolescents who engaged in severe dieting were 18 times more likely to develop an eating disorder 2 years later (Patton et al., 1999). Early identification of eating disorders has been recommended as it leads to more successful treatment outcomes (Bulik, Berkman, Brownley, Sedway, & Lohr, 2007).

YRBSS was designed to focus the nation on adolescent behaviors contributing to the leading causes of mortality and morbidity and to assess how risk behaviors change over time (Eaton et al., 2010). Analysis of such data not only explored the UWCB trends, predictive factors, and relationships with other risk behaviors, but also established greater generalizability, founded on the large sampling size and weighting methods.

Although risk factors such as peer influences, social norms about weight loss behaviors, media influences were not included in YRBS, variables such as gender, weight, height, perceived weight status, physical activity, dietary behaviors were collected and can help to design more effective intervention curriculum against UWCB, reduce risk, and improve health outcomes among adolescents.

Research has shown that a curricular program that uses cognitive social learning, developmental, and contextual principals may help prevent development of negative body image and unhealthy weight management techniques in girls and boys as they move from late childhood to early adolescence (Smolak & Levine, 2001). The findings of this study could be used as the foundation to understand adolescent's risk behaviors and to develop tailored UWCB prevention curriculum and interventions, and optimally reduce the morbidity and mortality caused by UWCB and promote adolescent's health.

Research Aims

This study was designed to assess the trends of UWCB among high school students, to investigate the possible risk and protective factors of UWCB, and explore the associations

between UWCB and selected risk behaviors by analyzing the YRBS data. The specific aims are as following:

This study aimed to analyze YRBS data to

Aim 1: describe the 1999-2009 prevalence trends of healthy and unhealthy weight control behaviors as defined by CDC's YRBSS.

Aim 2: examine the differences of UWCB prevalence in 2009 by gender, ethnicity/race, overweight status, present weight control tendency and Body Image Distortion (BID).

Aim 3: identify the predictive factors of UWCB.

Aim 4: explore the relationships between UWCB and selected risk behaviors, including tobacco use, alcohol use, drug use, multiple sexual partners, suicidal ideation and attempt, physical/sexual violence, and been bullied.

CHAPTER 2 TRENDS OF WEIGHT CONTROL BEHAVIORS AMONG HIGH SCHOOL STUDENTS

Background

The prevalence of obesity in the United States has been more than doubled over the past 3 decades (Y. Wang & Beydoun, 2007). The latest National Health and Nutrition Examination Survey (NHANES) data indicated that over one third of American adults were obese and over two thirds were overweight or obese (Flegal et al., 2010). Among adolescents aged 12-19 years old, 18% have age-specific BMI greater than 95th percentile, which is considered obese, and 34% have age-specific BMI greater than 85th percentile, which is considered overweight (Ogden & Flegal, 2010; Ogden et al., 2010). Such tendency from adolescence to adulthood, if persist, can cause enormous health problems and result in significant economic lost.

To prevent weight gain, people voluntarily engage in various weight control practices. Although many adolescents use healthy strategies, unhealthy or extreme weight control strategies, such as fasting, using diet pills/powders/liquids, vomiting, or taking laxatives are also common among adolescents (Eaton et al., 2010). Unhealthy weight control behaviors, such as these (Eisenberg et al., 2005; Haines et al., 2006; D. Neumark-Sztainer et al., 2003), could predict the onset of more severe disordered eating behaviors, including anorexia nervosa, bulimia nervosa, and binge eating disorder, as well as depression and other medical and psychosocial morbidity(Fonseca et al., 2009). Contrary to the commonly projected weight loss, dieting (particularly during adolescence) had been shown to predict weight gain over time (Fonseca et al., 2009; D. Neumark-Sztainer et al., 2009). In addition, adolescents who had unhealthy weight control behaviors had been shown to have approximately 3 times greater risk for being overweight and 6 times risk for uncontrollable binge eating 5 years later (D. Neumark-Sztainer et al., 2006).

According to the 2009 Youth Risk Behavioral Surveillance System (YRBSS), 59% of female and 31% of male students in grades 9–12 reported trying to lose weight. In 2009, for the purpose of losing weight or keeping from gaining weight, 10.6% of high school students did not eat for 24 or more hours, 5.0% had taken diet pills, powders, or liquids without a doctor’s advice, and 4.0% had vomited or taken laxatives during the 30 days before the survey (Eaton et al., 2010). However, the longitudinal trends by participant’s demographics have not been well investigated. It is important to examine such trends in order to identify the high risk populations for better intervention effectiveness.

Researchers had found the distinction between sexes in related to unhealthy weight control behaviors among adolescents. Gender difference was found in body image, weight concern, and weight control behaviors. Literature showed girls engaged in more bulimic symptoms than boys; particularly among overweight girls (McCabe & Ricciardelli, 2009). In addition, about 40% of overweight girls and 20% of overweight boys engaged in at least one of the disordered eating behaviors (binge eating and / or extreme weight control) (D. R. Neumark-Sztainer et al., 2007). Other demographic characteristics, such as race/ethnicity, have not been clearly identified. Although several studies had presented the ethnical differences in unhealthy weight control behaviors (Austin et al., 2011; Haley et al., 2010; Silverman et al., 2001; Story et al., 1994), the overall trends remain inconsistent.

In addition, adolescent’s body weight status makes a difference in weight control behaviors. Researchers found overweight youth were more likely to engage in weight control behaviors, both healthy and unhealthy, than their non-overweight peers (Austin et al., 2011; Fonseca et al., 2009; Foti & Lowry, 2010). Furthermore, the interaction of gender and body image was found to be a significant contributor of unhealthy weight control behaviors. Girls with

Body Image Distortion (BID), which refers to a discrepancy between perceived and actual weight status, exhibited 4.3 times greater odds of extreme weight loss behaviors (e.g., vomiting, laxatives, diet pills) and 2.3 times higher likelihood of dieting to control weight one year later (Liechty, 2010). Although the findings of the aforementioned studies are quite inspiring, they are either lack of national sampling representation, small in sample size, cross-sectional design in timing, or inconclusive in findings. To advance scientific understanding of adolescent's weight control behaviors, this study examined the longitudinal data from YRBSS' nationally representative samples.

This study was designed to describe the longitudinal trends of healthy and unhealthy weight control behaviors as defined by the Centers for Disease Control and Prevention (CDC) YRBSS among high school students and to examine the prevalence differences by gender, ethnicity/race, and BID. Results are expected to help identifying the high risk populations and provide critical information in designing tailored weight control programs specifically targeting adolescents.

Methods

The Division of Adolescent and School Health at the CDC established the nation's biennial epidemiologic surveillance system in 1991 to monitor health-risk behaviors among youth and young adults. The Youth Risk Behavior Surveillance System (YRBSS) monitors the prevalence of obesity and asthma as well as the six categories of priority high-risk behaviors, including behaviors that contribute to unintentional injuries and violence, tobacco use, alcohol and other drug use, sexual behaviors, unhealthy dietary behaviors, and physical inactivity. The YRBSS surveys students in grades 9-12 from nationally sampled schools across the United States and applies a weighting system, thus providing the most representative data for youth health practices. The Youth Risk Behavior Survey (YRBS) has been given biennially since 1999.

Official brief descriptive statistics were reported in the Morbidity and Mortality Weekly Report in the year following the survey and YRBSS' website. The data collected by the YRBSS is an important source of information in the research of weight control behaviors and were used as a basis for analyzing trends in this study. We analyzed weighted data from 1999 to 2009 because only these years' surveys asked about weight control behaviors.

CDC's YRBS groups fasting, taking diet pills or laxatives, and inducing vomiting during the past 30 days to lose weight or to keep from gaining weight into Unhealthy Weight Control Behaviors (UWCB) (Centers for Disease Control and Prevention (CDC), 2010b). In this study, UWCB was operationally defined as: When a student reported yes in one or more of the following three YRBS questions, he/she was classified as having UWCB:

During the past 30 days, did you go without eating for 24 hours or more (also called fasting) to lose weight or to keep from gaining weight?

During the past 30 days, did you take any diet pills, powders, or liquids without a doctor's advice to lose weight or to keep from gaining weight? (Do not include meal replacement products such as Slim Fast.)

During the past 30 days, did you vomit or take laxatives to lose weight or to keep from gaining weight?

YRBS also groups exercise and eat less food, fewer calories, or foods low in fat to lose weight or to keep from gaining weight during the past 30 days into Healthy Weight Control Behaviors (HWCB). When a student reported yes in one or both of the following two YRBS questions, he/she was classified as having HWCB:

During the past 30 days, did you exercise to lose weight or to keep from gaining weight?

During the past 30 days, did you eat less food, fewer calories, or foods low in fat to lose weight or to keep from gaining weight?

Body Image Distortion (BID) is the variable generated by comparing the perceived body weight and actual weight of each participant. Overweight was defined as a Body Mass Index (BMI) being equal to or larger than the 85th percentile of the age (Kuczmarski et al., 2002). The participant who had their BMI below their respective 85th percentiles was classified as non-overweight. In YRBS, participants were asked “How do you describe your weight?” The response options include “Very underweight”, “Slightly underweight”, “About the right weight”, “Slightly overweight”, “Very overweight”. The responses in the first three options were pooled as perceived nonoverweight and the last two were considered perceived overweight. The body weight perception was cross-tabulated with the respondent’s overweight status based on their actual BMI percentiles. The participants whose BMI was equal to or larger than the 85th percentile and perceived themselves as overweight and the ones whose BMI was less than the 85th percentile and perceived themselves as nonoverweight were defined as no BID. The participants whose BMI was equal to or larger than the 85th percentile and perceived themselves as nonoverweight and the ones whose BMI was less than the 85th percentile and perceived themselves as overweight were defined as having BID. Consequently, four weight X BID categories were formed in this study: nonoverweight without BID, nonoverweight with BID, overweight without BID, and overweight with BID.

Analyses were performed over the weighted YRBS data using SPSS 19. All statistics were conducted using the YRBS 1999-2009 data downloaded from YRBSS’ website. To assure the quality of analysis, our descriptive statistics were fully compared with the official YRBSS statistics on the Youth Online. To examine longitudinal trends, linear and quadratic time (year)

variables were entered into the curve estimation that tested for UWCB's and HWCB's secular trends. The presence of a significant linear time coefficients (beta) indicates an overall increase or decrease over the years. A significant linear time beta accompanied by a nonsignificant quadratic time beta indicates the presence of linear change. A significant quadratic time beta accompanied by a significant linear time beta indicates the presence of nonlinear change in addition to an overall increase or decrease over time. A significant quadratic time beta accompanied by a nonsignificant linear time beta indicates the presence of nonlinear change with no overall increase or decrease over time. A nonsignificant quadratic time beta accompanied by a nonsignificant linear time beta indicates the absence of any significant variation in the data.

Bivariate logistic regression was conducted to examine the associations between weight control behaviors (UWCB and HWCB) and sex, grade, race/ethnicity, and BID. Odd ratios and their corresponding 95% confidence intervals (95% CI) were generated over the pooled data from 1999-2009.

Results

The Table 2-1 contained the demographic characteristics of respondents as well as the prevalence of BID, trying to lose weight, HWCB, and UWCB during 1999 to 2009. Overall, 88,547 participants completed YRBS across 10 years. Male and female adolescents were evenly distributed as well as the grade with slightly more (28.8%) 9th graders and less (21.4%) 12th graders. Most students were Caucasian (60.8%). About 44.6% of students were trying to lose weight; 65.4% engaged in HWCB and 17.2% engaged in UWCB. The majority of students were nonoverweight without BID (61.3%) while 20.2% of students had BID.

To describe the trends, quadratic and linear models were estimated in model fit. All quadratic models showed nearly complete collinearity among the model terms. Thus, only linear models were performed. The curve estimation revealed that UWCB exhibited a linear time beta

($\beta=-0.05$, $p<.001$) showing a significant descending trend. Additional close-in observation found the presence of a linear ascending trend over 1999 (18.2%) to 2001 (19.4%) and an descending trend from 2003 (19.4%) to 2009 (15.8%). The descending trend was found in the majority of the years. Analysis over HWCB prevalence rates exhibited a significant linear increase ($\beta =0.03$, $p<.001$) from 1999 (63.2%) to 2009 (66.5%). Additional close-in observation found the trend had no apparent fluctuation over the 10 years.

The Table 2-2 exhibits the UWCB prevalence rates by demographic subgroups and BID categories. Among these four characteristics, three subgroups consistently exhibited higher UWCB prevalence rate over their counterparts. First, female adolescents consistently exhibited about twice as high prevalence rates of UWCB over males. Moreover, female adolescents exhibited about 2.5 times higher risk of engaging in UWCB than male adolescents (OR=2.51, $p<.001$). Second, American Indian/Alaska Native adolescents showed the highest UWCB prevalence rate among all races across the years. Compared to Caucasian, Asian (OR=0.73, $p<.001$) and African American (OR=0.91, $p<.001$) adolescents tended not to engage in UWCB, while adolescents of Hispanic (OR=1.08, $p<.05$), multiple race with Hispanic origin (OR=1.20, $p<.001$), and multiple race without Hispanic origin (OR=1.30, $p<.001$) tended to engage in UWCB. Lastly, nonoverweight adolescents with BID showed the highest UWCB prevalence rate in all surveys. Compared with nonoverweight without BID, nonoverweight with BID (OR=3.93, $p<.001$), overweight without BID (OR=2.81, $p<.001$), and overweight with BID (OR=1.62, $p<.001$) had higher risk engaging in UWCB.

In addition, the curve estimation over each category revealed similar results as the pooled UWCB and HWCB data where quadratic models could not be established. Although data showed some fluctuation over time, the linear time beta showed significant negative values in all

subgroups from 1999 to 2009 except American Indians/Alaska Natives and multiple race with Hispanic origin. Such trends indicated the UWCB prevalence rates decreased across sex, grade, race/ethnicity over the years. However, the UWCB prevalence rates among American Indians/Alaska Native adolescents and adolescents with multiple race and Hispanic origin remained relatively high overall.

HWCB trends by the demographic subgroups and BID categories are presented in the Table 2-3. Three subgroups consistently exhibited higher or lower prevalence rates of HWCB from their counterparts across the years. First, more female adolescents engaged in HWCB than male students. Females adolescents had greater likelihood to practice HWCB than male adolescents (OR=2.38, $p<.001$). In addition, African American (OR=0.69, $p<.001$) and Asian (OR=0.92, $p<.05$) adolescents practiced less HWCB, while adolescents in multiple race with Hispanic origin (OR=1.20, $p<.001$) and Hispanic (OR=1.11, $p<.001$) engaged in more HWCB than Caucasians. Lastly, about 90% of nonoverweight adolescents with BID engaged in HWCB which also represented the highest HWCB prevalence rate among other BID categories. In fact, nonoverweight adolescents with BID (OR=7.47, $p<.001$), overweight adolescents without BID (OR=6.09, $p<.001$), and overweight adolescents with BID (OR=1.90, $p<.001$) tended to practice HWCB more than nonoverweight adolescents without BID.

When we examined the longitudinal trends, several subgroups including male, 10th grade, 11th grade, 12th grade, American Indian/Alaska Native, Caucasian, Hispanic, nonoverweight without BID, and overweight with BID exhibited a significant linear ascending trend of HWCB across years. Besides, more than half of the adolescents engaged in HWCB in all subgroups and the prevalence rates were found gradually increased over the years.

Discussion

This investigation represents the first effort to examine the trends of weight control behaviors by year among adolescents. Our findings were consistent with the high prevalence rates of UWCB (ranged from 9.4% to 21.2%) in a previous study using longitudinal surveys in Minnesota (D. Neumark-Sztainer, Wall, Eisenberg, Story, & Hannan, 2006). Over time, our findings suggested the prevalence trends of UWCB decreased and trends of HWCB increased across years. Our findings of ascending HWCB trends echoed the success of long term (2 to 10 years) healthy weight loss interventions (Batch, 2005; Epstein et al., 1994; Reinehr et al., 2009) and benefits (K. E. Hart & Warriner, 2005) among adolescents and implied that adolescents might have been more aware of the benefits of HWCB over UWCB.

Subgroup analyses also showed the presence of similar trends of HWCB and UWCB among sex, ethnic groups, and BID status. Female adolescents and nonoverweight adolescents with BID exhibited higher prevalence rate of weight control behaviors in both healthy and unhealthy approaches across years when compared to their counterparts. Previous research results also supported our findings that female adolescents exhibited higher percentage of engaging in weight control behavior than male adolescents (43.7% v.s. 22.3%) (Serdula et al., 1999). Also, female exhibited significant higher rate of fasting than male (6.3% v.s. 4.0%) (Striegel-Moore et al., 2009). Only one previous study investigated the influence of BID on adolescent in which the researchers suggested female adolescents with BID exhibited 4.3 times greater odds of onset of UWCB (Liechty, 2010). With the national representative data, this study confirmed this difference and further indicated the risk of UWCB for adolescents by the combination of overweight status and BID. These comparisons may provide more scientific evidences for the design of intervention and the identification of risk population.

Limitations

Several important limitations were identified in this study. Although YRBS has been well recognized as a sound instrument for youth risk behaviors, the use of 3 and 2 items to assess UWCB and HWCB respectively may not have satisfactory reliability and validity. This same scenario may be applicable to the assessment of BID. They may be considered as less reliable than a more sophisticated instrument with known psychometrics. In addition, the findings from this sample of public high school attendees may not be generalizable to other groups of adolescents, such as private high school students and individuals who did not attend or dropped out of high school.

Future Research and Implications

Based on these nationally representative surveys, the results of this study clearly demonstrated the trends of weight control behaviors and possible linkage between weight control behavior and gender, race/ethnicity, and body image distortion among high school students. We suggest the continuation of such large-scale longitudinal studies to monitor the weight control behaviors. Additional studies can be done to investigate the risk/preventive factors of UWCB, and its associated risk behaviors. Further studies to investigate the underlying psychosocial mechanisms of choosing UWCB over HWCB are recommended to provide further insights for proper weight control interventions.

Despite the needs for additional research, findings of this study have significant implications for prevention programming in a number of areas. First, UWCB is prevalent. As a result, early identification and prevention efforts in this area are needed and the development and implementation of prevention programs specific to adolescent weight control are recommended. Second, UWCB is prevalent in some demographic subgroups. Thus, those high risk groups, including females, American Indians/Alaska Natives, and overweight and normal weight

adolescents who perceived themselves as overweight need to be targeted. Lastly, practitioners working in obesity prevention are suggested to foster proper body image and develop programs using healthy weight control methods.

Table 2-1 Descriptive statistics of participant’s demographics, BID, weight loss tendency, UWCB, and HWCB by year

Characteristics	1999		2001		2003		2005		2007		2009		Overall	
	n	(%)	n	(%)	n	(%)								
Sex														
Female	7608	(49.6)	6953	(51.3)	7361	(48.6)	6858	(49.5)	6942	(49.4)	7816	(47.8)	43538	(49.3)
Male	7727	(50.3)	6609	(48.7)	7787	(51.4)	7006	(50.5)	7084	(50.5)	8537	(52.2)	44750	(50.7)
Grade														
9 th	4424	(28.9)	4030	(29.7)	4448	(29.4)	4021	(29.0)	4052	(29.0)	4570	(28.0)	25546	(28.8)
10 th	3984	(26.0)	3509	(25.9)	3947	(26.1)	3591	(25.9)	3663	(26.2)	4273	(26.2)	22967	(25.9)
11 th	3607	(23.6)	3126	(23.1)	3532	(23.3)	3230	(23.3)	3265	(23.4)	3843	(23.5)	20602	(23.3)
12 th	3282	(21.4)	2873	(21.2)	3181	(21.0)	2997	(21.6)	2976	(21.3)	3628	(22.2)	18938	(21.4)
Race/Ethnicity														
AI/AN	131	(0.9)	94	(0.7)	158	(1.0)	143	(1.0)	135	(1.0)	101	(0.6)	762	(0.9)
Asian	456	(3.0)	454	(3.4)	507	(3.4)	460	(3.4)	480	(3.5)	546	(3.4)	2903	(3.3)
Black	2141	(14.1)	1747	(13)	2095	(13.9)	2004	(14.6)	2076	(15.1)	2320	(14.4)	12382	(14.2)
NH/PI	86	(0.6)	100	(0.7)	149	(1.0)	114	(0.8)	108	(0.8)	130	(0.8)	687	(0.8)
White	9219	(60.8)	9093	(67.5)	9271	(61.4)	8482	(61.9)	8321	(60.3)	9452	(58.7)	53838	(60.8)
Hispanic	1242	(8.2)	1388	(10.3)	2139	(14.2)	1310	(9.6)	1184	(8.6)	1766	(11.0)	9029	(10.2)
Multiple-H	328	(2.2)	221	(1.6)	364	(2.4)	759	(5.5)	1142	(8.3)	1223	(7.6)	4037	(4.6)
Multiple-NH	1555	(10.3)	367	(2.7)	423	(2.8)	419	(3.1)	345	(2.5)	572	(3.6)	3682	(4.2)
BID														
1.NOW-NBID	8681	(60.0)	7791	(62.1)	8133	(61.5)	7863	(60.2)	7861	(61.3)	9489	(62.9)	49819	(61.3)
2.NOW-BID	1797	(12.4)	1527	(12.2)	1536	(11.6)	1446	(11.1)	1285	(10.0)	1412	(9.4)	9002	(11.1)
3.OW-BID	1414	(9.8)	1106	(8.8)	1108	(8.4)	1099	(8.4)	1208	(9.4)	1431	(9.5)	7366	(9.1)
4.OW-NBID	2573	(17.8)	2126	(16.9)	2440	(18.5)	2652	(20.3)	2479	(19.3)	2748	(18.2)	15018	(18.5)
Trying to lose weight														
Yes	6527	(42.7)	6219	(46.0)	6554	(43.8)	6264	(45.6)	6209	(45.2)	7157	(44.4)	38930	(44.6)
Weight control behavior														
HWCB	9548	(63.2)	8674	(65.2)	9461	(64.8)	9003	(65.8)	9095	(66.8)	10662	(66.5)	56442	(65.4)
UWCB	2753	(18.2)	2570	(19.4)	2807	(19.4)	2216	(16.6)	2081	(15.8)	2277	(14.2)	14704	(17.2)

BID 1: Nonoverweight students without BID. 2: Nonoverweight students with BID.

3: Overweight students with BID. 4: Overweight students without BID.

Table 2-2 UWCB prevalence rates by year and participant's demographics and BID and their bivariate odds ratios

Characteristics	1999 %	2001 %	2003 %	2005 %	2007 %	2009 %	Linear β	Total sample	1999-2009 %	OR	95% CI
Sex											
Female	26.1	26.4	25.9	22.8	21.3	19.1	-.008**	9953	23.6	2.51	2.42, 2.61
Male	10.4	12.0	13.1	10.5	10.3	9.6	-.002**	4704	10.9	Reference	
Grade											
9 th	17.8	20.6	18.9	16.1	14.1	13.5	-.006**	4099	16.8	Reference	
10 th	18.9	19.9	18.3	16.1	16.8	13.7	-.005**	3820	17.2	1.03	0.98, 1.08
11 th	17.2	17.5	20.5	17.5	15.8	15.4	-.002**	3456	17.3	1.03	0.98, 1.09
12 th	19.0	18.8	19.7	16.8	16.5	14.3	-.005**	3208	17.4	1.04	0.99, 1.10
Race/Ethnicity											
AI/AN	20.6	26.6	29.6	16.9	22.7	26.7	.001	173	23.6	1.51	1.27, 1.79
Asian	13.6	12.0	22.1	11.3	13.4	6.3	-.007**	350	13.0	0.73	0.65, 0.82
AA	18.4	17.4	16.5	15.0	13.5	13.8	-.005**	1833	15.7	0.91	0.86, 0.96
NH/PI	17.9	17.4	22.8	20.9	14.6	15.9	-.003	117	18.2	1.09	0.89, 1.33
White	18.0	19.3	18.8	17.1	15.2	13.8	-.005**	8941	17.0	Reference	
Hispanic	18.3	22.8	21.4	15.5	15.8	13.8	-.008**	1564	18.1	1.08	1.02, 1.14
Multiple-H	15.0	26.3	18.6	19.0	21.5	19.4	.002	762	19.8	1.20	1.11, 1.31
Multiple-NH	21.2	21.8	27.2	14.4	22.8	19.5	-.002	755	21.1	1.30	1.20, 1.41
BID											
1.NW-NBID	12.0	12.8	12.1	10.9	10.4	8.9	-.003**	5431	11.1	Reference	
2.NW-BID	35.8	35.6	36.1	30.7	27.9	29.7	-.008**	2901	33.0	3.93	3.73, 4.14
3.OW-BID	15.8	20.1	19.9	15.2	16.5	14.7	-.003*	1205	16.8	1.62	1.51, 1.73
4.OW-NBID	28.0	30.3	27.4	25.1	25.2	21.4	-.007**	3842	26.0	2.81	2.69, 2.95

Note: *: p<.05; **: p<.01

Table 2-3 HWCB prevalence rates by year and participant's demographics and BID and their bivariate odds ratios

Characteristics	1999 %	2001 %	2003 %	2005 %	2007 %	2009 %	Linear β	Total sample	1999-2009 %	OR	95% CI
Sex											
Female	73.8	75.8	75.7	75.5	75.2	74.9	.001	32004	75.1	2.38	2.31, 2.45
Male	52.7	54.2	54.5	56.4	58.6	58.7	.006**	24301	55.9	Reference	
Grade											
9 th	64.7	68.5	64.6	67.1	68.9	66.3	.002	16454	66.6	Reference	
10 th	63.0	65.7	66.4	65.8	66.8	66.1	.003*	14742	65.6	1.03	0.98, 1.08
11 th	62.4	61.9	65.3	64.9	66.6	65.7	.004**	12975	64.5	1.03	0.98, 1.09
12 th	62.4	63.9	63.2	65.2	64.5	67.8	.005**	11996	64.6	1.04	0.99, 1.10
Race/Ethnicity											
AI/AN	49.6	67.0	66.7	65.9	71.4	64.6	.014*	470	64.2	0.92	0.79, 1.07
Asian	63.4	58.6	67.1	64.4	65.6	66.3	.005	1815	64.3	0.92	0.85, 0.99
AA	58.4	56.0	55.1	59.2	57.3	57.8	.001	6819	57.4	0.69	0.66, 0.71
NH/PI	58.3	65.6	75.7	66.7	68.6	71.7	.008	450	68.6	1.11	0.94, 1.31
White	63.4	66.9	66.1	66.2	68.1	66.9	.003**	34951	66.2	Reference	
Hispanic	66.4	67.3	67.4	70.5	68.8	70.5	.004*	6011	68.5	1.11	1.06, 1.16
Multiple-H	63.4	72.8	69.3	72.2	70.4	70.0	.003	2755	70.1	1.20	1.11, 1.28
Multiple-NH	68.5	66.2	62.5	64.0	71.6	69.3	.001	2434	67.5	1.06	0.98, 1.14
BID											
1.NW-NBID	51.4	53.9	54.5	53.7	56.4	56.6	.005**	26846	54.4	Reference	
2.NW-BID	89.6	91.2	90.7	89.3	88.7	89.9	-.001	8017	89.9	7.47	6.95, 8.02
3.OW-BID	63.7	68.1	69.1	70.7	74.6	70.8	.008**	5032	69.4	1.90	1.80, 2.00
4.OW-NBID	87.7	88.3	86.8	88.0	88.7	88.0	.001	13081	87.9	6.09	5.78, 6.42

Note: *: p<.05; **: p<.01

CHAPTER 3
RISK FACTORS OF UNHEALTHY WEIGHT CONTROL BEHAVIORS AMONG HIGH
SCHOOL STUDENTS

Background

Weight control behaviors are common among adolescents. According to the 2009 Youth Risk Behavioral Surveillance System (YRBSS), 59.3% of female and 30.5% of male students in grades 9–12 reported trying to lose weight (Eaton et al., 2010). Unhealthy Weight Control Behaviors (UWCB), such as fasting, using diet pills/powders/liquids, vomiting, or taking laxatives (Eisenberg et al., 2005; Haines et al., 2006; D. Neumark-Sztainer et al., 2003) were found common among adolescents. Recent YRBSS indicated that in 2009, 10.6% of high school students did not eat for 24 or more hours, 5.0% took diet pills, powders, or liquids without a doctor’s advice, and 4.0% vomited or took laxatives to lose weight or to keep from gaining weight during the 30 days before the survey (Eaton et al., 2010).

UWCB predicts the onset of more severe disordered eating behaviors and eating disorders, including anorexia nervosa, bulimia nervosa, and binge eating disorder, as well as depression and other medical and psychosocial morbidity(Fonseca et al., 2009). Contrary to the projected weight loss, particularly during adolescence, UWCB has been shown to predict weight gain over time (Fonseca et al., 2009); (D. Neumark-Sztainer et al., 2009). In addition, adolescents who had UWCB have approximately 3 times greater risk for being overweight and 6 times for binge eating with loss of control 5 years later (D. Neumark-Sztainer et al., 2006).

Besides, UWCB can impact adolescent’s psychological health, particularly during a time of rapid physical, psychological, and social development (Daee et al., 2002). Adolescents who were engaged in UWCB exhibited the most negative patterns of psychosocial and health behaviors, such as alcohol or marijuana use, school delinquency, unprotected sex, and suicide attempts (D. Neumark-Sztainer et al., 1996). Other health consequences caused by UWCB include fatigue,

dizziness, lack of energy, sore throat, abdominal pain, constipation, loss of dental enamel, and pancreatitis (Pritts & Susman, 2003). These medical complications may be irreversible and may simultaneously cause growth retardation, structural brain changes, and pubertal delay or arrest (Golden et al., 2003).

Recent studies have suggested several significant predictors of UWCB, including sex (K. Boutelle et al., 2002; Fonseca et al., 2009; Lowry et al., 2002; McCabe & Ricciardelli, 2009; D. Neumark-Sztainer et al., 2006; Striegel-Moore et al., 2009), race/ethnicity (Haley et al., 2010; Silverman et al., 2001), overweight status (K. Boutelle et al., 2002; Foti & Lowry, 2010), sedentary behaviors, physical activities (moderate-to-vigorous physical activity), dietary behaviors (fruit/vegetable intake, fast food, and sugar-sweetened beverages) (D. R. Neumark-Sztainer et al., 2007), and Body Image Distortion (BID), which refers to a discrepancy between perceived and actual weight status (Liechty, 2010).

However, these aforementioned studies have a similar limitation, the lack of sample representativeness and generalizability. In addition, these aforementioned predictors have not been examined on the same horizon in one same sample, without mentioning the fact that race/ethnicity and vegetable and fruit consumption are seldom linked with UWCB. Thus, important pieces of the puzzle were never made into one whole picture. Hence, the purpose of this study was to investigate the predictive factors of UWCB among American adolescents using recent national representative data. Results can help identify high risk populations and provide up-to-date information in designing tailored prevention programs specifically targeting adolescents.

Methods

The Division of Adolescent and School Health at the CDC established the nation's biennial epidemiologic surveillance system in 1991 to monitor health-risk behaviors among youth and

young adults. The Youth Risk Behavior Surveillance System (YRBSS) monitors the prevalence of obesity and asthma as well as the six categories of priority high-risk behaviors, including behaviors that contribute to unintentional injuries and violence, tobacco use, alcohol and other drug use, sexual behaviors, unhealthy dietary behaviors, and physical inactivity. The YRBSS employed a three-stage cluster sampling design to surveys students in grades 9-12 from nationally sampled schools across the United States and applies a weighting system, thus providing the most representative data for youth health practices. The Youth Risk Behavior Survey (YRBS) has been given biennially since 1999. Official brief descriptive statistics were reported in the Morbidity and Mortality Weekly Report in the year following the survey and YRBSS' website. The data collected by the YRBSS is an important source of information in the research of weight control behaviors and was used in this study as a basis to identify the risk factors of UWCB. For the 2009 national YRBS, the school response rate was 81%; the student response rate was 88%; the overall response rate was 71%.

Sample Demographics

The 2009 survey included 16,410 participants; 47.8% were females. Grades were fairly evenly distributed with slightly more (28%) 9th graders and less (22.2%) 12th graders. Most students were Caucasian (58.7%), followed by Hispanic and Multiple/Hispanic (18.6%), African American (14.4%), Multiple/non-Hispanic (3.6%), Asian (3.4%), Native Hawaiian/Other Pacific Islander (0.8%), and American Indian/Alaska Native (0.6%).

Measures

This study examined the UWCB predictors which were selected based on the available YRBS items that are demographics, psychologically related to UWCB, and lifestyle behaviors that directly related to energy intake/expenditure. The candidate predictors include sex, grade, race/ethnicity, BID, current weight control tendency, sedentary lifestyle, participation in

moderate physical activity, participation in vigorous physical activity, participation in daily physical education class, vegetable, fruit, and sugar-sweetened beverage consumption.

As described in the 2009 YRBS methodology, UWCB was assessed based on participant's self-identification from at least one of the following 3 questions: "During the past 30 days, did you go without eating for 24 hours or more (also called fasting) to lose weight or to keep from gaining weight?" (Response options: Yes, No), "During the past 30 days, did you take any diet pills, powders, or liquids without a doctor's advice to lose weight or to keep from gaining weight? (Do not include meal replacement products such as Slim Fast.)" (Response options: Yes, No), and "During the past 30 days, did you vomit or take laxatives to lose weight or to keep from gaining weight?" (Response options: Yes, No).

In this study, overweight was defined as a Body Mass Index (BMI) being equal to or larger than the 85th percentile of the age (Kuczmarski et al., 2002). Participants who had their BMI below their corresponding 85th percentiles were classified as non-overweight. As presented in the literature, perception about weight seems to play a more significant role in weight control. Following this track, Body Image Distortion (BID) was selected to predict UWCB. BID is the variable generated by comparing the perceived body weight and actual weight of each participant. In YRBS, participants were asked "How do you describe your weight?" The response options include "Very underweight", "Slightly underweight", "About the right weight", "Slightly overweight", "Very overweight". The responses in the first three options were pooled as perceived nonoverweight and the last two were considered perceived overweight. The body weight perception was cross tabulated with the respondent's overweight status based on their actual BMI percentiles. The participants whose BMI was equal to or greater than the 85th percentile and perceived themselves as overweight, and the ones whose BMI was less than the

85th percentile and perceived themselves as nonoverweight were defined as no BID. The participants whose BMI was equal to or larger than the 85th percentile and perceived themselves as nonoverweight, and the ones whose BMI was less than the 85th percentile and perceived themselves as overweight were defined as having BID. Consequently, four weight-BID categories were tabulated in this study: nonoverweight without BID, nonoverweight with BID, overweight without BID, and overweight with BID.

Current weight control tendency was assessed by asking the following question: "Which of the following are you trying to do about your weight?" (Response options: lose weight, gain weight, stay the same weight, or I am not trying to do anything about my weight). Participants who checked the "lose weight" option were classified as trying to lose weight while others were pooled as not trying to lose weight.

Sedentary behaviors were assessed by the sum of more than 2 hours per day of TV viewing time, video or computer games playing, or computer using for something that is not school work on an average school day (D. R. Neumark-Sztainer et al., 2007; US Dept of Health and Human Services, 2000). This measure was created by adding the responses from these 2 questions: "On an average school day, how many hours do you watch TV?" (Response options: I do not watch TV on an average school day, less than 1 hour per day, 1 hour per day, 2 hours per day, 3 hours per day, 4 hours per day, 5 or more hours per day), and "On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Include activities such as Nintendo, Game Boy, PlayStation, Xbox, computer games, and the internet." (Response options: I do not play video or computer games or use a computer for something that is not school work, less than 1 hour per day, 1 hour per day, 2 hours per day, 3 hours per day, 4 hours per day, 5 or more hours per day).

Regular participation in moderate physical activity was assessed by asking the following question: “On how many of the past 7 days did you participate in physical activity for at least 30 minutes that did not make you sweat or breathe hard, such as fast walking, slow bicycling, skating, pushing a lawn mower, or mopping floors?” (Response options are 0 to 7 days). The participation in vigorous physical activity was assessed by asking the question “On how many of the past 7 days did you exercise or participate in physical activity for at least 20 minutes that made you sweat and breathe hard, such as basketball, soccer, running, swimming, laps, fast bicycling, fast dancing, or similar aerobic activities?” (Response options are 0 to 7 days). Participation in daily school PE was assessed by asking, “In an average week when you are in school, on how many days do you go to physical education (PE) classes?” (Response options are 0 to 5 days).

The participation in moderate and vigorous physical activity, and daily PE class were analyzed as dichotomous variables according to their corresponding national health objectives and recommendations. These cut-off points include 30-minute moderate physical activity in 5 or more days per week, 20-minute vigorous physical activity in 3 or more days per week, and attendance in PE class 5 days per week (US Dept of Health and Human Services, 2000).

The 2009 YRBS data contain 2 variables, QNVEG and QNFRUIT, to determine if participants met the dietary recommendations by American Heart Association for children and adolescents, which suggested at least 3 times of vegetables and 2 times of fruit per day for ages 14 to 18 years (Gidding et al., 2005). QNVEG was assessed by combining 4 questions: “During the past 7 days, how many times did you eat green salad?”, “During the past 7 days, how many times did you eat potatoes? (Do not count french fries, fried potatoes, or potato chips.)”, “During the past 7 days, how many times did you eat carrots?”, and “During the past 7 days, how many

times did you eat other vegetables? (Do not count green salad, potatoes, or carrots.)”. (Response options include I did not eat vegetables during the past 7 days, 1 to 3 times during the past 7 days, 4 to 6 times during the past 7 days, 1 time per day, 2 times per day, 3 times per day, 4 or more times per day). QNFRUIT was assessed by combining 2 questions: “During the past 7 days, how many times did you drink 100% fruit juices such as orange juice, apple juice, or grape juice? (Do not count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)” and “During the past 7 days, how many times did you eat fruit? (Do not count fruit juice.)” (Response options include I did not eat fruit/drink fruit juice during the past 7 days, 1 to 3 times during the past 7 days, 4 to 6 times during the past 7 days, 1 time per day, 2 times per day, 3 times per day, 4 or more times per day).

The consumption of sugar-sweetened beverages was assessed by asking: “During the past 7 days, how many times did you drink a can, bottle, or glass of soda or pop, such as Coke, Pepsi, or Sprite? (Do not include diet soda or diet pop)” (Response options include I did not soda or pop during the past 7 days, 1 to 3 times during the past 7 days, 4 to 6 times during the past 7 days, 1 time per day, 2 times per day, 3 times per day, 4 or more times per day). In 1999-2004, US youth ages 2-19 years, consumed an average of 224 kcal per capita per day from sugar-sweetened beverages (Y. C. Wang, Bleich, & Gortmaker, 2008). A can, bottle, or glass of soda or pop was around the average. Therefore, the cut-off point was 1 time per day.

Data Analysis

IBM SPSS Statistics 19.0 software was used to conduct all analyses to account for the complex sampling design and weighting of the data. Per YRBS instructions, the weighting factor was applied in the data analysis to ensure national representation. Statistical analysis was performed over the YRBS 2009 data downloaded from YRBSS website. To assure the quality of

analysis, these descriptive statistics were fully compared against the Youth Online results, the official YRBSS statistics.

The outcome variable of this study, UWCB, is in a dichotomous categorical format. Considering the attribute of this outcome variable, logistic regression analysis was identified as the most rational statistical method. Stepwise multiple logistic regression with backward elimination allows all the candidate predictors placed into a regression model and deletes insignificant variables step by step from the model until reaching a point where the remaining variables make significant partial contribution in predicting the outcome variable (Agresti & Finlay, 1997). Hence, after the backward elimination, the predictive variables can be identified. To determine the interaction, two-way interactions of predictive variables were added to the model to test the significance. Similar backward elimination was applied to all the two-way interaction terms. The final model was determined by Akaike Information Criterion (AIC), which judges the model by how close its fitted values tend to be to the true expected values (Agresti, 2007).

Results

Table 3-1 presented the sample description and the distribution of UWCB by the candidate predictors. In 2009, the prevalence of trying to lose weight was 44.4% and prevalence of engaging in at least one UWCB was 14.2% among high school students. About 57.4% of adolescents had sedentary behaviors while 28.7% participated in moderate physical activity, 33.3% participated in daily school physical education, and 67.7% participated in vigorous physical activity. Regarding dietary behaviors, only 33.9% of adolescents consumed the recommended fruit, and 13.8% consumed enough vegetables while 29.2% drank sugar-sweetened beverages daily. Nine percent of adolescents were nonoverweight with BID, 10 percent were overweight with BID. The UWCB distribution was similar in 5 variables, i.e.,

grade, moderate physical activity, daily physical education, sedentary lifestyle, and fruit consumption. The other 7 variables exhibited statistical significance.

Table 3-2 presented the seven variables identified after stepwise multiple logistic regression analysis. Twenty-one possible two-way interaction terms were entered into the second block of the regression model. The backward elimination removed 13 non-significant two-way interaction terms. Although either model seemed reasonable, the complex model with 8 interaction terms only reduced the AIC value by 1.5% (9468 to 9318). Therefore, the model with seven main effects without interactions was adopted.

The final logistic regression model revealed that, after control other significant variables, the strongest predictive factor for UWCB was current weight lose tendency. Adolescents who were trying to lose weight demonstrated approximately 4.7 times significantly higher risk to engage in UWCB, in reference to those who were not (OR= 4.66, 95% C.I.: 4.06-5.35). In addition, compared with adolescents who were nonoverweight without BID, all other weight perception groups exhibited significantly elevated risk to engage in UWCB: adolescents who were nonoverweight and had BID (OR= 1.98, 95% C.I.: 1.69-2.32), overweight with BID (OR= 1.44, 95% C.I.: 1.20-1.73), and overweight without BID (OR= 1.38, 95% C.I.: 1.20-1.58).

Like most of the related research, our findings suggested female adolescents tended to engage more in UWCB, compared to male peers (OR=1.62, 95% C.I.: 1.45-1.82). On the contrary, another demographic factor, race/ethnicity, has not been well investigated in the literature. The results of the present study can bridge this gap. Several significant differences among races/ethnicity were uncovered. Compared with Caucasian adolescents, the American Indian/Alaska Native adolescents (OR=2.63, 95% C.I.: 1.56-4.45), adolescents of multiple race/ethnicity with non-Hispanic origin (OR= 1.55, 95% C.I.: 1.19-2.02), and adolescents of

multiple race/ethnicity with Hispanic origin (OR= 1.31, 95% C.I.: 1.08-1.59) exhibited higher odds of engaging in UWCB while Asian adolescents (OR=0.35, 95% C.I.: 0.22-0.55) tended not to engage in this behavior.

Among the candidate predictors that increase energy intake, vegetable and sugar-sweetened beverage consumption increased the risk of UWCB. Adolescents who ate recommended or greater amounts of vegetables exhibited significant higher odds of engaging in UWCB, compared to those who did not (OR=1.91, 95% C.I.: 1.66-2.18). In addition, adolescents who drank 1 or more sugar-sweetened beverages per day tended to engage in UWCB, compared to those who reported less than 1 (OR=1.59, 95% C.I.:1.42-1.78).

When the candidate predictors that increase energy expenditure were examined, only the lack of participation in vigorous physical activity appeared statistically significant. The results showed the adolescents who did not participate in vigorous physical activity tended to engage in UWCB, compared to those who participated 20 minutes of vigorous physical activity 3 or more days per week (OR=1.14, 95% C.I.:1.02-1.27).

Three multiple logistic analysis were conducted for each of the UWCBs. The results showed the same significant predictors and similar strengths of association in odds ratios. Thus, the significant predictors of each UWCB and their odds ratios can be considered approximately equivalent.

Discussion

This study aimed to explore the risk factors of UWCB among adolescents using the nationally representative YRBS data. Our findings suggested UWCB is moderately prevalent among female adolescents. This result is consistent from agreement among the existing studies that female adolescents are at higher risk for engaging in UWCB (K. Boutelle et al., 2002; Fonseca et al., 2009; Lowry et al., 2002; McCabe & Ricciardelli, 2009; D. Neumark-Sztainer et

al., 2006; Striegel-Moore et al., 2009). Besides, our findings confirmed Haley's findings in the relationships between UWCB and race/ethnicity in which American Indian/Alaska Native adolescents were at the highest risk and Asian adolescents were at the lowest risk (Haley et al., 2010). Based on the strength of this study to analyze the nationally representative data, our findings also expanded the generalizability to the national level. However, the latent effects behind these associations, such as social and culture influences are suggested for future research.

Even though our findings revealed weight control attempts were quite prevalent among adolescents, the prevalence of obesity is still increasing in the United States (Y. Wang & Beydoun, 2007). Nearly a half of the adolescents in the US were trying to lose weight. Among those who attempted to lose weight, approximately a quarter engaged in UWCB. Moreover, this study confirmed that Body Image Distortion increases the risk of UWCB (Liechty, 2010) and further demonstrated that the risk of UWCB elevates particularly among the nonoverweight adolescents with BID. Yet, the underlying factors of BID have not been explored in current literature. Further studies investigating the mechanism of how BID interacts with UWCB to provide insight into the foundation of UWCB prevention programs will be helpful.

Findings in this study also verified that vigorous physical activity was a strong protective factor against UWCB (D. R. Neumark-Sztainer et al., 2007), while daily sugar-sweetened beverage consumption was identified as a risk factor. Although frequent vegetable consumption was suggested as the key element of a healthy weight loss program (C. N. Hart et al., 2010), our findings demonstrated adolescents who consumed recommended amounts of vegetable (3 times/day) tended to engage in UWCB. Whether this discrepancy reflects a lack of knowledge about weight control methods or an inability to implement the healthy method effectively cannot be answered in this study. Further studies in monitoring the weight control behaviors, weight

control knowledge dissemination, and obstacles to healthy weight control behaviors are necessary to provide insight for weight control program planning specifically targeting adolescents.

Despite the need of further research, findings of this study have significant implications for prevention/intervention programming with adolescents in a number of important areas. First, UWCB is prevalent in some populations. As a result, early identification of eating disorders is recommended as it leads to more successful treatment outcomes (Bulik et al., 2007). Second, based on our findings, it is rational to believe a brief assessment of weight status and BID can help identify adolescents at risk. By strengthening the prevention efforts to such an at-risk population, the lower risk of UWCB can be projected. Finally, a combination of encouraging vigorous physical activity and decrease of sugar-sweetened beverage consumption can yield great benefits in promoting healthy weight control behaviors and preventing the unhealthy weight control behaviors.

Table 3-4 UWCB distribution by the candidate predictors

Characteristics	Total		UWCB	
	Frequency	Percent	Frequency	Percent
All participants	16035	100	2277	14.2
Sex				
Female	7816	47.8	1464	19.1
Male	8537	52.2	799	9.6
Grade				
9 th grade	4570	28.0	595	13.5
10 th grade	4273	26.2	577	13.7
11 th grade	3843	23.5	578	15.4
12 th grade	3628	22.2	507	14.3
Race/Ethnicity				
American Indian/Alaska Native	101	0.6	27	26.7
Asian	546	3.4	33	6.3
Black	2320	14.4	310	13.8
Native Hawaiian/Other Pacific Islander	130	0.8	20	15.9
Hispanic	1766	11.0	238	13.8
Multiple-Hispanic	1223	7.6	232	19.4
Multiple-Non-Hispanic	572	3.6	108	19.5
White	9452	58.7	1274	13.8
BID				
Nonoverweight without BID	9413	62.4	822	8.8
Nonoverweight with BID	1356	9.0	400	29.8
Overweight with BID	1507	10.0	223	15.0
Overweight without BID	2804	18.6	599	21.5
Current Weight Control Tendency				
To lose weight	7157	44.4	1757	24.7
Not to lose weight	8976	55.6	516	5.8
Vegetable Consumption				
Above recommendation	2239	13.8	456	20.7
Below recommendation	13980	86.2	1803	13.1
Fruit Consumption				
Above recommendation	5486	33.9	818	15.2
Below recommendation	10703	66.1	1432	13.6
Sugar-sweetened Beverage Daily				
Yes	4736	29.2	782	16.8
No	11503	70.8	1479	13.1
Sedentary Lifestyle				
Yes	9270	57.4	1344	14.8
No	6868	42.6	906	13.4
Vigorous Physical Activity				
Yes	10285	67.7	1322	13.1
No	4916	32.3	798	16.5
Moderate Physical Activity				

Yes	4296	28.7	597	14.0
No	10696	71.3	1521	14.3
Daily School Physical Education				
Yes	5239	33.3	674	12.9
No	10514	66.7	1548	14.8

Table 3-5 Results of stepwise multiple logistic regression

Characteristics	Odds Ratio	95% Confidence Interval
Sex		
Female	1.62***	(1.45, 1.82)
Male		Reference
Race/Ethnicity		
American Indian/Alaska Native	2.63**	(1.56, 4.45)
Asian	0.35***	(0.22, 0.55)
Black	1.03	(0.88, 1.21)
Native Hawaiian/Other Pacific Islander	1.17	(0.63, 2.17)
Hispanic	0.86	(0.72, 1.02)
Multiple-Hispanic	1.31**	(1.08, 1.59)
Multiple-Non-Hispanic	1.55***	(1.19, 2.02)
White		Reference
BID		
Nonoverweight with BID	1.98***	(1.69, 2.32)
Overweight with BID	1.44***	(1.20, 1.73)
Overweight without BID	1.38***	(1.20, 1.58)
Nonoverweight without BID		Reference
Current Weight Control Tendency		
To lose weight	4.66***	(4.06, 5.35)
Not to lose weight		Reference
Vegetable Consumption		
Above recommendation	1.91***	(1.66, 2.18)
Below recommendation		Reference
Consume Sugar-sweetened Beverage Daily		
Yes	1.59***	(1.42, 1.78)
No		Reference
Vigorous Physical Activity		
No	1.14*	(1.02, 1.27)
Yes		Reference

Note: *: p<.05, **: p<.01, ***: p<.001

CHAPTER 4
THE RELATIONSHIP BETWEEN UNHEALTHY WEIGHT CONTROL BEHAVIORS AND
SELECTED HEALTH RISK BEHAVIORS AMONG HIGH SCHOOL STUDENTS

Background

Unhealthy Weight Control Behaviors (UWCB) such as fasting, using diet pills/powders/liquids, vomiting, or taking laxatives are prevalent among U.S. adolescents (Eisenberg et al., 2005; Haines et al., 2006; D. Neumark-Sztainer et al., 2003). A recent Youth Risk Behavior Survey (YRBS) suggested, in 2009, 10.6% of high school students did not eat for 24 or more hours; 5% had taken diet pills, powders, or liquids without a doctor's advice; and 4% had vomited or taken laxatives to lose weight or to keep from gaining weight during the 30 days before the survey (Eaton et al., 2010)

Although UWCB did not project immediate life threatening dangers, but studies have suggested that UWCB can lead to more complicated ailments such as eating disorders, anorexia nervosa, and bulimia nervosa (Daee et al., 2002; Patton et al., 1999), as well as other health-compromising behaviors including suicide attempts, tobacco, alcohol, and marijuana use, unprotected sexual intercourse, and multiple sexual partners (Haley et al., 2010; D. Neumark-Sztainer et al., 1996). To further explore the relationship between each health risk behavior, we conducted a comprehensive literature review and summarized the findings by the risk behaviors below.

Researchers who examined UWCB and its association with substance use among adolescents and found that alcohol, tobacco, and other drug use (ATOD) was associated with adolescent's UWCB. (Cance et al., 2005; Croll et al., 2002; French et al., 2001; Haley et al., 2010). Studies found alcohol users had about 2.5 times higher risk than non-users. In addition to alcohol, tobacco use also was associated with UWCB among adolescents. Researchers found that some students smoked cigarettes as a method of weight control (Johnson et al., 2009), especially

female adolescents (Lowry et al., 2002). The literature also showed an increased likelihood of UWCB among adolescent smokers. In terms of risk, adolescent smokers were significantly more likely to engage in UWCB (Strauss & Mir, 2001), and adolescent smoker's odds ratio was approximately 2 times higher than non-smokers (Johnson et al., 2009). In addition, female adolescents exhibited a higher association between UWCB and ATOD use than male peers (Croll et al., 2002).

In regard to the relationship between UWCB and other substance misuse among adolescents, research also indicated that those who engaged in UWCB reported more health compromising behaviors such as substance use in the past year (McGuire et al., 2002). A study analyzing 2003 YRBS data, which included illicit drug use, suggested juvenile delinquents were more likely than non-delinquents to engage in UWCB (Ho et al., 2006). In addition, adolescent females who used laxatives or vomited to lose weight in the past year were more likely than those who did not do so to use substances including ecstasy, inhalants, nonmedical psychotherapeutics, marijuana, cigarettes, and alcohol during the past year (Cance et al., 2005). The same study also reported that girls who used illicit drugs or tobacco were 4 times more likely to engage in UWCB than non-users. Among both sexes, UWCB was associated significantly with substance use including illicit drug, tobacco, and binge drinking (Haley et al., 2010). Conversely, from the prevention standpoint, adolescents who reported abstinence from alcohol or drugs were less likely to report purging (French et al., 2001).

Suicide represents the third leading cause of death among youth aged 15-19 years in 2010. A prior suicide attempt was identified as one of the most significant risk factors for a fatal adolescent suicide case (Centers for Disease Control and Prevention (CDC), 2010b). Similarly, adolescents who engaged in UWCB were more likely to report a history of suicide attempts in

the past year (McGuire et al., 2002). Furthermore, adolescents engaging in multiple UWCB were at greater risk of having suicidal thoughts (Kim et al., 2009). In terms of risk, adolescents with suicidal ideation exhibited more than a 3 times higher risk of engaging in UWCB when compared to their counterparts (Haley et al., 2010). As mentioned previously, female adolescents were more likely to engage in UWCB. One study revealed that female adolescents who engaged in UWCB exhibited 4.2 times higher odds of suicidal thoughts and 3.4 times higher odds of suicide attempts than their counterparts (Cook et al., 2007).

Relationships between UWCB and sex-related behaviors also have been reported. For example, researchers suggested that female adolescents who engaged in UWCB were more likely to report being sexually active (McGuire et al., 2002). The study indicated that adolescent girls who engaged in UWCB exhibited a 1.6 times higher odds of ever had vaginal intercourse compared to the girls who did not engage in UWCB (Cook et al., 2007). When examining relationships between UWCB and sexual behaviors from the prevention perspectives, researchers suggested that values related to abstinence from alcohol and sex appear to be protective factors against unhealthy eating behaviors, and may reflect a general resilience that buffers against a broad range of health risk behaviors (French et al., 2001).

Studies also showed that physical and sexual dating violence against adolescents was associated with a 2 to 5 times increased risk of UWCB (Haley et al., 2010; Silverman et al., 2001). Although no literature directly indicated bullying victimization was associated with UWCB, bullying in schools was associated with psychological distress and poor physical health (Rigby, 2003). Thus, a potential linkage between bullying and UWCB has yet to be explored.

The preceding literature review highlights the potential linkages between UWCB and the selected health risk behaviors. However, most of the investigations were based on researcher-

initiated studies with relatively smaller sample sizes. In addition, most of the aforementioned associations relied on bivariate statistics. Collectively, these findings suggested paired associations between UWCB and the selected risk behaviors among adolescents, and strength of association varied from study to study. Thus, more timely, in-depth, and inclusive investigations with multivariate statistical analysis are warranted.

As health behavior researchers suggested, practitioners and researchers should attempt to address multiple behaviors, not merely one health practice at a time, and consider contextual and environmental factors necessary to understand the broader context and more effectively influence health behaviors (Werch et al., 2009). Therefore, this study aimed to elucidate the associations between UWCB and health risk behaviors based on nationally representative participants. The results can help provide discerning information for planning prevention and intervention programs.

Methods

Study Design

Data for this study were obtained from the national YRBS administered in 2009. Conducted every 2 years, YRBS tracks the prevalence of health risk behaviors that can lead to morbidity and mortality among US high school students. A three-stage cluster sampling method and a weighting system were applied to represent all students attending high school in the country. In the data set, several variables were assessed by more than one item. All results presented in this study are based on analyses of weighted data. A detailed description of survey methodology is available elsewhere (Brener et al., 2004).

Measures

Variables examined in this study were originated from 25 YRBS items and recoded according to YRBS definitions (Eaton et al., 2010). UWCB was assessed by participant's "Yes"

response to at least one of the following 3 questions: “During the past 30 days, did you go without eating for 24 hours or more (also called fasting) to lose weight or to keep from gaining weight?” (Response options: Yes, No); “During the past 30 days, did you take any diet pills, powders, or liquids without a doctor’s advice to lose weight or to keep from gaining weight? (Do not include meal replacement products such as Slim Fast.)“ (Response options: Yes, No); and “During the past 30 days, did you vomit or take laxatives to lose weight or to keep from gaining weight?” (Response options: Yes, No). Hence, UWCB is considered a dichotomous variable in this study.

Alcohol use in the past 30 days was assessed by 2 questions. Adolescents who responded with at least 1 day to the question, “During the past 30 days, on how many days did you have 5 or more drinks of alcohol in a row, that is, within a couple of hours?” were classified as binge drinking. Students who were not binge drinking but responded at least 1 day to the question, “During the past 30 days, on how many days did you have at least one drink of alcohol?” (Response options: 0 days, 1 or 2 days, 3 to 5 days, 6 to 9 days, 10 to 19 days, 20-39 days, all 30 days), were classified as casual drinking. The students who did not drink in the past 30 days were coded as abstinence.

Cigarette smoking was assessed by the following question: “During the past 30 days, on how many days did you smoke cigarettes?” (Response options: 0 days, 1 or 2 days, 3 to 5 days, 6 to 9 days, 10 to 19 days, 20-29 days, all 30 days). The adolescents who responded 0 day were classified as non-smokers. The students who respond 20 or more days were classified as frequent smokers. The rest were classified as occasional smokers.

Drug use was coded into 3 levels: never used drugs, used drugs beyond 30 days, and used drugs in the past 30 days. The participants who responded one or more times in either one of the

following two questions were classified as used drug in 30 days. “During the past 30 days, how many times did you use marijuana?” and “During the past 30 days, how many times did you use any form of cocaine, including powder, crack, or freebase?” (Response options: 0 times, 1 or 2 times, 3 to 9 times, 10 to 19 times, 20 to 39 times, 40 or more times).

Participants who responded 0 times in the aforementioned questions, but answered at least once in one of the 8 lifetime drug use questions, were coded as used drugs beyond 30 days. The 8 questions included “During your life, how many times have you used marijuana?”; “During your life, how many times have you used any form of cocaine, including powder, crack, or freebase?”; “During your life, how many times have you sniffed glue, breathed the contents of aerosol spray cans, or inhaled any paints or sprays to get high?”; “During your life, how many times have you used heroin (also called smack, junk, or China White)?”; “During your life, how many times have you used methamphetamines (also called speed, crystal, crank, or ice)?”; “During your life, how many times have you used ecstasy (also called MDMA)?”; “During your life, how many times have you taken steroid pills or shots without a doctor's prescription?”, (Response options: 0 times, 1 or 2 times, 3 to 9 times, 10 to 19 times, 20 to 39 times, 40 or more times); and “During your life, how many times have you used a needle to inject any illegal drug into your body?” (Response options: 0 times, 1 time, 2 or more times). Only adolescents who responded 0 times to all 10 questions were classified as never used drugs.

Suicidal behavior was categorized into three levels: never thought about it, suicidal ideation, and suicidal attempt. Suicidal attempt was assessed by asking “During the past 12 months, how many times did you actually attempt suicide?” (Response options: 0 times, 1 time, 2 or 3 times, 4 or 5 times, 6 or more times). Adolescents who responded 1 or more times were classified as attempting suicide. Suicidal ideation was assessed by asking "During the past 12 months, did you

ever seriously consider attempting suicide?” Adolescents who responded “yes”, but answered no in suicidal attempts, were coded as having suicidal ideation but no attempts.

Three questions assessed sexual behavior and sexual partners: “Have you ever had sexual intercourse?” (Response options: Yes, No); “During your life, with how many people have you had sexual intercourse?” (Response options: I have never had sexual intercourse, 1 person, 2 people, 3 people, 4 people, 5 people, 6 or more people); and “During the past 3 months, with how many people did you have sexual intercourse?” (Response options: I have never had sexual intercourse, I have had sexual intercourse but not during the past 3 months, 1 person, 2 people, 3 people, 4 people, 5 people, 6 or more people). Students who responded with 2 or more people either in the past 3 months or lifetime were classified having multiple sex partners. Adolescents who responded never having sexual intercourse in all 3 questions were classified as never had sex. The remainder were classified as having sex with one partner.

In this study, violence included physical violence, sexual violence, and been bullied. Physical violence was assessed by asking “During the past 12 months, did your boyfriend or girlfriend ever hit, slap, or physically hurt you on purpose?” Sexual violence was assessed by asking “Have you ever been physically forced to have sexual intercourse when you did not want to?” Been bullied was assessed by asking “During the past 12 months, have you ever been bullied on school property?” All questions had 2 response options: Yes or No.

Data Analysis

To explore relationships between UWCB and the selected risk behaviors including alcohol use, cigarette smoking, drug use, multiple sex partners, and suicidal behavior, Goodman and Kruskal’s Gamma statistics were used to determine bivariate correlations due to the ordinal data format. Bivariate relationships between UWCB and physical violence, sexual violence, and been bullied were evaluated by Pearson’s Phi coefficient due to binary data format. Multiple logistic

regression was conducted to determine the odds ratios for the main effects while controlling the other covariates. To assure the quality of analysis, the descriptive statistics were fully compared with the official YRBSS statistics on the Youth Online. All analyses were conducted by gender because the literature suggested existence of significant differences by gender in each of these health risk behaviors. IBM SPSS Statistics 19.0 software was used to conduct the data analyses and to account for the complex sampling design and weighting of data.

Results

The 2009 YRBS survey included 16,410 participants, with 47.8% female. Grade levels were fairly evenly distributed with slightly more (28%) 9th graders and fewer (22.2%) 12th graders. Most students were Caucasian (58.7%), followed by Hispanic and Multiple races with Hispanic origin (18.6%), African American (14.4%), Multiple Races and non-Hispanic origin (3.6%), Asian (3.4%), Native Hawaiian/Other Pacific Islander (0.8%), and American Indian/Alaska Native (0.6%).

Table 1 presents the two-way contingency table of UWCB and the selected health risk behaviors by gender. Proportions of UWCB were found in ascending order, while strength or severity of health risk behaviors was increased for both female and male adolescents. This finding implies a dose-response relationship in the associations of UWCB and each of the selected risk behaviors. In addition, the Goodman and Kruskal's Gamma statistics indicated that UWCB was highly correlated with each of the selected health risk behaviors ranging from .34 to .62 with very high statistical significance ($p < .001$). Among the selected risk behaviors, the highest UWCB prevalence rates were observed in both female (46.0%) and males (40.5%) adolescents who attempted suicide. Suicidal behaviors also showed the highest correlation with UWCB in female adolescents ($r = .552$, $p < .001$) and male adolescents ($r = .621$, $p < .001$). The Pearson's Phi coefficients indicated UWCB was associated with physical violence, sexual

violence, and been bullied among both male and female adolescents (r_{ϕ} ranged from .11 to .19). All correlation coefficients were highly significant at $p < .001$ level.

Table 2 presents relationships between UWCB and selected health risk behaviors by gender. The logistic regression model revealed that, after controlling for confounding risk behaviors, the strongest relationship between UWCB and the selected health risk behaviors was suicidal behavior in both male and female adolescents. Among female adolescents, when compared with adolescents who never thought about suicide, those who had suicidal ideation exhibited significantly elevated risk to engage in UWCB (OR=2.04; 95% CI, 1.65-2.52), and with a 3.2 times significantly higher risk for those who attempted suicide (OR=3.19; 95% CI, 2.55-4.00). In addition, female adolescents who ever tried drugs beyond 30 days exhibited significantly higher risk (OR=1.78; 95% CI, 1.47-2.15), and those who used drugs in the past 30 days exhibited an even higher risk (OR=1.90; 95% CI, 1.51-2.37) compared with those who never used drugs. In comparison to those who never smoked, both female occasional smokers and frequent smokers demonstrated an elevated risk of engaging in UWCB (OR=1.71; 95% CI, 1.38-2.10 for occasional smokers; OR=1.73; 95% CI, 1.31-2.27 for frequent smokers). Compared with abstinence, casual drinking females tended to engage in UWCB with OR at 1.37 (95% C.I.: 1.12-1.67), and binge drinking females were at higher risk (OR=1.53, 95% C.I.: 1.25-1.86). One additional significant risk behavior was been bullied. Female adolescents who have ever been bullied exhibited a higher risk of UWCB compared to those who had not been bullied (OR= 1.35; 95% CI, 1.14-1.60)

Conversely, the logistic regression model revealed 7 significant health risk behaviors among male adolescents. After controlling for other health risk behaviors, male adolescents who reported suicidal ideation had a 1.69 times higher risk of engaging in UWCB (95% C.I.: 1.20-

2.38), and those who attempted suicide had a 3.55 times higher risk (95% C.I.: 2.51-5.03) when compared with those who never think about suicide. In reference to abstinence, both casual drinking and binge drinking male adolescents had a higher risk of engaging in UWCB (OR= 1.47; 95% CI, 1.08-2.01 for casual drinking, and OR=2.16; 95% CI, 1.63-2.85 binge drinking). In addition, having one sex partner showed a 1.44 times higher risk of UWCB (95% C.I.: 1.13-1.86), and multiple sex partners showed 1.64 times higher risk (95% C.I.: 1.22-2.22), when compared to those who never had sex. Both male occasional smokers (OR=1.65; 95% CI, 1.24-2.19) and frequent smokers (OR=1.41; 95% CI, 1.01-1.99) had a higher risk of engaging in UWCB when compared to those who never smoke. Lastly, male adolescents who were victims of physical violence (OR=1.47; 95% CI, 1.10-1.95), sexual violence (OR=1.71; 95% CI, 1.14-2.57), and been bullied (OR=1.85; 95% CI, 1.47-2.32) also showed a higher risk of engaging in UWCB when compared to those who were not victims.

Discussion

Our multivariate analyses based on a nationally representative sample confirmed some of the bivariate findings in the literature and provided more in-depth statistical analyses. Co-occurrences of UWCB and the selected risk behaviors were found in both male and female adolescents. However, our findings also suggested different degrees of the association. Although our bivariate analysis revealed significant associations between UWCB and all of the selected health risk behaviors in both genders, the multivariate analyses suggested a different list of significant risk behavior associations between males and females. Among female adolescents, alcohol drinking, cigarette smoking, drug use, suicidal behaviors, and been bullied were associated with UWCB, while male adolescent's UWCB exhibited significant associations with alcohol drinking, cigarette smoking, multiple sex partners, suicidal behaviors, physical violence, sexual violence, and been bullied.

Consistent with the findings from previous studies (Cance et al., 2005; Croll et al., 2002; Haley et al., 2010), adolescents in this study who used substances such as alcohol, cigarette, and drugs were more likely to engage in UWCB. Although Haley and colleagues' bivariate analysis (2010) showed that girls who used alcohol, illicit drugs, and tobacco were 3-4 times more likely to engage in UWCB than non-users, our multivariate analysis with an adjustment over the other 7 risk behaviors showed female substance users had only about 1.7 times elevated risk compared to non-users. The strength of the association was similar with Cance and colleagues' multivariate analysis controlling for demographics and other substance use. In addition, findings from this study suggested a higher risk of UWCB among female adolescents when they used more substances in frequency or quantity. However, this phenomenon was only observed with alcohol use among male adolescents.

In regard to the relationship between UWCB and sexual behaviors, previous studies showed female adolescents who engaged in UWCB were approximately 1.6 times more likely to report being sexually active (Cook et al., 2007; McGuire et al., 2002). Although our bivariate analysis supported this association among female adolescents, the multivariate analysis did not suggest a statistically significant association. Yet, our findings suggested male adolescents who had one sexual partner were 1.4 times more likely to engage in UWCB than male adolescents who had not have sex. Moreover, male adolescents who had multiple sexual partners exhibited an even higher likelihood (1.6 times) to engage in UWCB when compared to those who never had sex.

In addition, the strong association between UWCB and suicidal behavior echoed similar strength (2-4 times) of the association found in previous studies (Cook et al., 2007; Kim et al., 2009; Silverman et al., 2001). However, the association between UWCB and suicidal behavior

was in a different direction. Our findings suggested that adolescents who attempted suicide exhibited a higher risk of UWCB than those who only contemplated (thought about suicide), while Cook and colleagues' multivariate analysis (2007) found that adolescents with suicidal ideation exhibited higher risk of UWCB than those who attempted suicide. Such differences warranted further investigation.

Our multivariate findings also confirmed the association between UWCB and violence behaviors. Male adolescents who experienced physical and sexual violence, (Haley et al., 2010; Silverman et al., 2001) and had been bullied in school, tended to be more likely to engage in UWCB, while female only adolescents exhibited a significant association between UWCB and the experience of being bullied. Our findings did not show multivariate significance in the association between UWCB and physical and sexual violence among females. This result differs from Silverman and colleagues' multivariate analysis (2001) using 1997 and 1999 Massachusetts YRBS, which showed strong associations between UWCB and physical and sexual violence among female adolescents. Whether such differences occurred due to sample size (7,300s vs. 2,000s), year of study (2009 vs. 1997 and 1999), coverage (U.S. vs. 1 state), outcome variable in the regression (UWCB vs. lifetime violence from dating partners), selection of covariates in the regression, or other methodological considerations can shed light for future studies. Moreover, the study had shown that bullying occurs when conflict exists involving an imbalance of power in which the victim is less powerful than the aggressor (Rigby, 2003). Findings in the current study may imply that male students with UWCB were relatively less powerful than their male counterparts and their intimate sexual partner. Results from the study suggest prevention efforts should be extended to male adolescents who experienced physical and sexual violence and had been bullied on school property.

Results from this study clearly demonstrate links between UWCB and the selected health risk behaviors, future research should determine the underlying psychological and social mechanisms behind the co-occurrence of these health risk behaviors for use in developing more effective interventions that address multiple risk behaviors. Such research initiatives may include the development of more detailed, multiple-item instruments with sound psychometric properties to assess each of the selected health risk behaviors among adolescents.

Some study limitations should be noted. Due to the cross-sectional design, the direction of causality between UWCB and selected health risk behaviors cannot be determined. In addition, though the data included representative samples of high school adolescents across the U.S., which allows for the extrapolations of findings from the study population to a larger extent, the results do not represent adolescents who did not attend school.

With the limitations and the needs for additional research duly noted, findings from this study still have significant implications for intervention and prevention program for adolescents in a number of ways. First, health risk behaviors were prevalent and highly associated with each other among high school adolescents. As a result, school health professionals should routinely screen UWCB and the related health-compromised behaviors to help identifying high-risk adolescents, especially those with more frequent or a greater degree of exposure, such as heavy alcohol drinkers, frequent smokers, recent drug users, and those who had multiple sex partners and have attempted suicide. Second, although female adolescents were more prevalent in UWCB, male adolescents who engaged in UWCB also need attention because health risk behaviors such as suicidal behaviors, substance use, multiple sexual partners, physical and sexual violence, and having been bullied can co-occur with their UWCB. Lastly, adolescents who engaged in UWCB face a higher risk of engaging in many different health-compromising

behaviors. Therefore, practitioners working in school, community, and clinical sites to combat substance abuse, sexual risk behavior, suicidal behavior, and violence are encouraged to include UWCBS in the range of their prevention programs. Intervention programs with comprehensive strategies that cover multiple risk behaviors are highly recommended.

Table 4-6 UWCB distribution by sex and selected health risk behaviors

Health Risk Behaviors	Female				Correlation	Male				Correlation
	Yes n	%	No n	%		Yes n	%	No n	%	
Alcohol					.417***					.437***
Abstinance	487	12.2	3519	87.8		233	5.1	4304	94.9	
Casual drinking	274	21.2	1018	78.8		96	8.6	1019	91.4	
Binge drinking	540	31.1	1194	69.9		335	16.7	1666	83.3	
Tobacco					.506***					.466***
Non-smoker	795	14.2	4823	85.8		317	5.9	5097	94.1	
Occasional smoker	369	33.5	733	66.5		229	13.7	1437	86.3	
Frequent smoker	183	38.9	287	61.1		127	20.3	499	79.7	
Drug					.449***					.370***
Never used drug	536	12.2	3869	87.8		275	6.0	4298	94.0	
Used drug beyond 30 days	385	25.3	1134	74.7		158	11.2	1252	88.8	
Drug use in 30 days	446	33.8	875	66.2		281	15.1	1580	84.9	
Sexual Risk Behavior					.338***					.423***
Never had sex	537	13.7	3381	86.3		223	5.3	3974	94.7	
Had sex- one partner	491	21.3	1815	78.7		218	10.4	1883	89.6	
Had sex- multiple partners	326	32.9	666	67.1		246	17.4	1170	82.6	
Suicidal Behavior					.552***					.621***
Never thought about it	854	14.6	4980	85.4		470	7.0	6271	93.0	
Suicidal ideation but never attempted	216	32.0	460	68.0		61	12.9	424	87.1	
Attempted	263	46.0	309	54.0		137	40.5	201	59.5	
Physical Violence					.112***					.120***
Yes	233	32.9	475	67.1		170	20.1	676	79.9	
No	1226	17.7	5698	82.3		625	8.4	6819	91.6	
Sexual Violence					.141***					.191***
Yes	271	35.1	500	64.9		129	35.8	231	64.2	
No	1131	17.1	5497	82.9		653	8.4	7088	91.6	
Been bullied					.114***					.111***
Yes	428	27.8	1112	72.2		245	16.6	1235	83.4	
No	962	16.8	4770	83.2		529	8.1	5990	91.9	

Note: ***: p<.001

Table 4-7 Relationships between UWCB and selected health risk behaviors by sex

Health Risk Behaviors	Female		Male	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Alcohol				
Casual drinking	1.37**	1.12, 1.67	1.47*	1.08, 2.01
Binge drinking	1.53***	1.25, 1.86	2.16***	1.63, 2.85
Abstinence	Reference			
Tobacco				
Occasional smoker	1.71***	1.38, 2.10	1.65***	1.24, 2.19
Frequent smoker	1.73***	1.31, 2.27	1.41*	1.01, 1.99
Non-smoker	Reference			
Drug				
Used drug beyond 30 days	1.78***	1.47, 2.15	1.15	0.87, 1.53
Drug use in 30 days	1.90***	1.51, 2.37	0.92	0.68, 1.26
Never used drug	Reference			
Sexual Risk Behavior				
Had sex-one partner	1.01	0.84, 1.20	1.44**	1.13, 1.86
Had sex-multiple partners	1.18	0.93, 1.49	1.64***	1.22, 2.22
Never had sex	Reference			
Suicidal Behavior				
Suicidal ideation but never attempted	2.04***	1.65, 2.52	1.69**	1.20, 2.38
Attempted	3.19***	2.55, 4.00	3.55***	2.51, 5.03
Never thought about it	Reference			
Physical Violence				
Yes	1.20	0.95, 1.52	1.47**	1.10, 1.95
No	Reference			
Sexual Violence				
Yes	1.23	0.98, 1.55	1.71**	1.14, 2.57
No	Reference			
Been bullied				
Yes	1.35***	1.14, 1.60	1.85***	1.47, 2.32
No	Reference			

Note: *: p<.05, **: p<.01, ***: p<.001

CHAPTER 5 SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS

Summary

The present study focused on the Unhealthy Weight Control Behaviors (UWCB) among high school students. Specifically, the study served three purposes: 1) to estimate the trends of UWCB and Healthy Weight Control Behavior (HWCB). 2) to identify the predictive factors of UWCB. 3) to explore the relationship between UWCB and the selected health risk behaviors.

The study in Chapter 2 analyzed YRBS 1999-2009 data to examine the possible linear and quadratic trends of HWCB and UWCB among high school students. Findings suggested weight control behaviors were prevalent among high school students. Moreover, a significant linear descending trend of UWCB and a significant linear ascending trend of HWCB were identified. Subgroup analyses also showed the presence of similar trends of HWCB and UWCB by sex, ethnic groups, and BID status. The bivariate analyses on the pooled data revealed that female adolescents and nonoverweight adolescents with BID tended to engage more in both HWCB and UWCB. Compared with Caucasian, Asian and African American adolescents tended not to engage in UWCB, while adolescents of Hispanic, multiple race with Hispanic origin, and multiple race without Hispanic origin tended to engage more in UWCB. African American and Asian adolescents practiced less HWCB, while adolescents in multiple race with Hispanic origin and Hispanic engaged in more HWCB than Caucasians.

Chapter 3 used the most recent (2009) YRBS data to identify the predictive factors of UWCB among high school students. The stepwise multiple logistic regression with backward elimination modeled 7 predictive factors. Two-way interactions of significant variables were considered and the backward elimination retained 8 significant 2-way interaction effects. However, the complex model with 8 interaction effects only reduced 1.5% of Akaike

Information Criterion (AIC), which judges the model by how close its fitted values tend to be the true expected values. Therefore, the model with 7 main effects without interactions was adopted. The final logistic regression revealed that trying to lose weight, being American Indian/Alaska Native or multiple race/ethnicity, nonoverweight but having body image distortion (BID), eating the recommended amount of vegetables, being female, drinking sugar-sweetened beverage daily, and being not vigorous in physical activity tended to engage more in UWCB.

Chapter 4 also used 2009 YRBS data to explore the relationships between UWCB and selected health risk behaviors. The bivariate analysis revealed significant association between UWCB and alcohol use, cigarette smoking, drug use, suicidal behaviors, multiple sexual partners, physical and sexual violence, and been bullied among both male and female adolescents. Findings from this analysis also indicated a dose-response relationship in the associations of UWCB and each of the selected risk behaviors. Moreover, the multivariate analysis identified significant associations between UWCB and suicidal behaviors, drug use, cigarette smoking, alcohol use, and been bullied among female adolescents, while male adolescents demonstrated more significant associations, including suicidal behaviors, alcohol use, multiple sexual partners, cigarette smoking, physical and sexual violence, and been bullied.

Conclusions

These investigations represented the first efforts to examine trends of weight control behaviors, predictive factors of UWCB, associations between UWCB and selected health risk behavior among high school adolescents based on national representative survey data. Findings from this line of research suggested one out of seven adolescents engaged in UWCB in 2009 and confirmed female adolescents were at higher risk of engaging in UWCB (K. Boutelle et al., 2002; Fonseca et al., 2009; Lowry et al., 2002; McCabe & Ricciardelli, 2009; D. Neumark-Sztainer et al., 2006; Striegel-Moore et al., 2009). This study also confirmed that Body Image

Distortion increased the risk of UWCB (Liechty, 2010) and further demonstrated the elevated risk of UWCB among the nonoverweight adolescents with BID. Findings in this study also verified that vigorous physical activity was a strong protective factor against UWCB (D. R. Neumark-Sztainer et al., 2007), while daily sugar-sweetened beverage consumption was identified as a risk factor.

In regards to the associations between UWCB and selected health risk factors, this study confirmed adolescents who used substances, such as alcohol, cigarette, and drug were more likely to engage in UWCB (Cance et al., 2005; Croll et al., 2002; Haley et al., 2010). In addition, the strong association between UWCB and suicidal behavior echoed similar strength (2-4 times) of the association found from the previous studies (Cook et al., 2007; Kim et al., 2009; Silverman et al., 2001). However, the association between UWCB and suicidal behavior was found in different direction after multivariate analysis. Our findings suggested that adolescents who attempted suicide exhibited higher risk of UWCB than those who only contemplated (thought about suicide), while Cook and colleagues' multivariate analysis (2007) showed the adolescents with suicidal ideation exhibited higher risk of UWCB than those who attempted suicide. Lastly, Male adolescents who experienced physical and sexual violence (Haley et al., 2010; Silverman et al., 2001) and been bullied in school tended to be more likely to engage in UWCB, while female adolescents only exhibited significant association between UWCB and the experience of being bullied.

Recommendations for Future Research

The findings of this study suggest the following actions:

- To investigate the latent effects such as social and culture influences behind associations between UWCB and sex, race/ethnicity, and BID.

- To investigate the mechanisms of how BID interacts with UWCB in order to provide insights to the effectiveness of UWCB prevention programs.
- To monitor the weight control behaviors, weight control knowledge dissemination, and obstacles to healthy weight control behaviors to provide insights for weight control program planning specifically targeting adolescents.
- To determine the underlying psychological and social mechanisms behind the co-occurrence of these health risk behaviors and to develop more effective interventions with coverage of multiple risk behaviors. Such research initiatives may include the development of more detailed, multiple-item instruments with sound psychometric properties to assess each of the selected health risk behaviors among adolescents.

Implications

Despite the need for further research, findings of this study have significant implications for prevention/intervention programming with adolescents in a number of important areas. First, UWCB is prevalent in some populations. As a result, early identification of eating disorders is recommended as it had been shown to lead to more successful treatment outcomes (Bulik et al., 2007). Thus, school health professionals should routinely screen UWCB and the related health-compromised behaviors to help identifying high-risk adolescents, especially the ones with more frequent and/or greater degree of exposure, such as heavy alcohol drinker, frequent smokers, recent drug users, and those who had multiple sex partners and have attempted suicide. Second, based on our findings, it is reasonable to believe a brief assessment of weight status and BID can help identify adolescents at risk. By strengthening the prevention efforts for such an at-risk population, the lower risk of UWCB can be projected. Third, although UWCB appeared more prevalent among female adolescents, male adolescents who engaged in UWCB also need

attentions because health risk behaviors, such as suicidal behaviors, substance use, multiple sexual partners, physical/sexual violence and been bullied could co-occur with their UWCB. Fourth, a combination of encouraging vigorous physical activity and discouraging sugar-sweetened beverage consumption can yield great benefits in promoting healthy weight control behaviors and preventing the unhealthy weight control behaviors. Lastly, adolescents who engaged in UWCB are at higher risk of engaging in many different health-compromising behaviors. Therefore, the practitioners working in school, community, and clinical sites to combat substance abuse, sexual risk behavior, suicidal behavior, and violence are encouraged to include UWCB in the range of their prevention programs. Intervention programs with comprehensive strategies that cover multiple risk behaviors are highly recommended.

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BIOGRAPHICAL SKETCH

Chung-Bang “Ben” Weng was born in 1974 in Chia-Yi, Taiwan. Ben grew up in southern Taiwan and graduated from Chia-Yi High School in 1992. Ben attended the Fu-Jen Catholic University (FJU) and earned a Bachelor of Physical Education degree in 1996. In summer 1999, Ben enrolled at the Central Michigan University pursuing Master of Art in exercise science. Upon graduation, Ben continued his study at the Illinois Institute of Technology and earned a Master of Science in computer science degree in 2002. Ben started teaching website design, database, and computer network at Northern Taiwan Institute of Technology since 2003. Ben also taught badminton, golf, volleyball, and several other P.E. courses in FJU and Ming-Chun University since 2004. Ben’s teaching experience in Taiwan led him to pursue the Ph.D. degree in health related field.

Ben entered the Ph.D. program in the Department of Health Education and Behavior at the University of Florida (UF) in 2007. During his first year at UF, Ben explored a range of health behaviors and clarified his research focus. He developed a line of research investigating weight control behaviors among young people. Ben’s doctoral dissertation includes three scientific manuscripts readily to submit for peer review in scholarly journals. Ben received a Doctor of Philosophy degree in health and human performance with an emphasis in health behavior and a minor in statistics through the College of Health and Human Performance in December of 2011.