DISSERTATION

GENDER, RACE, YEAR IN SCHOOL AND FIVE CO-OCCURRING HEALTH RELATED BEHAVIORS OF COLORADO STATE UNIVERSITY STUDENTS

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ABSTRACT

GENDER, RACE, YEAR IN SCHOOL AND FIVE CO-OCCURRING HEALTH RELATED BEHAVIORS OF COLORADO STATE UNIVERSITY STUDENTS

The incidence of premature morbidity and mortality reduces when individuals practice protective health related behaviors (HRBs) such as not smoking cigarettes or marijuana, limiting alcohol consumption, participating in regular physical activity, and consuming five or more servings of fruits and vegetables daily. Research indicates that many college students do not practice multiple protective HRBs, yet most educational interventions are aimed at changing only one HRB. Therefore, the purpose of this study was to investigate college student's co-occurring risk and protective health behaviors in order to provide insight to health educators regarding what HRBs to include in multiple health behavior change (MHBC) interventions and how to tailor and target the interventions based on race, gender, and year in school.

This study assessed Colorado State University (CSU) students' pairs and clustering HRBs by gender, race, and year in school via an analysis of a pre-collected National College Health Assessment (NCHA). The final sample consisted of 928 undergraduate students aged 18-23 years old who were enrolled in one of eight class sections of an elective Health and Wellness class in the spring 2009 semester, who attended class the day the NCHA was administered, and who volunteered to participate. The sample was not representative of the total CSU population when considering major of study, year in school and age, but was representative by gender and race.

A quantitative, non-experimental, cross-sectional design was used to explore the relationship between co-occurring HRBs and gender, race, and year in school of students at one

point in time. Descriptive statistics revealed that 39% of the students practiced at least three of five risk HRBs. Cluster analysis showed 27 patterns of risk and protective HRBs with 63% of students in five clusters. Regression demonstrated that more females than males were likely to be in three of the five HRB clusters, and upperclassman were less likely to be in two of the five clusters. Phi statistical test showed a significant association between five of the ten HRB pair combinations, and regression demonstrated that more females than males practiced one risk pair and males more than females practiced three risk pairs.

The study helps improve the understanding of how health behaviors co-occur in college students and provides college administrators and health educators insights into the behaviors to include in MHBC interventions, how to prioritize interventions, which students to target and how to tailor the interventions. Findings from the study will help plan interventions aimed at preventing clusters and pairs of risk HRBs in college students, which may potentially be more effective, more economical and less demanding for health educators than interventions targeted to single HRBs.

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CHAPTER 1: INTRODUCTION

The incidence of premature morbidity and mortality reduces when individuals practice protective health behaviors, such as avoiding tobacco, eating a healthy diet, exercising regularly, drinking alcohol in moderation, avoiding illegal drugs, practicing safe sex, avoiding sunbathing and tanning beds, and keeping immunizations up-to-date (Glanz, Rimer, & Viswanath, 2011). In contrast, many opposing risk health behaviors (e.g., smoking cigarettes, not participating in physical activity, too much alcohol consumption, etc.) promote premature death and disability that result mainly from chronic diseases such as heart disease, stroke, cancer, emphysema, chronic obstructive pulmonary disease, and arthritis (National Center for Health Statistics [NCHS], 2009). Specifically, 50% of the mortality in the United States is linked to health related behaviors (HRBs), which have both health-protective and health-risk effects (Powell, 1988; United Health Foundation, 2006).

Not all Americans practice protective behaviors. According to the 2010 Behavioral Risk Factor Surveillance System (BRFSS), a compilation of annual state-based health surveys, 51% of U.S. adults over the age of 18 years did meet recommendations for physical activity, 24% did meet fruit and vegetable consumption recommendations, and 81% did meet smoking cigarettes recommendations (Centers for Disease Control and Prevention [CDC], 2010.

Also, many college students do not practice protective HRBs (American College Health Association [ACHA], 2010). According to the 2010 spring National College Health Assessment [NCHA], a compilation of U.S. college-based health surveys, 49% of students did meet physical activity recommendations, 6% consumed the recommended daily servings of fruit and vegetables, 82% did not smoke cigarettes, 83% did not smoke marijuana, and 65% did not binge drink (ACHA, 2010).

Due to the need to promote protective HRBs, health professionals design interventions to meet the objectives outlined in Healthy People, a national health promotion directive aimed at increasing the adoption of protective HRBs (U.S. Department of Health & Human Services [U.S. DHHS], 2000). Similarly, Healthy Campus aims to improve student health through college campus interventions. The objectives pertain to physical activity, obesity and being overweight, tobacco use and substance abuse, responsible sexual behavior, mental health, injury and violence, environmental quality, immunizations, and access to healthcare (ACHA, 2002).

Research Rationale

Achieving the objectives outlined in Healthy Campus (ACHA, 2002) may be the key to improving the health of college students. Research suggests many adult behaviors are established during late adolescence, a time when many people attend college (Dishman & Sallis, 1994). Based on the U.S. Census estimates, 12.1 million individuals ages 18-24 were enrolled in post-secondary institutions in 2009 (U.S. Census Bureau, 2011a). The potential impact is considerable because in the college setting, a large population base is centrally located and readily accessible for interventions.

When implementing college campus interventions, health professionals benefit by understanding the HRBs of college students. Compared to non-college peers of similar age, college students' HRBs vary in degree. For instance, compared to their non-college peers, a greater percentage of college students practice the risk behavior of binge drinking, but more college students practice protective behaviors of not smoking cigarettes or marijuana (Johnston, O'Malley, Bachman, & Schulenberg, 2009). Health educators should implement interventions designed specifically for college students' needs.

Statement of Problem

Health educators are faced with an overwhelming task when implementing health intervention programs (Farrell, 2008). They must understand student health trends, determine the areas of highest priority, design new programs, evaluate current strategies, and allocate staff and monetary resources for intervention programs (ACHA, 2005a; Bernhardt, 2006). Program implementation is increasingly difficult due to the current economic crisis and the subsequent decline in financial resources to support health interventions (Christmas, 2010). Consequently, alternative approaches are needed that are effective, economical, and less demanding for health educators (Prochaska, Spring, & Nigg, 2008).

To identify alternative approaches, Bernhardt (2006) suggested evidence-based intervention strategies, and Prochaska (2008) suggested interventions that target more than one health behavior. However, there is limited evidence-based intervention research that addresses multiple health behavior changes (MHBC) in college students (Prochaska et al, 2004; Werch et al., 2007; Werch et al., 2008). Most health behavior interventions focus on changing a single behavior (King, Marcus, Pinto, Emmons, & Abrams, 1996; Nigg, Lee, Hubbard, & Min-Sun, 2009; Prochaska, Butterworth et al., 2008; Strecher, Wang, Derry, Wildenhaus, & Johnson, 2002).

The limited number of evidence-based interventions for MHBC is partly due to insufficient knowledge about when and how multiple behaviors change together and which types of interventions promote change (Prochaska, 2008). Inadequate evidence exists regarding theories of health behavior change, which directly address the issue of promoting MHBC (Prochaska, Spring et al., 2008). Without utilizing health behavior theory, health professionals have little insight into how interventions are tailored and targeted for an individual or population (U.S. DHHS, 2005).

To expand theories of changing multiple HRBs, clarification is needed regarding the relationship between HRBs; specifically, to determine whether they are independent or if they co-occur (King et al., 1996; Ory, Jordan, & Bazzarre, 2002). The identification of the co-occurrence of risk and protective health behaviors (multiple behaviors that occur together) provides additional insight into co-variation (multiple behaviors that can be changed together) (Prochaska, 2008; Wankel & Sefton, 1994). For example, the identification of the co-occurrence of two risk behaviors suggests an interrelationship between the behaviors. The deduction can be made that behaviors with common concepts (such as knowledge, belief, or attitudes) may be targeted in an intervention to promote the co-variation of the risk behaviors.

However, there remains inconclusive evidence regarding co-occurring health behaviors in college students and the concepts underlying co-variation. Continued investigations into the co-occurrence of risk and protective HRBs may provide researchers with the knowledge to design successful MHBC interventions to change more than one behavior (Noar, Chabot, & Zimmerman, 2008).

Statement of Purpose

The finding that two behaviors co-occur suggests an interrelationship between the behaviors. Researchers have theorized that because co-occurring behaviors may be apt to change together (co-variation), the identification of the co-occurrence of health behaviors may translate into effective strategies to promote their change (Johnson, Nichols, Sallis, Calfas, & Hovell, 1998; Noar et al., 2008; Wankel & Sefton, 1994). Likewise, identifying behaviors for simultaneous co-variation may be efficient because fewer resources are needed to implement one intervention for multiple risk behaviors versus implementing separate interventions for each behavior (Prochaska, 2008).

The practice of protective and risk HRBs differs based on specific social or demographic characteristics, such as gender, race, living arrangements, and income (Insel & Roth, 2011; Institute for Fiscal Studies, 2004). Tailoring interventions based on common sociodemographic characteristics can be effective in promoting HRB change (CDC, 2010b; Green & Kreuter, 2007). Health educators benefit by understanding the variations of sociodemographic characteristics by co-occurring health behaviors. For example, recognizing that one gender more than the other does not meet recommendations for one pair of co-occurring behaviors leads to an awareness of the highest risk population to target in an intervention.

Through this research, health educators may gain insight into the behaviors to include in MHBC interventions, how to prioritize interventions, which students to target, and how to tailor the interventions. Thus, research into co-occurring HRBs can help health professionals prioritize funding and resources to design efficient and effective MHBC interventions for college students.

The purpose of this study was to (a) identify Colorado State University (CSU) undergraduate students aged 18-23 years old enrolled in an elective Health and Wellness class who practice risk or protective behaviors for each of the five Healthy Campus 2010 (ACHA, 2002) objectives (see Appendix A) for smoking cigarettes, alcohol consumption, smoking marijuana, physical activity, and fruit and vegetable consumption (see Table 1); (b) examine whether HRBs differ by sociodemographic characteristics of gender, race, and/or year in school (see Table 2); (c) identify students who practice risk behaviors for one, two, three, four, and all five of the HRBs; (d) determine whether the number of risk behaviors differ by gender, race, and/or year in school; (e) examine the risk and protective HRB clustering patterns of students and the characteristics of the cluster; (f) determine the co-occurring behaviors from 10 pairs of HRBs and identify the characteristics of the pairs.

Table 1

Classification of Meeting and Not Meeting Healthy Campus 2010 Objectives

Health Related Behaviors	Meet Objective	Not Meet Objective
Smoking cigarettes	Never used or have used but not in the past 30 days	≥ 1 day in past 30 days
Alcohol consumption	No binge drinking in the past 2 weeks	Binge drink at least one or more times in the past 2 weeks
Smoking marijuana	Never used or have used but not in the past 30 days	≥ 1 day in past 30 days
Physical activity	≥3 days of moderate (30 min.) or vigorous (20 min.) in week	< 3 days of moderate (30 min.) or vigorous (20 min.) in week
Fruit and vegetable	≥ 5 servings usually in a day	< 5 servings usually in a day

Table 2

Definitions of Sociodemographic Characteristics

Variable	Definition
Race	
White	Indicated White
Non-White	Indicated Black, Asian, Indian, Hispanic, other, or two or more of non-White or a mix of non-White and White
Year in School (undergraduate)	
1st	18-23 yrs and identified as 1st year
2nd	18-23 yrs and identified as 2nd year
3rd	18-23 yrs and identified as 3rd year
4th and 5th	18-23 yrs and identified as 4th and 5th year

Research Questions

The following research questions are addressed in this study:

1. What percentage of students meet and do not meet the Healthy Campus 2010 (ACHA, 2002) objectives and target goals (see Appendix A) for behaviors related to smoking cigarettes, alcohol consumption, smoking marijuana, physical activity, and fruit and vegetable consumption?
2. What are the differences in students who meet and do not meet the Healthy Campus 2010 (ACHA, 2002) objectives by sociodemographic characteristics (gender, race, and year in school)?
3. What percentages of students practice risk behaviors for one, two, three, four, or all five of the risk HRBs?
4. What are the variations for one, two, three, four, or all five of the risk HRBs by sociodemographic characteristics (gender, race, and year in school)?
5. What are the clusters of the five risk and protective HRBs by sociodemographic characteristics (gender, race, and year in school)?
6. What are the pairs of HRBs and do the pairs vary by sociodemographic characteristics (gender, race, and year in school)?

Definition of Terms

The following terms are defined to assist in understanding this research:

1. Binge drinking: more than five drinks on a single occasion (CDC, 2011a).

2. Compensation effects: when individuals perform risk or protective behaviors and offset them by performing opposing risk or protective health behaviors (Nigg et al., 2009). For example, an individual may begin regular protective physical activity as a way to compensate for the calories consumed from risk binge drinking every weekend.

3. Co-occurrence: the association, coupling, or synergy of more than one HRB in an individual or population; includes pairs (two behaviors) and multiple behaviors (more than two) (Prochaska, Spring et al., 2008).

4. Co-variation: the changing of more than one HRB (Prochaska, Spring et al., 2008). For example, stopping both cigarette smoking and binge drinking.

5. Gateway behavior: a behavior that, when intervened upon, acts as an influence on other behavior changes (Nigg et al., 2009).

6. Health protective behaviors: behaviors that positively influence the overall morbidity and mortality of an individual, such as: avoiding tobacco, eating a healthy diet, exercising regularly, drinking alcohol in moderation, avoiding illegal drugs, practicing safe sex, avoiding sunbathing and tanning beds, and keeping immunizations up-to-date (Glanz et al., 2011).

7. Health related behaviors (HRBs): protective and risk behaviors that have a delayed or immediate effect on health (Glanz et al., 2011).

8. Health risk behaviors: behaviors that negatively influence the overall morbidity and mortality of an individual, such as: smoking tobacco, not consuming fruit and vegetables, not exercising, too much alcohol consumption, using drugs, unsafe sex practices, not wearing a seat belt, sunbathing, and not keeping immunizations up-to-date (Glanz et al., 2011).

9. Multiple health behavior change (MHBC): the modification of two or more HRBs together (Prochaska, Spring et al., 2008).

10. MHBC interventions: strategies designed to target as many risk behaviors as feasible rather than limiting the focus to single risk behaviors (Prochaska, Spring et al., 2008).

11. Sequential interventions: strategies designed to change one risk behavior and then to change a second risk behavior (Prochaska, Spring et al., 2008).

12. Simultaneous interventions: strategies designed to simultaneously change two or more target risk HRBs (Prochaska, Spring et al., 2008).

13. Sociodemographic characteristics: demographic and social characteristics of an individual or population (e.g., gender, race, and year in school) (Institute for Fiscal Studies, 2004).

14. Tailored interventions: strategies intended to reach one person. The messaging includes factors important in behavioral change that are typically not included in

targeted messages, such as messages based on the Transtheoretical Model (TTM) constructs (Jibaja-Weiss, Volk, Kingery, Smith, & Holcomb, 2003).

15. Targeted interventions: interventions directed toward a subgroup of the general population, which shares one or more sociodemographic characteristics (Marcus & Forsyth, 2003).

16. Transfer effects: when individuals pass on their knowledge and confidence from one behavior change to another (Nigg et al., 2009).

17. Transtheoretical Model (TTM): a health behavior theory that claims behavior change is not a discrete event but occurs over time through a series of six stages of change (Prochaska & DiClemente, 1983).

Delimitations

The study was based on survey data collected from a sample of CSU undergraduate students, age 18-23 years old, enrolled in an elective Health and Wellness course, and who completed the NCHA assessment during their class periods. Each student was informed regarding the study protocol; completion of the survey was voluntary and agreement to participate was their informed consent. The sample size was the number of individuals enrolled in eight class sections during spring 2009 semester. The survey response rate was 97%, (N = 1,025) with 3% not completing the survey because they were absent the day of the survey.

Limitations of the Study

There are certain limitations and conditions that may restrict the scope of this study or influence the outcome. For example, the researcher´s personal experience, beliefs and feelings may have influenced the research methods and interpretation of results. Specifically, the

researcher´s perspective regarding the topic of study and interpretation of results is vulnerable to personal bias.

Further, the study was based on self-reported data, which is subject to error due to participants' having intentionally or unintentionally misreported information (Stevens, 2002). Students may have intentionally misreported HRB information if they felt pressure to give socially accepted responses (ACHA, 2005b). Likewise, subjects may have unintentionally reported HRBs because they did not understand the instructions for interpreting the behavior. For instance, fruit and vegetable consumption is based on the number of servings daily; research demonstrates consumers underestimate serving sizes for fruit and vegetables (Pollard, Daly, & Binns, 2009). Therefore, students may have under-reported consumption. Furthermore, the various time frames (i.e., past seven days, two weeks, and last 30 days) in which the students were asked to recall HRBs may have limited consistency and reliability of responses. Students may have interpreted time frames differently (e.g., past seven days is the last Sunday through Saturday or is today and the last 6 days) or they might have been able to recall HRBs of recent time frames (e.g., last day) more accurately than those farther in the past (e.g., last 30 days).

Another limitation concerns the temporal scope of the survey and whether or not the findings represent actual HRB patterns beyond the time frame in question. Most of the questions about HRBs were specific and bound to certain time periods (e.g., past seven days of physical activity; number of days out of the past 30 days the individual consumed alcohol or smoked cigarettes or marijuana). So the question arises whether, for instance, an individual's physical activity pattern in the past week represented the usual weekly physical activity pattern.

The generalizability of the study findings may be limited due to the selection sample (Stevens, 2002). It was estimated that many of the students surveyed were in the College of

Applied Human Sciences. These students may have had different initial motivations or intentions regarding HRBs. For example, students of those particular majors may have already been mindful of the importance of health and may practice more protective HRBs. Therefore, it is unknown if the sample is representative of the theoretical CSU population who may or may not have practiced more protective HRBs.

Researcher's Perspective

Currently I am a research professional for a national not-for-profit organization which advocates for immunizations. Throughout my career I have worked in other health promotion environments, such as student health, corporate wellness, employee health, cardiac and cancer rehabilitation, and state public health. I have both Bachelor and Master of Science degrees in Health and Exercise Science. My current interest is a holistic approach to health for young adults. I believe the key to promoting life-long healthy behaviors is targeting individuals when they are defining who they are, a time when many individuals attend college. Throughout my career I have faced challenges related to limited resources for health promotion initiatives. That is why my goal is to assist health educators in identifying health intervention approaches that are effective, economical, and less demanding. Therefore, I have chosen co-occurring health behaviors of college students for my research topic.

CHAPTER 2: LITERATURE REVIEW

This chapter provides an overview of the literature related to five Healthy Campus 2010 (ACHA, 2002) (see Appendix A) Health Related Behaviors (HRBs), specifically physical activity, alcohol consumption, fruit and vegetable consumption, smoking marijuana, and smoking cigarettes, and their co-occurrence in college students. The impact on health, prevalence, level of use, sociodemographic characteristics and interventions are reviewed. Literature relating to the success and limitations of multiple health behavior change (MHBC) interventions and health behavior theory is discussed, especially as it relates to co-occurring HRBs.

Health Related Behaviors

Fifty percent of U.S mortality is linked to health behaviors that individuals choose to practice (Powell, 1988; United Health Foundation, 2006). HRBs have both health-protective and health-risk effects, which can either be delayed or immediate. For example, health behaviors that have a protective impact on health include not smoking, limiting alcohol consumption to one serving a day, eating five or more servings of fruit and vegetables a day, etc. These same HRBs can have a risk impact when the opposite is practiced, such as smoking cigarettes, binge drinking, not consuming fruit and vegetables daily, etc. HRBs such as regular physical activity and adequate fruit and vegetable consumption have a more delayed impact on health (e.g., control of cholesterol and overweight and obesity). However, behaviors such as alcohol consumption can have both a long-term impact (e.g., cirrhosis of the liver) and an adverse immediate impact if abused (e.g., binge drinking leading to blood alcohol poisoning).

Many individuals practice multiple risk HRBs and fail to meet the recommendations for protective HRBs. For instance, Fine, Philogene, Gramling, Coups and Sinha (2004), and Pronk,

Peek, and Goldstein (2004) found that a majority of U.S. adults practice two or more risk HRBs. In contrast Reeves and Rafferty (2005) showed that 3% of adults in the United States did meet the Healthy People 2010 (U.S. DHHS, 2000) four objectives for fruit and vegetable consumption, physical activity, smoking, and maintaining a healthy weight.

The same trend is evident in college students. Mellen (2008) identified that 57% of a convenience sample of 912 students practiced three or more risk HRBs related to aerobic exercise, fruit and vegetable intake, smoking, and high-risk alcohol consumption. Likewise, Quintiliani, Allen, Marino, Kelly-Weeder, and Li (2010) found that 65% of 1,463 surveyed female students reported more than two risk behaviors for alcohol consumption, smoking cigarettes, physical activity, fruit and vegetable consumption, risky sex, and cervical screening.

Due to the overwhelming need to increase the number of Americans practicing protective HRBs, the U.S. government and the American College Health Association (ACHA) outline health-related objectives every 10 years in two efforts, Healthy People (U.S. DHHS, 2000) and Healthy Campus (ACHA, 2002). These initiatives serve as the basis for the development of state, community, and college plans for interventions related to: physical activity, obesity and overweight, tobacco and substance abuse, responsible sexual behavior, mental health, injury and violence, environmental quality, immunizations, and access to healthcare. The Healthy People (U.S. DHHS, 2000) and Healthy Campus (ACHA, 2002) detail objectives for many HRBs because healthcare burden (both in terms of medical consequences and costs) decreases with the adoption of multiple protective HRBs (Eddington, Yen, & Witting, 1997; Prochaska, Nigg, Spring, Velicer, & Prochaska, 2010; Shinton, 1997).

The following section summarizes literature related to Healthy People (U.S. DHHS, 2000) and Healthy Campus 2010 (ACHA, 2002) objectives for five health behavior: smoking

cigarettes, alcohol consumption, smoking marijuana, fruit and vegetable consumption, and physical activity (see Appendix A). For each HRB, the following is discussed: the impact on health, prevalence, sociodemographic characteristics, interventions, and the need for continued education on college campuses.

Smoking cigarettes

Impact on health. Smoking tobacco has an adverse impact on the nation's overall health by causing increases in illnesses such as cancer and respiratory diseases (United Health Foundation, 2006). The United Health Foundation (2006) and the Centers for Disease Control and Prevention (CDC) (2007) reported that tobacco smoking is the number one preventable risk factor for disease and death. It accounts for more than 440,000 (2%) of the 2.4 million annual deaths in the United States (American Heart Association [AHA], 2010a). Further, for every individual who dies from a smoking-related disease, 20 individuals are living with illnesses attributable to smoking (Hyland et al., 2003). Not only do health problems exist for regular smokers (more than 10 cigarettes a day), but similar health concerns exist for individuals who lightly smoke (fewer than 10 cigarettes a day), occasionally smoke (non-daily), or those involuntarily exposed to second-hand tobacco smoke (Moran, Wechsler, & Rigotti, 2004; U.S. DHHS, 2006).

Prevalence. Smoking cigarettes for adults over the age of 18 in the United States and Colorado declined over the past 10 years (see Figure 1). According to the Behavioral Risk Factor Surveillance System (BRFSS), a compilation of annual state-based health surveys, the percentage of U.S. adults who are current smokers (smoke daily) dropped from 23.2 in 2000 to 17.3 in 2010, a decrease of 25.4% (CDC, 2010a). In Colorado, the percentage of adults who smoke currently dropped from 20.0 in 2000 to 16.0 in 2010, a decrease of 23.1% (CDC, 2010a).

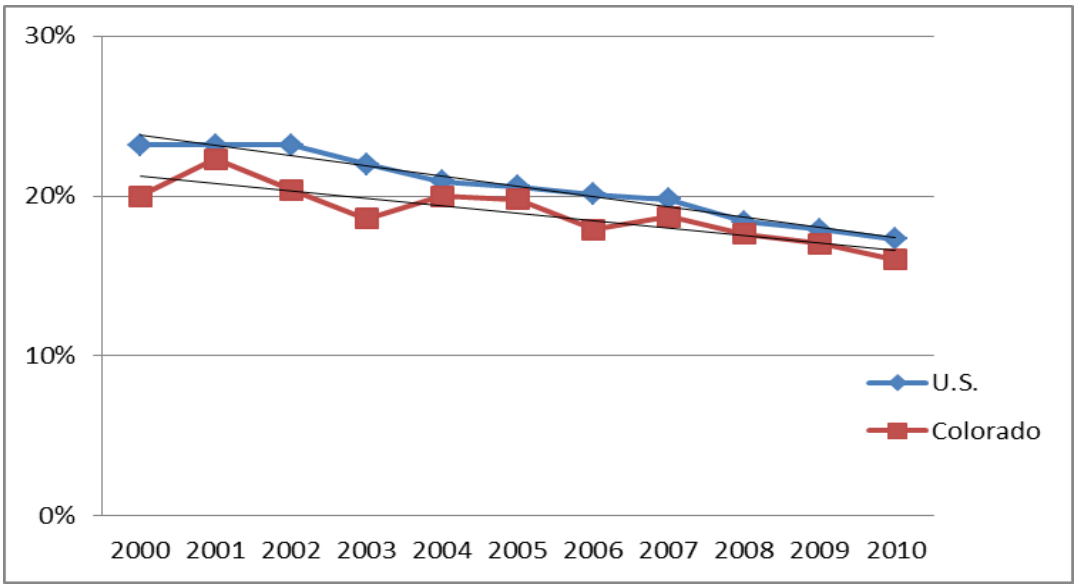

Figure 1. Prevalence of smoking cigarettes daily for adults in the United States and Colorado, 2000 to 2010.

Note. From "Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System: Prevalence and Trends Data, 2000-2010."

The same downward trend can be observed in college students (see Figure 2). The spring 2010 American College Health Association (ACHA) Reference Report indicated that 16% of college students smoked cigarettes in the last 30 days (ACHA, 2010). The target goal of Healthy Campus 2010 (ACHA, 2002) was to decrease the percentage of college students who smoked cigarettes from the baseline of 25.1% in 2000 to 10.5% in 2010. Over the past decade there was a 36% decrease in the percentage of college students who smoke cigarettes, 5.5 percentage points under the 2010 target goal.

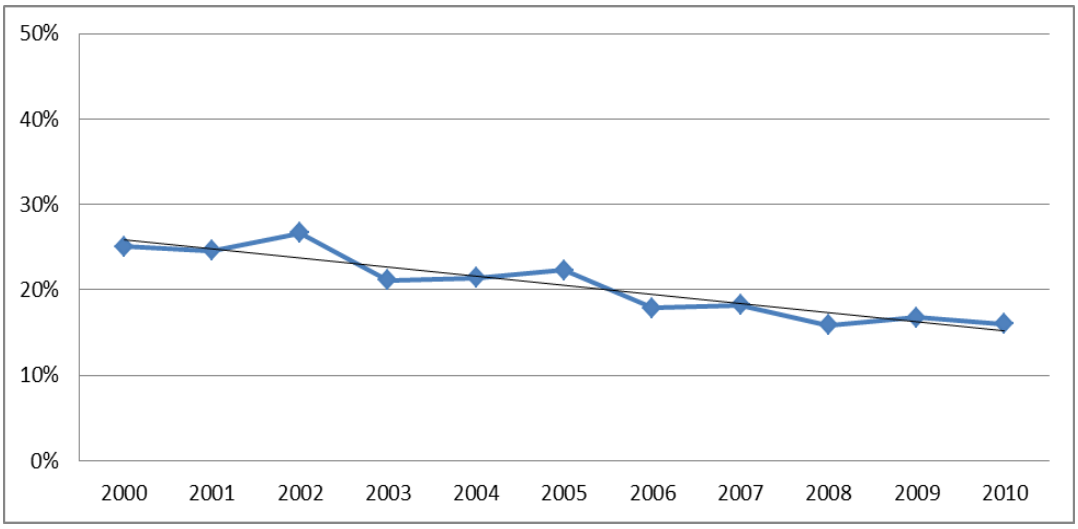

Figure 2. Prevalence of smoking cigarettes in the last 30 days for college students in the United States, 2000 to 2010.

Note. From "American College Health Association - National College Health Assessment: Reference: Publications and Reports, 2000-2010."

The national decline in smoking is partly attributable to increases in tobacco control programs to prevent smoking (Copeland, Kulesza, Patterson, & Terlecki, 2009). The increase of tobacco control programs, funded by the CDC, support state- and community-based efforts to reduce tobacco use by improving health communication, cessation programs, surveillance, and program evaluation (CDC, 2007). Many of the tobacco control programs have prompted environmental changes, such as smoke-free policies in work and public places as restaurants, which are proven effective for promoting smoking cessation (CDC, 2007).

Similar factors contribute to the reduction of smoking prevalence for college students. Specifically, research demonstrates a direct link between state spending for tobacco control programs and an increase in the probability that college students who are daily smokers will attempt to quit smoking (Ciecierski, Chatterji, Chaloupka, & Wechsler, 2010). Tobacco control policies are increasingly common, partially due to the ACHA's and American Cancer Society's (ACS) recommendations for U.S. colleges and universities (Rigotti, Regan, Majchrzak, Knight,

& Wechsler, 2002). These policies include banning smoking in buildings, tobacco advertising in college publications, tobacco sponsorship of college events, and tobacco sales on campus, as well as providing smoking cessation treatments (ACS, 2001; ACHA, 2009).

Thus, the physical environments which enable smoking on college campuses are rapidly changing. Based on survey results of 50 universities, banning smoking in residence halls increased from 1% to 54% from 1994-1995 and 2002-2003 (Halperin & Rigotti, 2003). This trend is promising because research demonstrates smoke-free residence halls help students who are not regular smokers before college avoid taking up tobacco during college (Wechsler, Lee, & Rigotti, 2001). One other possible environmental influence is the increasing cost of cigarettes, which historically has been linked to the decrease in smoking prevalence among high school students (Chaloupka & Wechsler, 1997).

Sociodemographic characteristics. Research consistently demonstrates that smoking prevalence varies by certain social or demographic characteristics of college students, such as gender, race, year in school, Greek affiliation, and peer and family smoking, (Ames et al., 2010; Emmons, Wechsler, Dowdall, & Abraham, 1998; Gaffney, Wichaikhum, & Dawson, 2002; Martinelli, 1999; Moran et al., 2004; Patterson, Lerman, Kaufmann, Neuner, & Audrain-McGovern, 2004; Rigotti, Lee, & Wechsler, 2000; Scott-Sheldon, Carey, & Carey, 2008; U.S. DHHS, 1994).

For example, more females than males smoke cigarettes daily; however, more males than females smoke cigarettes occasionally or at least once within the last 30 days (ACHA, 2010; Emmons et al., 1998; Gaffney et al., 2002; Moran et al., 2004). Regarding race, more White college students than non-White college students smoke cigarettes (Ames et al., 2010; Martinelli, 1999; Rigotti et al., 2000; Saules et al., 2004).

Further, students' smoking behavior may vary by year in school. Borders, Xu, Bacchi, Cohen, and SoRelle-Miner (2005) found smoking prevalence decreased as students advanced as undergraduates. Based on a sample of 184,559 students attending 13 colleges in Texas, a higher class year was associated with the probability of not smoking. Alternatively, smoking initiation in other colleges appears to happen as students advance as undergraduates. For example, Saules et al. (2004) found that 50% of University of Michigan female seniors began smoking cigarettes after entering college. Contrary to researchers' expectations, no college students initiated occasional or social smoking during the freshman year. Staten et al. (2007) identified a similar trend in a sample of 1,500 students attending a Southeastern university: most students who never smoked were freshman. Smoking initiation occurred primarily in the sophomore year, which suggests a pattern for prolonged smoking initiation while attending college.

Interventions. College campus interventions occur at an individual or population level (e.g., campus cessation or prevention programs) or at an institutional level (e.g., smoke-free policies, smoking restrictions) (Murphy-Hoefer et al., 2005). According to the American Lung Association (2009), as of October 2009, 176 colleges and universities in the United States had 100% tobacco-free campus policies. Based on the 1999 Harvard School of Public Health College Alcohol Study (CAS), 81% of surveyed U.S. college campuses prohibited smoking in all public areas (e.g., buildings, residence hall common areas, and residences, including student rooms), and 56% provided cessation programs (Wechsler, Lee, & Kuo, 2002).

College campuses potentially play a valuable role in the prevention and cessation of smoking in students (Debernardo et al., 1999). To illustrate, based on a survey of 13,000 undergraduate students at 12 universities or colleges in the state of Texas, Borders et al. (2005) found that a preventive education program on campus was associated with lower percentages of

student smokers. Likewise, Hancock (2001) found a residence hall-based social norms marketing campaign beneficial for smoking prevention by students at a Virginia university.

Even though the potential exists for successful college-based smoking interventions, there are fewer studies that describe successful interventions (Murphy-Hoefer et al., 2005). For example, based on identified published studies of college-based smoking interventions from 1980 to 2004, Murphy-Hoefer et al. (2005) identified the reporting of 12 interventions in the United States that met the following criteria: peer reviewed, empirical evaluation of an intervention, and based at a college/university. Patterson et al's. (2004) review of smoking interventions on college campuses concluded, "To advance our knowledge of college smoking practices further, more rigorous studies are required…" (p. 209).

Need for continued education. Even though the number of college students who smoke cigarettes has decreased over the last 10 years, there is still a need for continued prevention and cessation efforts on campuses. Research demonstrates that students who smoke in college continue smoking cigarettes into adulthood (Everett et al., 1999; Kenford et al., 2005). Other research demonstrates that college students are more likely to occasionally or socially smoke compared to their non-college peers; however, they are less likely to identify themselves as smokers and are less likely to quit (Berg et al., 2009; Harrison, Hinson, & McKee, 2009; Moran et al., 2004). Thus, there may be an undocumented number of college students who occasionally or socially smoke cigarettes and who will make no effort to stop. Therefore, universities should continue to improve efforts to support smoking cessation and non-initiation.

Alcohol consumption

Impact on health. Even though moderate alcohol consumption provides some health benefits, excessive alcohol consumption leads to health and safety problems (Gandy, 2010; Kerr & Yu, 2010). Heavy drinking (more than two drinks per day for men and more than one drink

per day for women) or binge drinking (more than five drinks on a single occasion) adversely impacts health by causing immediate and long-term problems (CDC, 2011a). Immediate health risks include unintentional injuries, risky sexual behavior, miscarriage and stillbirth, and alcohol poisoning (CDC, 2011a). Long-term health risks include neurological, cardiovascular and gastrointestinal problems; psychiatric conditions; cancer; and liver disease (CDC, 2010c).

Both immediate and long-term health risks can lead to hospitalizations, as well as premature mortality and morbidity. In 2005, 1.6 million hospitalizations and more than 4 million emergency room visits in the United States were due to alcohol consumption (Chen & Yi, 2007). According to the Alcohol Related Disease Impact Tool (ARDI), approximately 79,000 deaths annually in the United States are attributed to alcohol (CDC, 2010c). Alcohol abuse is the third leading lifestyle related cause of death in the United States (Mokdad, 2004).

College student alcohol use contributes to premature morbidity and mortality and social problems. College students frequently binge drink, which leads to high blood alcohol concentrations (BAC) (Fournier, Ehrhart, Glindemann, & Geller, 2004). The epidemiological evidence suggests high BAC contributes substantially to serious injury, risky sex behaviors, violent behavior, and social and psychological problems (Wechsler, Dowdall, Davenport, & Castillo, 1995). For example, according to an earlier report in the 1994 Commission on Substance Abuse at Colleges and Universities (1994), alcohol consumption was a factor in two-thirds of student suicides, nine of ten rapes, and 95% of campus public crimes. Hingson, Heeren, Zakocs, Kopstein, and Wechsler (2002) concluded alcohol is the greatest contributor to college student morbidity and mortality. In 2001, alcohol contributed to an estimated 1,717 deaths among U.S. college students (Hingson et al., 2002).

Prevalence. Binge drinking for adults over the age of 18 in the United States and Colorado remained consistent from 2006 to 2009 (see Figure 3). According to the BRFSS, an average of 16.0% of U.S. adults reported binge drinking within the past two weeks in 2006 through 2010 (CDC, 2010a). Binge drinking for adults in Colorado decreased from 16.0 in 2006 to 15.0 in 2010, a 6.3% change.

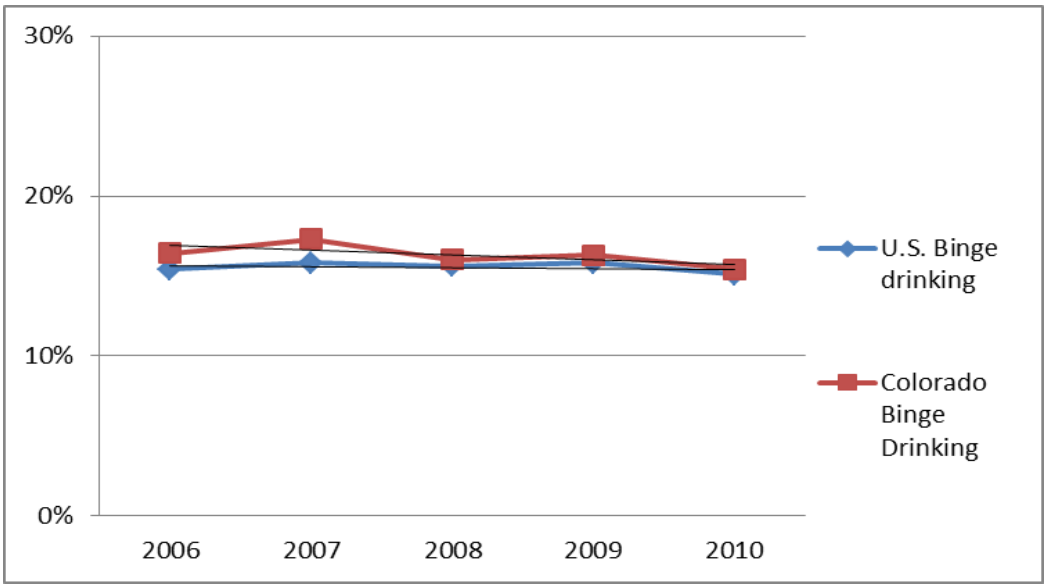

Figure 3. Prevalence of binge drinking for adults in the United States and Colorado, 2006 to 2010.

Note. From "Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System: Prevalence and Trends Data, 2006-2010."

A slight downward trend in binge drinking has been observed in college students (see Figure 4). In 2010, the ACHA Spring Reference Report indicated 35.0% of college students binge drank in the previous two weeks (ACHA, 2010). The Healthy Campus 2010 (ACHA, 2002) target goal was to decrease the percentage of college students who binge drink from the baseline of 39.0% in 2000 to 20.0% in 2010. Over the past decade, there was a 10.3% decrease in the percentage of college students who binge drink, 15.0 percentage points under the 2010 target goal.

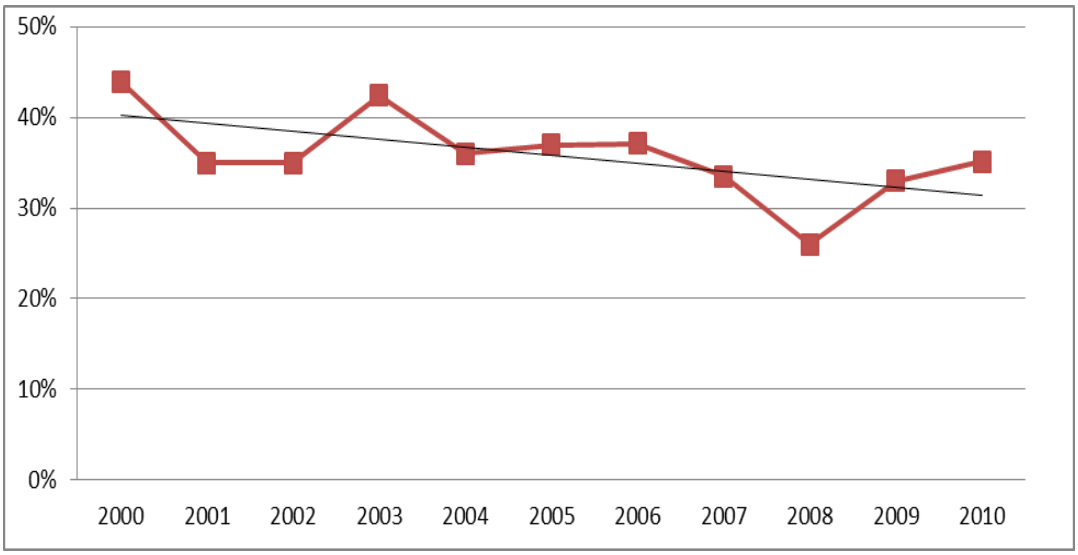

Figure 4. Prevalence of binge drinking for college students in the United States, 2000 to 2010.

Note. From "American College Health Association - National College Health Assessment: Reference: Publications and Reports, 2000-2010."

The decreasing trend (10.3%) in college students' binge drinking was influenced by the increase in alcohol-based interventions on college campuses and state and local policies that decrease opportunities for alcohol abuse (Mitchel, Toomey, & Erickson, 2005). Since the mid-1980s, many universities have supported enhanced enforcement of alcohol policies, restricted alcohol consumption during Greek rush, eliminated drinking at campus-based events, restricted alcohol consumption in residence halls, implemented alcohol monitoring training for restaurant and bar servers, and promoted alcohol education events for students (Turner, Perkins, & Bauerle, 2008). For example, Colorado State University's (CSU) Drug and Alcohol Policy includes legal sanctions for possession of alcohol under the legal age of 21, open containers, and drinking while driving (CSU, 2005). In addition, the policy specifies alcohol cannot be sold at events on campus and is not permitted in residence halls (CSU, 2010c). Nelson, Naimi, Brewer, and Weschler (2005) found that the states with stricter alcohol control policies had lower rates of binge drinking for college students. Further, in a representative sample of universities across the United

States, Wechsler et al. (2001) found that colleges that promote substance-free residence halls demonstrated reduced rates of alcohol consumption and alcohol related problems, compared to colleges with students living in housing with unrestricted alcohol policies.

Sociodemographic characteristics. Research consistently demonstrates college student alcohol consumption varies by certain social or demographic characteristics, such as gender, athletic participation, race, year in school, Greek affiliation, peer and family alcohol use, and religious affiliation (Martens, Watson, & Beck, 2006; Scott-Sheldon et al., 2008; Theall et al., 2009; Yusko, Buckman, White, & Pandina, 2008).

For example, more males drink more often than females and in greater quantities (ACHA, 2010; Adams & Nagoshi, 1999; Baer, Marlatt, Kivlahan, & Fromme, 1992; Del Boca, Darkes, Greenbaum, &Goldman, 2004; Greenbaum, Del Boca, Wang, & Goldman, 2005; Werner, Walker, & Greene, 1996; White et al., 2006). Regarding race, White college students are more likely than non-White college students to consume greater quantities of alcohol and binge drink (Ernst, Hogan, Vallas, Cook, & Fuller, 2009; Wechsler et al., 2002).

Research regarding variations of alcohol consumption by the year of school is limited. Most research has investigated the prevalence and predictors of freshman drinking, but failed to distinguish use based on subsequent years in school (Adams & Nagoshi, 1999; Harford, Wechsler, & Seibring, 2002; McCabe et al., 2005; Wechsler et al., 2002; White et al., 2006). An exception is the research conducted by Borsari, Murphy, and Barnett (2007), which showed the amount of alcohol consumption for freshmen was the same for older college students.

Interventions. Alcohol-focused interventions sponsored by colleges and universities include individualized or population-based approaches (e.g., campus cessation or prevention programs) or efforts at the institutional level (e.g., alcohol consumption-free policies).

Individual-based interventions are delivered either via an individual (e.g., counselor) or through no-contact approaches such as mail or web (Zisserson, Palfai & Saitz, 2007). Content of the interventions include individualized cognitive behavioral training to teach skills to modify beliefs or behaviors, such as instruction on how to self-monitor drinking, limit drinking, and refuse drinks (Baer et al., 1992; Cronin, 1996; Garvin, Alcorn, & Faulkner, 1990; Kivlahan, Marlatt, Fromme, Coppel, & Williams, 1990; Larimer & Cronce, 2002). Similarly, individual-based brief motivational interventions aim to increase the motivation to change behaviors by providing personalized formative feedback, skills training, and advice on how to reduce drinking (Borsari & Carey, 2000; Larimer et al., 2001; Marlatt et al., 1998).

Other interventions on college campuses include population-based media advertisements (e.g., social marketing) to correct misperceptions about peer drinking and promote responsible behavior through social norms modeling (Haines & Spear, 1996; Perkins, Haines, & Rice, 2005). Research suggests interventions that correct misperceptions about peer drinking and promote responsible behavior improve alcohol consumption-based student behavior (Borsari & Carey, 2003; Haines & Spear, 1996; Perkins et al., 2005).

Two examples of the variety of interventions available on college campuses are CSU's "DAY (Drug Alcohol and You)" program and the "Practice Safe, Eighty-Nine" campaign. The "DAY" program consists of individualized cognitive-behavioral psycho-education and risk management counseling interventions for referred or volunteer students (administrative assistant for the CSU "DAY" program, personal communications, September 22, 2010). The "Practice Safe, Eighty-Nine" campaign is a population-based social norms modeling intervention designed to change the misperceptions of use by peers regarding designated drivers (CSU, 2010b).

Need for continued education. The prevalence of binge drinking remains 15 percentage points under the Healthy Campus 2010 target goal (ACHA, 2002), despite considerable efforts over several decades to curb the trend (Barnett & Read, 2005). This may be due to alcohol being regarded as a part of college social life. Research demonstrates students' views of the importance of parties and supportive social interactions are linked to heavy drinking (Reifman & Watson, 2003). For example, Del Boca et al. (2004) found three-quarters of students' alcohol consumption occurs on Thursdays, Fridays, and Saturdays, the days when social functions, alumni events, and campus athletic events are often scheduled.

Education efforts should continue because United States college students drink more than individuals of the same age who do not attend college (Johnston et al., 2009). Research has shown that interventions are not reaching the students with alcohol problems because the students are not identified and referred to treatment (Black & Coster, 1996; Foote, Wilkens, & Vavagiakis, 2004). Other students have not been interested in alcohol programs because they do not think they have a problem (Greenfield, Keliher, & Sugarman, 2003). Even though college students may mature out of problem drinking after college, many keep the pattern in adulthood and may even show an escalating use into adulthood (Jackson, Sher, Gotham, & Wood, 2001; Jennison, 2004).

Smoking marijuana

Impact on health. Nonmedical marijuana smoking has an adverse impact on physical and behavioral health. Even though medical marijuana is beneficial for some therapeutic purposes, recreational marijuana use and initiating smoking marijuana at a young age predisposes individuals to white brain matter damage, residual neuro-psychological effects, and adverse effects on the cardiovascular and respiratory systems (Abou-Saleh, 2010; Mittleman,

Lewis, & Maclure, 2001; Polen, Sidney, Tekawa, Sadler, & Friedman, 1993; Tashkin, 1990). Smoking marijuana is also associated with elevated risk of depression and suicide, increased motor vehicle risk behaviors (e.g., not wearing seatbelts), and academic and behavioral problems for college students (e.g., lack of concentration, missing class, lower academic performance) (Caldeira et al., 2009; Copeland, 2006; Everett et al., 1999; Pope & Yurgelun-Todd, 1996). Additional research is needed to fully understand the primary adverse effects of marijuana smoking on psychomotor performance (Pies, 2010).

Prevalence. Nonmedical marijuana use for individuals 12 years and older in the United States remains consistent since 2002 but has increased in Colorado (see Figure 5). According to the National Survey on Drug Use and Health (NHSDA), an annual survey of non-institutionalized populations, the percentages of individuals 12 years and older who smoked marijuana in the past 30 days were six in 2002 and seven in 2009, an increase of 16.7% (NHSDA, 2009). In Colorado, legalization of medical marijuana was enacted in 2000 (Colorado Department of Public Health and Environment, 2011). The percentages of individuals aged 12 years and older who smoked marijuana in the past 30 days increased from seven in 2004 to eight in 2007, an increase of 14.3% (NHSDA, 2009).

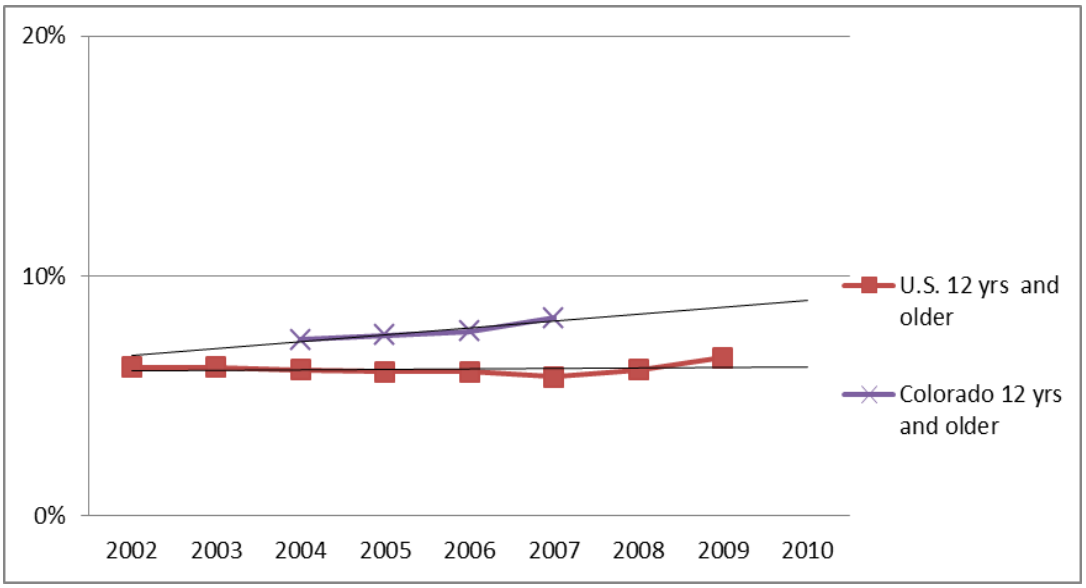

Figure 5. Prevalence of smoking marijuana in the past 30 days, United States, 2002 to 2009, and Colorado, 2004 to 2007.

Note. From "National Survey on Drug Use and Health: State Reports on Alcohol and Illegal Drugs, 2002-2009."

There appears to be a slight decrease in marijuana use in college students, but the prevalence between 2000 (14.8%) and 2010 (17.0%) increased by 15.0% (see Figure 6). The spring 2010 ACHA Reference Report indicated that 17.0% of college students smoked marijuana in the last 30 days (ACHA, 2010). The target goal of Healthy Campus 2010 (ACHA, 2002) was to decrease the percentage of college students who smoked marijuana in the past 30 days from the baseline of 14.8% in 2000 to 1.0% in 2010 (ACHA, 2002). Even though there appears to be slightly fewer college students who smoke marijuana, the prevalence increased to 17.0% in 2010 and remains 16.0 percentage points under the Healthy Campus 2010 (ACHA, 2002) target goal.

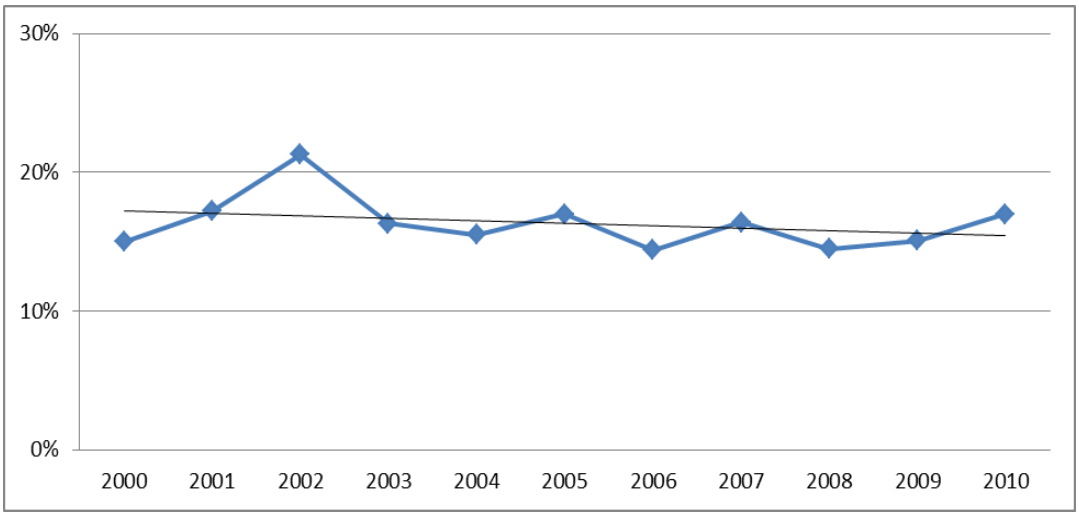

Figure 6. Prevalence of smoking marijuana in the last 30 days for college students in the United States, 2000 to 2010.

Note. From "American College Health Association - National College Health Assessment: Reference: Publications and Reports, 2000-2010."

Limited research was identified that provides insight into why marijuana smoking in college students changed slightly over the past decade but increased 15.0% in 2010 compared to 2000. Most research referred to the prevalence of marijuana smoking between 1990 and the beginning of 2000 (Gledhill-Hoyt, Lee, Strote, & Wechsler, 2000; Kerr & Yu, 2010; Mohler-Kuo, Lee, & Wechsler, 2003). The research into other HRBs provides some insight into recent marijuana prevalence. For example, health professionals suggest that the declines in smoking cigarettes and alcohol consumption in college students are due to changes in policy (e.g., greater punishment for use), environments (e.g., less access), social norms (e.g., perception of peer use), and increased intervention and education efforts (Copeland et al., 2009; Turner et al., 2008).

Alternatively, marijuana policies, environments, social norms, and education support its use. Mohler-Kuo et al. (2003) suggested that college campus officials take significant action to reduce alcohol and cigarette use but neglect marijuana. Also, there is knowledge about the benefits of medicinal marijuana but a lack of education regarding the differences between the

benefits and risks of recreational and medicinal marijuana use (Tullis, DuPont, Frost-Pineda, & Gold, 2003).

In addition, the environment promotes marijuana use: many states' penalties are less severe; certified curriculums teach home marijuana growing and maintenance; and marijuana is available in legal dispensaries (Hoffmann & Weber, 2010; Pies, 2010). Also, college students' marijuana use is influenced by perceptions of peer use, which are generally higher than actual use (Lenz, 2004; McCabe, 2008; Page & Roland, 2004). Therefore, one can theorize the trend in smoking marijuana did not decline, as in the case of alcohol and cigarettes, but increased 15.0% from 2000 to 2010 for several possible reasons: students' perceived risk for marijuana is less; the drug is more socially acceptable; it is easily obtained; and students are educated more about the negative effects of cigarette and alcohol use than marijuana.

Sociodemographic characteristics. Research demonstrates that the prevalence of marijuana use varies by certain social or demographic characteristics of college students, such as gender, race, Greek affiliation, team sport affiliation, and religious beliefs (ACHA, 2010; McCabe et al., 2005; Mohler-Kuo et al., 2003; Nasim, Corona, Belgrave, Utsey, & Fallah, 2007; Page & Roland, 2004).

As an example, the spring 2010 ACHA Reference Report found that more males than females had smoked marijuana in the last 30 days (21.1% vs. 14.4%) (ACHA, 2010). Likewise, based on results from four CAS studies in 1993, 1997, 1999, and 2000, more males than females smoked marijuana in the past 30 days (Mohler-Kuo et al., 2003). Regarding race, more White college students than non-White college students smoked marijuana in the past 30 days (Mohler-Kuo et al., 2003). Further, the student's marijuana smoking behavior appears to vary based on

year in school: marijuana use is highest in the freshman year and then declines over subsequent college years (Gledhill-Hoyt et al., 2000; Jackson et al., 2001; Mohler-Kuo et al., 2003).

Interventions. Intervention programs on college campuses include institutional, population, and individual-based approaches similar to the ones conducted for alcohol, such as: distribution of educational flyers and brochures, increasing drug-free student activities, peer education, curriculum inclusion, teaching drug refusal skills, promoting social norms modeling, campus policy changes, administrative interventions, and sponsoring drug awareness events (Larimer & Cronce, 2002). Federal financial aid and legislation, such as the Anti-Drug Abuse Act of 1986, have historically supported efforts to achieve drug-free campuses (Licciardone, 1996). For example, many programs from the late 1980s to the mid-1990s were supported by the Fund for the Improvement of Postsecondary Education (FIPSE) for collegiate alcohol and other drug prevention efforts, the largest federal block grant intended to prevent substance abuse (Licciardone, 1996).

College campuses potentially may play a valuable role in preventing recreational marijuana smoking because research demonstrates most use occurs between the ages of 18-22, when most individuals attend college (Wagner & Authony, 2002). For example, Miller, Toscova, Miller, and Sanchez (2000) implemented a successful multilevel intervention on a college campus that included print and video media focusing on perceived risk, drug awareness, and lifestyle assessments. Pre- and post-test survey results indicated that marijuana use, as well as several other classes of illicit drugs and some alcohol behaviors, decreased following the intervention.

Even though the potential exists for successful college-based interventions, fewer studies evaluate such interventions based on strong research designs (Larimer et al., 2001). Licciardone

(1996) evaluated 336 substance prevention programs sponsored by FIPSE funds. Survey results from responding institutions indicated 34.0% of the interventions evaluated outcomes based on statistical analysis; however, there was no indication of pre-or post-test measures. More recent investigations by Larimer et al. (2001) into college campus drug prevention programs led to one identified published study of a U.S. intervention implemented in a controlled setting.

Need for continued education. Marijuana education on college campuses is needed, because, unlike cigarette and alcohol use, marijuana use has not decreased dramatically over the last decade and appears to have increased in 2010. Universities have a vested interest in the prevention of recreational marijuana use because of the negative impacts on students' academic success. Increases in recreational marijuana use may occur with more states legalizing medical marijuana. Without additional education and prevention efforts, students' perceived risk of recreational use and related consequences may lessen. This may lead to increases in use. Therefore, continued education and intervention efforts should consider the relationships of medical marijuana availability to recreational use.

Physical activity

Impact on health. Physical activity is defined as any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure. It includes different types of activities: lifestyle, moderate aerobic, vigorous aerobic, and muscle-strengthening (U.S. DHHS, 2001) (see Table 3). Physical activity is directly linked with morbidity and mortality as it aids in the prevention of disease and chronic illness, such as coronary heart disease, stroke, diabetes, and high blood pressure and cholesterol (AHA, 2010b). Physical activity also helps individuals maintain a healthy weight; contributes to healthy bones, muscles, and joints; relieves arthritis

pain; lowers the risk of colon and breast cancers; reduces symptoms of anxiety and depression; and is associated with fewer hospitalizations or physician visits (U.S. DHHS, 2008a; b).

Table 3

Definition and Examples of Physical Activity Types

Types	Definition	Examples
Lifestyle	Daily activities that a person conducts which result in energy expenditure	Taking the stairs, walking instead of driving, gardening, cleaning the house
Moderate Aerobic	Movement of the body's large muscles in a rhythmic manner for a sustained period of time and results in energy expenditure	Walking briskly, mowing the lawn, dancing, swimming, bicycling on level terrain
Vigorous Aerobic		Jogging, mowing the lawn with a push-mower, participating in high-impact aerobic dancing, swimming continuous laps, bicycling uphill, carrying more than 25 lbs up a flight of stairs and standing or walking with more than 50 lbs
Muscle Strengthening	Activity that increases skeletal muscle strength, power, endurance, and mass	Strength training, resistance training, muscular strength and endurance exercises

Note. Adapted from Wyaley, M., Brubaker, P., Otto, R., & Armstrong, L. (2006). *American College of Sports Medicine's Guidelines for Exercise Testing and Prescription (7th ed.)* Philadelphia: Lippincott Williams & Wilkins and Centers of Disease Control and Prevention (2012). *CDC Glossary and Terms for Physical Activity*.

Prevalence. Physical activity in adults over the age of 18 in the United States and Colorado increased over the past decade (see Figure 7). According to the BRFSS, the percentage of U.S. adults who did meet the weekly guideline (30 minutes of moderate physical activity five or more days per week, or 20 minutes of vigorous physical activity three or more days per week) increased from 46 in 2001 to 51 in 2009, an increase of 11.9% (CDC, 2010a). In Colorado, the percentage of adults who did meet aerobic objectives increased from 53 in 2001 to 57 in 2009, an increase of 7.5% (CDC, 2010a).

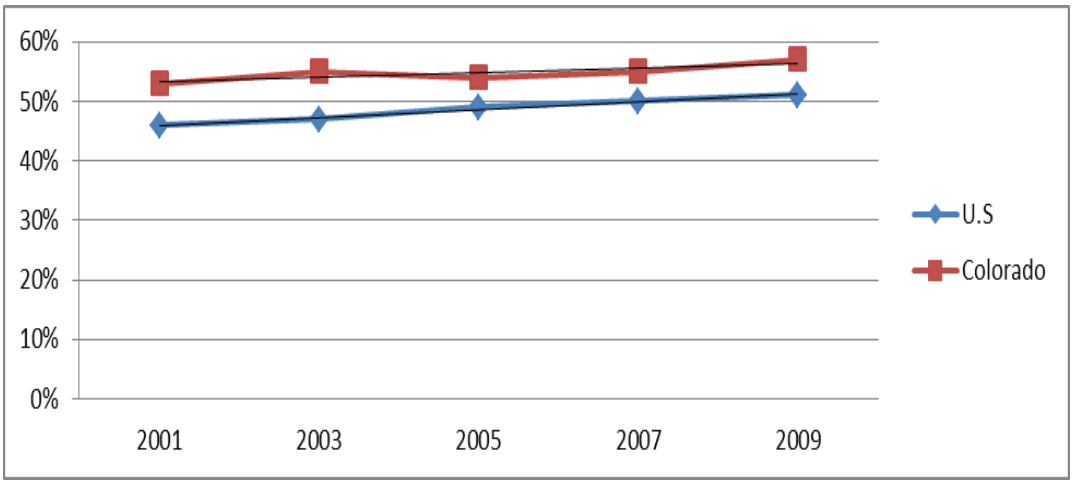

Figure 7. Prevalence of physical activity for adults in the United States and Colorado, 2001 to 2009.

Note. From "Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System: Prevalence and Trends Data, 2000-2009."

The same upward trend is observed in college students (see Figure 8). The spring 2010 ACHA Reference Report indicated 49% of college students did meet aerobic physical activity objectives: 30 minutes on five or more days per week, or vigorous intensity for at least 20 minutes on three or more days per week, or a combination of the two (ACHA, 2010). The target goal of Healthy Campus 2010 (ACHA, 2002) was to increase the percentage of college students engaging in aerobic physical activity at least three days per week (includes moderate physical activity for at least 30 minutes or vigorous physical activity for 20 more minutes per occasion) from a baseline of 40.3% in 2000 to 55.0% in 2010 (ACHA, 2002). Over the past decade, 22% more college students have met aerobic physical activity objectives, six percentage points under the 2010 target goal. However, this percentage may not be representative because the Healthy Campus 2010 (ACHA, 2002) and ACHA objectives differ. The Healthy Campus (ACHA, 2002) objective is three or more days of moderate or vigorous activity, but the ACHA objective is defined as five or more days of moderate activity, 3 or more days of vigorous activity, or a combination of the two. Therefore, the students exercising 3-4 days of moderate and no days of

vigorous physical activity are not included as meeting the Healthy Campus (ACHA, 2002) objective.

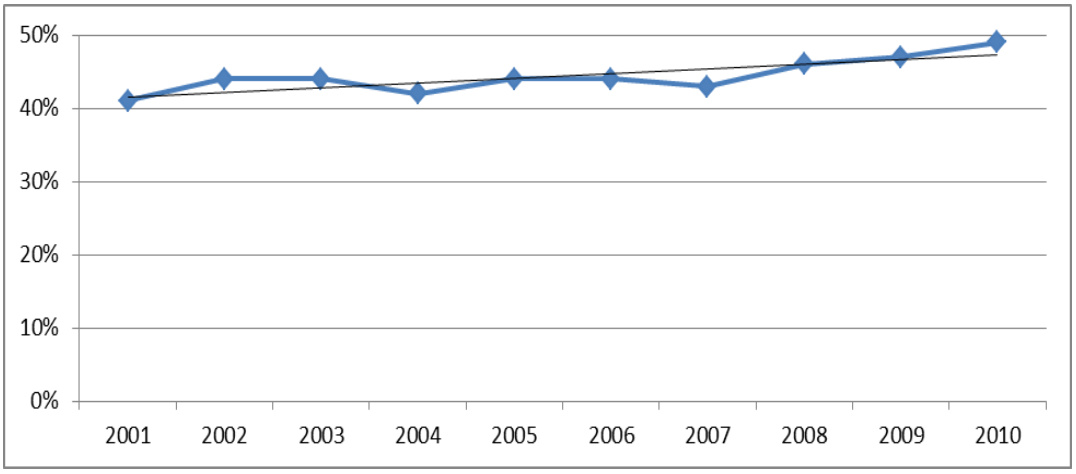

Figure 8. Prevalence of physical activity in the last week for college students in the United States, 2000 to 2010.

Note. From "American College Health Association - National College Health Assessment: Reference: Publications and Reports, 2010." Years 2001-2008 -- students meeting moderate activity for at least 30 minutes or vigorous intensity for at least 20 minutes for three or more days per week and years 2009-2010 -- students meeting moderate activity for at least 30 minutes on five or more days or vigorous intensity for at least 20 minutes on three or more days per week or a combination of the two (2 moderate exercise periods = 1 vigorous intensity).

The increase in people participating in physical activity over the past decade may be partly attributed to its emergence as a public health priority because of the link to overweight and obesity (U.S. DHHS, 2001; 2008a; b). National guidelines and recommendations urge officials, policy makers, and health educators to create environments and policies that promote physical activity (U.S. DHHS, 2001). Environments that encourage physical activity (e.g., commuter bike paths, sidewalks, gyms at workplaces) and physical activity promoting policies (e.g., break time at work for physical activity, physical activity requirements in school) are more common (Humpel, Owen, & Leslie, 2002; Leslie, Sparling, & Owen, 2001; Owen, Humpel, Bauman, & Sallis, 2004). Likewise, the physical activity promoting policies and environments on college campuses contribute to increases in student activity. For instance, physical education courses

promote physical activity skills and knowledge; recreational facilities are more accessible; and technological devices (e.g., home video game or computer-based programs) help foster physical activity (Buckworth & Nigg, 2004; Casebolt, 2009; Leslie, Sparling et al., 2001; Reed & Philips, 2005).

Sociodemographic characteristics. Research demonstrates physical activity prevalence varies by certain social or demographic characteristics of college students, such as gender, race, Greek affiliation, living location, and socioeconomic status (Buckworth & Nigg, 2004; Calfas, Sallis, Lovato, & Campbell, 1994; Dinger & Waigandt, 1997; Irwin, 2004; Johnson et al., 2008; Leslie, Fotheringham, Owen, & Bauman, 2001; McArthur, Rosenberg, & Howard, 2002).

For example, regarding race, most studies reported more White college students participate in aerobic physical activity than non-White college students (Buckworth & Nigg, 2004; Dinger & Waigandt, 1997; Irwin, 2004; Leslie, Sparling et al., 2001). However, research findings regarding gender are not consistent; some studies reported no gender differences and others reported more males participating in physical activity (ACHA, 2010; Buckworth & Nigg, 2004; Dinger & Waigandt, 1997; Irwin, 2004; Leslie, Sparling et al., 2001). In Irwin's review and analysis of literature from 1985-2001, the prevalence of college students' participation in physical activity was the lowest among African-American women (Irwin, 2004). Unlike race and gender, no significant relationships have been found for year in school (Calfas et al., 1994; Dunn & Wang, 2003; Leslie, Sparling et al., 2001; Pinto, 1995).

Interventions. Interventions on college campuses occur at an individual or population level (e.g., campus physical activity promotion programs, personal trainers at student health centers) or at an institutional level (e.g., curriculum requirements, access to recreational facilities, bike and walking paths) (Buckworth & Nigg, 2004; Hensley, 2000; Johnson et al.,

2008; Keating, Guan, Pinero, & Bridges, 2005; Leslie, Fotheringham et al., 2001). College campuses play a valuable role in promoting physical activity by changing the environment and policies to foster college student's physical activity. For example, according to Hensley (2000), approximately 60% of U.S colleges offer conceptual education courses that combine a lecture component with a physical activity course. Further, campuses may be remodeled or designed to promote physical activity; student fitness centers and intramural sports programs can provide additional opportunities for physical activity; health and fitness services (e.g., health risk appraisals, computer monitoring) help students establish regular physical activity patterns; and physical activity curriculum requirements may be modified to include a lecture component that educates students about lifelong physical activity (Keating et al., 2005).

Even though the potential exists for successful college-based physical activity interventions, there has been a limited amount of literature reporting successful interventions (Keating et al., 2005). Moreover, studies may identify interventions that are effective for short-term changes in physical activity, but most do not adequately address long-term maintenance (Ferrara, 2009). Based on a review of studies of college-based physical activity interventions, Keating et al. (2005) identified two U.S. interventions evaluated based on an experimental model. Keating concluded, "after more than three decades of efforts to combat sedentary lifestyles in the general population, a handful of researchers report college students' physical activity… has been seriously neglected as a research topic" (p. 117).

Need for continued education. Even though physical activity participation increased 22% over the last decade, there is a need for continued intervention efforts on college campuses because approximately 44% of students fail to meet Healthy Campus (ACHA, 2002) physical activity objectives. It is critical that intervention efforts continue because research demonstrates

the greatest declines in physical activity occur in early adulthood (age 18-24), the time when many people attend college (U. S. DHHS, 2001). The pattern of a decline of physical activity by age is troubling because other research suggests physical activity habits established during college continue into adulthood (Calfas et al., 1994; Malina, 2001).

Another concern is the documented weight gain in the first years of college, partly attributable to lack of physical activity in addition to the overconsumption of food, which contributes to individuals becoming overweight and obese after college (Racette, Deusinger, Strube, Highstein, & Deusinger, 2005). Even though the weight gain may be similar in noncollege peers of the same age, intervention efforts should continue because weight gain is evident before, during, and after college (Zagorsky & Smith, 2011). With obesity steadily becoming more prevalent in young adults, efforts to promote physical activity must be a priority for college campuses (Mokdad et al., 2001; Ogden, 2006).

Fruit and vegetables

Impact on health. Fruits and vegetables provide vitamins, minerals, and fiber and are essential for good health (CDC, 2011b). A number of nutrients that are under-consumed in the United States (e.g., folate, magnesium, potassium, dietary fiber, and vitamins A, C, and K) are found in fruit and vegetables (U. S. Department of Agriculture [USDA], 2011a). In particular, eating a diet rich in fruits and vegetables is linked with reduced morbidity and mortality because of reductions in disease and chronic illness, such as coronary heart disease, stroke, diabetes, high blood pressure, cholesterol, and cancer (USDA, 2011b). Consuming more fruits and vegetables helps individuals maintain a healthy weight because they are naturally low in fat and calories; they also contain fiber, which helps provide a feeling of fullness and leads to eating less (USDA, 2011b). For the greatest impact on health, the USDA Dietary Guidelines for Americans

recommends the equivalent of four to 13 servings per day, based on gender and age (see Table 5) (USDA, 2011b).

Table 4

Fruit and Vegetable Consumption Recommendations by Gender and Age

Gender	Age	Recommendation
Male	14-18 yrs	Fruit: 2 cups Vegetables: 3 cups
	19-50 yrs	Fruit: 2 cups Vegetables: 3 cups
	51+ yrs	Fruit: 2 cups Vegetables: 2 ½ cups
Female	14-18 yrs	Fruit: 1 ½ cups Vegetables: 2 ½ cups
	19-30 yrs	Fruit: 2 cups Vegetables: 2 ½ cups
	31-50 yrs	Fruit: 1 ½ cups Vegetables: 2 ½ cups
	51+ yrs	Fruit: 1 ½ cups Vegetables: 2 cups

Note. From the United States Department of Agriculture. (2011b). *Nutrition policy and promotion. 2010 dietary guidelines for Americans 2010.*

Prevalence. Fruit and vegetable consumption for adults over the age of 18 in the United States and Colorado very slightly increased over a 10-year period (see Figure 9). According to the BRFSS, the percentages of U.S. adults who did meet the daily consumption guideline of five or more servings of fruits and vegetables was 23.2 in 2000 and 23.4 in 2009, an increase of 0.9% (CDC, 2010a). In Colorado, the percentage of adults who did meet fruit and vegetable consumption objectives increased from 23.4 in 2000 to 24.8 in 2009, an increase of 6.0% (CDC, 2010a).

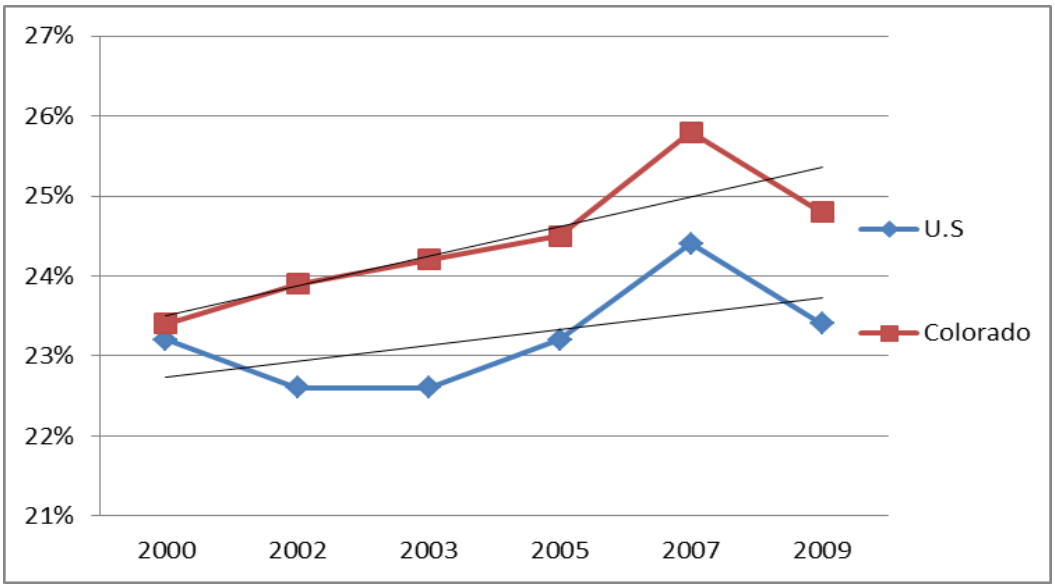

Figure 9. Prevalence of daily fruit and vegetable consumption, United States and Colorado, 2000 to 2009.

Note. From "Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System: Prevalence and Trends Data, 2000-2009."

Fewer college students meet the objectives than adults over the age of 18 (see Figure 10). The spring 2010 ACHA indicated 6% of college students did meet fruit and vegetable objectives of five or more servings per day (ACHA, 2010). The target goal of Healthy Campus 2010 (ACHA, 2002) was to increase the percentage of college students who consume five servings of fruit and vegetable per day from a baseline of 7.4% in 2000 to 25.5% in 2010. Over the past decade 19.0% fewer college students did meet fruit and vegetable target goals, 19.5 percentage points under the 2010 target goal.

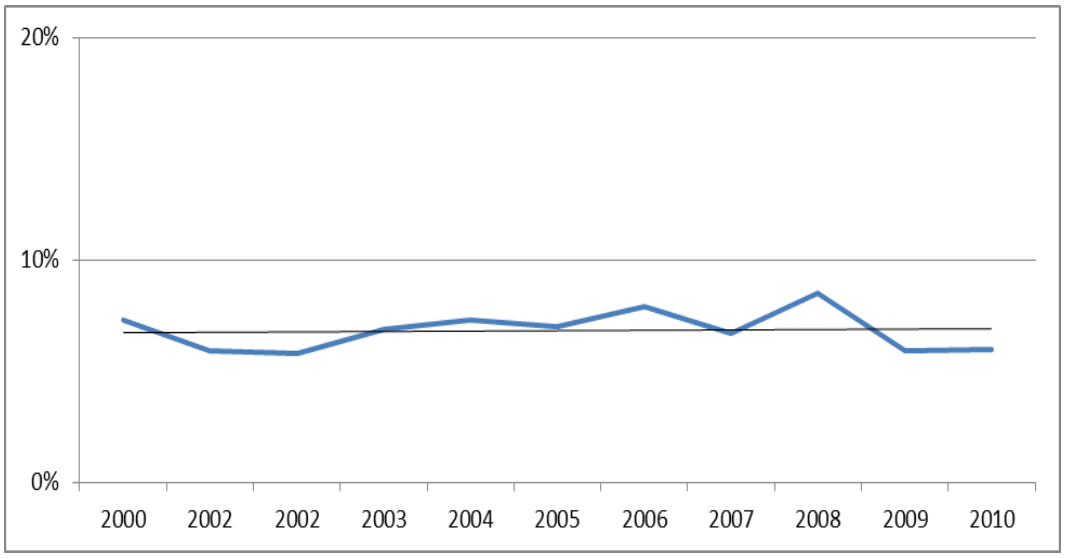

Figure 10. Prevalence and trend of daily fruit and vegetable consumption for college students in the United States, 2000 to 2010.

Note. From "American College Health Association - National College Health Assessment: Reference: Publications and Reports, 2000-2010."

Many researchers have hypothesized about why adults and college students do not consume the recommended amounts of fruit and vegetables. Nestle (2002) suggested fruit and vegetable consumption is lower because fewer media advertisements promote fruit and vegetables compared to the widespread media attention given to nutritionally poor foods. Other researchers suggest that eating at fast food restaurants, which offer fewer fruit and vegetable options, is more common for adults and particularly for college students because of convenience (Frazier, 2007; French, Harnack, & Jeffery, 2000; Nicklas, Baranowski, Cullen, & Berenson, 2001).

Another common rationale for low fruit and vegetable consumption concerns barriers to finding and purchasing adequate fruit and vegetables (Harnack, Block, & Subar, 1997). For example, for low income families, lower fruit and vegetable consumption is particularly prevalent due to limited access for purchase (e.g., no grocery stores in neighborhood), as well as the higher costs of fresh fruit and vegetables compared to prepared foods (Morland, Wing, Diez,

& Poole, 2002; Nestle, 2002; Treiman, Freimuth, & Damron, 1996). College students must overcome similar challenges of access and cost. Many campuses feature fast food restaurants, convenience stores, and coffee shops, which offer limited fruit and vegetable options; campus vendors with affordable fresh fruit and vegetables are less common (Driskell, Kim, & Goebel, 2005).

The low intake of fruit and vegetables for adults and college students may also be explained by habit and environment (Shepherd, 2005). Laforge, Greene, and Prochaska (2002) discovered that adopting poor eating behaviors at a young age influenced fruit and vegetable intake of adolescents. Another study found that fruit and vegetable consumption was associated with household support, which suggests positive support of fruit and vegetable consumption by the family is associated with increased consumption (Sorensen et al., 1998). Specifically for college students, research shows that living arrangements (e.g., residence halls vs. living off campus) have been reported to influence food choices and the intake of nutrients (Grace, 1997). Students living on campus have better eating patterns compared to students living off campus.

Sociodemographic characteristics. Research demonstrates that fruit and vegetable consumption varies based on certain social or demographic characteristics of college students, such as gender, race, year in school, and being a part-time student (Adams & Colner, 2008; Despues & Friedman, 2007; Dinger & Waigandt, 1997; Huang et al., 2003).

For example, regarding race, White college students more than non-White college students consume more servings of fruit and vegetables, with African-Americans and Hispanics consuming fewer servings than any other racial or multiracial groups (Adams & Colner, 2008; Despues & Friedman, 2007). Regarding gender, findings are inconclusive. Some studies reported no difference between females and males (Dinger & Waigandt, 1997; Huang et al., 2003). Others

found either more males or females consumed more servings of fruits and vegetables (McArthur et al., 2002).

Fruit and vegetable consumption appears to vary based on year in school. In a sample of 192 students randomly recruited to complete one survey, underclassmen consumed less fruit and vegetables than upperclassman (McArthur et al., 2002). Also, Sturgeon (2008) discovered that freshman and sophomore students consumed fewer servings of fruit daily than senior students. The 268 surveyed students were part of either a wellness, English composition, or a general psychology class at Oklahoma State University. Likewise, Driskell et al. (2005) found variations of fruit and vegetable consumption based on year in school for a sample of 258 students at a midwestern university: freshmen and sophomores consumed fewer servings of fruit and vegetables than junior and senior students.

Interventions. Fruit and vegetable interventions occur at the individual or population level (e.g., campus promotion programs) or at the institutional level (e.g., policies for meal plans and living on campus, on-campus facilities with fruit and vegetables, nutrition based curriculum requirements) (Adams & Colner, 2008; Clifford, Anderson, Auld, & Champ, 2009; Driskell et al., 2005; Richards, Kattelmann, & Ren, 2006). College campuses play a valuable role in promoting fruit and vegetable consumption, similar to physical activity, because different aspects of the environment can be modified to foster it. Dining halls may be remodeled or designed to promote fruit and vegetables by offering them easily packaged and pre-cut and close to the check-out lines in dining halls (Buscher, Martin, & Crocker, 2000). Nutrition services (e.g., nutrition appraisals) help establish regular fruit and vegetable patterns (Ha & Caine-Bish, 2009). Campus-based media like television can promote educational programming about nutrition (Clifford et al., 2009; Richards et al., 2006). Health curriculum requirements can be modified to

include a lecture component that educates students how to increase fruit and vegetable consumption (Matvienko, Lewis, & Schafer, 2001; Skinner, 1991).

Even though the potential exists for successful college-based fruit and vegetable interventions, there has been a limited amount of literature that identifies successful interventions with consistently promising results (Adams & Colner, 2008). Moreover, although studies have identified effective interventions for increasing knowledge or promoting short-term changes in fruit and vegetable consumption, most have failed to adequately address long-term maintenance by study design (Goldfield & Epstein, 2002; Schnoll & Zimmerman, 2001). Adams and Colner (2008) remarked, "surprisingly few researchers have conducted nutrition intervention studies of this population. A better understanding of demographic and behavioral characteristics of college students who are most likely to make poor nutrition choices may facilitate design of programs to promote fruit and vegetable intake" (p. 456).

Need for continued education. There is a need for continued intervention efforts on college campuses, as approximately 93% of students continue to fall short of recommended fruit and vegetable objectives. Historically, the time between the end of high school and the end of college is a critical period for intervening and helping college students adopt healthy behaviors (Cullen, Koehly, & Anderson, 1999). Identifying successful interventions to improve fruit and vegetable consumption by college students is crucial to help control several chronic diseases that may occur in adulthood, such as obesity, type 2 diabetes, cardiovascular disease, stroke, and high blood pressure (Adams & Colner, 2008; Ferrara, 2009).

Multiple Health Behavior Change Interventions (MHBC)

The preceding review of HRBs provides insights into the need to continue interventions to promote all five protective HRBs in college students: not smoking cigarettes, not smoking marijuana, not binge drinking, participating in regular physical activity, and consuming ≥5 servings of fruit and vegetables daily. MHBC interventions, which are defined as efforts to promote the co-variation (i.e., change) of two or more health behaviors, are one avenue to address multiple HRBs. MHBC interventions are ideal because health promotion contact opportunities are limited (Prochaska, Velicer, Prochaska, Delucchi, & Hall, 2006). Focusing on multiple behaviors in one intervention reduces the strain on sparse resources compared to implementing multiple single health behavior interventions (Prochaska, Spring et al., 2008). In addition, effectively changing multiple behaviors reduces overall health care costs. Historical research conducted by Eddington et al. (1997) illustrated that changing two risk behaviors effectively in one individual reduces health care costs by $2,000 per year. By addressing multiple HRBs, MHBC interventions maximize reach and improve the health of a population (Prochaska, Spring et al., 2008).

Despite the benefits associated with MHBC interventions, most HRB interventions focus on changing a single behavior (King et al., 1996; Nigg et al., 2009; Prochaska et al., 2010; Prochaska, Spring et al., 2008; Strecher et al., 2002; Werch et al., 2008). For example, the CDC 2007 Fruit and Vegetables - More Matters public health initiative aimed to improve the health of adults and decrease obesity and overweight through the consumption of fruits and vegetables. However, physical activity was not part of the initiative, even though it also contributes to managing weight (CDC, 2011c). One review of health behavior interventions in primary care found that most interventions target single behaviors (Goldstein, Whitlock, DePue, & Planning Committee of the Addressing Multiple Behavioral Risk Factors in Primary Care Project, 2004).

Prochaska et al. (2010) surveyed health providers and concluded that the lack of MHBC interventions might have been due to health care professionals' views of the multiple challenges related to implementing these interventions.

There are few real-world applications that illustrate the potential of MHBC interventions (Morabia & Costanza, 2010). Historically, most MHBC interventions have been unsuccessful. Prochaska, Spring et al. (2008) reviewed literature reporting MHBC interventions from the 1970s to the early 2000s, and, with the exception of one project, found that interventions designed to change more than one health behavior were not effective. Likewise, in a review of comprehensive school health programs, one of 14 MHBC interventions was effective for dietary behaviors and physical activity (Summerbell et al., 2005).

Successes

Research suggests that MHBC interventions can be effective for certain populations and health behaviors (Prochaska, 2008). MHBC interventions have been conducted for the following groups: adults (Prochaska et al., 2006); adolescents (Prochaska & Sallis, 2004); college students (Werch et al., 2007; 2008; 2010); employees at work sites (Prochaska, Butterworth et al., 2008); patients in primary care (Prochaska et al., 2005); adults diagnosed with high cholesterol or cardiovascular disease (Ketola, Sipila, & Makela, 2002; Ornish et al., 1998); Type 2 diabetes (Norris, Engelgau, & Narayan, 2001); and adenomatous colorectal polyps (Emmons et al., 2005). These MHBC interventions targeted numerous combinations of health behaviors including: alcohol consumption; smoking cigarettes and marijuana; physical activity; dietary fat intake; fruit, vegetable and red meat consumption; high-risk sun exposure; adherence to lipid medication and multivitamins; and stress management.

Technology based interventions. Upon review of the successful MHBC interventions in adults, adolescents, and college students, Prochaska, Butterworth et al., (2008) hypothesized that success in these interventions was partly due to increases in using technology. Health professionals use technology-based interventions because they are increasingly less expensive to develop and implement (Strecher et al., 2002). Computers and other technological systems may contribute to the increased impact of MHBC interventions because they reach more individuals than traditional clinic-based models (Prochaska, Butterworth et al., 2008). Computers and technological systems allow for additional delivery channels for interventions, such as homes, schools and work sites.

Tailored interventions. Tailored messaging (a strategy intended to reach one person or a defined group), which is commonly delivered through technologically-based interventions, may also be a factor in successful interventions (Prochaska, Butterworth et al., 2008). Tailored interventions are delivered in a modular approach specific to the individual, with each behavior accompanied by tailored messaging (Prochaska, Butterworth et al., 2008; Strecher et al., 2002). For example, a web-based intervention for physical activity assessment and prescription can apply gender-specific messaging throughout the education and exercise prescription component.

Many tailored interventions apply a stage-based approach by tailoring messaging to all people, rather than only the individuals ready to take action for changing the behavior, a theoretically-based approach proven successful for changing single-risk behaviors (Prochaska, Redding, & Evers, 2008). For example, in two studies, employees at work sites and patients in primary care received computerized messaging based on their readiness to change high-fat diets, sun exposure, and smoking. (Prochaska et al., 2005; Velicer et al., 2004). Both computerized

tailored Transtheoretical Model (TTM) MHBC interventions, except for smoking at the work site, were effective in improving the readiness to change multiple HRBs.

Likewise, tailored feedback based on the participants' associated self-images has been shown to simultaneously improve health behaviors (Werch et al., 2003; 2008; 2010; Werch, Moore, DiClemente, Bledsoe, & Jobli, 2005). Based on the behavioral image model (BIM), the creation of new self and social images can promote change of multiple health behaviors (Werch et al., 2007). For example, a number of studies showed that tailored messaging based on the BIM promoted the simultaneous change of risk behaviors in adolescents (Werch et al., 2003; 2005; 2008).

Limitations and challenges

Even with the success of MHBC interventions, research is limited and findings are inconsistent for populations, health behaviors, and intervention design methods and measurements (Morabia & Costanza, 2010; Prochaska, Butterworth et al., 2008; Prochaska, Spring et al., 2008). The lack of information poses challenges when designing interventions to promote MHBC (Morabia & Costanza, 2010).

Populations. Research has failed to clearly demonstrate that MHBC interventions are consistently effective for all targeted populations. A series of research studies was conducted to investigate brief MHBC interventions for adolescents and college students (Werch et al., 2003; 2005; 2007). All brief MHBC interventions were designed based on the BIM, which utilizes social and self-imagery to promote behavior change (Werch, 2007). Results illustrated significant effects on the co-variation of risk behaviors of alcohol, marijuana, and cigarette HRBs in adolescents but not in college students (Werch et al., 2003; 2005; 2007). However, in the 2008 Werch et al. study of college students, the intervention was effective for alcohol and

marijuana but not cigarettes.

Research has not conclusively shown whether or not MHBC-based interventions are more effective if they are tailored based on sociodemographic characteristics (Prochaska & Sallis, 2004; Prochaska et al., 2005; Velicer et al., 2004). The specific demographic and social characteristic profile of individuals (including gender, socio-economic status, race, etc.) should be taken into account when designing interventions because risk behaviors differ based on these characteristics (Institute for Fiscal Studies, 2004). The lack of investigations into how these characteristics vary based on MHBC provides little insight into who to target or what components to include in the intervention for at-risk groups (Staten et al., 2007). Therefore, health professionals are restricted in their knowledge about whether or not to target or tailor MHBC intervention by sociodemographic characteristics.

Health behaviors. The identified research has not consistently demonstrated that MHBC interventions are effective for all combinations and numbers of health behaviors. For example, in two studies with separate samples that investigated similar brief BIM-based MHBC interventions for college students, one study showed significant effects of an intervention for physical activity and nutrition (Werch et al., 2007; 2008). Moreover, in college populations, two studies were identified that investigated MHBC interventions designed to include all the health behaviors related to the Healthy Campus 2010 (ACHA, 2002) objectives for physical activity, fruit and vegetable consumption, and substance abuse (Werch et al., 2007; 2008). Without a clear direction of the type and number of behaviors, health professionals face challenges when designing successful MHBC interventions.

Intervention methods. Another limitation of MHBC intervention design consists of the gaps in knowledge about the methods for addressing multiple health behaviors in the

intervention (Prochaska, Spring et al., 2008). There are questions about whether interventions should be designed to address multiple health behaviors simultaneously or sequentially, and whether the investigator or the participants should determine the order of receiving sequential interventions (Noar et al., 2008). These questions pose challenges for health professionals because few research studies investigate sequential or simultaneous interventions. Vandelanotte, Reeves, Brug, and Boordeaudhuij (2008) found no effect of intervention design when examining sequential versus simultaneous interventions for physical activity and dietary intake in adults. In contrast, Hyman, Pavlik, Taylor, Goodrick, and Moye (2007) found the simultaneous approach may be inferior to sequential interventions for exercise, sodium intake, and tobacco use for adults.

Intervention measurements. MHBC intervention limitations are associated with measuring the success of an intervention. There is a debate about whether success should be based on subjective measures (the participant reports change) or objective measures (the researcher measures change anthropometrically) (Prochaska, Spring et al., 2008). As with single health behavior interventions, the researcher must weigh limitations. In particular, anthropometric measures, such as changes in body composition, are expensive to monitor and sometimes only achieved with prolonged time. Subjective measures are based on participants' opinions and reports of immediate change, intention to change, or stage of change. Other studies observe actual behavior change. Without consistent measures across research studies, it is challenging to identify successful MHBC interventions.

Theory. The lack of MHBC theory contributes to the limitations and challenges associated with planning MHBC interventions for varying populations. When planning and evaluating a health intervention designed for a single behavior, explanatory and change theories

explain why and how people do, or do not, adopt certain health behaviors. Explanatory theory provides insight into what can be changed and why individuals change risk behaviors, and change theories provide insight into how individuals change risk behaviors and which strategies to use for changing them (McKenzie, Neiger, & Smeltzer, 2005) (see Figure 11).

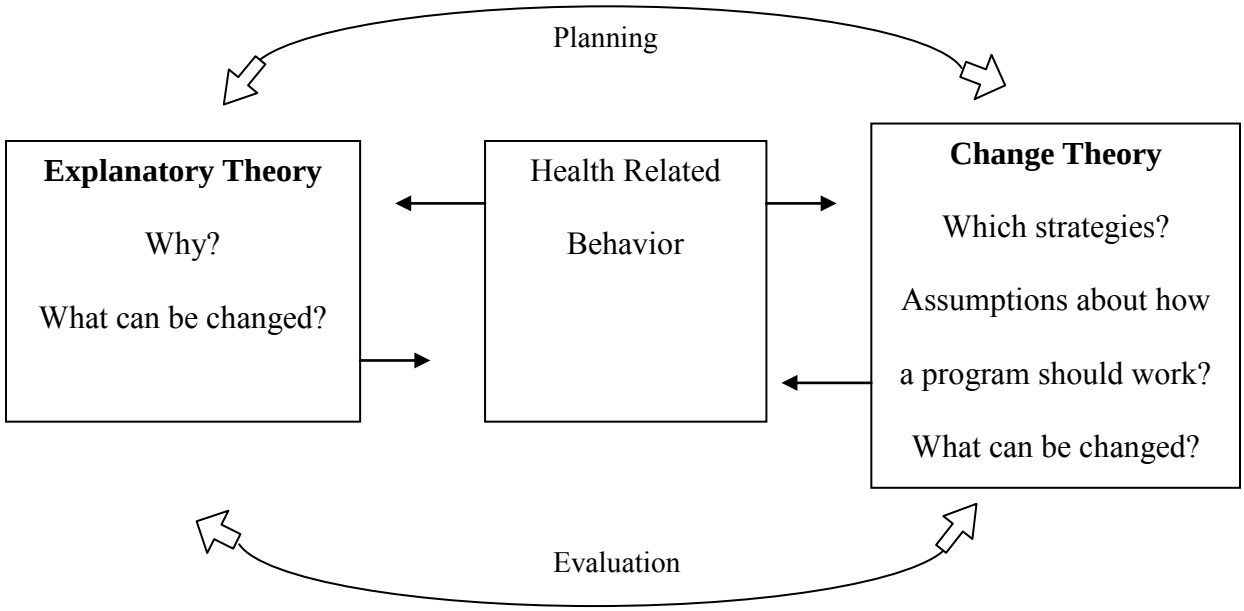

Figure 11. Use of explanatory and change theories in the planning and evaluation of health programs.

However, theories of health behavior do not directly address how to construct interventions designed to change more than one health behavior (co-variation) (Noar et al., 2008; Orleans, 2004; Prochaska, Spring et al., 2008; Werch et al., 2010). Without health behavior theory, health professionals have little insight into how interventions can be tailored and targeted for an individual or population (U.S. DHHS, 2005). To advance MHBC research, there is a need to expand the theoretical approaches that can explain the co-variation of two or more HRBs

(Allegrante, Peterson, Boutin-Foster, Ogedegbe, & Charleson, 2008; Nigg, Allegrante, & Ory, 2002; Patterson et al., 2004).

Health Behavior Theory

Even though theories of health behavior do not currently address MHBC, some insights come from exploring theories about changing single behaviors. Common theories of health behavior have been applied successfully across multiple HRBs. For example, Noar, Benac, and Harris (2007) reviewed health interventions for a broad range of behaviors and found that TTM is a commonly used theoretical framework for successful single behavior change. Prochaska (2008) suggested this demonstrates that common theoretical-based single behavior interventions can change multiple behaviors.

Specifically, Noar et al. (2007), Prochaska (2008), and Ray, Turrisi, Abar, and Peters (2009) proposed that the constructs of common health behavior theory are the specific mechanisms that provide insight into MHBC (see Table 5). Noar suggested the same theoretical-based interventions can be applied to MHBC interventions because the same constructs (e.g., perceived risk, self-efficacy, outcome expectations, social norms, decisional variables, and intrinsic and extrinsic motivation) can be applied to a variety of behaviors. Hall and Rossi's (2008) literature review of single behavior change interventions showed that the theoretical constructs of decisional balance (an individual's weighing of the pros and cons of behavior) are common among 48 health behaviors. At the time of the study, King et al. (1996) found significant positive correlations between the theoretical construct of self-efficacy and a participant's choice to engage in regular physical activity and refrain from smoking.

Table 5

Common Health Behavior Theories, Concepts and Associated Constructs

Theories	Concept	Constructs
Behavioral image model (BIM)	Activating existing or creating new images of attractive others (social images or prototypes) and improved possible selves (future self-images) can integrate and motivate change across divergent health behaviors	Social Norms
Health belief model (HBM)	Individual's perceptions of the threat posed by a health problem, the benefits of avoiding the threat, and factors influencing the decision to act	Perceived susceptibility Perceived severity Perceived benefits Perceived barriers Cues to action Self-efficacy
Transtheoretical model (TTM)	Individual's motivation and readiness to change a behavior	Stages of change Process of change Decisional balance Self-efficacy
Theory of planned Behavior (TPB)	Individual's attitude toward a behavior, perceptions of norms, and beliefs about the ease or difficulty of changing	Behavioral intention Attitude Subjective norm Perceived behavioral control
Social cognitive Theory (SCT)	Personal factors, environmental factors, and human behavior exert influence on each other	Reciprocal determinism Behavioral capacity Expectations Self-efficacy Observational learning Reinforcements

Note. Adapted from United States Department of Health and Human Services, *Theory at a glance: A guide for health promotion practice, 2005,* Washington, DC, NIH Publication No. 05-3896.

Specifically, two theories show promise for structuring MHBC interventions. The BIM is effective for promoting simultaneous co-variation of two or more risk behaviors in adolescents and college students through the creation of new self and social images (Werch et al., 2003; 2005; 2007; 2008; 2010). Similarly, the TTM, based on the stages of change, is effective for changing multiple risk behaviors of employees at worksites and patients in primary care (Prochaska et al., 2005; Velicer et al., 2004). However, as previously mentioned, the studies reporting MHBC interventions based on the BIM or TTM are limited in number and the findings are inconsistent (Morabia & Costanza, 2010; Prochaska, Butterworth et al., 2008). The lack of theoretical-based information poses challenges when designing interventions to promote MHBC (Morabia & Costanza, 2010).

Common theories of health behavior change and its constructs are the keys to understanding MHBC, but the existing research is lacking and its findings are conflicting. HRB theories for MHBC have been hypothesized but marginally researched (Halperin, Smith, Heiligenstein, Brown, & Fleming, 2010; Ory et al., 2002; Vandelanotte et al., 2008). To overcome the knowledge gaps associated with MHBC theory, research should continue testing hypothesized theoretical constructs.

Gateway Behaviors

Although not considered a health behavior theory, the hypothesized "gateway behavior" (one behavior that influences another behavior) provides further insight into promoting MHBC. Several researchers have suggested that HRBs change through one behavior stimulating change in another behavior (Johnson et al., 1998; Nigg et al., 2009). The gateway behavior may have a compensation effect (the adoption of protective behaviors to compensate for risk behaviors) or a transfer effect (the adoption of a protective or risk behavior that stimulates change in another

protective or risk behavior) (Nigg et al., 2009). For example, an individual may begin regular physical activity as a way to compensate for calories consumed from binge drinking every weekend. On the other hand, starting a physical activity program could transfer into smoking cessation as a way to ease pulmonary discomfort when exercising.

It is not clear whether each HRB acts as a gateway behavior; however, research into substance abuse behaviors (e.g., smoking cigarettes and marijuana and alcohol consumption) provides some support for the gateway behavior transfer effect hypothesis. For example, two research studies linked the initiation of the risk behavior of smoking cigarettes with alcohol risk behaviors. Based on a sample of 437 undergraduate students aged 18-25 years, Staten et al. (2007) showed that first-time smoking initiation was associated with at least one alcoholic drink in the last 30 days, eight and a half more times than students who never smoked cigarettes (Odds Ratios [OR] = 8.59, $p < .0001$). Similarly, Reed, Wang, Shillington, Clapp, and Lange (2007) illustrated alcohol consumption was associated with past-year smoking initiation for 1,113 undergraduate students aged 18-24 attending a large public university in the Southwest. Respondents who drank on three or more occasions in the past year were more likely to become smokers during that time ($\chi^2 = 150.04$, $p < .001$). Additional findings showed that participants who reported 40 or more drinking occasions during the last year were 16 times more likely to become smokers within that time frame than non-drinkers (Reed et al., 2007). Both research teams concluded that alcohol appears to act as a gateway for smoking initiation in college students.

The gateway transfer effect of smoking cigarettes and alcohol consumption appears to occur daily. Dierker et al. (2006) showed that the prevalence of the initiation of smoking cigarettes daily and alcohol consumption could be predicted by within-day person behavior. The

sample included 225 college students who had established patterns for both behaviors: smoking and drinking on 10 or more occasions during their first year of college. A longitudinal bivariate time series analysis conducted over a period of 210 days revealed a within-person positive relationship between smoking and drinking. The most common pattern of predicting alcohol consumption was within-day smoking cigarette behavior when compared to individuals who smoked none or an average of less than one cigarette over the 210-day time frame ($\chi^2 = 16.2$, $p < 0.0001$).

Similarly, empirical evidence suggests smoking marijuana acts as a gateway behavior for initiating cigarette use. The research of Tullis et al. (2003) showed that, of the surveyed 233 college students attending University of Florida, students who initiated smoking marijuana first were significantly more likely to smoke cigarettes in the same hour than students first initiating cigarettes in the same hour ($\chi^2 = 7.81$, $p = 0.005$). Subsequently, of the 85 students who smoked cigarettes and marijuana in the same hour, 73% reported marijuana use first before ever smoking cigarettes or simultaneously smoking cigarettes and marijuana.

Researchers have provided various hypotheses to explain the phenomenon of gateway behaviors. Tullis et al. (2003) concluded that the inhalation of marijuana vapors acts as a gateway for learning to smoke cigarettes. Nigg et al. (2009) hypothesized that individuals who are non-smokers transfer their knowledge and confidence about non-smoking to their ability to limit alcohol consumption, and, similarly, non-drinkers transfer their knowledge and confidence to smoking fewer cigarettes. Thus, both researchers suggested that gateway behaviors promote change because theoretical-based constructs (e.g., knowledge, self-efficacy) act as mediators for impacting other HRBs.

Even though the aforementioned gateway behavior research provides insights into MHBC, research is limited and does not include other combinations of risk and protective HRBs. Research is needed to determine what behaviors have gateway effects and to explain the theoretical concepts underlying MHBC.

Co-occurrence of Health Behaviors

Investigations into the co-occurrence of health behaviors (multiple behaviors occurring together) may provide insight into gateway behaviors and the knowledge to develop theory designed for successful MHBC interventions for co-variation of HRBs (Noar et al., 2008; Quintiliani et al., 2010). Understanding the interrelationships between HRBs, specifically if they are independent or interact, provides insight into HRBs that people may be more inclined to change together (King et al., 1996; Ory et al., 2002). For example, the finding that physical activity and fruit and vegetable consumption co-occur suggests an association between the behaviors. One could hypothesize that these behaviors have common concepts, such as knowledge, belief, attitudes, or self-efficacy, which can be targeted in interventions to promote the co-variation of the risk behaviors. Nigg et al. (2009) suggested "this type of evidence is required prior to developing integrated intervention approaches that can take advantage of data and point to the synergy that exists among multiple health behaviors" (p. 40).

Existing research in college students

The research into the co-occurrence of HRBs in college students includes many variations of clusters and pairs of behaviors and various models for investigating the co-occurring HRBs. Some researchers identified the number of clustering protective or risk behaviors or the clustering patterns of more than two HRBs (Keller, Maddock, Hannover, Thyrian, & Basler, 2007; Quintiliani et al., 2010). Other researchers identified co-occurring pairs of behaviors by

assessing correlations or the odds ratios of the behaviors occurring together (Dierker et al., 2006; Halperin et al., 2010; Keller et al., 2007; Reed et al., 2007; Rigotti et al., 2000; Weitzman & Chen, 2005). In other research, models were built to predict the occurrence of a single health behavior based on the practice of another behavior (Adams & Colner, 2008; Emmons et al., 2005; Halperin et al., 2010; Johnson et al., 1998).

To provide more insight into co-occurring behaviors, the following sections review research that investigated clusters and pairs of HRBs in college students.

Clustering HRBs

Six research studies were identified that investigated the clustering of more than two HRBs in college students. The identifiable empirical evidence suggests many students practice more than two risk HRBs. For example, Mellen (2008) found 57% of 912 students in a convenience sample and 54% of 378 students from a random sample practiced three or more risk HRBs relating to aerobic physical activity, fruit and vegetable consumption, smoking cigarettes, and smoking marijuana. The two survey samples included students aged 18-24 who attended the University of Iowa. Similarly, from a convenience sample, Quintiliani et al., (2010) found 65% of 1,463 female students enrolled in a northeastern university reported practicing more than two risk behaviors for alcohol consumption, smoking cigarettes, physical activity, fruit and vegetable consumption, risky sex, and cervical screening.

The research reveals that college students cannot be solely differentiated into those who lead a healthy lifestyle or those that do not; however, it does suggest a majority of students may fall within a few unique cluster patterns (Laska, Pasch, Lust, Story, & Ehlinger, 2009; Quintiliani et al., 2010). Laska et al. (2009) identified five unique cluster patterns for 2,026 males and females attending an unidentified university and classified each cluster as either a poor lifestyle,

high-risk lifestyle, moderate lifestyle, health conscious, or classic jock. Sixty-four percent of females were classified into two of the five groups: poor life style (40%) (not meeting objectives for diet, physical activity, and sleep, but meeting objectives for smoking cigarettes, binge drinking, sexual risk, drunk driving), and high-risk lifestyle (24%) (high substance use, intoxicated sex, drunk driving, poor diet, inadequate sleep). Also, 85% of males could be classified into two of the five groups: moderate lifestyle (51%) (low-risk smoking, binge drinking, sexual risk, drunk driving) and high-risk lifestyle (34%) (high substance use, intoxicated sex, drunk driving, poor diet, inadequate sleep).

Health risk patterns. Research demonstrates that the clustering of some behaviors can be characterized as health risk patterns. In the previously mentioned research by Laska et al. (2009), both males (34%) and females (24%) practice clusters of high-risk behaviors: high substance use, intoxicated sex, drunk driving, poor diet, and inadequate sleep. Mohler-Kuo et al. (2003) found that 3% of 54,586 undergraduate students surveyed in 119 colleges across the United States used illicit drugs, smoked cigarettes and smoked marijuana in the past 30 days, and binge drank in the last two weeks. Similarly, Gledhill-Hoyt et al. (2000) found that 3% of 14,138 students surveyed across the United States engaged in four risk substance abuse behaviors and 57% of those who binge drank reported using another substance. Specifically, 6% of students who binge drank in the past two weeks also used both cigarettes and marijuana.

Health promoting patterns. The review of literature demonstrates that college students exhibit clusters of health promoting patterns. Mohler-Kuo et al. (2003) found 49% of students did not smoke cigarettes and marijuana in the last 30 days and did not binge drink in the past two weeks. Similarly, Gledhill-Hoyt et al. (2000) found that 47% of students did not smoke cigarettes and marijuana in the last 30 days and did not binge drink in the past two weeks. Another

researcher found that a single health promoting behavior was associated with decreased likelihood of practicing a cluster of risk behaviors (Adams & Colner, 2008). Based on a cross-sectional sample of 40,209 students across the United States, higher fruit and vegetable consumption was associated with a reduced likelihood of smoking cigarettes, alcohol consumption, and drinking and driving in both men and women.

The reviewed literature provides insights about how HRBs cluster. Students do not practice all health promoting behaviors, but many of the clustering behaviors co-occur and are classified as either health promoting or health risk patterns. There is a need for additional research regarding college students' HRB clustering patterns (Quintiliani et al., 2010). Research is needed that provides insight into the variations of clustering patterns and differences by sociodemographic characteristics and the intervention designs to change the cluster. Research will help identify which HRBs to target for MHBC interventions on college campuses.

Pairs

Additional investigations can provide insight into pairing of various HRBs. The following review of literature details each of the 10 HRB pair combinations for smoking cigarettes, alcohol consumption, smoking marijuana, physical activity, and fruit and vegetable consumption. Each co-occurring HRB pair is reviewed based on: research specific to college students, variations based on level of use (i.e., number of servings of fruits and vegetables, intensity of physical activity, amount of alcohol, etc.) and sociodemographic characteristics, and interventions designed to promote co-variation of the paired risk behavior.

Smoking cigarettes and alcohol consumption

Prevalence. Research among college students has clearly demonstrated the co-occurrence of risk and protective patterns of smoking cigarettes and alcohol consumption.

Weitzman and Chen (2005) analyzed national survey data collected for the 2001 CAS. Based on a representative sample of 10,924 students in 120 colleges across the United States, 98% of cigarette smokers drank alcohol, and 44% to 59% of drinkers smoked cigarettes. An earlier study by Werner et al. (1996) showed that 973 undergraduate students enrolled in a university in Hawaii who were non-smokers also consumed less alcohol ($F = 126.70$, $p < 0.01$), and non-drinkers smoked fewer cigarettes ($F = 256.67$, $p < .01$).

Level of Use. The strength of the relationship between risk patterns of alcohol consumption and cigarette smoking appears to be dose-related and becomes stronger in the context of heavier use of either substance. For example, one of the first investigations by Werner et al. (1996) demonstrated that smoking cigarettes was the most important predictor of the quantity and frequency of alcohol consumption ($\beta = .384$, $p < .000$) for 452 freshmen students ($R^2 = 0.50$, $p < .0001$), consistent in a follow-up time period at the end of their junior year ($R^2 = 0.53$, $p < .0001$).

Similarly, other national surveys of college students demonstrate the association between risk patterns of smoking cigarettes and binge drinking. The 1997 CAS, a large nationally representative random survey sample of 25,627 undergraduate students attending 140 four-year colleges, provided evidence that binge drinking increased the likelihood of smoking cigarettes (OR = 4.89) (Emmons et al., 1998). Likewise, Jones, Oeltmann, Wilson, Brener, and Hill (2001) found that students who binge drank were five times more likely than students who did not binge drink to report ever trying or currently smoking cigarettes (OR = 5.0, $p < .001$). The results were based on a representative sample of 2,857 undergraduate students completing the 1995 National College Health Risk Behavior Survey implemented by the CDC in 148 universities.

Results were similar for a recent regional survey of college students. Halperin et al's. (2010) data were compiled from a health screening survey completed by 2,091 college students at five universities in Wisconsin and Washington. Students who smoked less than one cigarette ($\chi^2 = 79.4$. $p < .001$) on average per day binge drank less than students who smoke cigarettes at higher rates ($\chi^2 = 85.7$, $p < .001$). In addition, daily cigarette smoking was more likely to occur with binge drinking compared to students who did not smoke cigarettes daily (OR = 1.6, $p < .05$). The same trend was shown in other early research. Schorling, Gutgesell, Klas, Smith, and Keller (1994) showed that occasional smokers and regular daily smokers were four times (OR = 4.15, $p < .05$) more likely than nonsmokers to engage in binge drinking in the last two weeks. Results were based on surveys at 10 public colleges in Virginia, with 3,374 undergraduate students participating.

Sociodemographic characteristics. Limited research was identified that provides insight into whether the co-occurrence of smoking cigarettes and alcohol consumption varies by sociodemographic characteristics, such as gender, race, and year in undergraduate school. For the identified research, findings are inconsistent and provide inadequate insight into smoking cigarettes and alcohol consumption protective health behaviors.

The findings for the co-occurrence of smoking cigarettes and alcohol consumption by race are mixed and vary based on the decade of investigation. Ames et al. (2010) conducted an analysis of 1,623 survey responses collected from undergraduate students attending two public universities in the Southwest. More White students than Black students smoked cigarettes and consumed alcohol in the past 30 days ($p < .001$). On the contrary, Schorling et al. (1994) found no association between smoking cigarettes and binge drinking for the last two weeks for Black

(OR = 0.24) or Asian (OR = 0.26) students compared to White students attending a university in Virginia almost two decades ago.

The pair of smoking cigarettes and alcohol consumption varies by gender. For instance, a previously mentioned regional survey (Werner et al., 1996) showed tobacco use for male students was a greater predictor of the quantity and frequency of alcohol consumption ($\beta = 0.318$, $p < .0006$) than for females ($\beta = 0.224$, $p < .01$). Similarly, Ames et al. (2010) showed more males than females smoked cigarettes and consumed alcohol ($p < .001$). On the contrary, based on a 2001 national survey, more females than males smoked cigarettes and consumed alcohol (OR = 1.61) (Weitzman & Chen, 2005). Specifically, females who consumed 20 or more drinks in the past month were five times as likely as their lighter-drinking female counterparts (< 20 drinks) to smoke cigarettes in the past month. In comparison, males who consumed more than 20 drinks in the past month were three times as likely as their lighter-drinking male counterparts to smoke cigarettes in the last month. However, unlike the previously mentioned studies, earlier research of Schorling et al. (1994) found no significant variations by gender for the association between smoking behavior and binge drinking in the last two weeks for university students in Virginia.

One study provides insight into the co-occurrence of smoking cigarettes and alcohol consumption and the student's year in school. Werner et al. (1996) investigated the variation of year in school and found that smoking cigarettes was similarly correlated with the quantity and frequency of alcohol consumption for the same sample of 452 undergraduate students during freshman year ($R^2 = 0.50$, $p < .0001$), as in their junior year ($R^2 = 0.53$, $p < .0001$). Based on the paired comparison, freshmen who smoked cigarettes and consumed alcohol during the freshmen year continued the pattern in the junior year.

Interventions. There has been limited identified research that investigates health interventions for the co-variation of smoking cigarettes and alcohol consumption in college students. Three research studies were identified that reported interventions designed to change smoking cigarettes and alcohol consumption in college students.

Werch et al. (2007; 2008; 2010) focused on interventions designed to change more than one HRB in college students. All interventions were based on the BIM model, which utilizes social and self-imagery to promote behavior change (Werch et al., 2007). In the Werch et al. (2007) intervention, 155 students who visited the campus medical center were recruited and randomly assigned to either the control group, who received standard health education print materials, or to one of three intervention groups: contract with calendar log; consultation only; or contract, calendar log, and consultation. All participants completed two surveys that collected pre- and post- data on alcohol, cigarette and marijuana smoking, exercise behaviors, nutrition habits, sleeping, stress, and five other areas of quality of life. After a one-month follow-up, none of the three interventions changed smoking cigarettes or alcohol consumption (Werch, 2007).

However, Werch et al's. 2008 results demonstrate the BIM interventions versus the control group were effective for decreasing alcohol consumption ($F = 2.73$), but were not effective for decreasing cigarette use after a three-month follow-up. A random sample of 303 college students was randomly assigned to either the BIM-based intervention (one-on-one consultation with scripted messages, tailored content addressing each of the problem health behaviors, and a one-page goal plan) or the control group (standard health education print materials). Similar to the Werch et al. 2007 study, students completed pre- and post- surveys that collected data on health-promoting behavior, including exercise, nutrition habits, sleep habits, and use of stress management techniques.

Subsequently, Werch et al. (2010) conducted a 12-month follow-up for the sample of 303 college students in the 2008 study, and found no significant changes for alcohol or cigarette use and concluded their findings demonstrate the need for research to assess interventions for sustained behavior change for more than one health behavior.

Alcohol consumption and smoking marijuana

Prevalence. Research among college students demonstrates the co-occurrence of risk patterns for alcohol consumption and smoking marijuana. Shillington and Clapp (2006) analyzed survey data from 1,113 college students attending one of two southwestern universities and found 29% had consumed alcohol and smoked marijuana in the past year.

Level of Use. The relationship between risk behaviors associated with alcohol consumption and smoking marijuana appears to be in the context of heavy drinking, and the results are consistent for studies conducted in the mid-1990s and early 2000s. For example, Mohler-Kuo et al. (2003) showed a correlation of 30-day marijuana use and binge drinking (r = 0.56, $p < .001$). The results were derived from analyzing four combined CAS surveys administered between 1993 and 2001 to a large nationally representative sample of 54,586 undergraduate students attending 119 four-year colleges. Specifically, the students who smoked marijuana in the past 30 days were more likely than non-marijuana smokers to binge drink (OR = 6.83, p = no report). Wechsler et al's. (1995) results were similar when analyzing one CAS survey year. Students who reported marijuana smoking were significantly more likely to binge drink than students who did not smoke marijuana (OR = 7.13, p = no report). Likewise, Jones et al., (2001) surveyed 2,857 undergraduate students attending 148 colleges across the United States and found students who binge drank were significantly more likely to report marijuana use than those who did not binge drink (OR = 9.0, $p < .001$).

Sociodemographic characteristics. Limited research was found that investigated the co-occurrences of risk or protective patterns of alcohol consumption and smoking marijuana by sociodemographic characteristics, such as gender, race, and undergraduate year. One study reported White students (65.4%) were significantly more likely to report alcohol consumption and smoking marijuana than non-White (23.9%) students ($\chi^2 = 10.31$, $p < .001$) (Shillington & Clapp, 2006). In addition, users of alcohol and marijuana were significantly younger ($F = 48.89$, $p < .001$) than alcohol-only users.

Interventions. Limited research was identified that investigated successful interventions for the co-variation of alcohol consumption and smoking marijuana in college students. Three previously mentioned studies focused on BIM interventions designed to change more than one HRB in college students (Werch et al., 2008; 2010; Werch et al., 2007). Three interventions (contract with calendar log; consultation only; contract, calendar log, and consultation) implemented for the 155 students were effective for either smoking marijuana or alcohol consumption after one-month follow-up (Werch et al., 2007). Werch et al's. 2008 results showed that the BIM intervention, versus the control group (education materials), was effective in influencing alcohol consumption ($F = 2.73$) and smoking marijuana ($F = 3.18$) after a three-month follow-up. However, after a 12-month follow-up with the sample of 303 college students, Werch et al. (2010) found no significant decreases in alcohol consumption or smoking marijuana and concluded the findings demonstrate a need for research to assess interventions for prolonged behavior change for more than one health behavior.

Other researchers (White et al., 2006) conducted a study to evaluate two brief personal feedback substance-use interventions for students mandated to attend the Rutgers University Alcohol and Other Drug Assistance Program for Students. A sample of 222 students received

either a brief motivational interview intervention or a written feedback-only intervention. Students in both interventions reduced last month's heavy alcohol consumption ($F = 4.44$, $p = 0.04$) and smoking marijuana ($z = 1.97$, $p < .05$), although there was no significant change in frequency of alcohol consumption ($F = 3.79$, $p = 0.05$) or smoking marijuana ($F = 3.61$, $p = 0.06$). White et al. (2006) concluded there is a need for research to determine whether results were due to the interventions or to being caught, reprimanded, and referred to treatment.

Smoking cigarettes and smoking marijuana

Prevalence. Research among college students demonstrates the risk and protective patterns of the co-occurrence of smoking cigarettes and smoking marijuana. Multiple researchers examined several years of CAS surveys. Emmons et al. (1998) conducted the first analysis from CAS survey data collected in 1997 from 17,592 undergraduates at 140 colleges. Results showed that smoking marijuana raised the likelihood of smoking cigarettes (OR = 3.78, $p < .001$). Rigotti et al. (2000) showed similar results from CAS data collected in 1999 from 14,138 undergraduates at 119 colleges in the United States: students who smoked cigarettes were more likely to smoke marijuana (OR = 4.12, $p < .001$). Comparable results were found when analyzing four combined CAS surveys administered between 1993 and 2001 from a sample of 54,586 undergraduate students attending 119 four-year colleges. Mohler-Kuo's (2003) research showed students who used marijuana in the past 30 days were more likely than non-smokers of marijuana to smoke cigarettes in the same time period (OR = 6.70, p = no report).

Other localized research demonstrates risk and protective patterns for smoking cigarettes and smoking marijuana. Sheriff (2010) analyzed three annual data sets (2004, 2006, 2008) of female undergraduate students attending Northeastern University and found a correlation between female students who smoked cigarettes and smoked marijuana ($\chi^2 = 33.18, 49.48,$

37.86; $p = 0.000, 0.001, 0.001$). For those who did not use marijuana compared to those who did, the odds of using tobacco decreased (OR = 0.37, 0.36, 0.38; $p = 0.000, 0.000, 0.002$). Lenz's (2002) investigation into the relationship between smoking cigarettes and smoking marijuana for 203 18-19 year-olds at a midwestern university found past month marijuana use increased the likelihood of being a tobacco user (OR = 1.9, $p = 0.002$).

Level of Use. Unlike smoking cigarettes and alcohol consumption and alcohol consumption and smoking marijuana studies, which has linked the level of one substance with the co-occurrence of another substance, there is less research that links smoking cigarettes and smoking marijuana in the context of heavier use of another substance. One set of researchers, Tullis et al. (2003), hypothesized that higher potency marijuana may result in the co-occurrence of smoking cigarettes. In anecdotal evidence, students reported that smoking cigarettes reduced the sedative effects of marijuana and stimulated other synergistic toxicities like nicotine.

Sociodemographic characteristics. Limited research was found that investigated the co-occurrences of risk or protective patterns of smoking cigarettes and smoking marijuana by sociodemographic characteristics, such as gender, race, and year in undergraduate school. One study reported variations of the co-occurrence of smoking cigarettes and smoking marijuana by gender (Emmons et al., 1998). At the time of the study, female students (OR = 4.68, $p = 0.0001$) were more likely to report marijuana use increasing the likelihood of smoking cigarettes than male students (OR = 3.05, $p = 0.0001$). Tullis et al. (2003) concluded that research examining the sociodemographic differences in smoking cigarettes and smoking marijuana in college students may indicate where the greatest need for prevention and education efforts is.

Interventions. Limited research studies were found that examined interventions designed to promote the co-variation of smoking cigarettes and smoking marijuana in college students.

Werch et al. (2007; 2008; 2010) conducted three previously mentioned research studies that focused on BIM interventions. None of the three interventions (contract with calendar log; consultation only; contract, calendar log, and consultation) implemented for 155 students was effective in changing smoking cigarettes and smoking marijuana after a one-month follow-up (Werch et al., 2007). However, Werch's et al 2008 results showed that the BIM interventions, as opposed to the control group (education materials), were effective for changing smoking marijuana ($F = 3.18$) but not smoking cigarettes after a three-month follow-up. In 2010, after a 12-month follow-up for the sample of 303 college students, Werch et al. (2010) found no significant changes for smoking marijuana or smoking cigarettes.

Physical activity and smoking cigarettes

Prevalence. Research among college students demonstrates the co-occurrence of risk and protective patterns of physical activity and smoking cigarettes. Seo, Nehl, Agley, and Ma (2007) showed physical activity and smoking cigarettes protective patterns from a sample of 1,200 students attending one of four universities in three midwestern states. Nonsmoking students were more likely to participate in vigorous physical activity (OR = 2.3, p = no report) or moderate physical activity (OR = 1.7, p = no report) than students who smoked cigarettes. Nigg et al. (2009) found similar results when exploring the health behaviors of 973 undergraduate students at a university in Hawaii: students engaging in regular physical activity smoked less ($p < .02$).

Level of Use. The relationship between physical activity and smoking cigarettes appears to vary based on levels of either risk behavior. Dinger and Vesely (2001) found that a sample of United States college students who smoked cigarettes in the last 30 days were more likely (OR = 1.47, p = no report) to have low levels of physical activity (zero days of vigorous activity and less than two days of moderate activity in the past week) than non-smoking students. Likewise,

Halperin et al. (2010) analyzed survey data collected from 2,091 undergraduate and graduate students at one of five United States colleges and found that students with lower exercise levels (<3 times per week) were more likely to have smoked in the past three months compared to students who did not smoke in the past three months (OR = 1.3, $p < .01$). Subsequently, students with lower exercise levels smoked daily versus students who exercised more often (OR = 2.0, $p < .005$).

Higher levels of protective physical activity appear to impact the level of smoking cigarettes. For example, VanKim, Laska, Ehlinger, Lust, and Story (2010) surveyed 9,757 undergraduate students attending one of 14 two- or four-year universities in Minnesota. Students engaging in vigorous physical activity had a lower adjusted relative risk (ARR) of either weekday light smoking (light: ≤ 10 cigarettes/day) (ARR: 0.86) or weekday heavy smoking (heavy: ≥ 11 cigarettes/day) (ARR: 0.58), as compared to students not engaging in vigorous physical activity.

The protective behaviors of physical activity and smoking cigarettes occur in college student athletes, a population who has regularly practiced vigorous physical activity. Wechsler and Davenport (1997) found 15% of students who participated in intercollegiate athletics smoked cigarettes in the past 30 days versus 23% of students who did not participate in intercollegiate athletics. Emmons et al's (1998) research into the health practices of 17,592 undergraduates in 140 colleges in the U.S showed that non-participation in college athletics raised the likelihood of smoking cigarettes (OR = 1.53, $p < .001$). VanKim et al. (2010) suggested "smoking tends to have a negative impact on physical activity performance, and this may influence active young adults to refrain from smoking" (p. 7).

However, not all studies demonstrate an association between differing levels of physical activity and smoking cigarettes. For example, Lenz (2002) found no association between smoking and at least twenty minutes of aerobic activity in the past year, month, week, or day for 203 students aged 18-19 who attended a midwestern university (Lenz, 2002). Likewise, Johnson et al. (1998) did not find associations for any type of physical activity (leisure, strengthening, moderate, vigorous) and smoking cigarettes in the past 30 days for 575 students attending a university in southern California. Johnson et al. (1998) concluded that the low rate of smoking in the sample reduced the likelihood of an association.

Sociodemographic characteristics. Limited research has investigated the co-occurrence of either risk or protective behaviors of physical activity and smoking cigarettes by sociodemographic characteristics. Dinger and Vesely (2001) found no significant interactions with gender or race. However, two studies investigated the variations of intercollegiate athletic participation based on gender and their impact on the co-occurrence of physical activity and smoking cigarettes. Emmons (1998) showed non-participation in athletics increased the likelihood of smoking for males (OR = 1.91, $p = 0.0001$) more than females (OR = 1.25, $p = 0.0001$). However, Wechsler and Davenport (1997) did not find any gender relationship for students participating in intercollegiate sports.

Interventions. Three previously mentioned research studies by Werch et al. (2007; 2008; 2010) focused on interventions designed to promote the co-variation of physical activity and smoking cigarettes in college students. One intervention implemented for 155 students was effective for increasing physical activity ($F = 6.12$, $p = 0.00$) but not for decreasing smoking cigarettes after a one-month follow-up (Werch et al., 2007). Univariate tests showed significant increases in the length of time engaged in each session of physical activity ($F = 5.60$), $p = 0.02$),

the 30-day frequency of moderate physical activity ($F = 14.96$, $p = 0.00$), and the seven-day frequency of physical activity ($F = 13.67$, $p = 0.00$) for all three intervention groups (contract with calendar log; consultation only; contract, calendar log and consultation) but there was no significant difference among groups. Werch et al. (2010) reported a significant interaction for moderate exercise in the past 30 days, ($p = 0.04$), with small effects at both three and 12-month follow-ups for the BIM tailored intervention with combined fitness goal plan after a 12-month follow-up for the same sample of 303 college students. Werch et al. (2010) did not address the physical activity differences reported in the 2008 study versus the 2010.

Physical activity and alcohol consumption

Prevalence. Research investigating the co-occurrence of risk and protective patterns for physical activity and alcohol consumption in the form of binge drinking is limited and inconsistent and presents unique associations between risk and protective behaviors. Most researchers have not investigated the general college population but rather have focused on the alcohol consumption of college athletes, a population with high physical activity (VanKim et al., 2010). The researchers investigating the general student population failed to find any significant associations between physical activity and alcohol consumption (Moore & Werch, 2008; Seo et al., 2007). Moore and Werch (2008) suggested that the failure to identify a relationship between physical activity and alcohol consumption indicates physical activity levels are not adequate in the college population. Other studies reported a positive co-occurrence between risk and protective HRBs of physical activity and alcohol consumption, high levels of physical activity associated with binge drinking.

Level of Use. The studies that reported a significant association between physical activity and alcohol consumption in the general college population demonstrated that alcohol

consumption risk behaviors are associated with certain levels of physical activity protective behaviors. College students who engage in higher levels of physical activity are more likely to binge drink than those with little or no involvement in physical activity. Musselman and Rutledge (2010) investigated the physical activity and binge drinking patterns of 296 undergraduate students at a small liberal arts college. There was a 22% increase in the chance of being in a higher physical activity category, based on an exertion measure (METS) (calculated based on the past week's frequency and intensity of physical activity), and binge drinking in the last 30 days. Likewise, VanKim et al. (2010) found 9,757 undergraduate students attending one of 14 two- or four-year universities in Minnesota who were engaged in higher levels of moderate and vigorous ($\geq$ 2.5 hours/week) versus low levels ($\leq$ 2 hours/week) of physical activity were 29% and 44% more likely to binge drink in the last two weeks than students who participated in less physical activity. Dinger and Vesely (2001) reported 2,638 undergraduate and graduate students attending one of 74 institutions in the United States who binge drank one to two times in the past 30 days were less likely to have low levels of physical activity (0 days vigorous or < 2 days moderate) in the last seven days than those who did not report binge drinking (OR = 0.73, *p* = no report).

Even though considerable data indicates a positive association between protective physical activity and risk alcohol consumption, it is important to note that most of the studies did not consider team membership or participation in intercollegiate athletics as a confounding variable for the level of physical activity. This is important because substantial empirical evidence indicates intercollegiate athletics and involvement in team sports (e.g., intramural, club sports), as well as type of team sport (e.g., football vs. track), are important in the relationship between physical activity and alcohol consumption (Borsari & Carey, 1999; Ford, 2007; Nattiv,

Puffer, & Green, 1997). High levels of protective patterns of physical activity may not be the guiding factor for alcohol consumption; rather, it may be social and peer influence of participating in intercollegiate and team sports.

Researchers have hypothesized that intercollegiate athletic or team sport participation is a factor in risk alcohol consumption. Vickers et al. (2004) suggested the relationship compares to how fraternity involvement is associated with binge drinking, as reported by Scott-Sheldon et al. (2008). The group involvement invokes social norms and socio-environmental influence on young adults. Vickers et al. (2004) hypothesized that students involved in team sports and intercollegiate athletics have more opportunities for social drinking and may have greater peer influence to binge drink. Rockafellow and Saules's (2006) findings support this theory. Athletes involved in intercollegiate sports of any kind binged on alcohol more frequently than non-athlete exercisers who reported involvement in intramural or club sports or who participated in cardiovascular endurance exercise for at least 20 minutes per day three times a week ($F = 8.15$, $p = 0.01$). Additionally, when combining athletes and exercisers and recoding based on team sport participation, both athletes and exercisers who engaged in team sports binge drank more frequently ($F = 17.57$, $p = 0.01$) compared to non-team sports participants.

Sociodemographic characteristics. Limited research was identified that investigated the co-occurrence of risk and protective patterns of physical activity and alcohol consumption for the general college population by sociodemographic characteristics. Most research investigated characteristics specifically for intercollegiate athletes (Musselman & Rutledge, 2010; Nattiv et al., 1997).

Interventions. Even though the previously reviewed research suggests protective physical activity co-occurs with risk alcohol consumption, physical activity interventions appear

to act as mediators or "gateway behaviors" for the co-variation of protective physical activity and alcohol consumption. For example, two experimental studies showed that college students with high substance abuse behaviors lowered their alcohol levels with a physical activity intervention (Correia, 2004; Murphy, Pagano, & Marlatt, 1986). Correia (2004) demonstrated students who received physical activity instructions significantly reduced the number of alcohol consumption days and the total number of drinks consumed. A total of 105 college students who were not seeking to change were randomized into three groups: instruction to reduce substance abuse, instruction to increase physical activity, or a no-instruction control group. The three groups continued for 4 weeks and students self-reported their behaviors. Similarly, Murphy et al. (1986) conducted a randomized study of 60 college students who were heavy drinkers. The students were grouped into one of three groups: an exercise intervention group that met 3 times a week for 8 weeks for a structured running program; a mediation intervention; or a control group with no intervention. Based on self-reported behaviors, the physical activity intervention resulted in the greatest reductions in alcohol consumption (measured in milliliters of ethanol) after eight weeks and a six-week follow-up, and effect size estimates were most significant when compared to the control group (d = 0.97-1.19).

The previously-mentioned BIM interventions designed to change more than one HRB in college students showed mixed and non-sustained results (Werch et al., 2007; 2008; 2010). The intervention implemented for 155 students was effective for physical activity (F = 6.12, p = 0.00) but not for 30-day frequency and quantity of alcohol consumption after a one-month follow-up (Werch, 2007). Univariate tests showed significant increases in the length of time engaged in physical activity (F = 5.60, p = 0.02), 30-day frequency of moderate physical activity (F = 14.96, p = 0.00), and 7-day physical activity (F = 13.67, p = 0.00) for all 3 intervention groups

(contract with calendar log; consultation only; contract, calendar log, and consultation) but there was no significant difference among groups. The intervention reported in 2008 showed inverse results to those reported in the 2007 study: the intervention was not effective for physical activity but was effective for alcohol consumption (Werch et al., 2008). The students in the brief intervention group drank alcohol less frequently ($F = 8.70$, $p = 0.00$), and drank heavily less frequently ($F = 10.79$, $p = 0.00$), whereas the control group (students receiving commercial health education materials) increased the frequency and quantity of alcohol use. At a 12-month follow-up for the same sample of 303 college students, Werch et al. (2010) reported increases in alcohol consumption and increases in moderate physical activity in the past 30 days, ($p = 0.04$) for the BIM tailored intervention with combined fitness goal plan. Werch et al. (2010) suggested results demonstrate the need to bolster communications and re-introduce interventions to sustain long-term alcohol use outcomes.

Physical activity and smoking marijuana

Prevalence. Limited research has been identified that investigated the co-occurrence of risk and protective patterns of physical activity and smoking marijuana in college students (Ford, 2007; Moore & Werch, 2008). Two studies examined physical activity and smoking marijuana in college students and both reported non-significant associations (Dinger & Vesely, 2001; Moore & Werch, 2008). More frequently, research pertained to covariates of marijuana smoking in the college student population, such as Greek affiliation, or other substance abuse behaviors, such as alcohol consumption (Bell, Wechsler, & Johnston, 1997). Other researchers instead focused solely on college athletes or compared athletes' substance abuse patterns to those of non-athletes (Ford, 2007; Green, Uryansz, Petr, & Bray, 2001; Page & Roland, 2004; Rockafellow & Saules, 2006).

Level of Use. Insight is gained from the studies that have investigated college athletes. Similar to physical activity and alcohol consumption, the type of sport may promote an atmosphere of risk smoking marijuana. For example, Ford (2007) examined the 1999 CAS survey for substance abuse levels of college non-athletes and athletes by type of team sport participation. At the time of the study, even though overall marijuana use patterns of athletes was lower than that of non-athletes, male hockey players were more likely to report smoking marijuana (38.5%) than non-athletes (31.0%), and female soccer players were more likely to report smoking marijuana (37.8%) than non-athletes (25.0%).

Alternatively, unlike the previously mentioned relationship between protective physical activity and risk alcohol consumption, protective physical activity appears to be associated with protective smoking marijuana in athletes. For example, two studies reported that college athletes refrained from smoking marijuana compared to non-athletes (Ford, 2007; Page & Roland, 2004). Page and Roland (2004) found past-month marijuana use among non-athletes attending a northwestern university was higher compared to athletes (23.9 vs. 15.6 percent).

Nevertheless, caution must be taken with the assumption that higher levels of physical activity because of athletic participation are associated with protective or risk behaviors of smoking marijuana. As previously mentioned in the summary of physical activity and alcohol consumption, confounders relate to participation in college athletics; hence, high physical activity levels may not be the guiding factor for protective smoking marijuana but rather the social and peer influence of intercollegiate and team sports. Wechsler and Davenport (1997) suggested student athletes understand that a risk behavior such as smoking marijuana is illegal and may result in disciplinary action or will hamper their performance, resulting in the loss of coordination, decreased reaction time, and altered motivation and cognition. Further, there is

possible peer pressure among team members to maintain performance by not smoking marijuana. Consequently, additional research is needed to better understand the factors associated with physical activity and smoking marijuana in both athletic and non-athletic college students.

Sociodemographic characteristics. Limited research has been identified that investigated the co-occurrence of risk and protective patterns of physical activity and smoking marijuana by sociodemographic characteristics. Most research investigated the sociodemographic characteristics of student athletes and not the general college population. This research demonstrated more male college athletes smoke marijuana than female college athletes (Ford, 2007; LaBrie, Grossbard, & Hummer, 2009; Rockafellow & Saules, 2006).

Interventions. The identified interventions designed for the co-variation of physical activity and smoking marijuana utilized BIM interventions, with mixed and unsustained results similar to those of studies of physical activity and alcohol consumption (Werch et al., 2007; 2008; 2010). The interventions implemented for 155 students were effective for physical activity ($F = 6.12$, $p = 0.00$) but not for 30-day smoking marijuana after one-month follow-up (Werch et al., 2007). Univariate tests showed significant increases in the length of time engaged in physical activity ($F = 5.60$, $p = 0.02$), 30-day frequency of moderate physical activity ($F = 14.96$, $p = 0.00$), and seven-day physical activity ($F = 13.67$, $p = 0.00$) for each intervention group (contract with calendar log; consultation only; contract, calendar log, and consultation), but no significant difference was found between the groups. Another intervention by Werch et al. (2008) showed inverse results which were reported in the 2007 study: the intervention was not effective for physical activity but was effective for smoking marijuana. Students in the brief intervention group smoked less marijuana ($F = 4.99$, $p = 0.03$) and smoked heavily less frequently ($F = 5.98$, $p = 0.02$), whereas students receiving the commercial health education materials increased the

frequency and quantity of their marijuana use. From a 12-month follow-up for the same sample of 303 college students, Werch et al. (2010) reported increases in smoking marijuana and a significant increase in moderate physical activity in the past 30 days ($p = 0.04$) for the BIM tailored intervention with a combined fitness goal plan. Werch et al. (2010) suggested that the results demonstrate the need to bolster communications and re-introduce interventions to sustain long-term substance use outcomes.

Fruit and vegetables and physical activity

Prevalence. Many researchers investigated the influence of fruit and vegetable consumption and physical activity on anthropometric measures such as weight, body mass index, or body fat percentage (Huang, et al., 2003; Kasparek, Corwin, Valois, Sargent, & Morris, 2007; Lowry et al., 2000; Marrone, 2010; Racette et al., 2005). This research is prevalent because levels of fruit and vegetable consumption and physical activity contribute to overweight and obesity, which is a leading cause of death in the United States (Mokdad et al., 2001). Specifically, much of the research pertaining to college students focused on poor nutrition and physical inactivity because of their contribution to the phenomenon known as the "freshman 15," a trend of significant weight gain during the freshman year of college (Butler, Black, Blue, & Gretebeck, 2004; Ferrara, 2009; Graham & Jones, 2002; Levitsky, Halbmaier, & Mrdjenovic, 2004; Lowry et al., 2000). However, recent research into freshman weight gain based on a U.S. representative sample found the gain is not fifteen pounds and is similar to individuals of the same age who do not attend college (Zagorsky & Smith, 2011). This research suggests that college freshman are not at increased risk of weight gain compared to individuals of the same age who do not attend college; nevertheless, weight gain for both populations was evident. Therefore, interventions should continue for all young adults because research reveals that a diet

high in fat and calories (versus a low fat and low calorie diet of fruits and vegetables) plus a lack of physical activity are key factors that contribute to the increased risk of weight gain and the prevalence of overweight and obesity.

Even though numerous researchers have investigated fruit and vegetable consumption and physical activity in college students, there is little insight into how the variables interact to impact overweight and obesity (Driskell, Dyment, Mauriello, Castle, & Sherman 2008; Huang et al., 2003; Kasparek et al., 2007; Lowry et al., 2000; Marrone, 2010; Racette et al., 2005). Many researchers do not report statistical measures; thus, less research focuses on the co-occurrence of fruit and vegetable consumption and physical activity. Specifically, there is uncertainty about the interaction between fruit and vegetable consumption and physical activity (e.g., practicing both behaviors vs. practicing one or the other behavior) and the various levels of fruit and vegetable consumption and physical activity (e.g., moderate fruit and vegetable consumption and moderate physical activity vs. high fruit and vegetable consumption and vigorous physical activity). For example, Kasparek et al. (2007) investigated fruit and vegetable consumption and physical activity and their relationship to six-month weight changes in college freshmen. There were no reported baseline and post-test levels of co-occurring fruit and vegetable consumption and physical activity measures, nor were there reports about whether the co-occurring fruit and vegetable consumption and physical activity were associated with weight. Thus, there is a recognition that both fruit and vegetable consumption and physical activity contribute to weight change, but there is little insight about whether the combination or the synergy of fruit and vegetable consumption and physical activity at various levels impacts weight change.

Level of use. Researchers who conducted analyses of the co-occurrence of fruit and vegetable consumption and physical activity reported risk and protective patterns that vary based

on levels (e.g., amount of servings and levels of physical activity) (Adams & Colner , 2008; Dinger & Vesely; 2001). The researchers reported an association between high fruit and vegetable consumption (i.e., more servings) and high levels of physical activity, as well as between low fruit and vegetable consumption and lower levels of physical activity. Adams and Colner (2008) analyzed data from two years of the NCHA to investigate the associations of health behaviors with fruit and vegetable intake. Based on a representative sample of 40,209 college students across the United States, predictors of more daily servings of fruit and vegetables included students who were more likely to engage in more days of vigorous physical activity weekly (women OR = 1.12, $p = 0.001$ and men OR = 1.10, $p = 0.001$). Similarly, regarding risk patterns, Dinger and Vesely's (2001) study reported students were more likely to be less active (0 days of vigorous physical activity and < two days of moderate activity) if they consumed fewer than five servings of fruit, juice, or vegetables the previous day (OR = 4.24, p = no report). The results are based on a sample of U.S. students who took the National College Health Risk Behavior survey distributed to undergraduate and graduate students attending one of 74 institutions.

Researchers also reported the co-occurrence of protective patterns for fruit and vegetable consumption and physical activity levels based on regional samples of college students. Johnson et al. (1998) conducted a survey of 576 senior students attending a southern California university. Consumption of more servings of fruit and vegetables the previous day related to more days of vigorous activity in the past seven days for women and vigorous and moderate physical activity among men ($p < .05$). Similarly, Seo et al. (2007) showed that students who ate fruit two or more times per day were more likely to participate in vigorous physical activity (OR = 3.8, p = no report) or moderate physical activity (OR = 1.72, p = no report) and were less likely

to be inactive (OR = 0.06) than students who did not eat fruit in the past seven days. However, vegetable consumption was not associated with physical activity. Results were based on a sample of 1,200 students attending one of four universities in three midwestern states.

As previously mentioned, other insights are gained from studies of college athletes. Most identified research investigated other components of athletes' nutrition, such as supplement use and total fat and caloric intake, and did not focus on fruit and vegetable consumption (Noda et al., 2009). However, one study demonstrated no difference in fruit and vegetable consumption between college athletes and non-athletes. Cole et al. (2005) evaluated the dietary practices of National Collegiate Association Division I football players across the United States. Data from the National Health and Nutrition Survey showed that football players reported low fruit and vegetable consumption (fewer than two servings), which was similar to data for the same age and gender group of non-athletes. Results suggest that, despite athletes' need for additional nutrients, fruit and vegetable consumption is not a priority.

Sociodemographic characteristics. Limited research has been identified that investigated risk and protective patterns of co-occurring fruit and vegetable consumption and physical activity by sociodemographic characteristics. No studies were identified that investigated race and fruit and vegetable consumption and physical activity. Two previously mentioned studies revealed gender differences for moderate physical activity but none for vigorous physical activity and higher fruit and vegetable consumption (Adams & Colner, 2008; Johnson et al., 2008). Specifically, one study showed that more days of vigorous physical activity weekly were associated with consuming more servings of fruit and vegetables daily; however, there were no significant differences between genders (women OR = 1.12, $p = 0.001$ and men OR = 1.10, $p = 0.001$) (Adams & Colner, 2008). The other study by Johnson et al.

(1998) found that eating more servings of fruit and vegetables was related to moderate and vigorous physical activity among men and vigorous activity for women ($p < .05$).

Regarding year in school, many of the reviewed studies did not investigate its relationship to fruit and vegetable consumption and physical activity. One study reported year in school and found no significant difference. Driskell et al. (2008) reported no significant difference between fruit and vegetable consumption and physical activity patterns of freshman and sophomore versus junior and senior college students.

Interventions. Ferrara (2009) conducted a review of literature and identified multiple successful nutrition and physical activity interventions for college students, but most interventions focused on a single behavior's impact on weight. For example, Hivert, Langlois, Berard, Cuerrier, and Carpentier (2007) observed differences in body weight (intervention: 0.7 + 0.6 kg vs. control: -0.6 + 0.5 kg, $p = 0.04$) of students randomly assigned to a 24-month physical activity and nutrition intervention compared to a control group; however, no consumption measures were reported. Thus, there is no insight into whether the intervention was successful because of the co-variation of fruit and vegetable consumption and physical activity.

Other results regarding fruit and vegetable consumption and physical activity interventions are inconsistent. One example consists of the three previously mentioned BIM interventions designed to change more than one HRB in college students (Werch et al., 2007; 2008; 2010). The interventions implemented for 155 students were effective for increasing physical activity ($F = 6.12$, $p = 0.00$), but not for 30-day fruit and vegetable consumption at one-month follow-up (Werch et al., 2007). However, Werch et al's. 2008 study demonstrated improvements in fruit and vegetable consumption and physical activity for the intervention and control groups. After a 12-month follow-up for the same sample of 303 college students, Werch

et al. (2010) reported no significant improvements for fruit and vegetable consumption, but did identify a significant interaction for moderate exercise in the past 30 days ($p = 0.04$) for the BIM tailored intervention, but not the control group.

Fruit and vegetables and smoking cigarettes

Prevalence. There is limited identified research that investigated the co-occurrence of risk and protective patterns of college students' fruit and vegetable consumption and cigarette smoking behaviors. Three identified research studies investigated protective patterns of fruit and vegetable consumption and cigarette smoking. Adams and Colner (2008) analyzed data from two years of the NCHA for the associations of health behaviors with fruit and vegetable consumption. Based on a representative sample of 40,209 college students across the United States, the students who did not smoke cigarettes in the past 30 days also consumed more daily servings of fruit and vegetables (women OR = 0.97, $p = 0.001$ and male OR = 0.26, $p = 0.001$). Similarly, Martinelli (1999) found the frequency of eating five or more fruits and vegetables a day for the past year was associated with the probability of no tobacco use for 228 undergraduates in a mid-Atlantic university. However, Lenz (2002) did not find significant differences between how often 203 18-19 year-old students at a midwestern university consumed five or more fruit and vegetable servings per day and smoked cigarettes.

Level of Use. Due to the lack of identified empirical research, there is limited insight into whether the co-occurrence of fruit and vegetable consumption and cigarette smoking varies based on level of use.

Sociodemographic Characteristics. The three identified studies provide minimal insight into whether fruit and vegetable consumption and cigarette smoking vary based on sociodemographic characteristics. A majority of the identified sociodemographic research into

smoking cigarettes and nutrition-related measures pertained to body satisfaction and weight control factors predominantly found in women (Anderson & Bulik, 2004). Even though fruit and vegetable consumption is considered a weight control method (because of low calories and the fiber that provides a full feeling), the identified research failed to assess fruit and vegetable consumption but rather focused on other behaviors such as dieting, anorexia, and bulimia. However, the previously mentioned study by Adams and Colner (2008) provides some insight into gender differences for fruit and vegetable consumption and cigarette smoking. Women were three times more likely than men to consume more daily servings of fruits and vegetables and were less likely to smoke cigarettes in the past 30 days (women OR = 0.97, $p = 0.001$ and men OR = 0.26, $p = 0.001$). Other sociodemographic characteristics such as race and year in school were not assessed in the reviewed literature.

Interventions. There was less research that examined interventions designed to promote the co-variation of fruit and vegetable consumption and cigarette smoking in college students. The three previously mentioned BIM interventions shown to be effective for changing various multiple HRBs in college students were not effective for fruit and vegetable consumption and cigarette smoking (Werch et al., 2008; 2010; Werch et al., 2007). Therefore, there is no insight into successful interventions for the co-variation of fruit and vegetable consumption and cigarette smoking in college students.

Fruit and vegetables and alcohol consumption

Prevalence. Research investigating the co-occurrence of protective and risk behavior patterns of fruit and vegetable consumption and alcohol consumption in college students is limited. Two identified research studies suggested either protective or risk behavior patterns of fruit and vegetable consumption and alcohol consumption. Nelson, Lust, Story and Ehlinger

(2009) conducted a randomized mail survey of 6,000 University of Minnesota students. Based on 3,206 responses, the students who binge drank in the past two weeks were more likely to consume fewer fruits and vegetables (<5 daily fruits/vegetables servings) (OR = 1.07, $p \leq .01$). In regard to protective patterns, Adams and Colner (2008) found college students who consumed more daily servings of fruits and vegetables also had the reduced likelihood of alcohol consumption (women OR = 1.00, $p = 0.12$ and men OR = 0.99, $p = 0.001$.)

Level of Use. Because the lack of identified research, there is little insight into whether the co-occurrence of fruit and vegetable consumption and alcohol consumption varies based on level of use.

Sociodemographic Characteristics. There is limited research that investigated the sociodemographic characteristics of college students in relation to the co-occurrence of fruit and vegetable consumption and alcohol consumption. Similarly to fruit and vegetable consumption and cigarette smoking, a majority of the gender-specific research into binge drinking and nutrition-related behaviors pertained to women's eating disorders (Anderson & Bulik, 2004; Krahn, Kurth, Gomberg, & Drewnowski, 2005). However, in the Nelson and Lust study (2009), year in undergraduate school and gender were analyzed but not found to be significantly different for risk behaviors. Likewise, Adams and Colner (2008) identified no gender differences related to protective patterns of fruit and vegetable consumption and alcohol consumption. Race was not investigated in either of the studies.

Interventions. The research investigating interventions designed for the co-variation of fruit and vegetable consumption and alcohol consumption in college students is lacking. Of the identified studies, one of the three previously mentioned BIM interventions was effective for reducing alcohol consumption ($F = 2.73$) but fruit and vegetable consumption did not change

(Werch et al., 2008). Therefore, there is limited insight into interventions designed for the co-variation of fruit and vegetable consumption and alcohol consumption.

Fruit and vegetables and smoking marijuana

Literature about fruit and vegetable consumption and smoking marijuana was the least prevalent compared to the nine previously mentioned pairs of HRBs. There was no information regarding level of use or sociodemographic characteristic.

Prevalence. One formerly mentioned study of a large cross-sectional sample of students in the United States provided insight into the protective behavior of fruit and vegetable consumption as associated with the risk behavior of smoking marijuana based on gender (Adams & Colner, 2008). Female college students consuming more daily servings of fruit and vegetables were more likely to smoke marijuana in the past 30 days (women OR = 1.02, $p = 0.012$). Adams and Colner (2008) were surprised at this finding and suggested additional research is needed to investigate why there may be an association between protective fruit and vegetable consumption and smoking marijuana risk patterns in female students.

Interventions. There is limited research that examined interventions designed to promote the co-variation of fruit and vegetable consumption and smoking marijuana in college students. Of the identified studies, one of the three previously mentioned BIM interventions was effective for impacting smoking marijuana ($F = 3.18$) but not for fruit and vegetable consumption (Werch et al., 2008). Therefore, there is less insight into successful interventions for the co-variation of fruit and vegetable consumption and smoking marijuana in college students.

Conclusion

HRBs play a key role in the health and mortality of individuals; however, many adults and college students fail to practice most protective HRBs. Health professionals are

overwhelmed with the task of promoting multiple protective HRBs with shrinking resources and have little insight into designing interventions for more than one HRB (Christmas, 2010). The design criteria include: (a) the applicability of sociodemographic characteristics; (b) the number and types of HRBs that should be targeted; (c) types of intervention design, methodologies, and measurements; and (d) the theories to explain the change of more than one behavior. Prochaska (2008) summarized MHBC intervention challenges with the assertion that little is known about when and how multiple behaviors change together and what types of interventions promote change.

To overcome knowledge gaps, continued investigations into the co-occurrence of health behaviors may provide researchers with the insight to design successful MHBC interventions for the co-variation of risk HRBs (Noar et al., 2008; Quintiliani et al., 2010). Further, focusing on college students may be an effective strategy to impact a large percentage (approximately 39%) of the U.S. population because many lifelong adult behaviors are established before and during the time when individuals attend college (Dishman & Sallis, 1994; U.S. Census Bureau 2011a; b). However, the identified empirical evidence for the co-occurrence of clusters and pairs of the five Healthy Campus 2010 (ACHA, 2002) objectives is limited and in many cases presents contradictory results. There is also no conclusive evidence of the co-occurrence of HRBs by sociodemographic characteristics. Nigg et al. (2009) recommended that researchers continue to examine the complex relationships between health risk and protective behaviors. The following chapter reviews a research design to investigate the co-occurrence of five HRBs in college students and the variations by sociodemographic characteristics.

CHAPTER 3: METHODS

The purpose of this chapter is to describe the research methods involved in this study. The following topics are reported: (a) research design, (b) data collection instrument, (c) participants and site, (d) data collection procedures, and (e) data analysis.

Research Design

The research design of the study was based on the postpositive knowledge paradigm, which states that complicated problems are composed of knowledge and facts and they are more comprehensible when broken into smaller parts (Creswell, 2002). This paradigm is appropriate for this study because the research questions were modeled on knowledge-based theory (e.g., health related behaviors (HRBs) differ by sociodemographic characteristics), information was collected, and biases (e.g., error) were considered (Leedy & Ormrod, 2005). Based on this paradigm, absolute truth can never be found; therefore, research questions are tested but do not lead to conclusions of absolute truth.

The approach used to answer the research questions was quantitative, which is generally utilized with the postpositive knowledge paradigm (Creswell, 2002; Gliner & Morgan, 2000). A non-experimental, cross-sectional design was used to explore the relationship between co-occurring HRBs and the sociodemographic characteristics of students at one point in time (see Figure 12).

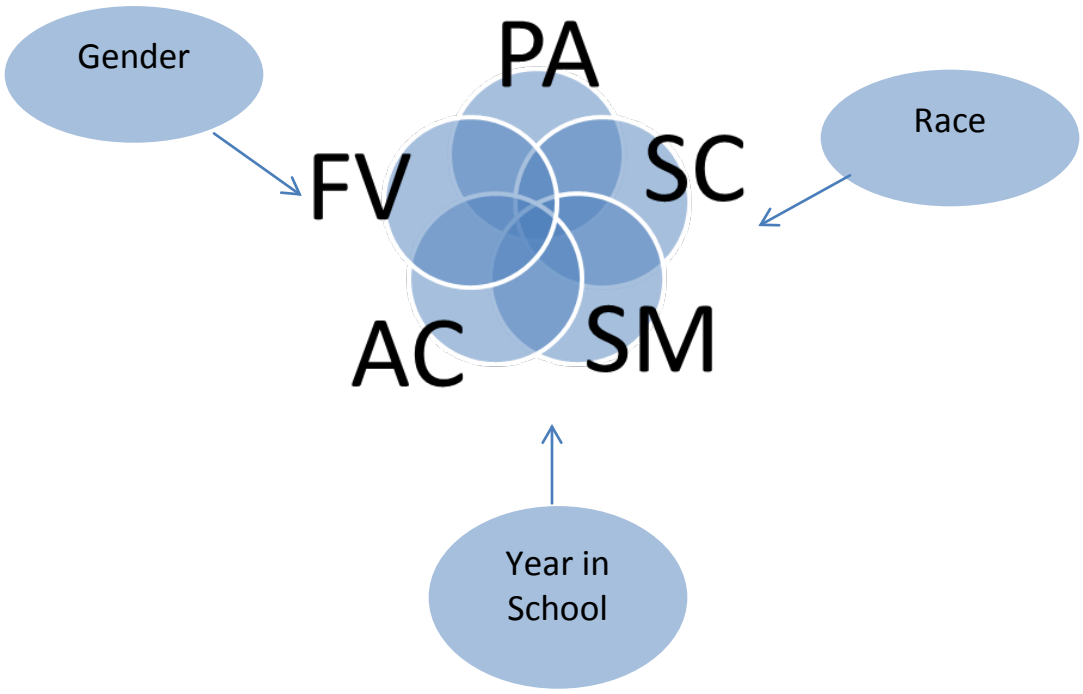

Figure 12. Relationship between co-occurring HRBs by sociodemographic characteristics

Data Collection Instrument

The original National College Health Assessment (NCHA) was utilized to collect information about health behaviors and sociodemographic characteristics of Colorado State University (CSU) students (see Appendix B). The assessment was developed by the American College Health Association (ACHA), a non-profit organization that aims to assist health educators, health service providers, counselors, and administrators in collecting data about students' behaviors and perceptions of the most prevalent health topics (ACHA, 2011). The NCHA contains 58 questions that assess risk and protective behaviors, impediments to academic performance, health status, health problems, and perceived norms of college students (ACHA, 2005b). The assessment covers many areas of health and wellness such as: injury prevention,

personal safety and violence; alcohol, tobacco, and other drug use; sexual health; weight, nutrition and exercise; and mental health. Reliability and validity analysis of the original instrument was conducted by ACHA. Relevant percentages, reliability analysis, construct validity analysis, and measurement validity were compared with nationally representative databases: the National College Health Risk Behavior Survey (NCHRBS); the Harvard School of Public Health 1999 College Alcohol Study (CAS); the National College Women Sexual Victimization Study (NCWSV); and NCHA 1998, Spring 1999 and Fall 1999 pilots (ACHA, 2005b). Various statistical procedures, through triangulation, demonstrated that the instrument appears to be both reliable and valid for representing the nation's students (ACHA, 2011).

The variables chosen for this study consisted of five Healthy Campus 2010 (ACHA, 2002) objectives (see Appendix A): smoking cigarettes (SC), alcohol consumption (AC), smoking marijuana (SM), physical activity (PA), and consuming fruits and vegetables (FV), and three sociodemographic characteristics (gender, race, and year in undergraduate school). Table 6 provides the survey question number, its level of measurement, and number of levels of measurement for each health behavior and sociodemographic variable collected from NCHA.

Table 6

Variables from National College Health Assessment by Survey Number, Level of Measurement, and Number of Levels

Variable	Survey Number	Level of Measurement	Number of Levels
Health Behaviors			
Smoking Cigarettes (SC)	9	Ordinal	8
Alcohol Consumption (AC)	16	Scale	11
Smoking Marijuana (SM)	9	Ordinal	8
Physical Activity (PA)	39	Scale	8
Fruits and Vegetables (FV)	38	Ordinal	4
Sociodemographic Characteristics			
Gender	46	Dichotomous	2
Race	51	Nominal	6
Year In School	49	Ordinal	8

The five HRBs' questions, definitions, and levels are as follows:

Smoking cigarettes (SC):

Question: Within the last 30 days, how many days did you use cigarettes?
Definition: Number of days in the last 30 days the student used.
Levels: The eight levels: never; have used but not in the past 30 days; 1-2 days; 3-5 days; 6-9 days; 10-19 days; 20-26 days; used all 30 days.

Alcohol consumption (AC):

Question: Think back over the last 2 weeks. How many times, if any, have you had five or more alcoholic drinks in one sitting?
Definition: Number of times the student consumed more than five alcoholic beverages at a sitting in the past two weeks. One alcoholic beverage is defined as a 12 oz. beer, a 4 oz. glass of wine, a shot of liquor, or a mixed drink.
Levels: The eleven levels: 0; 1; 2; 3; 4; 5; 6; 7; 8; 9 or more times in the last two weeks.

Smoking marijuana (SM):

Question: Within the last 30 days, how many days did you use marijuana?
Definition: Number of days in the last 30 days the student used.
Levels: The eight levels: never; have used but not in the past 30 days; 1-2 days; 3-5 days; 6-9 days; 10-19 days; 20-26 days; all 30 days.

Physical activity (PA):

Question: On how many of the past seven days did you participate in vigorous exercise for at least 20 minutes or moderate exercise for at least 30 minutes?
Definition: Number of days in the past week the individual participated in at least 20 minutes of vigorous activity and/or 30 minutes of moderate activity.
Levels: The eight levels consisted of: 0, 1, 2, 3, 4, 5, 6; 7 days.

Fruits and vegetables (FV):

Question: How many servings of fruits and vegetables do you usually have per day?
Definition: Number of servings the students usually consumes per day. One serving size is defined as a medium piece of fruit; ½ cup chopped, cooked, or canned fruit or vegetable; ¾ cup of vegetable or fruit juice; small bowl of salad greens; or ½ cup of dried fruit.
Levels: The four levels were: do not eat (0), 1-2, 3-4, 5 or more servings.

Participants and Site

Participants for this study were students enrolled in a CSU Health and Wellness course during the spring 2009 semester. CSU is a public, regional accredited, comprehensive research university located in the Rocky Mountain region. The Health and Wellness course is an elective three-credit lecture-based class that focuses on personal health behaviors and personal choices regarding wellness (CSU, 2011a).

The sample consisted of 1,025 students (approximately 5% of the total undergraduate student population) who were enrolled in one of eight class sections of the Health and Wellness course, who attended class the day the National College Health Assessment (NCHA) was administered, and who volunteered to participate. The eight class sections were taught by faculty in the health and exercise science, food science and human nutrition, and environmental and radiological health departments. Approximately 14% of the participants were health and exercise majors, but there is no information regarding the majors of the other students. What is known is that the College of Applied Human Sciences contains the second highest number of undergraduate students enrolled (n = 4,226) and 79% of the courses offered in the College are taken by majors within the college, including the health and exercise science or food science and

human nutrition departments (CSU, 2010a). Comparatively, fewer undergraduate students are enrolled (n = 628) in the College of Veterinary Medicine and Biomedical Sciences, which contains the environmental and radiological health department (CSU, 2010a). So it is assumed that the sample consisted of more students from the College of Applied Human Sciences (n = 4,226) when compared to the College of Veterinary Medicine and Biomedical Sciences (n = 628) or other colleges (n = 16,350) (CSU, 2010a).

The demographic statistics of age, gender, race, and year in school were compared to the university population in 2009 (CSU, 2010a) to determine if the sample was representative (see Table 7). The age distribution of the 18-23 year old population (80%) versus CSU population (56%) consisted of more 18, 19 and 20 year olds than 21, 22, or 23 year olds. Fifty-one percent of the university population was female and the survey sample consisted of 54% females. The survey participants included 13% of the non-White population, while the university percentage of non-White students was 21% in 2009. More of the surveyed students were first- and second-year students (78%), when compared to CSU students (50%). Thus, the survey and final sample was not representative of the total CSU population when considering major of study, year in school and age, but was representative by gender and race.

Not all the completed surveys were used in the analysis. Nine-hundred and twenty eight students were included because they fit the study criteria: undergraduate students between the ages of 18-23 years old (see Table 7). Students who were 24 years or older, in graduate school, or who did not indicate their age were dropped from the sample. These constraints are relevant because this study aimed to investigate the sociodemographic characteristic of young adults who are undergraduate students.

The final sample was a desirable sample size which helped to reduce the possibility of committing a Type II error (Cohen, 1988). Specifically, to ensure adequate power of the population, a sample size of at least 300 is required to test the sample at alpha .05 with a medium effect size (Hsieh, Block, & Larsen, 1998).

Table 7

Demographic Characteristics of Total CSU Population (N = 21,204), Students Surveyed (N =1,025), and Final Survey (N = 928), 2009

Characteristic	CSU (N)	CSU %	Survey (N)	Survey %	Survey % Cum	Survey Final (N)	Survey Final %	Survey Cum %
Gender								
Male	10,308	49	395	39		351	40	
Female	10,896	51	560	54		535	60	
Missing			70	7		42		
Age (years)								
18	3,830	18	331	32	32	331	36	36
19	4,198	20	343	34	66	343	37	73
20	3,874	18	144	14	80	144	16	88
21	3,533	17	58	6	94	58	6	94
22	2,238	11	31	3	97	31	3	98
23	1,006	5	21	2	99	21	2	100
Race[a]								
White	16,729	80	902	88		828	88	
Black	535	3	18	2		17	2	
Hispanic	1,387	7	56	5		53	6	
Asian	635	3	31	3		26	3	
Indian	344	2	12	1		11	1	
Other	1,213	6	24	2		1	<1	
Missing						6		
Year in school (undergraduate)								
1st	5,874	28	410	42	42	390	44	44
2nd	4,762	22	347	36	78	334	37	81
3rd	4,703	22	137	14	92	113	12	94
4th	5,865	28	51	5	97	55	6	100
5th	-	-	24	2	99	-	-	-
Missing						36		

[a] Some students indicated 2 or more races and were counted as non-White for the final sample

Data Collection Procedures

Approval to conduct the study based survey data collected in 2009 from the NCHA assessment was obtained from the CSU Human Subjects Institutional Review Board in 2012 (see

Appendix C). The survey data were previously collected by instructors of the spring 2009 semester Health and Wellness sections who were asked to have their classes participate in the survey; participation rate of instructors was 100%. Students who were enrolled in one of eight Health and Wellness courses were asked to complete the NCHA survey. At the beginning of the class period, a graduate research assistant read a script (see Appendix D) that explained the purpose of the study and informed the students their survey responses would remain anonymous and their decision to participate would not impact their grade. The assistant asked the instructor to leave the room during survey administration so the students did not feel pressured to participate. Students who volunteered to participate completed the assessment during class and returned it to the research assistant. Students choosing not to complete the survey stayed in the classroom while their peers completed the assessment. Consent to participate was assumed by the student's completion of the assessment. There was a 97% student participation rate.

Data analysis

To test the research questions, most of the variables in Table 6 were recoded to the variables in Table 8. The variables were recoded dichotomously based on the protective behavior of meeting, or the risk behavior of not meeting, Healthy Campus 2010 (ACHA, 2002) objectives (see Appendix A). Meeting behavior objectives was defined as a protective HRB and not meeting objectives was defined as a risk HRB. Table 9 displays the risk and protective HRB counts and percentages of the final sample based on meeting and not meeting Healthy Campus 2010 objectives (see Appendix A) (ACHA, 2002).

Table 8

Recoded HRB Variables and Definitions of the Level of Measurement

HRB Objective	Level of Measurement	Protective Behaviors	Risk Behaviors
Smoking cigarettes	Dichotomous	Never used or have used but not in the past 30 days	≥ 1 day in past 30 days
Alcohol consumption	Dichotomous	No binge drinking in the past 2 weeks	Binge drink at least once or more times in the past 2 weeks
Smoking marijuana	Dichotomous	Never used or have used but not in the past 30 days	≥ 1 day in past 30 days
Physical activity	Dichotomous	≥3 days of moderate (30 min.) or vigorous (20 min.) in week	< 3 days of moderate (30 min.) or vigorous (20 min.) in week
Fruit and vegetable consumption	Dichotomous	≥ 5 servings usually in a day	< 5 servings usually in a day

Table 9

Counts and Percentages of Risk and Protective HRBs based on Students Meeting and Not Meeting Healthy Campus 2010 Objectives for Final Sample (N = 928)

Objective	Number	Percentage
Smoking Cigarettes (SC)		
Protective Behavior	732	79
Risk Behavior	195	21
Alcohol Consumption (AC)		
Protective Behavior	478	52
Risk Behavior	442	48
Smoking Marijuana (SM)		
Protective Behavior	720	78
Risk Behavior	206	22
Physical Activity (PA)		
Protective Behavior	522	57
Risk Behavior	394	43
Fruit and Vegetable Consumption (FV)		
Protective Behavior	67	8
Risk Behavior	805	92

Race and year in school were recoded. Due to the low number of non-White students, race was recoded into White (indicated only White) and non-White (Black, Asian, Indian, Hispanic, other, or two or more of non-White or a mix of non-White and White). Year in school remained the same for years one through three, but years four and five were combined. If gender, race, or year in school was not indicated, a missing value was assigned to the record. The recoded health behavior and sociodemographic variables' frequency distributions and percentages are represented in Table 10.

Table 10

Recoded Sociodemographic Characteristics of Final Sample ($N = 928$)

Characteristic	Number	Percentage	Cumulative Percentage
Gender			
Female	535	58	
Male	351	38	
Missing	42		
Race			
White	806	87	
Non-White	116	13	
Missing	6		
Year in School (undergraduate)			
1st	390	44	44
2nd	334	37	81
3rd	113	13	94
4th and 5th	55	6	100
Missing	36		

A combination of descriptive, differential, and associational statistical analyses were used to answer the following six research questions:

1. What percentage of students meet and do not meet the Healthy Campus 2010 (ACHA, 2002) objectives and target goals (see Appendix A) for behaviors related to smoking cigarettes,

alcohol consumption, smoking marijuana, physical activity, and fruit and vegetable consumption?

2. What are the differences in students who meet and do not meet the Healthy Campus 2010 (ACHA, 2002) objectives by sociodemographic characteristics (gender, race, and year in school)?

3. What percentages of students practice risk behaviors for one, two, three, four, or all five of the risk HRBs?

4. What are the variations for one, two, three, four, or all five of the risk HRBs by sociodemographic characteristics (gender, race, and year in school)?

5. What are the clusters of the five risk and protective HRBs by sociodemographic characteristics (gender, race, and year in school)?

6. What are the pairs of HRBs and do the pairs vary by sociodemographic characteristics (gender, race, and year in school)?

The choice of statistical tests used to address the research questions was based on the intent of the research questions and the number and levels of the independent and dependent variables. For example, the purpose of research questions one, three, five, and six was to describe: (a) students who practice risk and protective HRBs based on meeting and not meeting Healthy Campus 2010 (ACHA, 2002) objectives and target goals for single (Q1) and co-occurring behavior pairs (Q6), (b) the number of students practicing risk behaviors for one, two, three, four, or five HRBs (Q3), and (c) the most frequent clustering patterns of student risk and protective HRBs (Q5) (see Table 11). Therefore, descriptive statistics were appropriate, including counts, percentages, and cumulative percentages.

Research questions two and five aimed to test those who meet and do not meet the Healthy Campus 2010 (ACHA, 2002) objectives and the top five cluster patterns by sociodemographic characteristics (gender, race, and year in school) (see Table 11). A combination of multiple 2x2 or 4x2 Chi squared tests for each combination of HRBs or clusters were the appropriate inferential statistical tools.

Finally, associational statistical tests used for questions four, five, and six identified the associated pairs of risk and protective co-occurring health behaviors (Q6), number of risk health behaviors (Q4), and cluster patterns for both risk and protective HRBs (Q5) and their variations by sociodemographic characteristics (gender, race, and year in school) (see Table 11). For example, a Phi statistical test at a significance level of $p < .01$ was the criteria for determining each of the pairs of risk and protective co-occurring behaviors (Q6). For each of the associated pairs of risk and protective co-occurring behaviors, logistic regression tested who practiced the pairs by gender, race, or year in school (Q6). Ordinal regression determined who practiced risk HRBs for one, two, three, four, or five of the risk HRBs by gender, race, or year in school (Q4). Cluster analysis characterized the students who were in the cluster and multinomial regression determined the variations of the clusters by gender, race, or year in school (Q5).

Table 11

Research Questions, Related Variables and Levels, and Statistical Analysis

Research Questions	Variables	#	Levels	Analysis
Question 1	SC	2	Meet; not meet objective	Descriptive
	AC	2	Meet; not meet objective	Statistics
	SM	2	Meet; not meet objective	
	PA	2	Meet; not meet objective	
	FV	2	Meet; not meet objective	
Question 2	IV Sociodemographics			Chi Squared
	Gender	2	Male; Female	
	Race	2	White; non-White	
	Year in School	4	1^{st} ; 2^{nd};3^{rd} ;$4/5^{th}$;	
	DV		As above in Q1	
Question 3	Number of HRB	6	Risk HRB for 0 of 5; 1 of 5; 2 of 5; 3 of 5; 4 of 5; 5 of 5	Descriptive Statistics
Question 4	IV Sociodemographics		As above in Q2	Ordinal Regression
	DV Number of HRBs		As above in Q3	
Question 5	Cluster group	2	In or not in cluster Descriptive	Cluster Analysis Descriptive Statistics
Question 5	IV Sociodemographics		As above in Q2	Chi Squared
	DV Cluster group[a]			
Question 5	IV Sociodemographics		As above in Q2	Multinomial Regression
	DV Cluster group[a]		As above in Q5	
Question 6	5 HRBs		5 HRBs	Phi $p < .01$
Question 6	Associated pair[b]	2	Risk and protective HRB	Descriptive Statistics
Question 6	IV Sociodemographics		As above in Q2	
	DV Associated pair[b]	2	Risk and protective HRB	Logistic Regression

[a] The number clusters tested depends on the number representing a majority of students identified in the cluster analysis.

[b] The number of HRB pairs tested depends on the outcome of the Phi ($p < 0.01$) analysis.

Other factors were considered when conducting and interpreting the data analysis. First, the assumptions about the statistical tests were considered when choosing the appropriate analysis. This included choosing the appropriate test according to homogeneity of variances and whether the variable was normally distributed (Gliner & Morgan, 2000). Analysis of effect size was reported to interpret the strength of the relationships between independent and dependent variables (Gliner & Morgan, 2000). Last, researcher bias and assumptions of internal and external validity were considered when interpreting the findings.

Internal validity

When interpreting the results, internal validity was considered when examining the relationships that exist between health behaviors and sociodemographic characteristics. Caution was used when interpreting a high correlation between independent variables and dependent variables. Further, a major threat to internal validity was the selection criteria for the study participants. Participation was voluntary, but, to minimize the threat, a large sample size of 928 was used for this study. Internal validity was assumed to be low because there was no control group in the design of the study (Gliner & Morgan, 2000).

External validity

Both population and ecological external validity were considered when examining the relationships between health behaviors and sociodemographic characteristics. First, when considering whether the actual sample of participants in the Health and Wellness courses was

representative of the CSU undergraduate population, gender, race, and year in school was compared with the data of the university. Also, it is possible that participants who chose to enroll in the Health and Wellness course may have had different initial motivations or intentions regarding HRBs. Students enrolled in this course may have already been mindful of the importance of health-related behaviors, thus being unrepresentative of the theoretical population. Therefore, population external validity is low to medium (Gliner & Morgan, 2000).

Next, ecological external validity was considered. Because the study questions were specific and bound to a certain time period, no inference was made that the findings are consistent or applicable over a longer time period, and caution was used when inferring that the measured HRBs were actually representative of the typical student behaviors. Additionally, due to the self-report nature of the instrument, caution was used because self-reporting is not a direct measure of the actual behavior in a typical environment. Therefore, the ecological population external validity is assumed to be medium (Gliner & Morgan, 2000).

CHAPTER 4: FINDINGS

The purpose of this study was to investigate five co-occurring health related behaviors (HRBs)--(smoking cigarettes (SC), alcohol consumption (AC), smoking marijuana (SM), physical activity (PA), and consuming fruits and vegetables (FV)) of students by gender, race, and year in school. The statistical tests used in the quantitative study were descriptive, associational, and differential in nature.

This chapter presents the data collected and analyzed to answer the research questions:

1. What percentage of students meet and do not meet the Healthy Campus 2010 (ACHA, 2002) objectives and target goals (see Appendix A) for behaviors related to smoking cigarettes, alcohol consumption, smoking marijuana, physical activity, and fruit and vegetable consumption?

2. What are the differences in students who meet and do not meet the Healthy Campus 2010 (ACHA, 2002) objectives by sociodemographic characteristics (gender, race, and year in school)?

3. What percentages of students practice risk behaviors for one, two, three, four, or all five of the risk HRBs?

4. What are the variations for one, two, three, four, or all five of the risk HRBs by sociodemographic characteristics (gender, race, and year in school)?

5. What are the clusters of the five risk and protective HRBs by sociodemographic characteristics (gender, race, and year in school)?

6. What are the pairs of HRBs and do the pairs vary by sociodemographic characteristics (gender, race, and year in school)?

Description of the Sample

The sample of this study included 928 Colorado State University (CSU) undergraduate students aged 18-23 years old, who were enrolled in one of eight class sections of an elective Health and Wellness class in the spring 2009 semester, and who volunteered to participate. With respect to age, 73% of the students were 18 or 19 years old. For the data analysis, race was recoded into White (n = 806, 87%) and non-White (n = 116, 13%) for the students indicating Black, Asian, Indian, Hispanic, other, or two or more of non-White or a mix of non-White and White. More students were freshmen or sophomore (underclassmen) (81%) than junior or senior (upperclassman) (19%) (see Table 12). It was assumed that the sample consisted of more students from the College of Applied Human Sciences (n = 4,226) than the College of Veterinary Medicine and Biomedical Sciences (n = 628) or other colleges (n = 16,350) (CSU, 2010a). Therefore, the sample was not representative of the total CSU undergraduate student population when considering major of study, year in school and age, but was representative by gender and race.

Table 12

Sociodemographic Characteristics of the Final Sample (N = 928), 2009

Characteristic	Number	Percentage	Cumulative Percentage
Age (years)			
18	331	36	36
19	343	37	73
20	144	16	88
21	58	6	94
22	31	3	98
23	21	2	100
Gender			
Male	351	40	
Female	535	60	
Missing	42		
Race			
White	828	87	
Non-White	116	13	
Missing	6		
Year in School			
1st	390	44	44
2nd	334	37	81
3rd	113	12	94
4th and 5th	55	6	100
Missing	36		

Single HRBs

The purpose of research question one was to identify the number of students who meet and do not meet Healthy Campus 2010 (ACHA, 2002) objectives and target goals for behaviors related to the five HRBs in Appendix A. Counts and percentages were used to determine the distribution of students who meet or do not meet the objectives (see Table 13).

Table 13

2010 Target Goal Percentages, Counts, and Percentages of Students Meeting and Not Meeting Healthy Campus 2010 Objectives for Five Heath Related Behaviors, Final Sample (N = 928)

HRB	2010 Target Goal Percentage	Number	Percentage
Smoking Cigarettes (SC)			
Meet Objectives		732	79
Do Not Meet Objectives	10.5	195	21
Alcohol Consumption (AC)			
Meet Objectives		478	52
Do Not Meet Objectives	20.0	442	48
Smoking Marijuana (SM)			
Meet Objectives		720	78
Do Not Meet Objectives	1.0	206	22
Physical Activity (PA)			
Meet Objectives	55.0	522	57
Do Not Meet Objectives		394	43
Fruit and Vegetable (FV)			
Meet Objectives	25.0	67	8
Do Not Meet Objectives		805	92

The HRB with the largest number of students (n = 805, 92%) not meeting the objectives was fruit and vegetable consumption; it was 17 percentage points under/less than the Healthy Campus 2010 (ACHA, 2002) target goal. Alcohol consumption (n = 442, 48%) was the second HRB with the most students for not meeting objectives. Alcohol consumption was 28 percentage points under/less than the Healthy Campus 2010 (ACHA, 2002) target goal. Not meeting physical activity objective (n = 393, 43%) was the third HRB for not meeting objectives; however, it was two percentage points more than the Healthy Campus 2010 (ACHA, 2002). The HRBs with the fewest number of students not meeting the objectives were smoking cigarettes (n = 195, 21%) and smoking marijuana (n = 206, 22%), with similar percentages of students not

meeting the objectives for each of the behaviors. The Healthy Campus 2010 (ACHA, 2002) target goal for smoking was 10.5 percentage points under/less than the goal. However, smoking marijuana had a larger gap: 20 percentage points under/less than the goal.

In summary, the data reveals that the HRB with the highest percentage of students not meeting Healthy Campus 2010 (ACHA, 2002) objectives was the consumption of five servings of fruits and vegetables daily, with alcohol consumption ranking second. The sample did meet the 2010 target goal percentages for physical activity, with alcohol consumption being the health behavior most divergent from the Healthy Campus (ACHA, 2002) target goal.

Single HRBs and Gender, Race and Year in School

Research question two was to determine whether students meeting or not meeting the Healthy Campus 2010 (ACHA, 2002) objectives vary by gender, race, and/or year in school. A Pearson Chi-squared statistical test ($p \leq .05$) was used to test race and gender (2x2) and Cramer's statistical test ($p < .05$) was used to test year in school (4x2). Table 14 shows the results of the analysis and indicates significant differences for some HRBs by gender and year in school, but not race.

Eighty-one percent of females did meet the smoking marijuana objective versus 74% of the males, and 25% of males did not meet objective ($\chi 2 = 5.28$, $df = 1$, N = 884, $p < 0.01$). Similarly, 54% of females met alcohol consumption objective versus 39% of males, and 61% of males did not meet objective versus 45% of females ($\chi 2 = 21.66$, $df = 1$, N = 879, $p < 0.00$). Phi, which indicates the strength of the association between gender and the HRB, was -0.08 for smoking marijuana and -0.16 for alcohol consumption; thus, the effect sizes were considered to be small or smaller than typical (Cohen, 1988).

A greater proportion of males than females met physical activity objective (χ 2 = 5.46, *df* = 1, N = 877, $p < 0.01$); 61% of males met the physical activity objective versus 53% of females. Phi, which indicates the strength of the association between gender and physical activity, was 0.08 for physical activity; thus, the effect size was considered to be small or smaller than typical (Cohen, 1988).

The 4x2 Chi-squared tests for year in school demonstrated differences between meeting and not meeting physical activity objective (χ 2 = 14.74, *df* = 3, N = 880, $p < 0.00$). Fifty percent of second-year students did not meet physical activity objective, which was more than other year students (first year = 38%, third year = 43%, fourth/fifth year = 29%). Similarly, fewer second-year students (50%) met physical activity objective versus the other years (62%, 57%, 71%). The effect size was small or smaller than typical (0.13) (Cohen, 1988).

Findings suggest that meeting or not meeting objective differs by gender and year in school. Females were more likely than males to meet the objective for smoking marijuana or alcohol consumption, but males were more likely than females not to meet the objective for smoking marijuana or alcohol consumption. In addition, meeting physical activity objective appears to be less prevalent for females and second-year students in general when compared to first, third or fourth/fifth-year students.

Table 14

Chi-Squared Analysis of Meeting or Not Meeting HRB Objectives By Gender, Race, and Year in School

Variable	Number	Objectives Not Meeting	Meeting	$\chi 2$	*p*
		Smoking Cigarettes (SC)			
Gender					
Female	506	108	427	1.32	0.14
Male	350	82	268		
Totals	885	190	695		
	805	172	633		
Race					
White	805	172	633	0.65	0.25
Non-White	116	21	95		
Totals	921	193	728		
Year in School					
1st	390	69	321	4.04	0.26
2nd	334	78	256		
3rd	112	25	87		
4/5th	55	13	42		
Totals	891	185	706		
		Alcohol Consumption (AC)			
Gender					
Female	533	241	292	21.66	0.00*
Male	346	212	134		
Totals	453	453	426		
Race					
White	744	617	127	0.30	0.35
Non-White	107	91	16		
Total	851	708	143		
Year in School					
1st	387	197	190	0.47	0.93
2nd	331	172	159		
3rd	112	59	53		
4/5th	54	30	24		
Totals	884	458	426		

		Physical Activity (PA)			
Gender					
Female	531	245	286	5.46	0.01*
Male	346	132	214		
Totals	877	377	500		
Race					
White	797	345	452	0.06	0.45
Non-White	114	48	66		
Totals	911	393	518		
Year in School					
1st	384	147	237	14.74	0.00*
2nd	331	166	165		
3rd	110	47	63		
4/5th	55	16	39		
Totals	880	199	691		
		Fruit and Vegetable (FV)			
Gender					
Female	510	465	45	2.41	0.08
Male	323	304	19		
Totals	833	769	64		
Race					
White	758	701	57	0.07	0.45
Non-White	9		9		
Totals	867	801	66		
Year in School					
1st	362	334	28	2.00	0.57
2nd	320	297	23		
3rd	105	93	12		
4/5th	51	47	4		
Totals	838	771	67		
		Smoking Marijuana (SM)			
Gender					
Female	535	103	432	5.28	0.01*
Male	349	90	259		
Totals	884	193	691		

Race					
White	804	182	108	2.09	0.09
Non-White	116	23	10		
Totals	920	205	118		
Year in School					
1st	390	87	303	1.42	0.70
2nd	334	76	258		
3rd	111	27	84		
4/5th	55	9	46		
Totals	890	199	691		

* $p < .05$.

To answer the remaining research questions, student reported behaviors were coded as meeting and not meeting Healthy Campus 2010 (ACHA, 2002) objectives. Those were redefined as either risk behaviors when not meeting the objectives or protective behaviors when meeting the objectives (see Table 8).

Number of Risk Behaviors

Identifying the percentages of students who practice risk behaviors for one, two, three, four, or all five of the risk HRBs was the goal of research question three. Descriptive characteristics of frequencies and percentages were used to answer the question. The students included in the analysis were those who indicated practicing either a risk or protective behavior for all five HRBs (n = 855, 92%) (see Table 15).

Seventy-two percent of the students practiced at least two risk behaviors and 39% at least three of five risk behaviors. Most students (n = 281, 33%) practiced risk behaviors for two of the five HRBs, followed by students who practiced three (n = 198, 23%). Twenty-four students (3%) reported practicing none of the risk behaviors, while 32 students (4%) practiced all five.

Table 15

Prevalence of Students Practicing Risk Behaviors (N = 855)

Number of Risk HRBs	Number	Percentage	Cumulative Percentage
5	32	4	4
4	106	12	16
3	198	23	39
2	281	33	72
1	214	25	97
0	24	3	100

In summary, the data reveals that approximately one-third of students practiced three of the five risk behaviors, with just fewer than three-quarters of the students practicing two or more risk HRBs. A similar percentage of students practiced either all or none of the five risk HRBs.

Number of Risk HRBs and Gender, Race, and Year in School

The goal of research question four was to determine whether the number of risk behaviors varies by gender, race, or year in school. Ordinal regression was used to determine whether gender, race or year in school were predictors of the number of risk behaviors. Findings of the preliminary Polytomous Universal Model (PLUM) analysis indicated that 25% of the cells equaled zero, so the catagories of number of risk behaviors were combined to account for independent variables that had levels with few observations. The students with zero risk behaviors were combined with one risk; four risks were combined with five risks. In addition, fourth and fifth-year students were combined with third-year students. Secondary PLUM analysis indicates gender, race and year in school were not associated with the number of risk behaviors ($\chi 2 = 7.60$, $df = 4$, N = 788, $p = 0.11$).

Cluster Patterns

The purpose of question five was to identify the cluster patterns of the five risk and protective HRB variations by student's gender, race, and year in school. A Ward Hierarchical Cluster analysis was conducted to identify the cluster patterns. Descriptive characteristics of frequencies and percentages were used to describe the groups. For the five most frequent cluster patterns, Chi-squared was conducted of the total sample to determine whether being in the cluster pattern varied by gender, race, and year. Multinomial regression was conducted for the students in the most frequent cluster patterns to determine whether gender, race, and year in school predicted the most frequent cluster patterns.

Eight hundred and fifty-five students (92%) of the total sample were included in the analysis because they indicated either a risk or protective behavior for each of the five HRBs. Twenty-seven unique cluster patterns were identified in the cluster analysis, of 32 possible combinations. Table 16 indicates the unique cluster patterns based on the students' risk behaviors. For 55% of the students who practiced two or three risk HRBs, there were 16 unique cluster patterns.

Sixty-three percent (n = 578) of the students were represented in five of the 27 unique cluster patterns (see Table 17). All of the five most frequent cluster patterns contained the risk behavior of not consuming five daily servings of fruits and vegetables, while three contained the risk behavior for alcohol consumption. The most frequent cluster patterns have a range of 5-20% of students represented in each group.

Table 16

Clustering Patterns Based on Risk Health Related Behaviors: Counts and Percentages (N = 855)

Cluster Risk Pattern		Number	Percentage
All 5 Risk HRBs			
	PA/FV/AC/SM/SC	32	3.40
4 Risk			
	PA/FV/AC/SM	29	3.10
	PA/FV/AC/SC	39	4.20
	PA/FV/SM/SC	5	0.50
	FV/AC/SM/SC	33	3.60
3 Risk			
	PA/FV/AC	74	8.00
	PA/FV/SM	11	1.20
	PA/FV/SC	15	1.60
	PA/AC/SM	3	3.00
	PA/AC/SC	2	0.20
	FV/AC/SM	50	5.40
	FV/AC/SC	36	3.90
	FV/SM/SC	4	4.00
	AC/SM/SC	3	3.00
2 Risk			
	PA/FV	144	15.50
	PA/AC	1	0.01
	FV/AC	118	12.70
	FV/SM	7	0.80
	FV/SC	6	0.60
	AC/SM	4	0.40
	AC/SC	1	0.10
1 Risk			
	PA only	8	0.90
	FV only	189	20.40
	AC only	14	1.50
	SM only	2	0.20
	SC only	1	0.10
0 Risk			
	No/Risk	24	2.60
	Total	855	

Table 17

Five Most Frequent Cluster Patterns for Risk HRBs (N = 578)

Cluster Risk Pattern	Number	Percentage
FV only	189	20
FV/PA	144	16
FV/AC	118	13
PA/FV/AC	74	8
FV/AC/SM	50	5
Total	578	63

The remaining 22 clusters had fewer than 39 students in each group (range 1-39, 0.01 - 4.2%). The most frequent cluster pattern was for students practicing a risk behavior for fruit and vegetable consumption (FV only) but practicing protective behaviors for smoking marijuana and cigarettes, physical activity, and alcohol consumption (n = 189, 20%). The second most prevalent cluster was for the risk behaviors of fruit and vegetable consumption and physical activity (FV/PA) and protective behaviors for alcohol consumption, smoking marijuana and smoking cigarettes (n = 144, 16%).

To investigate whether being in the most frequent cluster patterns varies by race, gender, and year in school (n = 855), a Chi-squared statistical test for the total sample was used (see Table 18). Specifically, Pearson Chi-squared indicated that males and females were significantly different in whether they were in the cluster group FV/PA (χ 2 = 13.55, df = 1, N = 820, p = 0.00) or cluster group of FV/AC (χ 2 = 17.70, df = 1, N = 821, p = 0.00). Twenty percent of females were in the FV/PA cluster versus 11% of the males, but 21% of males were in the FV/AC cluster versus 10% of the females. Phi, which indicated the strength of the association between gender and cluster, was 0.15 for FV/AC and 0.13 FV/PA; thus, the effect sizes were considered to be small or smaller than typical (Cohen, 1988).

For year in school, the cluster groups FV/PA and FV only were significantly different. Cramer's V statistic indicated the clusters of FV/PA ($\chi 2 = 12.13$, $df = 3$, N = 821, $p = .01$) and FV ($\chi 2 = 12.90$, $df = 3$, N = 821, $p = .01$) varied based on whether the student was a first, second, third, or fourth/fifth-year undergraduate. More second-year students were in the FV/PA cluster (23%) than the other year-students (first-year = 14%, third-year = 11%, fourth/fifth-year = 12%). However, more fourth/fifth year students were in the FV only cluster (32%) versus the other year students (first-year = 26%, second-year = 16%, third-year = 23%). Phi, which indicated the strength of the association between year in school and cluster, was 0.12 for FV/PA and 0.13 for FV; thus, the effect size was considered to be small or smaller than typical (Cohen, 1988).

Table 18

Chi Squared Analysis of Most Frequent Clusters by Gender, Race, and Year in School

Variable	Number	Not in cluster	In cluster	$\chi 2$	*p*
			FV Only		
Gender				0.77	0.22
Female	506	388	118		
Male	314	249	65		
Totals	820	637	183		
Race				1.30	0.16
White	744	585	159		
Non-White	107	79	28		
Totals	851	664	851		
Year in School				0.13	0.01*
1st	356	264	92		
2nd	315	265	50		
3rd	100	77	23		
4/5th	50	34	16		
Totals	821	640			
			FV/PA		
Gender				13.55	0.00*
Female	506	401	105		
Male	314	280	34		
Totals	820	691	139		

Race					
White	744	617	127	0.30	0.35
Non-White	107	91	16		
Totals	851	708	143		
Year in School				0.12	0.01*
1st	356	305	51		
2nd	315	244	71		
3rd	100	89	11		
4/5th	50	44	6		
Totals	821	682	139		
			FV/AC		
Gender				17.70	0.00*
Female	506	457	49		
Male	314	251	63		
Totals	820	708	112		
Race				1.08	2.09
White	636	636	108		
Non-White	107	97	10		
Totals	851	733	118		
Year in School				0.04	0.71
1st	356	301	55		
2nd	315	272	43		
3rd	100	87	13		
4/5th	50	45	5		
Totals	821	705	116		
			PA/FV/AC		
Gender				0.09	0.45
Female	506	461	45		
Male	314	288	26		
Totals	820	749	71		
Race				1.84	0.12
White	744	683	61		
Non-White	107	94	13		
Totals	851	777	74		
Year in School				0.01	0.99
1st	356	326	30		
2nd	315	290	25		
3rd	100	91	9		

4/5th	50	46	4		
Totals	821	753	68		
			FV/AC/SM		
Gender				0.14	0.41
Female	506	480	26		
Male	314	296	18		
Totals	820	776	44		
Race				0.02	0.56
White	744	700	44		
Non-White	107	101	6		
Totals	851	801	50		
Year in School				0.04	0.76
1st	356	333	23		
2nd	315	300	15		
3rd	100	93	7		
4/5th	50	47	3		
Totals	821	773	48		

* $p < .05$.

A multinomial regression was conducted to see if the combination of gender, race, and year in school predicted the subset of students in the most frequent cluster patterns versus those that practiced all five risk behaviors (all-risk cluster). The years in school for years three and four/five were merged to account for unexpected similarities in the Hessian matrix. Results revealed that the combination of gender, race, and year in school did predict the cluster patterns ($\chi 2 = 62.80$, $df = 20$, N = 556, $p = 0.00$) (see Table 19).

When examining the predictor variable for each cluster versus the all-risk cluster reference group, gender distinguished FV only ($p = 0.01$), FV/PA ($p = 0.00$), and PA/ FV/AC ($p = 0.02$) from the all-risk cluster. Being a female increased the likelihood of being in three of the five risk groups; specifically, approximately two times more for FV, three and a half times more for FV/PA, and two times more for PA/ FV/AC.

Year in school individually distinguished FV only (p = .03) and FV/AC/SM (p = .03) from the all-risk groups. Results demonstrated that as the students in the five clusters progressed through undergraduate school, they were 82% less likely to be in the FV only or 85% less likely to be in the FV/AC/SM cluster.

In summary, there were 27 unique cluster patterns with 63% of the students represented in five clusters. The cluster with the most students was for students practicing a risk behavior for FV only. When investigating the total sample, more females than males were likely to be in the FV/PA cluster, but males were more likely than females to be in the FV/AC cluster. Further, fourth-year students were more likely to be in the FV only cluster than the other students, but second-year students were more likely to be in the FV/PA cluster than other students. When considering the subset of students in the largest clusters, being a female increased the likelihood of being in FV only, FV/PA, or PA/ FV/AC, and as students' progressed through undergraduate school, they were less likely to be in the FV only or FV/AC/SM cluster.

Table 19

Multinomial Regression of the Most Frequent Clusters Patterns by Gender, Race, and Year in School.

Variable	β	*SE*	Odds ratio	*p*
Risk FV				
Gender (F)	1.09	0.43	2.96	0.01*
Race (White)	-1.47	1.05	0.23	0.16
Year in School				
1st	-0.59	0.81	0.56	0.47
2nd	-1.69	0.79	0.18	0.03*
3/4/5rd				
Risk FV/PA				
Gender (F)	1.54	0.44	4.67	0.00*
Race (White)	-1.27	1.06	0.28	0.23
Year in School				
1st	-0.35	0.83	0.71	0.67
2nd	-0.59	0.80	0.45	0.46
3/4/5rd				
Risk FV/AC				
Gender (F)	0.22	0.44	0.24	1.24
Race (White)	-0.96	1.07	0.37	0.35
Year in School				
1st	-0.41	0.83	0.36	0.62
2nd	-1.22	0.81	0.30	0.13
3/4/5rd				
Risk PA/FV/AC				
Gender (F)	1.08	0.47	2.96	0.02*
Race (White)	-1.94	1.07	0.14	0.07
Year in School				
1st	-0.53	0.85	0.59	0.54
2nd	-1.25	0.83	0.29	0.13
3/4/5rd				
Risk FV/AC/SM				
Gender (F)	0.96	0.51	2.60	0.06
Race (White)	-1.34	1.13	0.26	0.24
Year in School				
1st	-0.73	0.87	0.48	0.40
2nd	-1.91	0.87	0.15	0.03*
3/4/5rd				

* $p < .05$.

Pairs

For question six, logistic regression was used to determine if the associated pairs of risk and protective behavior combinations vary by race, gender, and year in school. Phi was used to indicate if there was an association between the two variables, the direction of the relationship, and the effect size. Descriptive characteristics provided details about the counts and percentages of the associated pairs.

Five of the ten HRB pair combinations had a relationship (phi $p \leq 0.01$): SC&AC (phi = 0.33, $p = 0.00$), AC&SM (phi = 0.35, $p = 0.00$), SC&SM (phi = 0.30, $p = 0.00$), SC&PA (phi = 0.11, $p = 0.00$), and PA&FV (phi = 0.12, $p = 0.00$) (see Table 20*).* The phi statistic indicated all five pairs had a significant positive relationship, which suggests that either the protective HRB was related to the other protective HRB or that the risk behavior was related to the other risk behavior. The effect size, the strength of the relationship between the HRB pairs, indicated two pairs with a medium or typical relationship (SC&AC and AC&SM), one pair with a small to medium relationship (SC&SM), and two pairs with a small or smaller than typical relationship (PA&FV and SC&PA) (Cohen, 1988).

Table 20

Associations of Risk and Protective Health Related Behavior Pair Patterns of Students

HRB	Number	HRB Risk	HRB Protective	phi	*p*
Smoking Cigarettes		Alcohol Consumption			
Risk	194	162	32	0.33	0.00*
Protective	725	316	409		
Smoking Marijuana		Alcohol Consumption			
Risk	204	172	32	0.35	0.00*
Protective	714	305	409		
Smoking Cigarettes		Smoking Marijuana			
Risk	194	90	104	0.3	0.00*
Protective	732	116	616		
Smoking Cigarettes		Physical Activity			
Risk	190	102	88	0.11	0.00*
Protective	725	291	434		
Alcohol Consumption		Physical Activity			
Risk	470	196	274	-0.24	0.47
Protective	438	193	245		
Smoking Marijuana		Physical Activity			
Risk	201	92	190	0.03	0.35
Protective	731	300	413		
Fruit and Vegetable		Physical Activity			
Risk	800	355	445	0.12	0.00*
Protective	63	14	49		
Smoking Cigarettes		Fruit and Vegetable			
Risk	180	172	8	0.06	0.07
Protective	691	632	59		
Alcohol Consumption		Fruit and Vegetable			
Risk	445	415	30	0.04	0.26
Protective	421	384	37		
Smoking Marijuana		Fruit and Vegetable			
Risk	187	174	13	0.02	0.66
Protective	683	629	54		

* $p < .05$.

Each of the five statistically significant associated pairs was recoded into risk and protective variables with two levels, pair or no pair, in order to examine the pairs of HRBs. Table 21 displays the frequencies and percentages of students with a pair or no pair for each risk and protective pair pattern.

Table 21

Counts and Percentages of Five Associated HRB Pair Combinations

HRB Pair	Number	Percent
Protective SC&SM		
No Pair	310	34
Pair	616	67
Risk SC&SM		
No Pair	836	90
Pair	90	10
Protective PA&FV		
No Pair	814	98
Pair	49	5
Risk PA&FV		
No Pair	508	55
Pair	355	38
Protective AC&SM		
No Pair	509	55
Pair	409	44
Risk AC&SM		
No Pair	746	80
Pair	172	19
Protective SC&AC		
No Pair	510	55
Pair	409	44
Risk SC&AC		
No Pair	757	82
Pair	162	18
Protective SC&PA		
No Pair	481	52
Pair	434	47
Risk SC&PA		
No Pair	813	88
Pair	102	11

Findings showed that three quarters of students (77%) practiced either risk (10%) or protective (67%) smoking cigarettes and smoking marijuana paired behaviors versus the single non-paired behaviors of smoking cigarettes or smoking marijuana. A similar percentage of students practiced either risk or protective pairs of behaviors versus single behaviors: PA&FV (65%), AC&SM (63%), SC&AC (63%), and SC&PA (59%). Figure 13 indicates the percentages of students with either a protective or risk pair for the five associated pairs.

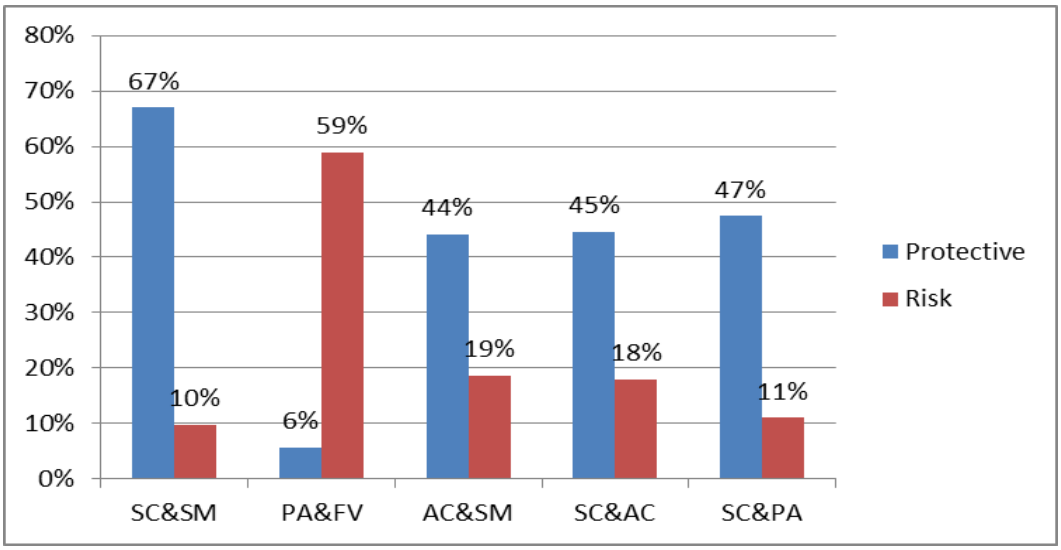

Figure 13. Percentages of students practicing protective and risk pair

Logistic regression was conducted to assess whether gender, race, or year in school predicted whether or not students practiced pairs of risk or protective behaviors for the five pair combinations. When gender, race, and year in school variables were considered together, they significantly predicted whether or not a student practiced pairs of risk or protective behaviors for two of the five pairs: protective SC&AC ($\chi 2 = 11.81$, $df = 3$, N = 842, $p < 0.01$) and protective AC&SM ($\chi 2 = 15.591$, $df = 3$, N = 841, $p < 0.00$). However, the effect size indicated a small or less than typical relationship, which suggests that the combination of the three sociodemographic variables was not robust for predicting protective AC&SM ($R^2 = 0.03$) and protective SC&AC

(R^2 = 0.02) (Cohen, 1988).

Results showed that females were more likely than males to practice protective paired behaviors for SC&AC (p = 0.00) and AC&SM (p = 0.00), yet females were more likely than males to practice paired risk behaviors for PA&FV (p = 0.01). Males were more likely than females to practice risk behaviors for SC&AC (p = 0.01), AC&SM (p = 0.01) and SC&SM (p = 0.02).

Tables 22 and 23 display the odds ratios of gender, race, or year in school for predicting whether or not students practiced pairs of risk or protective behaviors. Gender, but neither year in school nor race, predicted whether or not students practiced pairs of risk or protective behaviors. Female students were more likely to practice pairs of protective behaviors for SC&AC by 37% and 43% for protective AC&SM, but more likely to practice risk pairs for PA&FV by 31% (see Table 22). Similarly, male students were more likely to practice pairs of risk behaviors: 58% more for SC&AC, 58% more for AC&SM, 74% more for SC&SM (see Table 23).

In summary, five of the 10 pair combinations had a statistically significant association: PA&FV, SC&AC, AC&SM, SC&PA, and SC&SM. Gender, but not year in school or race, could predict the students who practiced protective paired behaviors for SC&AC, AC&SM and risk paired behaviors for PA&FV, SC&AC, AC&SM, SC&SM.

Table 22

Logistic Regressions Predicting Who Practices Pairs of Protective Behaviors

Variable	β	*SE*	Odds ratio	*p*
SC&SM				
Gender (Male)	-0.15	0.15	0.86	0.30
Race (non-White)	0.19	0.23	1.21	0.41
Year in School	-.010	0.08	0.90	0.22
PA&FV				
Gender (Male)	-0.66	0.34	0.52	0.05
Race (non-White)	0.26	0.43	1.30	0.55
Year in School	0.24	0.16	1.27	0.14
AC&SM				
Gender (Male)	-0.57	0.15	0.57	0.00*
Race (non-White)	-0.00	0.21	1.00	0.99
Year in School	-0.03	0.08	0.97	0.72
SC&AC				
Gender (Male)	-0.47	0.14	0.63	0.00*
Race (non-White)	0.08	0.21	0.08	0.70
Year in School	-0.10	0.08	0.10	0.18
SC&PA				
Gender (Male)	0.20	0.14	1.21	0.17
Race (non-White)	-0.00	0.21	1.00	0.99
Year in School	-0.04	0.08	0.97	0.65

* $p < .05$.

Table 23

Logistic Regressions Predicting Who Practices Pairs of Risk Behaviors

Variable	β	*SE*	Odds ratio	*p*
SC&SM				
Gender (Male)	0.56	0.23	1.74	0.02*
Race (non-White)	-0.47	0.41	0.63	0.25
Year in School	-0.04	0.13	0.97	0.77
PA&FV				
Gender (Male)	-0.37	0.15	0.69	0.01*
Race (non-White)	0.10	0.22	0.64	1.11
Year in School	0.05	0.09	1.05	0.56
AC&SM				
Gender (Male)	0.46	0.18	1.58	0.01*
Race (non-White)	-0.17	0.28	0.64	0.54
Year in School	0.05	0.10	1.54	0.60
SC&AC				
Gender (Male)	0.46	0.18	1.58	0.01*
Race (non-White)	-0.14	0.28	0.88	0.63
Year in School	0.12	0.10	1.13	0.22
SC&PA				
Gender (Male)	-0.03	0.23	0.98	0.92
Race (non-White)	-0.28	0.37	0.75	0.44
Year in School	0.11	0.12	1.13	0.34

* $p < .05$.

Summary

In summary, a combination of descriptive, associational, and differential statistics were used to test six research questions. Five of six research questions led to insights regarding single and co-occurring HRBs and their variations by gender and race. Table 24 summarizes the results of each research question.

Table 24

Summary of Results by Research Question

Research Question		Summary
#1	Healthy Campus 2010 objectives and target goals	• Most students did not meet fruit and vegetable objective • 1/2 of students did not meet alcohol consumption objective • Target goal for physical activity was met but the other four HRBs were not met • Alcohol consumption was the most divergent from the target goal
#2	Healthy Campus 2010 objectives by gender, race, and year	• More females met objectives for smoking marijuana and alcohol consumption • Fewer females met the physical activity objective • Fewer 2nd yr students met the physical activity objective
#3	Number of Risk Behaviors	• 1/3 of students practiced three or more risk behaviors • 3/4 of students practiced two or more risk behaviors
#4	Number of Risk Behaviors by gender, race, and year in school	No significant differences found
#5	Clusters of HRBs by gender, race, and year in school	• 27 cluster patterns • 63% of students in five clusters • FV only was the cluster with the most students • More females were in FV only, FV/PA, PA/FV/AC clusters • Upperclassman were less likely to be in FV only or FV/AC/SM cluster
#6	Pairs of HRBs by gender, race, and year in school	• Five of 10 pairs were associated • More females practiced risk PA&FV • More males practiced risk SC&AC, AC&SM, SC&SM

CHAPTER 5: DISCUSSION

The purpose of this chapter is to provide an overview of the present study and to interpret the research findings. This chapter is divided into six sections: (a) summary, (b) conclusions, (c) interpretation of results, (d) research implications, (e) recommendations for practice, and (f) concluding remarks.

Summary

In this study, data from Colorado State University (CSU) students were analyzed to investigate five co-occurring health related behaviors (HRBs). Comparisons were made by gender, race, and year in school. An investigative comparison was made with the Healthy Campus 2010 (ACHA, 2002) objectives and target goals.

The final sample consisted of 928 undergraduate students aged 18-23 years old who were enrolled in one of eight class sections of an elective Health and Wellness class in the spring 2009 semester, who attended class the day the National College Health Assessment (NCHA) was administered, and who volunteered to participate. The sample was not representative of the total population when considering graduate students, major of study, year in school, and age but was representative by gender and race.

It was the intent of the author to answer the following research questions:

Healthy Campus 2010 objectives and target goals

Research Question #1: What percentage of students meet and do not meet the Healthy Campus 2010 (ACHA, 2002) objectives and target goals (see Appendix A) for behaviors related to smoking cigarettes, alcohol consumption, smoking marijuana, physical activity, and fruit and vegetable consumption?

The data revealed that most students did not meet objectives for the consumption of five daily servings of fruits and vegetables (92%), and less than half did not meet the alcohol consumption (48%) and physical activity (43%) objectives. Fewer students did not meet the objective for smoking cigarettes (21%) and smoking marijuana (22%). When examining compliance with Healthy Campus 2010 target goals (ACHA, 2002), the sample did meet the target goal for physical activity (target goal of 55% of students meeting objective), but did not meet the target goals for smoking marijuana (target goal of 1% of students not meeting objective), smoking cigarettes (target goal of 10.5% of students not meeting objective), alcohol consumption (target goal of 20% of students not meet objective), and fruit and vegetable consumption (target goal of 25% of students meeting objective).

Healthy Campus 2010 objectives by gender, race, and year in school

Research Question #2: What are the differences in students who meet and do not meet the Healthy Campus 2010 (ACHA, 2002) objectives by sociodemographic characteristics (gender, race, and year in school)?

Chi-squared statistical findings demonstrated at a significance level of $p < 0.05$ that meeting or not meeting objectives differed by gender and year in school but not race. Eighty-one percent of females did meet the smoking marijuana objective versus 75% of the males, and 25% of males did not meet objective versus 19% of females (χ 2 = 5.28, df = 1, N = 884, $p < 0.01$). Similarly, 54% of females did meet alcohol consumption objective versus 39% of males, and 61% of males did not meet objective versus 45% of females (χ 2 = 21.66, df = 1, N = 879, $p <$ 0.00). More males than females did meet physical activity objective and more females than males did not meet objective (χ 2 = 5.46, df = 1, N = 877, $p < 0.01$); 61% of males did meet the physical activity objective versus 53% of females, and 38% of males did not meet objective

versus 46% of females. In addition, 50% of second-year students did not meet physical activity objective, which was more than other-year students (first-year = 38%, third-year = 43%, fourth/fifth-year = 29%). Similarly, a smaller percentage of second-year students (50%) did meet physical activity objective versus the other years (62%, 57%, 71%) ($\chi 2 = 14.74$, $df = 3$, N = 880, $p < 0.00$).

Number of risk behaviors

Research Question #3: What percentage of students practice risk behaviors for one, two, three, four, or all five of the risk HRBs?

Descriptive statistics revealed that 39% of the students practiced at least three of five risk behaviors, according to Healthy Campus 2010 (ACHA, 2002) objectives. Most students practiced two of the five risk HRBs (n = 281, 33%), followed by students who practiced three (n = 198, 23%). Twenty-four students (3%) practiced none of the risk behaviors, while 32 students (4%) practiced all five.

Number of Risk Behaviors by Gender, Race, and Year in School

Research Question #4: What are the variations for one, two, three, four, or all five of the risk HRBs by gender, race, and year in school?

PLUM analysis failed to find any significant variations of the number of risk behaviors by gender, race and year in school.

Cluster of HRB by gender, race, and year in school

Research Question #5: What are the clusters of the five risk and protective HRBs by sociodemographic characteristics (race, gender, year in school)?

Descriptive statistics showed that 63% (n = 578) of the students who indicated a risk or protective behavior for all five HRBs (n = 855) were in five of the 27 cluster patterns. The most frequent cluster pattern was of students practicing a risk behavior for only fruit and vegetable consumption but practicing protective behaviors for smoking marijuana and cigarettes, physical activity and alcohol consumption (FV only) (n = 189, 20%). The next largest cluster was practicing risk behaviors for fruit and vegetable consumption and physical activity with protective behaviors for alcohol consumption, smoking marijuana and smoking cigarettes (FV/PA) (n = 144, 16%). The next were those practicing risk behaviors for fruit and vegetable consumption and alcohol consumption, with protective behaviors for physical activity, smoking marijuana and smoking cigarettes (FV/AC) (n = 118, 13%). The fourth cluster were students practicing risk behaviors for physical activity, fruit and vegetable consumption, and alcohol consumption, with protective behaviors for smoking marijuana and smoking cigarettes (PA/ FV/AC) (n = 74, 8%). The fifth cluster were those practicing risk behaviors for fruit and vegetable consumption, alcohol consumption, and smoking marijuana, with protective behaviors for physical activity and smoking cigarettes (PA/AC/SM) (n = 50, 5%).

A Chi-squared test at a significant level of $p < 0.05$ revealed that some cluster patterns varied by gender and year in school, but not race. When investigating the total sample, more females than males were in the FV/PA cluster (χ 2 = 13.55, df = 1, N = 820, p = 0.00), but more males than females were in the FV/AC cluster (χ 2 = 17.70, df = 1, N = 820, p = 0.00). Fourth/fifth-year students were more likely to be in the FV only cluster (χ 2 = 12.90, df = 3, N = 821, p = .01) than the other students, but second-year students were more likely to be in the FV/PA cluster (χ 2 = 12.13, df = 3, N = 821, p = .01) than other students. There were no

variations of cluster groups by gender for PA/FV/AC, FV/AC/SM, or FV only, and no variations by year in school for PA/ FV/AC, FV/AC/SM, or FV/AC.

Multinomial regression showed that a combination of gender, race, and year in school did predict the clusters with the most students (χ 2 = 62.80, *df* = 20, N = 556, *p* = 0.00). When examining the predictor variable for each cluster versus the all-risk cluster reference group, results showed that being a female increased the likelihood of being in two of the five clusters: FV only (*p* = 0.01) or PA/ FV/AC (*p* = 0.02) by approximately two times and FV/PA (*p* = 0.00) by three and a half times. Year in school also individually distinguished FV only (*p* = 0.03) and FV/AC/SM (*p* = 0.03) from the all-risk groups. As the students in the five frequent clusters progressed through undergraduate school, they were 82% less likely to be in the FV only or 85% less likely to be in the FV/AC/SM cluster. None of the remaining most frequent cluster groups had individual predictor variables that were statistically significant.

Pairs of HRBs by gender, race, and year in school

Research Question #6: What are the pairs of HRBs and do the pairs vary by sociodemographic characteristics (race, gender, and year in school)?

Phi statistics revealed an association (significant at $p < 0.01$) between five of the ten HRB pair combinations: SC&AC (phi = 0.33, *p* = 0.00), AC&SM (phi = 0.35, *p* = 0.00), SC&SM (phi = 0.30, *p* = 0.00), SC&PA (phi = 0.11, *p* = 0.00), and PA&VF (phi = 0.12, *p* = 0.00). When each of the five associated pairs was recoded into risk and protective variables of a pair or no pair, findings showed that three quarters of students (77%) practiced either risk or protective smoking cigarettes and smoking marijuana paired behaviors versus the single non-paired behaviors of only smoking cigarettes or smoking marijuana. A similar percentage of students practiced either

risk or protective pairs of behaviors versus single behaviors for PA&FV (67%), AC&SM (63%), SC&AC (63%), and SC&PA (59%).

Logistic regression demonstrated that when gender, year in school, and race were considered together they could predict the students who practiced protective paired behaviors for SC&AC ($\chi 2 = 11.81$, $df = 3$, N = 842, $p < 0.01$) and AC&SM ($\chi 2 = 15.591$, $df = 3$, N = 841, $p < 0.00$). However, the effect sizes were small or less than typical, which suggests the combination of gender, race, and year in school was not robust for predicting protective AC&SM ($R^2 = 0.03$) and protective SC&AC ($R^2 = 0.02$) (Cohen, 1988). When examining each predictor variable independently, more female students (37%) were likely to practice pairs of protective behaviors for SC&AC and protective AC&SM (43%), but more likely to practice risk pairs for PA&FV (31%). Similarly, more male students were likely to practice pairs of risk behaviors: SC&AC (58%), AC&SM (58%), SC&SM (74%).

Conclusions

The following conclusions are made with the assumptions that the reported behavior represents typical behavior, and that the sampled students may be representative of CSU undergraduates for race and gender but not college of study, age, and year in school.

Health behavior status of students

A. Single HRBs. Many students do not practice protective HRBs (Research Question #1):

1. 21% smoke cigarettes at least once a month;
2. 48% binge drink at least once every two weeks;
3. 22% smoke marijuana at least once a month;

4. 43% do not participate in 20-30 minutes of moderate or vigorous physical activity at least three times a week; and
5. 92% do not consume five recommended servings of fruits and vegetables daily.

B. Healthy Campus 2010 Target Goals. Undergraduate students do not meet the Healthy Campus 2010 (ACHA, 2002) target goals for four of the five HRBs (Research Question #1):

1. Smoking cigarettes is 10.5 percentage points under/less than the Healthy Campus 2010 (ACHA, 2002) target goal;
2. Alcohol consumption is 28.0 percentage points under/less than the Healthy Campus 2010 (ACHA, 2002) target goal;
3. Smoking marijuana is 20.0 percentage points under/less than the Healthy Campus 2010 (ACHA, 2002) target goal; and
4. Fruit and vegetable consumption is 17.0 percentage points under/less than the Healthy Campus 2010 (ACHA, 2002) target goal.

C. Number of Risk Behaviors. More than one-third (39%) of college students practice three or more risk behaviors (Research Question #3).

Characteristics of co-occurring HRBs

A. Clusters. More than half (63%) of students are in one of five clusters (Research Question #5):

1. 20% of students practice a risk behavior for only fruit and vegetable consumption, but practice protective behaviors for smoking marijuana and cigarettes, physical activity, and alcohol consumption;

2. 16% of students practice risk behaviors for fruit and vegetable consumption and physical activity, and protective behaviors for alcohol consumption, smoking marijuana, and smoking cigarettes;
3. 13% of students practice risk behaviors for fruit and vegetable consumption and alcohol consumption, and protective behaviors for physical activity, smoking marijuana, and smoking cigarettes;
4. 8% of students practice risk behaviors for physical activity, fruit and vegetable consumption, and alcohol consumption, and protective behaviors for smoking marijuana, and smoking cigarettes; and
5. 5% of students practice risk behaviors for fruit and vegetable consumption, alcohol consumption, and smoking marijuana, and protective behaviors for physical activity and smoking cigarettes.

B. Pairs. Many students' health behavior practices are paired with other health behavior practices (Research Question #6):

1. 77% of students practice either risk or protective behaviors of the pair smoking cigarettes and smoking marijuana;
    a. 67% practice protective pair
    b. 10% practice risk pair
2. 67% of students practice either risk or protective behaviors of the pair physical activity and fruit and vegetable consumption;
    c. 6% practice protective pair
    d. 59% practice risk pair

3. 63% of students practice either risk or protective behaviors of the pair smoking cigarettes and alcohol consumption;
    a. 45% practice protective pair
    b. 18% practice risk pair
4. 63% of students practice either risk or protective behaviors of the pair alcohol consumption and smoking marijuana;
    a. 44% practice protective pair
    b. 19% practice risk pair
5. 59% of students practice either risk or protective behaviors of the pair smoking cigarettes and physical activity.
    a. 47% practice protective pair
    b. 11% practice risk pair

C. Sociodemographic Characteristics and HRB

1. Gender.

a. Single HRBs. (Female students compared to males)

(1) More meet objective for smoking marijuana (81% versus 75%) (Research Question #2);

(2) More meet objective for alcohol consumption (54% versus 39%) (Research Question #2);

(3) Fewer meet objective for physical activity (Research Question #2);

(4) Fewer do not meet objective for smoking marijuana (25% versus 19%) (Research Question #2);

(5) Fewer do not meet objective for alcohol consumption (61% versus 45%) (Research Question #2);

b. Number of risk HRBs. (Female students compared to males) Do not differ from males;

a. Clusters compared to all students. (Female students compared to males)

More practice risk behaviors for fruit and vegetable consumption and physical activity, and protective behaviors for alcohol consumption, smoking marijuana and smoking cigarettes (Research Question #5);

b. Clusters compared to all-risk group. (Female students compared to males)

(1) More practice risk behaviors for only fruit and vegetable consumption, but practice protective behaviors for smoking marijuana and cigarettes, physical activity and alcohol consumption (Research Question #5);

(2) More practice risk behaviors for fruit and vegetable consumption and physical activity, and protective behaviors for alcohol consumption, smoking marijuana and smoking cigarettes (Research Question #5);

(3) More practice risk behaviors for physical activity, fruit and vegetable consumption, and alcohol consumption, and protective behaviors for smoking marijuana and smoking cigarettes (Research Question #5);

(4) Fewer practice risk behaviors for fruit and vegetable consumption and alcohol consumption, and protective behaviors for physical activity, smoking marijuana and smoking cigarettes (Research Question #5).

c. Pairs. (Female students compared to males)

(1) 37% are more likely to practice protective paired behaviors for smoking cigarettes and alcohol consumption (Research Question #6);

(2) 43% are more likely to practice protective paired behaviors for alcohol consumption and smoking marijuana (Research Question #6);

(3) 31% are more likely to practice risk paired behaviors for physical activity and fruit and vegetable consumption (Research Question #6);

(4) 58% are less likely to practice risk paired behaviors for smoking cigarettes and alcohol consumption (Research Question #6);

(5) 58% are less likely to practice paired behaviors for alcohol consumption and smoking marijuana (Research Question #6); and

(6) 74% are less likely to practice risk paired behaviors for smoking cigarettes and smoking marijuana (Research Question #6).

2. Race. Health practices of students do not vary by race for:

a. Single HRBs (Research Question #2);

b. Number of risk HRBs (Research Question #4);

c. Clusters of HRBs (Research Question #5); and

d. Pairs of HRBs (Research Question #6).

3. Year in School.

a. Single HRBs.

More second-year students (50%) do not meet physical activity objective than other students (first-year = 38%, third-year = 43%, fourth/fifth-year = 29%), and fewer second-year students (50%) do meet physical activity objective than other students (first-year = 62%, third-year = 57%, fourth/fifth-year = 71%) (Research Question #2);

b. Number of risk HRBs.

Number of risk HRBs do not vary by year in school.

c. Clusters compared to all students.

(1) More fourth/fifth-year students practice risk behaviors for only fruit and vegetable consumption, but practice protective behaviors for smoking marijuana and cigarettes, physical activity, and alcohol consumption. (Research Question #5);

(2) More second-year students practice risk behaviors for fruit and vegetable consumption and physical activity, and protective behaviors for alcohol consumption, smoking

marijuana, and smoking cigarettes (Research Question #5);

d. Clusters compared to all-risk group.

(1) As students progress through undergraduate school they are 62% less likely to practice risk behaviors for only fruit and vegetable consumption and practice protective behaviors for smoking marijuana, smoking cigarettes, physical activity and alcohol consumption (Research Question #5); and

(2) As students progress through undergraduate school they are 85% less likely to practice risk behaviors for fruit and vegetable consumption, alcohol consumption, and smoking marijuana, and protective behaviors for physical activity and smoking cigarettes (Research Question #5).

e. Pairs

Pairs of HRBs do not vary by year in school.

Interpretation of Findings

The following section illustrates how the study findings correspond to the current literature and provides the author's interpretation of the conclusions reported above for: the health behavior status of college students, characteristics of co-occurring HRBs, and sociodemographic characteristics and HRBs. The section closes with the author's overall suggestion for MHBC interventions based on the review of literature.

Health behavior status of students

The incidence of premature morbidity and mortality is reduced when individuals practice protective health behaviors (Glanz et al., 2011). Many students do not practice protective HRBs, which could eventually promote premature death and disability that would result mainly from chronic diseases such as heart disease, stroke, cancer, emphysema, chronic obstructive pulmonary disease, and arthritis (NCHS, 2009).

The percentages of students practicing risk behaviors for smoking cigarettes, alcohol consumption, smoking marijuana, physical activity, and fruit and vegetable consumption are similar for the study surveyed students and students surveyed nationally (see Figure 14).

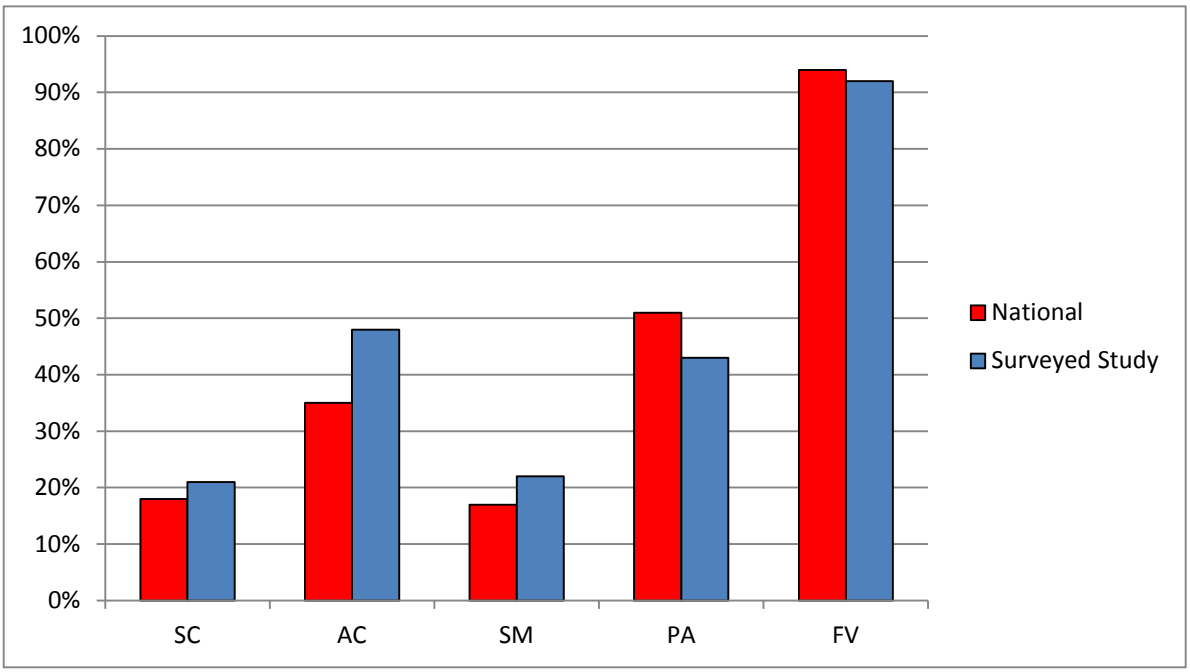

Figure 14. Percentages of students surveyed nationally and study surveyed students who practice risk behaviors.

Note. National data from "American College Health Association - National College Health Assessment: Reference: Publications and Reports, 2010."

Specifically, the sample of students meets the Healthy Campus 2010 target goals (ACHA, 2002) for one of the five objectives. The deficiency is similar to a finding by Reeves and Rafferty (2005) that 3% of adults in the United States met the Healthy People 2010 (U.S. DHHS, 2000) objectives for fruit and vegetable consumption, physical activity, smoking, and maintaining a healthy weight.

The empirical evidence suggests many students practice more than two risk HRBs. Findings here indicate that 39% of college students practice three, four, or five risk behaviors. This finding is consistent with Quintiliani et al. (2010), who found that 65% of 1,463 surveyed female students reported more than two risk behaviors for alcohol consumption, smoking cigarettes, physical activity, fruit and vegetable consumption, risky sex, and cervical screening. Similarly, Mellen (2008) found 57% of 912 students in a convenience sample and 54% of 378 students from a random sample practiced three or more risk HRBs relating to aerobic physical activity, fruit and vegetable consumption, smoking cigarettes, and smoking marijuana. Thus, this finding confirms the need to continue interventions to promote multiple HRBs in the student population.

Characteristics of co-occurring HRBs

Understanding the interrelationships between HRBs, specifically whether they are independent or interact, provides insights into the HRBs that people may be more inclined to change together (King et al., 1996; Ory et al., 2002). This study adds to this limited body of knowledge and enhances our understanding that certain HRBs of college students cluster and pair together.

Clusters. Although it has been documented that more than two HRBs cluster together, there are no identified studies that have assessed and characterized the five Healthy Campus

2010 (ACHA, 2010) health behavior goals for college students: smoking cigarettes, alcohol consumption, smoking marijuana, fruit and vegetable consumption, and physical activity. The findings here add to the research and confirm Laska's (2009) finding that HRBs do cluster into a few unique patterns: 63% of students where in practiced one of five cluster patterns, of 27 cluster combinations. In findings similar to those of Gledhill-Hoyt et al. (2000), Laska et al. (2009), and Mohler-Kuo et al. (2003), many of the clusters can be classified as predominantly health risk or health promoting. For example, 20% of students practiced one predominant health promoting pattern (risk behavior for fruit and vegetable consumption and protective behaviors for physical activity, alcohol consumption, smoking marijuana, and smoking cigarettes), and 5% of students practiced one predominant risk pattern (risk behaviors for fruit and vegetable consumption, alcohol consumption, and smoking marijuana, and protective behaviors for physical activity and smoking cigarettes). Thus this finding confirms, specifically for the top five Healthy Campus 2010 (ACHA, 2002) objectives, that college students cannot be differentiated into those that lead a healthy lifestyle and those that do not. But it does suggest more than half (63%) of students fall within a few predominantly risk or protective cluster patterns that could be targeted in an intervention.

Pairs. Investigations into the co-occurrence of health behavior pairs provides further insight into the unique associations among the five Healthy Campus 2010 (ACHA, 2010) objectives because there are no identified research studies that have assessed all the paired combinations of college students' HRBs. Further, other research into various pair combinations is lacking and in many cases presents contradictory results. The findings support the understanding that many of the five Healthy Campus 2010 (ACHA, 2010) priority health behaviors are associated with other health behaviors; specifically, five of the 10 pair

combinations were found to be significantly associated. In our study, 77% of students practiced either risk or protective smoking cigarettes and smoking marijuana pair behaviors; 67% of students practiced either risk or protective physical activity and fruit and vegetable consumption pair behaviors; 63% of students practiced either risk or protective smoking cigarettes and alcohol consumption behaviors; 63% of students practiced either risk or protective alcohol consumption and smoking marijuana pair behaviors; and 59% of students practiced pairs of risk or protective smoking cigarettes and physical activity behaviors.

Other researchers reported similar associations between pairs of HRBs. The finding that protective or risk patterns of smoking cigarettes and smoking marijuana are associated confirms studies by Emmons et al. (1998), Lenz (2002), Rigotti et al. (2000), and Sheriff (2010). Additionally, the smoking cigarettes and alcohol consumption associations are similar to studies by Emmons et al. (1998), Weitzman and Chen (2005), and Werner et al. (1996), and the alcohol consumption and smoking marijuana associations are similar to reports by Mohler-Kuo et al. (2003), Shillington & Clapp (2006) and Wechsler et al. (1995). Thus, these findings suggest that substance abuse behaviors are associated with other substance abuse behaviors, illustrating the need for continued interventions and the potential benefit in designing interventions to target more than one substance abuse behavior.

One other significant association common in the literature is the co-occurrence of risk and protective patterns of physical activity and smoking cigarettes; however, the identified literature assessed the co-occurrence of physical activity and smoking cigarettes based on levels of either behavior. Dinger and Vesely (2001), Halperin et al. (2010), Nigg et al. (2009), Seo et al. (2007), and VanKim et al. (2010) identified variations of levels based on physical activity (e.g., low, moderate, vigorous) or smoking cigarette patterns (e.g., light vs. heavy, smoke daily vs.

occasionally). However, findings in this study did not differentiate based on level but they did identify a co-occurrence based on meeting or not meeting Healthy Campus 2010 objectives (ACHA, 2010). Although these findings contribute to the limited body of knowledge regarding associations among the five Healthy Campus 2010 (ACHA, 2010) health behavior objectives, they do not address various levels of health behaviors, which could be informative when designing interventions. As a result, research should expand into the differences between levels for the five Healthy Campus 2010 (ACHA, 2010) health behavior objectives.

Identification of the co-occurrence of physical activity and fruit and vegetable consumption adds to the vast amount of literature in which many researchers have investigated the influence of fruit and vegetable consumption and physical activity on anthropometric measures but did not report whether there was a co-occurrence between the behaviors (Huang et al., 2003; Kasparek et al., 2007; Lowry et al., 2000; Marrone, 2010; Racette et al., 2005). As expected, distinct associations emerged between these behaviors, which had not been confirmed in much of the previous literature. Thus, findings illustrate the importance of targeting this pair in interventions, especially since 16% of the sample was in the cluster pattern of risk behaviors for physical activity and fruit and vegetable consumption but demonstrated protective behaviors for alcohol consumption, smoking marijuana and smoking cigarettes.

Our study provides valuable information about the relationship between health behavior pairs. Rather than students practicing a single behavior, a certain behavior is paired with another behavior. As indicated in the literature, the associations of the five pair combinations were positive, which indicates that a risk behavior was associated with another risk behavior, or that a protective behavior was associated with another protective behavior. These results show that each of the five pair associations could possibly be the result of a gateway behavior transfer

relationship: the adoption of a protective or risk behavior that stimulates change in another protective or risk behavior (Nigg et al., 2009). Although these findings illustrate a potential gateway effect, our research does not confirm these findings. Therefore, our study provides valuable suggestions about the health behavior pairs to target in an intervention, but additional research is needed to confirm whether gateway behaviors explain behavior associations and what behaviors to target to initiate behavior change though a gateway transfer effect.

Sociodemographic characteristics and HRBs

Health educators benefit from understanding the variations of co-occurring health behaviors by sociodemographic characteristics; targeting and tailoring interventions based on common characteristics can be effective in promoting HRB change (CDC, 2010b; Green & Kreuter, 2007). Although single health behavior variations by sociodemographic characteristics are documented in research, there are few studies which have assessed whether the clusters or pairs of five Healthy Campus 2010 (ACHA, 2010) health behavior objectives vary by gender, race, or year in school. Our study confirms past findings of gender and year in school variations based on single HRBs and adds to the limited body of literature that asserts that certain pair combinations and clusters of HRBs vary by gender and year in school. No race variations were identified for single or co-occurring HRBs, even though some research has revealed variations by race. One plausible reason why there were no variations could be the small sample (13%) of non-White students.

Gender

Single health behaviors. Variations of single health behaviors by gender and year in school are important to health educators because knowing the gender can help target interventions for a single health behavior. Female students more than males met the objectives

for smoking marijuana and alcohol consumption, and more males than females did not meet objectives. These findings are consistent with the spring 2010 ACHA Reference Report (ACHA, 2010) and with research by Adams and Nagoshi (1999), Baer et al. (1992), Del Boca et al. (2004), Greenbaum et al. (2005), Werner et al. (1996), and White et al. (2006), all of whom reported that males were more likely than females to smoke marijuana and consume alcohol. One reason may be that male college students view alcohol and marijuana usage less negatively than female college students (Gaher & Simons, 2007). Research has shown that perceived risk is important because lower perceived likelihood of negative consequences is associated with increased frequency of risky behaviors (McCarthy, Lynch, & Pederson, 2007). There may be benefit in targeting males for smoking marijuana and alcohol interventions and tailoring the interventions to change their perceptions of risk.

Although physical activity by gender has been well documented, the literature is inconsistent and inconclusive: some studies reported no gender differences and others reported more males participate in physical activity (ACHA, 2010; Buckworth & Nigg, 2004; Dinger & Waigandt, 1997; Irwin, 2004; Leslie, Sparling et al., 2001). Findings showed that more males than females met physical activity objective. More male students engage in physical activity than females, as college women are more motivated by higher perceived immediate benefits and lower perceived barriers to health behaviors (Reiser, 2008). One common perceived benefit of physical activity is maintaining weight; however, this benefit is not immediate. Other female students may perceive greater safety risks in walking on university campus, which has been linked to less overall physical activity (Reed et al., 2007). There may be benefit in targeting physical activity interventions to females and tailoring the interventions to improve perceived immediate benefits (i.e., more energy, improved mood, etc.), while promoting safe environments

and competency for feeling secure while walking on campus (i.e., lighting, night chaperone service, call boxes, self-defense classes, etc.).

There were no variations for meeting or not meeting smoking cigarettes and fruit and vegetable consumption objectives based on gender. Research reported inconsistent findings for gender and fruit and vegetable consumption. Dinger and Waigandt (1997) and Huang et al. (2003) reported no differences based on gender and others found either males or females consume a greater number of fruit and vegetable servings (McArthur et al., 2002). Other research into smoking cigarettes demonstrated that males smoked occasionally or at least once every 30 days (ACHA, 2010; Emmons et al., 1998; Gaffney et al., 2002; Moran et al., 2004). Findings suggested no gender differences for meeting or not meeting objective, so both males and females might equally benefit from smoking cigarettes and fruit and vegetable consumption interventions. Continued investment in interventions for these two behaviors is crucial because 92% of students do not consume five daily recommended servings of fruits and vegetables and 21% smoke cigarettes at least once a month.

Clusters. Findings showed differences in FV only, FV/PA, FV/AC, and FV/PA/AC clusters based on gender. When analyzing the total sample, FV/PA cluster patterns varied by gender. When considering the subsets of students in the most larger clusters, gender differences were found in three of the five clusters: two times more for FV only, three and half times for FV/PA, and two times more for FV/PA/AC.

These results revealed a consistent FV/PA cluster pattern for females when considering either the total sample or the subsets of students in the five clusters, but they also revealed a unique interaction between gender and FV/PA/AC, FV/AC and FV only cluster behaviors that was not present when considering the total sample versus subsets of students. Thus our research

implies a benefit in targeting females in interventions designed specifically for FV/PA and males in interventions designed for FV/AC. However, there may be more benefit in targeting and tailoring to gender in FV/PA/AC and FV only interventions because a greater percentage of students are in these clusters. This information is important to health educators because there has been less research investigating the clusters of the five Healthy Campus 2010 (ACHA, 2010) objectives by gender.

Paired health behaviors. This study demonstrated differences for four of the ten health behavior pairs by gender. Females were more likely than males to meet objectives and males were more likely than females not to meet objectives for both SC&AC and AC&SM pair patterns. The finding of patterns of increased substance abuse behaviors for SC&AC in males compared to females provides further insight into conflicting research (Ames et al., 2010; Schorling et al., 1994; Weitzman & Chen, 2005; Werner et al., 1996). The paired AC&SM finding adds to the existing research because there had been no literature identified that investigated gender variations for this pair. There is still a need to target males in interventions for SC&AC and AC&SM behaviors.

Unlike the two previously mentioned health behavior pairs, SC&SM and PA&FV showed gender variations based on not meeting objectives but did not display variations for meeting the objectives. More males than females did not meet the objectives for SC&SM but there was no variation for gender regarding meeting SC&SM objectives. More females than males did not meet objectives for PA&FV, but there was no variation for gender regarding meeting the PA&FV objectives. Our research adds to the existing literature as most investigations into PA&FV have focused on levels (low, moderate, or vigorous PA, or number of FV servings) (Adams & Colner, 2008; Johnson et al., 2008), and the research investigating

SC&SM is limited and possibly outdated (Emmons et al., 1998). Additionally, this study indicates that for a paired behavior gender based on not meeting objectives is not always identical to meeting the objectives for that paired behavior. Thus, for SC&SM and PA&FV pairs of behaviors, there is a need to target females for PA&FV interventions and males for SC&SM interventions.

There were no gender variations based on meeting or not meeting objectives for the following pairs of behaviors: PA&SC, PA&AC, PA&SM, FV&SC, FV&AC, and FV&SM. Research provided support for gender variations based on PA&SC, PA&AC, and PA&SM pairs of behaviors for college athletes (Emmons et al., 1998; Ford, 2007; LaBrie et al., 2009; Musselman & Rutledge, 2010; Nattiv et al., 1997; Rockafellow & Saules, 2006; Wechsler & Davenport, 1997), but the literature did not report for non-athlete college students. Also, there was no variation of gender for FV&SC, FV&AC, and FV&SM, and there is little to no research investigating gender differences for these pairs of behaviors.

This information is important to health educators because there has been limited and inconsistent literature investigating pair variations of the five Healthy Campus 2010 (ACHA, 2010) health behavior objectives by gender. They may now see the benefit in targeting gender in single interventions designed to change the SC&AC, AC&SM, PA&FV, SC&SM pairs of health behaviors, and limited benefit in targeting an intervention based on gender for PA&SC, PA&AC, PA&SM, FV&SC, FV&AC, and FV&SM.

Year in School

Single health behaviors. Our study revealed year in school differences based on single health behaviors for one of the five Healthy Campus 2010 (ACHA, 2010) health behavior objectives: physical activity, with second-year students more likely not to meet physical activity

objectives than first, third, or fourth-year undergraduate students. This is different from the literature that did not report variations of physical activity based on year in school (Calfas et al., 1994; Dunn & Wang, 2003; Leslie, Sparling et al., 2001; Pinto, 1995). The findings on year in school also conflict with literature that reported variations in fruit and vegetable consumption for underclassmen versus upperclassman (Driskell et al., 2005, McArthur et al., 2002; Sturgeon, 2008); increased marijuana use in the freshmen year (Gledhill-Hoyt et al., 2000; Jackson et al., 2001; Mohler-Kuo et al., 2003); and the prevalence of smoking cigarettes decreasing as students advance as undergraduates (Borders et al., 2005). Additionally, our findings add to the limited literature that investigated variations of alcohol consumption by the year of school, but fails to distinguish use based on subsequent years in school (Adams & Nagoshi, 1999; Harford et al., 2002; McCabe et al., 2005; Wechsler et al., 2002; White et al., 2006). Health educators now have insights into the potential benefits of targeting physical activity interventions to second-year students, and not targeting interventions based on year in school for smoking cigarettes, smoking marijuana, and fruit and vegetable and alcohol consumption.

Clusters. Findings showed cluster differences by year in school for three of the five frequent cluster patterns: FV only, FV/PA and FV/AC/SM. When analyzing the total sample, fourth/fifth-year students, compared to first, second or third-year students, were more likely to be in the FV only cluster, and second-year students, compared to the other-year students, were more likely to be in the FV/PA cluster. When considering the subset of students in the most frequent clusters, year in school predicted the students in two of the five frequent cluster patterns: FV only and FV/AC/SM. Specifically, as students progressed through undergraduate school they were 82% less likely to practice the risk behavior for FV only and 85% less likely to practice FV/AC/SM behaviors.

These findings are conflicting for FV only when comparing the total sample to the sub-sample of students in the most frequent clusters: fourth/fifth-year students were more likely to be in clusters but as undergraduates in the most frequent clusters progressed though school they were less likely to be in the FV only cluster. When considering FV/AC/SM cluster patterns, there is a strong indication that underclassmen in the most frequent clusters would benefit more from an intervention, but second-year students would benefit from a FV/PA intervention. No literature was found investigating variations in clusters of the five Healthy Campus 2010 (ACHA, 2010) health behavior objectives by year in school. Health educators now have insights into students' year in school as they would benefit most from a single intervention designed to change a cluster of health behaviors.

Paired health behaviors. This study demonstrated no pair differences based on year in school, which is valuable because there has been a lack of literature investigating pair variations in the five Healthy Campus 2010 (ACHA, 2010) behavior objectives by year in school. Health educators may see that it would not be beneficial to target students by year in school for single interventions designed to change pairs of health behaviors.

Intervention design

The reviewed literature suggests that theoretical-based interventions can be applied to multiple behaviors because the same constructs (e.g., perceived risk, self-efficacy, outcome expectations, social norms, decisional variables, and intrinsic and extrinsic motivation) are evident in a variety of behaviors (Hall & Rossi, 2008; King, 1996; Noar et al., 2007). Other literature provides insight into why the behaviors change together: the gateway behaviors promote change because of the theoretical-based constructs act as mediators for impacting other HRBs (Johnson et al., 1998, Nigg et al., 2009). Furthermore, the review of literature does

demonstrate that some approaches for MHBC interventions are effective for certain individuals and health behaviors (Prochaska, 2008). Specifically, a combination of three intervention approaches was identified in the literature that may be the key to MHBC: Transtheoretical Model (TTM) or the Behavioral Image Model (BIM) design; tailored messaging; and technological based delivery.

Transtheoretical Model (TTM) or the Behavioral Image Model (BIM) interventions, which are based on theoretical constructs of stages of change, decisional balance, and self-efficacy (TTM) or social norms (BIM), could be used as the theoretical based design of the MHBC interventions. In two studies, employees at work sites and patients in primary care received TTM based messaging and were successful in changing co-occurring behaviors of high-fat diets, sun exposure, and smoking (Prochaska et al., 2005; Velicer et al., 2004). In addition, a number of studies showed that interventions based on BIM promoted the simultaneous change of risk behaviors in adolescents (Werch et al., 2003; 2005; 2008).

Intervention approaches that tailor messaging in a modular approach specific to the individual, with each behavior accompanied by tailored messaging was found to be effective (Prochaska, Butterworth et al., 2008; Strecher et al., 2002). For instance, tailored feedback based on the participants' associated self-images has been shown to simultaneously improve multiple health behaviors in adolescents, adults, and college students (Werch et al., 2003; 2008; 2010; Werch, Moore, DiClemente, Bledsoe, & Jobli, 2005). The previously mentioned successful TTM intervention for employees at work sites and patients in primary care included tailored messaging (Prochaska et al., 2005; Velicer et al., 2004).

· Last, technology based interventions have shown to be an effective method for the delivery of the MHBC interventions (Prochaska, Butterworth et al., 2008). For example, web

applications have been successful in relaying TTM based messaging to each behavior (Prochaska et al., 2005; Velicer et al., 2004).

These three intervention approaches may be the key to promoting co-variation of the most frequently practiced single, cluster, and pair risk HRBs identified in this research:

Single:

(1) Too few servings of fruit and vegetables each day and (2) and too much alcohol consumption in the last two weeks.

Clusters:

(1) Too few servings of fruit and vegetables each day; (2) too few servings of fruits and vegetables each day and not enough physical activity each week; (3) too few servings of fruits and vegetables each day and too much alcohol consumption in the last two weeks; (4) not enough physical activity each week, too few servings of fruits and vegetables each day, and too much alcohol consumption in the last two weeks; and (5) too few servings of fruits and vegetables each day, too much alcohol consumption in the last two weeks, and too much marijuana smoking in the last 30 days.

Pairs:

(1) Not enough physical activity each week and too few servings of fruit and vegetables each day; (2) too much alcohol consumption in the last two weeks and too much marijuana smoking in the last 30 days; (3) too much cigarette smoking in the last 30 days and too much alcohol consumption in the last two weeks; (4) too much cigarette smoking in the last 30 days and not enough

physical activity each week; and (5) too much cigarette smoking and marijuana smoking in the last 30 days.

Research Implications

Researchers, college administrators, and health educators night gain insight into how health behaviors co-occur in college students. The major strength of this research is that it provides an examination of the clusters and pairs of the five Healthy Campus 2010 (ACHA, 2010) health behavior objectives. Second, the research demonstrates that certain co-occurring health behaviors vary by gender and year in school. This information is valuable when prioritizing interventions, targeting the interventions for the students with the greatest need, and tailoring the interventions according to the sociodemographic characteristic of the groups.

Suggestions for research

Even though our research provides insights into co-occurring health behaviors in college students, it does not address how HRBs co-occur based on level, whether the co-occurring behaviors are due to gateway effects, or the interventions that would be effective for promoting the co-variation of co-occurring risk behaviors. As a result, recommendations for research would explore the following.

Level. Studies investigating the co-occurring health behaviors based on the level of health behavior would follow the same methodology used in this study, but the difference would entail recoding variables for meeting and not meeting objectives into various ordinal levels of behaviors. For example, physical activity could be recoded based on low, moderate, or vigorous physical activity; fruit and vegetable consumption could be recoded into different numbers of serving sizes (e.g., 1-2, 3-4, or 5+); or smoking cigarettes could be recoded into none, occasional

(e.g., 1-10 days per month), frequent, (e.g., 11-29 days per month), and every day, etc. The potential findings would further address co-occurring behaviors and provide additional insight into how to tailor and target the messaging for multiple health behavior change (MHBC) interventions.

Gateway behaviors. Research addressing why HRBs co-occur could shed light on gateway behaviors. In addition to questions about current health practices, studies would need to include questions regarding the common constructs of health behavior change (e.g., perceived risk, self-efficacy, knowledge, beliefs, attitudes, etc.). For example, the identification of an association between alcohol consumption and smoking cigarettes and self-efficacy may provide evidence that the risk health behaviors co-occur because the individual does not have "self-efficacy" in his/her ability to withstand practicing the paired risk behavior (U.S. DHHS, 2005). Thus it could be hypothesized that targeting "self-efficacy" as one of the constructs in an intervention could result in a transfer gateway effect for changing the other behavior.

Interventions for co-variation. As stated in the literature review, there are a limited number of studies that address MHBC interventions, which could be attributed to the complexity of implementing an experimental design study. However, to advance the knowledge about successful methods and strategies for implementing MHBC interventions, research should investigate various intervention strategies for the identified co-occurring health behaviors. One possible experimental design would include a control group, two single intervention groups (one single HRB intervention for each group) and one MHBC group (one HRB pair intervention). The researcher could implement the interventions based on a known successful model for single health behavior change (e.g., Transtheoretical Model or Behavioral Image Model). It would be

illuminating if the paired behavior intervention were or were not successful versus the single behavior interventions.

Limitations of the study

As with any study, this study is not without limitations. Several limitations have been mentioned in previous chapters. One major limitation concerns the generalizability of the findings, because the sample is not representative of undergraduate students when considering college of study, age, or year in school. Secondly, there are accuracy and honesty limitations due to the self-report nature of the survey and the inability to confirm whether the reported behavior was intentionally or unintentionally misreported. Another limitation concerns the temporal scope of the survey and whether or not the findings represent actual HRB patterns beyond the time frame in question. Lastly, the study does not address all protective HRBs, various levels of health behaviors, gateway behaviors, and successful interventions for multiple health behavior change. So although health educators may gain valuable insights into the co-occurring behaviors that may be more likely to co-vary, continuing research is needed to confirm this theory and explore the best interventions for promoting change of more than one health behavior.

Recommendations for Practice

Findings suggest that there are certain clusters and pairs of the five Healthy Campus 2010 (ACHA, 2010) HRBs that occur in college students, and pairs and clusters vary by gender and year in school. University administrators and health educators can use this knowledge to: (a) prioritize MHBC interventions based on the likelihood of impacting a greater number of students, (b) reach the targeted group, (c) and identify how to target and tailor the MHBC interventions in order to motivate students to change their behaviors. Further, this information can be used to demonstrate need and provide justification in applications for funding

opportunities regarding multiple health behaviors of college students. For instance, the finding that more women than men are likely to have paired risk behaviors for physical activity and fruit and vegetable consumption could be sufficient justification to apply for grant opportunities for the prevention of heart disease in women.

This section contains the author's suggestions for targeting single and multiple behavior interventions based on the five Healthy Campus 2010 (ACHA, 2010) objectives and suggestions for intervention approaches that are based on findings from the review of literature. In some instances there is no clear direction of the intervention approaches best for the recommended single, cluster, or pair risk HRBs in college students. However, the review of literature does provide insight that MHBC interventions based on the TTM or BIM model that are tailored to each behavior and delivered using technology could be the best approach for changing the recommended pairs and cluster of HRBs. Therefore, the health educator should aim to implement these three approaches and evaluate their effectiveness.

The following intervention recommendations are ranked based on the number of students with the single, cluster, or pair risk HRBs because the potential for impact is greater (i.e., more students in the group so potentially able to change risk behavior of more students). However, administrators and health educators should consider re-ranking the priority interventions based on the needs of the university because these cannot be generalized. Specifically the following should be considered when re-ranking the interventions: (a) short term or long term consequences, (b) available resources, and (c) effect size.

Health educators should consider the short and long term consequences of the risk HRBs and prioritize interventions based on the problem areas identified specifically for the university. Short and long term consequences vary for each of the five HRBs. For example, risk alcohol

consumption can have both a short term consequence (i.e., binge drinking resulting in death) that is an immediate result of the risk behavior and a long term consequence (i.e., years of binge drinking resulting in liver cancer) that occurs over time from continuously practicing the risk behavior. Other HRBs, such as risk fruit and vegetable consumption and physical activity, have more of a long term consequence because they may contribute to chronic heart disease. One university may prioritize alcohol consumption interventions and other substance abuse pair/cluster interventions because of recent alcohol related deaths. However, another university may prioritize a fruit and vegetable and physical activity paired intervention because of a high overweight/obesity rate (partially due to risk fruit and vegetable consumption and physical activity), which is more predominant than the short term consequences from risk alcohol consumption.

Available resources should be considered when re-prioritizing interventions. For example, a university may be required to implement an intervention focused to one HRB, such as risk smoking cigarettes, because this is why they received funding (i.e., Federal tobacco grant to support staff salary for a smoking cessation intervention). Nevertheless, the single intervention could be modified to include other behaviors in a paired or cluster intervention and still meet grant requirements. Therefore, university administrators may prioritize, for example, a smoking cigarette and alcohol paired intervention over a physical activity and fruit and vegetable paired intervention because they have the available resources.

Lastly, the health educator should re-prioritize interventions based on the effect size of the finding and plans for the intervention. As many of the findings have an effect size that is small or smaller than typical, the health educator would need to weigh the practical significance of implementing the interventions (Leech, Barrett, & Morgan, 2005). For example, a small

effect size finding that more females practice risk fruit and vegetable consumption and physical activity would suggest that it may be practical to tailor in a social media campaign (i.e., low cost print materials with gender specific messaging) but not practical to tailor a web-based intervention (i.e., costly software changes to incorporate gender specific messaging). Prioritizing a social media intervention tailored to females may be an effective use of resources compared to a gender specific web-based intervention.

Single interventions

Two single HRBs are recommended for priority interventions: too few servings of fruit and vegetables each day and too much alcohol consumption in the last two weeks.
Health educators should prioritize implementing a fruit and vegetable intervention if the goal is to address the needs of the majority of students, and an alcohol consumption intervention if the goal is to address the need of half of the students or if the goal is to target the behavior that is most divergent from meeting the Healthy Campus 2010 (ACHA, 2002) target goal. Table 25 displays the priority intervention and the rationale for tailoring and targeting the intervention by sociodemographic characteristics, and applicable effect sizes so the health educator can gauge the practical significance and feasibility of implementing the interventions.

Table 25

Recommended Single Interventions: Rationale, Targeted Sociodemographic Characteristic, and Effect Size

Priority Intervention	Rationale	Targeted Sociodemographic	Effect Size
Fruit and vegetable consumption	Needs of majority 92% practice risk behaviors	None	
Alcohol consumption	Needs of half 48% practice risk behaviors		
		Males	Small or smaller than typical
	Most divergent from Healthy Campus target goal 28 percentage points under		
		Males	Small or smaller than typical

There was limited literature that identifies successful interventions for fruit and vegetable consumption with consistently promising results (Adams & Colner, 2008). Although studies have identified effective interventions for increasing knowledge or promoting short-term changes in fruit and vegetable consumption, most have not address long-term maintenance by study design (Goldfield & Epstein, 2002; Schnoll & Zimmerman, 2001). As for alcohol consumption, research suggests interventions that correct misperceptions about peer drinking and promote responsible behavior (i.e., social norms modeling) improve alcohol consumption-based student behavior (Borsari & Carey, 2003; Haines & Spear, 1996; Perkins et al., 2005).

Health educators should evaluate if the aforementioned MHBC interventions are successful in changing the prioritized single behaviors. For example, implementing three of the five recommended cluster interventions both address too few servings of fruit and vegetables each day and too much alcohol consumption in the last two weeks. The cluster intervention may not be successful for changing all the behaviors in the cluster but may promote change of a single risk behavior like too few servings of fruit and vegetables each day or too much alcohol consumption in the last two weeks.

Multiple health behavior change interventions

Health educators should prioritize implementing interventions designed to change more than one health behavior in a single intervention because more than 72% of students practice two or more risk behaviors.

Clusters. The recommendation includes designing interventions for changing the most frequent clusters of behaviors: (a) too few servings of fruit and vegetables each day (FV Only); (b) too few servings of fruits and vegetables each day and not enough physical activity each week (FV/PA); (c) too few servings of fruits and vegetables each day and too much alcohol consumption in the last two weeks (FV/AC); (d) not enough physical activity each week, too few servings of fruits and vegetables each day, and too much alcohol consumption in the last two weeks (PA/FV/AC); and (e) too few servings of fruits and vegetables each day, too much alcohol consumption in the last two weeks, and too much marijuana smoking in the last 30 days (FV/AC/SM). In addition, the recommendation includes prioritizing interventions based on the highest percentage of students in the cluster and targeting three of the five interventions based on gender and two of the five based on year in school (see Table 26).

Table 26

Recommended Cluster Interventions: Rationale, Targeted Sociodemographic Characteristic, and Effect Size

Priority Intervention	Rationale	Targeted Socio-demographic	Effect Size
#1. FV Only	20% of students are in the cluster		
		Underclassmen	62% less like to be in cluster as advance to upperclassman
		Females	Two times more likely in cluster
#2. FV/PA	16% of students are in the cluster		
		Females	Three and a half times more likely in cluster
#3. FV/AC	13% of students are in the cluster		
#4. PA/FV/AC	8% of students are in the cluster		
		Females	Two times more likely in cluster
#5. FV/AC/SM	5% of students are in the cluster		
		Underclassmen	85% less like to be in cluster as advance to upperclassman

There was limited research that identified interventions designed specifically for the clusters of HRBs. Even though there may be successful interventions identified for the risk behaviors within the cluster (i.e. FV/PA or SC/SM), it is not known if these interventions

contained strategies or messaging related to the positive HRBs within the clusters. Therefore, it cannot be assumed these intervention strategies could be successful for the cluster, so health educators are advised to implement TTM or BIM intervention designs that are tailored to each behavior and delivered using technology.

Pairs. Health educators should implement interventions for changing five of the 10 behavior pairs: (a) not enough physical activity each week and too few servings of fruits and vegetables each day (PA&FV); (b) too much alcohol consumption in the last two weeks and too much marijuana smoking in the last 30 days (AC&SM); (c) too much cigarette smoking in the last 30 days and too much alcohol consumption in the last two weeks (SC&AC); (d) too much cigarette smoking in the last 30 days and not enough physical activity each week (SC&PA); and (e) too much cigarette smoking and marijuana smoking in the last 30 days (SC&SM). The interventions should be prioritized based on the highest percentage of students practicing the risk pairs and targeted four of the five paired interventions based on gender (see Table 27).

Table 27

Recommended Pair Risk Behavior Interventions: Rationale, Targeted Sociodemographic Characteristic, and Effect Size

Priority Intervention	Rationale	Targeted Socio-demographic	Effect Size
#1. PA&FV	59% of students practice the risk pair		Small or smaller than typical
		Females	31% more likely to practice risk pair
#2. AC&SM	19% of students practice the risk pair		Medium or typical relationship
		Males	58% more likely to practice risk pair
#3. SC&AC	18% of students practice the risk pair		Medium or typical relationship
		Males	58% more likely to practice risk pair
#4. SC&PA	11% of students practice the risk pair		Small or smaller than typical
#5. SC&SM	10% of students practice the risk pair		Small or medium
		Males	74% more likely to practice risk pair

There was limited identified research that investigates health interventions for the co-variation of HRBs pairs in college students. For SC&AC, AC&SM, SC&SM and PA&VF pair interventions, one study demonstrated that the BIM intervention was effective for decreasing alcohol consumption, smoking marijuana, and fruit and vegetable consumption but not effective for decreasing smoking cigarettes and physical activity (Werch, 2008). For SC&PA interventions, two other Werch studies (2007; 2010) found that the BIM interventions were successful in increasing protective physical activity but not successful for decreasing risk smoking cigarettes. Therefore, a clear direction of a successful intervention is a BIM intervention designed to promote the change of AC&SM; however, all interventions were not delivered through technology. The other interventions may be successful in promoting the change of the other four risk pairs if they are designed based on the TTM or BIM models, tailored to each behavior, and delivered using technology.

Concluding Remarks

The findings of this research confirm the need to continue interventions for the five Healthy Campus 2010 (ACHA, 2010) objectives. The study helps improve the understanding of how health behaviors co-occur in college students, and provides college administrators and health educators insights into the behaviors to include in MHBC interventions, how to prioritize interventions, which students to target and how to tailor the interventions. Thus this study is valuable because in an era of budget cuts and shrinking resources, alternative approaches, such as MHBC interventions compared to traditional single HRB interventions, may potentially be more effective and economical and less demanding for health educators. By providing this insight to health educators, there is an opportunity to increase the number of college students practicing protective health behaviors, which could ultimately reduce the incidence of premature morbidity and mortality.

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Appendix A

Healthy Campus and Healthy People Objectives, Baseline and 2010 Target Goals

Objective		Baseline	2010 Targets Goals
Reduce cigarette smoking by adolescents, adults 18 years and older, college students[a]			
	Healthy People	24.0%	12.0%
	Healthy Campus	25.1%	10.5%
Reduce the proportion of college students engaging in high risk binge drinking of alcoholic beverages during the past two weeks			
	Healthy People	N/A	N/A
	Healthy Campus	39.0%	20.0%
Reduce the proportion of adolescents aged 12 to 17, college students, and adults reporting use of marijuana during the past 30 days			
	Healthy People	8.3%	.7%
	Healthy Campus	14.8%	1.0%
Increase the proportion of college students who consume at least five daily servings of fruits and vegetables			
	Healthy People	N/A	N/A
	Healthy Campus	7.4%	25.5%
Increase proportion of college students that engage in physical activity at least three days per week that includes moderate physical activity for at least 30 minutes or vigorous physical activity for 20 more minutes per occasion			
	Healthy People	Did not collect	Did not collect
	Healthy Campus	40.3%	55.0%

[a]National data are based on percentage who smoked at least 100 cigarettes in their lifetime and now smoke everyday or some days. College adolescent data are based on smoking at all in the last 30 days.

Note. From the American College Health Association. (2002). *Healthy Campus 2010 manual*. Baltimore, MD: Author and U.S. Department of Health and Human Services (2000) and *Healthy People 2010: Understanding and Improving Health. 2nd ed*. Washington, DC: U.S. Government Printing Office (2000).

Appendix B

National College Health Assessment

American College Health Association

National College Health Assessment

Instructions:

The following questions ask about various aspects of your health.

To answer the questions, fill in the oval that corresponds to your response.

Select only one response unless instructed otherwise.

Use a No. 2 pencil or blue or black ink pen only. Do not use pens with ink that soaks through the paper. CORRECT: ● INCORRECT: ✓ ✗ ◒ ⊙

This survey is completely voluntary. You may choose not to participate or not to answer any specific question. You may skip any question you are not comfortable in answering.

This survey is completely anonymous. Please make no marks of any kind on the survey which could identify you individually.

Composite data will then be shared with your campus for use in health promotion activities.

Thank you for taking the time and thought to complete this survey. We appreciate your participation!

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PAGE ONE

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The first 8 questions ask about health, health education, and safety.

1. **Considering your age, how would you describe your general health?**
   ○ Excellent ○ Very good ○ Good ○ Fair ○ Poor ○ Don't know

2. **On which of the following health topics have you ever received information from your college or university? (Select all that apply)**
   - ○ Tobacco use prevention
   - ○ Alcohol and other drug use prevention
   - ○ Sexual assault/relationship violence prevention
   - ○ Violence prevention
   - ○ Injury prevention and safety
   - ○ Suicide prevention
   - ○ Pregnancy prevention
   - ○ AIDS or HIV infection prevention
   - ○ Sexually transmitted disease (STD) prevention
   - ○ Dietary behaviors and nutrition
   - ○ Physical activity and fitness
   - ○ None of the above

(Please mark the best response for each question to the right)	3. Use the scale below to record the BELIEVABILITY of each source of health information. Believable		Neither Believable nor Unbelievable	Unbelievable	4. Do you usually get health-related information from any of the following sources? No	Yes
Leaflets, pamphlets, flyers	○	○	○		○	○
Campus newspaper articles	○	○	○		○	○
Health center medical staff	○	○	○		○	○
Health educators	○	○	○		○	○
Friends	○	○	○		○	○
Resident assistants/advisors	○	○	○		○	○
Parents	○	○	○		○	○
Religious center	○	○	○		○	○
Television	○	○	○		○	○
Magazines	○	○	○		○	○
Campus peer educators	○	○	○		○	○
Faculty/coursework	○	○	○		○	○
Internet/world wide web	○	○	○		○	○
Other: (please specify) _____	○	○	○		○	○

5. **Within the last school year, how often did you:**
   (Please mark the appropriate column for each row)

	Always	Most of the time	Sometimes	Rarely	Never	N/A didn't do this within the last school year
Wear a seatbelt when you rode in a car?	○	○	○	○	○	○
Wear a helmet when you rode a bicycle?	○	○	○	○	○	○
Wear a helmet when you rode a motorcycle?	○	○	○	○	○	○
Wear a helmet when you were inline skating?	○	○	○	○	○	○

6. **Within the last school year, were you:**

	Yes	No
In a physical fight?	○	○
Physically assaulted (do not include sexual assault)?	○	○

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PAGE TWO

7. Within the **last school year**, have you experienced:	Yes	No
Verbal threats for sex against your will?	○	○
Sexual touching against your will?	○	○
Attempted sexual penetration (vaginal, anal, oral intercourse) against your will?	○	○
Sexual penetration (vaginal, anal, oral intercourse) against your will?	○	○
8. Within the **last school year**, have you been in a relationship that was:		
Emotionally abusive?	○	○
Physically abusive?	○	○
Sexually abusive?	○	○

The next 11 questions ask about alcohol, tobacco, and drugs.

9. Within the **last 30 days**, on how many days did you use: (Mark one for each row)	Never used	Have used, but not in last 30 days	1-2 days	3-5 days	6-9 days	10-19 days	20-29 days	All 30 days
Cigarettes	○	○	○	○	○	○	○	○
Cigars	○	○	○	○	○	○	○	○
Smokeless tobacco	○	○	○	○	○	○	○	○
Alcohol (beer, wine, liquor)	○	○	○	○	○	○	○	○
Marijuana (pot, hash, hash oil)	○	○	○	○	○	○	○	○
Cocaine (crack, rock, freebase)	○	○	○	○	○	○	○	○
Amphetamines (diet pills, speed, meth, crank)	○	○	○	○	○	○	○	○
Rohypnol (roofies), GHB or Liquid X (intentional use)	○	○	○	○	○	○	○	○
Other drugs	○	○	○	○	○	○	○	○

10. Within the **last 30 days**, how often do you think the typical student at your school used: State your best estimate. (Mark one for each row)	Never used	One or more days	Used daily
Cigarettes	○	○	○
Cigars	○	○	○
Smokeless tobacco	○	○	○
Alcohol (beer, wine, liquor)	○	○	○
Marijuana (pot, hash, hash oil)	○	○	○
Cocaine (crack, rock, freebase)	○	○	○
Amphetamines (diet pills, speed, meth, crank)	○	○	○
Rohypnol (roofies), GHB or Liquid X (intentional use)	○	○	○
Other drugs	○	○	○

One drink or alcoholic beverage is defined as a 12 oz. beer, a 4 oz. glass of wine, a shot of liquor, or a mixed drink.

11. Within the **last 30 days**, did you: (Mark one for each row)	Yes	No	Not applicable/Don't drink	Not applicable/Don't drive
Drive after drinking any alcohol at all	○	○	○	○
Drive after having 5 or more drinks	○	○	○	○

12. The last time you "partied"/socialized, how many **hours** did you drink alcohol? State your best estimate. (If less than 10, code answers as 00, 01, 02, etc.)

HOURS

00	○ ○
01	○ ○
02	○ ○
03	○ ○
04	○ ○
05	○ ○
06	○ ○
07	○ ○
08	○ ○
09	○ ○

13. The last time you "partied"/socialized, how many alcoholic **drinks** did you have? State your best estimate. (If less than 10, code answers as 00, 01, 02, etc.)

DRINKS

00	○ ○
01	○ ○
02	○ ○
03	○ ○
04	○ ○
05	○ ○
06	○ ○
07	○ ○
08	○ ○
09	○ ○

PAGE THREE

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14. In the **last two weeks**, on how many occasions did you drink the same or more alcohol as indicated in item #13? State your best estimate. (If less than 10, code answers as 00, 01, 02, etc.)

TIMES

15. How many alcoholic **drinks** do you think **the typical student at your school** had the last time he/she "partied"/socialized? (If less than 10, code answers as 00, 01, 02, etc.)

DRINKS

16. Think back over the **last two weeks**. How many times, if any, have you had five or more alcoholic drinks at a sitting?

○ None ○ 1 time ○ 2 times ○ 3 times ○ 4 times ○ 5 times ○ 6 times ○ 7 times ○ 8 times ○ 9 or more times

(Please mark the appropriate column for each row)

17. During the **last school year**, if you "partied"/socialized, how often did you...

	Always	Usually	Sometimes	Rarely	Never	Not applicable/Don't drink
Alternate non-alcoholic with alcoholic beverages	○	○	○	○	○	○
Determine, in advance, not to exceed a set number of drinks	○	○	○	○	○	○
Choose not to drink alcohol	○	○	○	○	○	○
Use a designated driver	○	○	○	○	○	○
Eat before and/or during drinking	○	○	○	○	○	○
Have a friend let you know when you've had enough	○	○	○	○	○	○
Keep track of how many drinks you were having	○	○	○	○	○	○
Pace your drinks to 1 or fewer per hour	○	○	○	○	○	○
Avoid drinking games	○	○	○	○	○	○
Drink an alcohol look-alike (non-alcoholic beer, punch etc.)	○	○	○	○	○	○

(Please mark the appropriate column for each row)

18. If you drink alcohol, within the **last school year**, have you experienced any of the following **as a consequence of your drinking**?

	Yes	No	Not applicable/Don't drink
Physically injured yourself	○	○	○
Physically injured another person	○	○	○
Been involved in a fight	○	○	○
Did something you later regretted	○	○	○
Forgot where you were or what you did	○	○	○
Had someone use force or threat of force to have sex with you	○	○	○
Had unprotected sex	○	○	○

19. Within the **last 30 days**, what **percent** of students at your school used? State your best estimate.

% Used Cigarettes

% Used Alcohol

% Used Rohypnol or GHB

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PAGE FOUR

The next 11 questions ask about sex behavior, perceptions, and contraception.

20. Within the **last school year**, with how many partners, if any, have you had sex (oral, vaginal, or anal)? (If less than 10, code answers as 00, 01, 02, etc.) → PARTNERS

21. Within **last school year**, were your sexual partner(s), if any,
○ N/A ○ Female
○ Male ○ Both Male and Female

22. Within the **last school year**, with how many partners do you think **the typical student at your school** has had sex (oral, vaginal, or anal)? (If less than 10, code answers as 00, 01, 02, etc.) → PARTNERS

(Please mark the appropriate column for each row)

23. Within the **last 30 days**, if you are sexually active, how many times did you have:

	Never did this sexual activity	Have not done this during **last 30 days**	1-2 times	3-4 times	5-6 times	7-8 times	9-10 times	11 or more times
Oral sex?	○	○	○	○	○	○	○	○
Vaginal Intercourse?	○	○	○	○	○	○	○	○
Anal Intercourse?	○	○	○	○	○	○	○	○

(Please mark the appropriate column for each row)

24. How many times within the **last 30 days** do you think **the typical student at your school** has had:

	0 times	1-2 times	3-4 times	5-6 times	7-8 times	9-10 times	11 or more times
Oral sex?	○	○	○	○	○	○	○
Vaginal Intercourse?	○	○	○	○	○	○	○
Anal Intercourse?	○	○	○	○	○	○	○

(Please mark the appropriate column for each row)

25. Within the **last 30 days**, if you are sexually active, how often did you or your partner(s) use a condom during:

	Never did this sexual activity	Have not done this during **last 30 days**	Never	Rarely	Sometimes	Mostly	Always (CONDOM USE)
Oral sex?	○	○	○	○	○	○	○
Vaginal Intercourse?	○	○	○	○	○	○	○
Anal Intercourse?	○	○	○	○	○	○	○

(Please mark the appropriate column for each row)

26. Within the **last 30 days**, how often do you think **the typical student at your school** has used a condom during:

	The typical student at my school does not participate in this sexual activity	Never	Rarely	Sometimes	Mostly	Always (CONDOM USE)
Oral sex?	○	○	○	○	○	○
Vaginal Intercourse?	○	○	○	○	○	○
Anal Intercourse?	○	○	○	○	○	○

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PAGE FIVE

(Please mark the appropriate column for each row)

27. If you are sexually active, did you use a condom the last time you had:

	No	Yes	Never did this sexual activity	Don't know/Don't remember
Oral sex?	○	○	○	○
Vaginal intercourse?	○	○	○	○
Anal intercourse?	○	○	○	○

28. If you have had vaginal intercourse, what method did you or your partner use to prevent pregnancy the last time? (Select all that apply)

- ○ Have not had vaginal intercourse
- ○ Birth control pills
- ○ Depo Provera (shots)
- ○ Norplant (implant)
- ○ Condoms (male or female)
- ○ Diaphragm/Cervical cap/Sponge
- ○ Spermicide (e.g. foam)
- ○ Fertility awareness (calendar, mucous, basal body temperature)
- ○ Withdrawal
- ○ Other method
- ○ Nothing

29. Within the **last school year**, if you are sexually active, have you or your partner(s) used emergency contraception ("morning after pill")?

○ No ○ Yes ○ Don't know ○ Not sexually active

30. Within the **last school year**, have you **unintentionally** become pregnant or gotten someone else pregnant?

- ○ Have not had vaginal intercourse within the last school year.
- ○ No
- ○ Yes
- ○ Don't know

31. Have you ever been tested for HIV infection?

○ No ○ Yes ○ Don't know

32. Which of the following best describes you?

○ Heterosexual ○ Bisexual ○ Unsure
○ Gay/Lesbian ○ Transgendered

33. If you have a credit card(s) how much total credit card debt did you carry last month? That is, what was the total unpaid balance on all of your credit cards (that **you** are responsible for paying)?

- ○ None, I don't have any credit cards/I'm not responsible for paying
- ○ None, I pay the full amount each month
- ○ $1 - $99
- ○ $100 - $249
- ○ $250 - $499
- ○ $500 - $999
- ○ $1,000 - $1,999
- ○ $2,000 - $2,999
- ○ $3,000 - $3,999
- ○ $4,000 - $4,999
- ○ $5,000 - $5,999
- ○ $6,000 or more

34. What is your approximate cumulative grade average?

○ A ○ B ○ C ○ D/F ○ N/A

The next 5 questions ask about weight, nutrition, and exercise.

35. How do you describe your weight?

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

36. Are you trying to do any of the following about your weight?

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

37. Within the **last 30 days**, did you do any of the following? (Select all that apply)

- ○ Exercise to lose weight
- ○ Diet to lose weight
- ○ Vomit or take laxatives to lose weight
- ○ Take diet pills to lose weight
- ○ I didn't do any of the above

38. How many servings of fruits and vegetables do you usually have **per day** (1 serving = 1 medium piece of fruit, 1/2 cup chopped, cooked or canned fruits/vegetables, 3/4 cup fruit/vegetable juice, small bowl of salad greens, or 1/2 cup dried fruit)?

- ○ I don't eat fruits and vegetables
- ○ 1-2
- ○ 3-4
- ○ 5 or more

(Please mark the appropriate column for each row)

39. On how many of the **past 7 days** did you:

	0 days	1 day	2 days	3 days	4 days	5 days	6 days	7 days
Participate in vigorous exercise for at least 20 minutes or moderate exercise for at least 30 minutes?	○	○	○	○	○	○	○	○
Do exercises to strengthen or tone your muscles, such as push-ups, sit-ups, or weight lifting?	○	○	○	○	○	○	○	○
Get enough sleep so that you felt rested when you woke up in the morning?	○	○	○	○	○	○	○	○

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The next 4 questions ask about mental and physical health.

(Please mark the appropriate column for each row)

40. Within the **last school year** how many times have you:

	Never	1-2 times	3-4 times	5-6 times	7-8 times	9-10 times	11 or more times
Felt things were hopeless	○	○	○	○	○	○	○
Felt overwhelmed by all you had to do	○	○	○	○	○	○	○
Felt exhausted (not from physical activity)	○	○	○	○	○	○	○
Felt very sad	○	○	○	○	○	○	○
Felt so depressed that it was difficult to function	○	○	○	○	○	○	○
Seriously considered attempting suicide	○	○	○	○	○	○	○
Attempted suicide	○	○	○	○	○	○	○

41. Have you ever been diagnosed with depression?

○ Yes ○ No

(If you responded "no," please go to question 42)

	Yes	No
If Yes: Have you been diagnosed with depression within the last school year?	○	○
Are you currently in therapy for depression?	○	○
Are you currently taking medication for depression?	○	○

(Please mark the appropriate column for each row)

42. Have you:

	Yes	No	Don't Know
Been vaccinated against hepatitis B?	○	○	○
Been vaccinated against meningococcal disease (meningococcal meningitis)?	○	○	○
Been vaccinated against varicella (chicken pox)?	○	○	○
Been vaccinated with measles, mumps, rubella (2 shots)?	○	○	○
Been vaccinated against influenza (the flu) in the last year?	○	○	○
Had a dental exam and cleaning in the last year?	○	○	○
(Males) Performed testicular self exam in the last month?	○	○	○
(Females) Performed breast self exam in the last month?	○	○	○
(Females) Had a routine gynecological exam in the last year?	○	○	○
Had your blood pressure checked in the last 2 years?	○	○	○
Had your cholesterol checked in the last 5 years?	○	○	○
Used sunscreen daily?	○	○	○

43. (Please make two marks in the appropriate columns for each row)

	Have you **ever** been diagnosed with any of the following? Yes	Have you **ever** been diagnosed with any of the following? No	**Within the last school year,** have you had any of the following? Yes	**Within the last school year,** have you had any of the following? No
Allergy problems	○	○	○	○
Anorexia	○	○	○	○
Anxiety Disorder	○	○	○	○
Asthma	○	○	○	○
Bulimia	○	○	○	○
Chronic Fatigue Syndrome	○	○	○	○
Depression	○	○	○	○
Diabetes	○	○	○	○
Endometriosis	○	○	○	○
Genital herpes	○	○	○	○
Genital warts/HPV	○	○	○	○
Hepatitis B or C	○	○	○	○
High blood pressure	○	○	○	○
High cholesterol	○	○	○	○
HIV infection	○	○	○	○
Repetitive stress injury (e.g. carpal tunnel syndrome)	○	○	○	○
Seasonal Affective Disorder	○	○	○	○
Substance abuse problem	○	○	○	○
Back pain	○	○	○	○
Broken bone/fracture	○	○	○	○
Bronchitis	○	○	○	○
Chlamydia	○	○	○	○
Ear infection	○	○	○	○
Gonorrhea	○	○	○	○
Mononucleosis	○	○	○	○
Pelvic Inflammatory Disease	○	○	○	○
Sinus infection	○	○	○	○
Strep throat	○	○	○	○
Tuberculosis	○	○	○	○

3/8" spine perf

The next question asks about impediments to academic performance.

44. Within the **last school year**, have any of the following affected your academic performance? (Please select the most serious outcome for each item below)

	Received an incomplete or dropped the course	Received a lower grade in the course	Received a lower grade on an exam or important project	I have experienced this issue but my academics have not been affected	This did not happen to me/not applicable
Alcohol use	○	○	○	○	○
Allergies	○	○	○	○	○
Assault (physical)	○	○	○	○	○
Assault (sexual)	○	○	○	○	○
Attention Deficit Disorder	○	○	○	○	○
Cold/Flu/Sore throat	○	○	○	○	○
Concern for a troubled friend or family member	○	○	○	○	○
Chronic illness (diabetes, asthma, etc.)	○	○	○	○	○
Chronic pain	○	○	○	○	○
Death of a friend or family member	○	○	○	○	○
Depression/Anxiety Disorder/ Seasonal Affective Disorder	○	○	○	○	○
Drug use	○	○	○	○	○
Eating disorder/problem	○	○	○	○	○
HIV infection	○	○	○	○	○
Injury	○	○	○	○	○
Internet use/computer games	○	○	○	○	○
Learning disability	○	○	○	○	○
Mononucleosis	○	○	○	○	○
Pregnancy (yours or your partner's)	○	○	○	○	○
Relationship difficulty	○	○	○	○	○
Sexually transmitted disease	○	○	○	○	○
Sinus infection/ear infection/bronchitis/strep throat	○	○	○	○	○
Sleep difficulties	○	○	○	○	○
Stress	○	○	○	○	○
Other _____	○	○	○	○	○

The last questions ask about demographic characteristics.

45. How old are you? → Years

46. What is your sex?
- ○ Female
- ○ Male

47. What is your height in feet and inches? → Ft. / Inch (HEIGHT)

48. What is your weight in pounds? → Pounds (WEIGHT)

49. Year in school:
- ○ 1st year undergraduate
- ○ 2nd year undergraduate
- ○ 3rd year undergraduate
- ○ 4th year undergraduate
- ○ 5th year or more undergraduate
- ○ Graduate or professional
- ○ Adult special
- ○ Other

50. Are you a full-time student?
- ○ Yes ○ No

51. How do you usually describe yourself? (Mark all that apply)
- ○ White - not Hispanic (includes Middle Eastern)
- ○ Black - not Hispanic
- ○ Hispanic or Latino
- ○ Asian or Pacific Islander
- ○ American Indian or Alaskan Native
- ○ Other

52. Are you an international student? ○ Yes ○ No

53. What is your current relationship status?
- ○ Single
- ○ Married/domestic partner
- ○ Engaged or committed dating relationship
- ○ Separated
- ○ Divorced
- ○ Widowed

54. Where do you currently live?
- ○ Campus residence hall
- ○ Fraternity or sorority house
- ○ Other university/college housing
- ○ Off-campus housing
- ○ Parent/guardian's home
- ○ Other

55. Are you a member of a social fraternity or sorority? (National Interfraternity Conference, National Panhellenic Conference, or National Pan-Hellenic Council)
- ○ Yes ○ No

56. How many hours a week do you **work for pay**?
- ○ 0 hours
- ○ 1-9 hours
- ○ 10-19 hours
- ○ 20-29 hours
- ○ 30-39 hours
- ○ 40 hours
- ○ more than 40 hours

57. How many hours a week do you **volunteer**?
- ○ 0 hours
- ○ 1-9 hours
- ○ 10-19 hours
- ○ 20-29 hours
- ○ 30-39 hours
- ○ 40 hours
- ○ more than 40 hours

58. Do you have **any kind** of health insurance (including prepaid plans such as HMOs - health maintenance organizations)?
- ○ Yes ○ No ○ Not sure

THANK YOU FOR COMPLETING THIS SURVEY

SERIAL #

PLEASE DO NOT WRITE IN THIS AREA

Appendix C

Colorado State University Human Subjects Institutional Review Board Approval

Colorado State University

Research Integrity & Compliance Review Office
Office of Vice President for Research
Fort Collins, CO 80523-2011
(970) 491-1553
FAX: (970) 491-2293

Notice of Approval for Human Research

Principal Investigator: Cathy Kennedy, HES, 1582

Title: Administration of the National College Health Association's College Health Assessment

Protocol #: 03-218H **Funding Source:** N/A

Number approved: **The remaining 1,133 participants; this includes 1,000 participants for last year and 1,000 participants for this approval period.**

Committee Action: **Approval Date:** July 23, 2008 **Expires:** July 22, 2009

IRB Administrator: Janell Barker

Consent Process:
Because of the nature of this research, it will not be necessary to obtain a signed consent form. However, all subjects must receive a copy of the approved cover letter printed on department letterhead. No changes may be made to this document without first obtaining approval from the committee. The requirement of documentation of a consent form is waived under § _ _.117(c)(2). Parental permission for minors is waived under 116(d).

Investigator Responsibilities:

- It is the PI's responsibility to obtain consent from all subjects.
- It is the responsibility of the PI to immediately inform the Committee of any serious complications, unexpected risks, or injuries resulting from this research.
- It is also the PI's responsibility to notify the Committee of any changes in experimental design, participant population, consent procedures or documents. This can be done with a memo describing the changes and submitting any altered documents.
- Students serving as Co-Principal Investigators must obtain PI approval for any changes prior to submitting the proposed changes to the IRB for review and approval.
- The PI is ultimately responsible for the conduct of the project.
- A status report of this project will be required within a 12-month period from the date of review. Renewal is the PI's responsibility, but as a courtesy, a reminder will be sent approximately two months before the protocol expires. The PI will be asked to report on the numbers of subjects who have participated this year and project-to-date, problems encountered, and provide a verifying copy of the consent form or cover letter used. The necessary continuation form (H-101) is available from the RICRO web page http://ricro.research.colostate.edu.
- Upon completion of the project, an H-101 should be submitted as a close-out report.
- If approval did not accompany a proposal when it was submitted to a sponsor, it is the PI's responsibility to provide the sponsor with the approval notice. This approval is issued under Colorado State University's OHRP Federal Wide Assurance 00000647.
- **Should the protocol not be renewed before expiration, all activities must cease until the protocol has been re-reviewed.**

Please direct any questions about the Committee's action on this project to me for routing to the Committee. Additional information is available from the RICRO web site at http://ricro.research.colostate.edu.

Attachment Date of Correspondence: 9/3/2008

September 15, 2008

Dear Participant,

The Health Promotion Program at Colorado State University is conducting research to examine various aspects of your health. If you volunteer to participate in this study you will be asked to complete the *American College Health Assessment* during class. The anonymous questionnaire will take approximately 20 minutes to complete. Your decision whether or not to participate in this study will have no impact on your grade in this class. There are a few demographic questions included along with questions that you may find sensitive in nature, e.g., sexual activity, drug and alcohol use. You may skip any question you are not comfortable in answering. If you should feel distressed after completing (or attempting to complete) this assessment, please contact the University Counseling Center at 491-6052, and they will set up an appointment for you to speak with someone.

Although there are no known risks to participating in this research study, the benefits to be gained are that campus health professionals will be provided valuable information to better promote health services to all CSU students.

We would like to thank you for your consideration for involvement in this study and would welcome a phone call if you have any questions. Your consent to participate will be assumed by the completion of the questionnaire.

If the investigator of this study is the instructor of your class, the assessment will be administered by the co-investigator to assure your confidentiality in participation. Questions about participants' rights may be directed to Janell Barker at (970) 491-1655.

Sincerely,

Cathy Kennedy, Ph.D.
Director of Health Promotion
Department of Health and Exercise Science
(970) 491-1501

Deb Morris, B.S.N., M.A.
Director of Health Promotion
Hartshorn Health Center
(970) 491-1723

Script

Good morning/afternoon,

I am _____?_____ from the Department of Health and Exercise Science or Hartshorn Health Center. The Health Promotion Program at CSU is conducting research to examine various aspects of your health. If you volunteer to participate in this study you will be asked to complete the *American College Health Assessment* during class. The anonymous questionnaire will take approximately 20 minutes to complete. Your completed questionnaire will then be turned into me. Your decision whether or not to participate in this study will have no impact on your grade in this class. There are a few demographic questions included along with questions that you may find sensitive in nature, e.g., sexual activity, drug and alcohol use. You may skip any question you are not comfortable in answering. If you should feel distressed after completing (or attempting to complete) this assessment, please contact the University Counseling Center at 491-6052, and they will set up an appointment for you to speak with someone.

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Thank you for your time.

Appendix D

September 15, 2009

Dear Participant,

The Health Promotion Program at Colorado State University is conducting research to examine various aspects of your health. If you volunteer to participate in this study you will be asked to complete the *American College Health Assessment* during class. The anonymous questionnaire will take approximately 20 minutes to complete. Your decision whether or not to participate in this study will have no impact on your grade in this class. There are a few demographic questions included along with questions that you may find sensitive in nature, e.g., sexual activity, drug and alcohol use. You may skip any question you are not comfortable in answering. If you should feel distressed after completing (or attempting to complete) this assessment, please contact the University Counseling Center at 491-6052, and they will set up an appointment for you to speak with someone.

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If the investigator of this study is the instructor of your class, the assessment will be administered by the co-investigator to assure your confidentiality in participation.

If you have any questions, please contact Cathy Kennedy at (970) 491-1501 or Deb Morris at (970) 491-1723. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator, at 970-491-1655.

Sincerely,

Cathy Kennedy, Ph.D.
Director of Health Promotion
Department of Health and Exercise Science
(970) 491-1501

Deb Morris, B.S.N., M.A.
Director of Health Promotion
Hartshorn Health Center
(970) 491-1723