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Promoting health literacy through the school nutrition environment

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Promoting health literacy through the school nutrition environment

by

Amber Ann Appleton

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE

Major: Diet & Exercise

Program of Study Committee:
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Iowa State University

Ames, Iowa

2010

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ABSTRACT

Background: Health literacy and food perceptions influence health knowledge, behaviors, and subsequent health status. Improving health literacy and modifying food perceptions through social marketing nutrition messaging may prove beneficial, particularly in youth. Presently, schools are sending youth mixed messages. Healthful eating behaviors are taught and promoted in the classroom, but not modeled in the school nutrition environment; items sold in competitive food venues (i.e. vending, ala carte, school stores) are typically energy dense, nutrient poor. Thus, the purpose of this study was to improve student health literacy and food perceptions through social marketing nutrition messaging and improving the quality and composition of items offered in competitive food venues.

Methods: Students completed health literacy (N=255) and food perception assessments (N=253) in fall 2008 and spring 2010. The Newest Vital Sign assessment includes questions about a Nutrition Facts Panel and categorizes individuals into three health literacy categories. The food perceptions assessment consisted of an unstructured line (0-15 cm) gathering students' perceptions on six items typically sold in vending machines, ala carte, and school stores relative to six food attributes (expensive, tastes good, healthy, boosts energy, improves mental performance and improves physical performance). All competitive food venues available to students were inventoried at baseline and endpoint. Intervention schools (n=3) were provided social marketing nutrition messages over the course of the study in addition to training and technical assistance. They were also required to make three changes relative to competitive foods. Each school's Local Wellness Policy was gathered and scored at baseline and endpoint relative to competitive foods guidelines.

Results: Few changes were seen from the intervention, indicating health literacy, food perceptions and competitive foods are difficult to change. Taste was identified as a potent motivator in student food selection, while nutrition was a low motivator. Local Wellness Policies did not change over the course of the study and did not reveal any significant relationships with the data. Lastly, gender appears to play an important role in food perceptions.

Conclusions: Foodservice directors should focus on taste in marketing ‘healthy’ items to adolescents and less on nutrition. Free taste-testing of ‘healthy’ items in the cafeteria will likely influence students’ perception and is encouraged. A focus for competitive food venues should be incorporating novel, ‘healthy’ options rather than solely focusing on removing ‘unhealthy’ items. School nutrition professionals should also consider gender differences to create more effective gender-specific marketing of nutrition programs. Finally, school foodservice directors have an important role to ensure their school’s nutrition guidelines are rigorous and adequately implemented.

CHAPTER I: INTRODUCTION

Background

Childhood obesity is a growing issue of concern in the United States; over one-third of youth (2-19 years) are overweight (BMI \geq 85th percentile) and an alarming 17% are obese (BMI \geq 95th percentile) (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). While many factors contribute to obesity, health literacy (HL) and food perceptions are proposed as two influential factors.

HL is the degree to which individuals have “the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions” (United States Department of Health and Human Services [HHS], 2008b). Food perceptions can be thought of as views or beliefs about food determined by past experiences, which influence food choices and consumption patterns (Solms & Hall, 1981). Efforts to improve both HL and food perceptions may positively impact adolescent food choices, behaviors, and ultimately health and weight status.

Schools provide an ideal setting to influence student knowledge and behavior with roughly 95% of U.S. children (5-17 years) enrolled in, and spending over half of their waking hours at school (Centers for Disease Control and Prevention [CDC], 2008b; Koplan, Liverman, & Kraak, 2005). However, schools are presently sending students mixed messages. Healthful eating behaviors are taught and promoted in the classroom, but are not modeled in the school nutrition environment as items sold in competitive food venues (i.e. vending, ala carte, school stores) are typically energy dense, nutrient poor (Center for Science in the Public Interest, 2004; A. Gordon & Fox, 2007; United States Government Accountability Office [GAO], 2005). Schools provide the opportunity to improve student HL and modify food perceptions by promoting health inside and outside the classroom.

The combined effects of the school nutrition environment, HL, and food perceptions influence student consumption. Over time, these factors impact weight status and ultimately health.

Goals and Objectives

Goal 1: Examine the prevalence and options of competitive foods and venues in six Iowa high schools over a one and a half year span.

Objective 1: Measure availability of total competitive food items in each school at baseline and endpoint.

Objective 2: Evaluate change in the competitive food categories and percentages of items meeting and not meeting nutrition standards.

Objective 3: Compare Local Wellness Policy scores for school nutrition policies for all schools at baseline and endpoint relative to competitive food availability and composition.

Goal 2: Examine student HL in six high schools over one and a half years.

Objective 1: Compare change in HL scores from baseline to endpoint in all schools.

Objective 2: Compare change in HL scores from baseline to endpoint in control vs. intervention schools.

Goal 3: Examine student food perceptions in six high schools over one and a half years.

Objective 1: Conduct and analyze student focus group discussions to identify trends relative to food perceptions in all schools at baseline.

Objective 2: Compare change in food perceptions in all schools from baseline to endpoint.

Objective 3: Compare change in student food perceptions from baseline to endpoint in control vs. intervention schools.

Thesis Organization

This research based thesis will begin with a review of literature relative to overweight and obesity, the school nutrition environment, competitive foods, Local Wellness Policies (LWP), health literacy, and food perceptions. Next, the methods for the project are described in detail followed by two complete manuscripts. Conclusions, appendices, references, and acknowledgements will bring the thesis to a close.

CHAPTER II: REVIEW OF LITERATURE

Introduction

The United States' (U.S.) population has been consumed by overweight and obesity impacting individuals of all ages, including youth. At school, health behaviors contributing to overweight and obesity are influenced not only by academic curriculum in the classroom, but also the school nutrition environment. Availability of foods and beverages to students is an important component of the school nutrition environment. Foods are offered to students through the National School Lunch Program (NSLP) as well as competitive food venues (i.e. a la carte [ALC], vending machines, and school stores). Generally, food options provided through competitive food venues are of low nutrient density, high calorie and widely accessible. Providing a positive school health environment for students is important to foster learning and healthy lifestyle behaviors, which continue through adulthood. Intervention efforts to improve the school environment, particularly the nutrition environment, would benefit student health and help curb the overweight and obesity epidemic overtaking the nation's youth.

Classifying Overweight and Obese Youth

Obese youth have been defined as those with excess body fat whereas overweight youth are those with excess total body weight (Flegal, Tabak, & Ogden, 2006). Body mass index ($BMI = \text{weight [kg]} / \text{height [m]}^2$) is the current recommended standard for routinely screening children and adolescents for overweight ($\geq 85^{\text{th}}$, but $< 95^{\text{th}}$ percentile) and obesity ($\geq 95^{\text{th}}$ percentile) (Centers for Disease Control and Prevention [CDC], 2009b). Overweight and obesity terms used throughout the remainder of this review will be used in reference to these percentiles. These criteria are age and gender specific and appropriate for children and adolescents 2-20 years of age (CDC, 2009c). The CDC has utilized these recommendations for the development of BMI-for-age growth charts used to assess youth body composition.

Prevalence of Overweight and Obese Youth

Obesity is the result of excessive calorie consumption and/or low levels of physical activity (United States Department of Health and Human Services [HHS], 2001). From 1963 to 2006, obesity rates increased from approximately 4% to 17% in 6-11 year olds and 5% to 18% in 12-19 year olds (CDC, 2008c; Ogden, Carroll, & Flegal, 2008). In 2006, roughly 33% of 6-11 year olds and 34% of 12-19 year olds were overweight (BMI \geq 85th percentile), an alarming 11% and 13% had a BMI \geq 97th percentile (Ogden, et al., 2010; Ogden, et al., 2008).

National overweight and obesity trends are a concern at the state level as well. In 2007, approximately 14% of Iowa's 9th-12th graders were classified as overweight and 11% as obese (CDC, 2008e). These percentages were slightly lower than national rates of 16% overweight and 13% obese in the corresponding year; however, it is important to note that these percentages were derived from self-reported Youth Risk Behavior Surveillance System (YRBSS) data. Data from the 2008 Pediatric Nutrition Surveillance System (PedNSS) revealed Iowa's 2-5 year olds participating in the Women Infant and Children (WIC) supplemental nutrition program had higher rates of overweight and similar rates of obesity compared to the nation, ~18% vs. ~16% overweight and ~15% vs. ~15% obese, respectively (Iowa Department of Public Health [IDPH], 2008).

A national objective of Healthy People 2010 is to reduce the prevalence of obese youth 6-19 years of age from 11% (baseline established from the 1988-1994 National Health and Nutrition Examination Survey [NHANES], CDC, and the National Survey of Children's Health data) to a target of 5% (HHS, 2000b). A goal of Healthy Iowans 2010 is to slow weight gain and/or maintain weight status in children and adolescents less than 18 years of age (IDPH, 2000). Unfortunately, these national and state level goals will not be reached; research suggests little sign of decreasing overweight and obesity trends in any U.S. age group (Ogden et al., 2006).

Consequences of Overweight and Obesity

Overweight or obese individuals with poor diets and low physical activity levels have an increased risk of acquiring chronic diseases such as hypertension, type 2 diabetes, heart

disease, stroke, metabolic syndrome, osteoarthritis, fatty liver disease and some cancers (CDC, 2008d; HHS, 2010b). Many of these life threatening diseases play a role in the majority of disability and death seen in the U.S. (CDC, 2009a; HHS, 2010b). These consequences of excess weight, influencing individuals across the lifespan, have escalated concerns regarding overweight and obese youth. In fact, short immediate and long term effects of obesity in regards to wellness, self-worth, body image and social discrimination have been identified (Must & Strauss, 1999). Obese children and adolescents are more likely to have a lower quality of life than healthy youth, and similar quality of life ratings as youth diagnosed with cancer (Schwimmer, Burwinkle, & Varni, 2003). While childhood obesity has been more closely associated with perceived limitations in psychological health rather than physical health, there are still a number of physical health complications impacting these youth (Friedlander, Larkin, Rosen, Palermo, & Redline, 2003).

Overweight and Obesity Related Disorders

A linear relationship exists between BMI and coronary heart disease (CHD) risk; a high BMI in late adolescence was found to be a predictor of CHD in men before 55 years of age (Falkstedt, Hemmingsson, Rasmussen, & Lundberg, 2007). Similar results were observed in women under 60 years of age studied over a 25 year time period (Li et al., 2006). Results from the Bogalusa (Louisiana) Heart Study suggest approximately 60% of 5-17 year olds already have one or more CHD risk factors (Freedman, Dietz, Srinivasan, & Berenson, 1999).

Harmful physiological and health outcomes can result from childhood overweight and obesity such as: depression, poor body image, insulin resistance, type 2 diabetes, hypertension, sleep apnea, undesirable lipid panel, early puberty, fatty liver disease, and orthopedic problems (HHS, 2009). Obese youth (8-11 years) had a four-fold increased risk for lower physical functioning scores than normal weight youth (Friedlander, et al., 2003). Slipped capital femoral epiphysis (SCFE) is a condition seen in overweight adolescents where the femur is rotated externally under the growth plate, making walking painful or impossible and requiring surgery (Daniels, 2006). In Scotland, between 1981 and 2005, increasing weight corresponded to SCFE. During this time frame the incidence of SCFE

tripled in children and adolescents (6-18 years) while overweight and severely overweight youth (13-15 year olds) doubled and quadrupled, respectively (Murray & Wilson, 2008). Blount disease can also be a consequence of excess weight in youth leading to bowing of the tibia and abnormal gait (Daniels, 2006). Youth experiencing these problems are in need of greater medical attention, contributing to increased healthcare costs.

Cost of Overweight and Obesity

Consequences of inadequate physical activity and poor eating behaviors may replace smoking as the leading cause of avoidable death in the U.S. In 2000, these behaviors contributed to roughly 365,000 deaths and cost the nation approximately \$117 billion (Mokdad, Marks, Stroup, & Gerberding, 2004; United States Department of Agriculture [USDA], 2009b). An additional 15,000 deaths per year was estimated to occur if these behavior trends continued. Health care costs due to overweight and obesity are predicted to double every decade and contribute 16 to 18% of total health care costs (\$1 of every \$6) by 2030 (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). Iowa spent an estimated \$783 million in 2003 on medical costs due to adult obesity (\$261 per capita) (Finkelstein, Fiebelkorn, & Wang, 2004).

Wang and colleagues (2008) forecast that if current trends continue, in less than 40 years (2048) all American adults will be overweight or obese and almost 50% of children and adolescents will be overweight or obese by 2070. The physiological consequences and costs of overweight and obesity are clear, but excess weight also impacts other social aspects of life.

Social Impact

The social stigmatism associated with overweight and obesity can be as severe and damaging to youth as health complications. Obese adolescents tend to be less involved in social networks compared to normal weight adolescents. They are less likely to be identified as a friend by their normal weight peers, are perceived as less popular, and are less likely to have spent time with friends in the last week compared to their normal weight peers (Falkner et al., 2001; Strauss & Pollack, 2003).

Social relationships are also associated with physical activity. Normal weight females (12-21 years) engaging in regular vigorous exercise report most or all of their friends exercising and being involved with a sports team (Saxena, Borzekowski, & Rickert, 2002). Overweight students who spent less time watching television (TV) or playing video games and spent more time participating in school sports and clubs had significantly more friends along with their normal weight counterparts (Figure 1) (Strauss & Pollack, 2003).

Academic Impact

School performance has also been shown to differ between obese and normal weight students. Obese first and third grade students had poorer math and reading skills than never-obese peers (Gable, Britt-Rankin, & Krull, 2008). Obese middle and high school students report being 'held back' more times and considered themselves poorer students compared to their average weight counter parts (Falkner, et al., 2001).

Poor academic performance of obese students may be related to poor diet quality commonly associated with obesity. The risk of poor school performance in elementary students increases as unhealthy eating patterns increases (Fu, Cheng, Tu, & Pan, 2007). Those with either low intake of nutrient dense foods and dairy products or high intakes of sweets and fried foods were more likely to underperform in school. Florence and colleagues (2008) report similar results; fifth grade students with lower overall diet quality had an increased likelihood of performing poorly on assessments compared to students with higher diet quality.

Quality of Life Impact

Obese children and adolescents have reported lower health-related quality of life scores than their non-obese peers encompassing areas of physical, psychosocial, emotional, social, and school functioning (Schwimmer, et al., 2003) Parents of these obese youth also reported lower quality of life scores for their children than parents of non-obese youth. Emotional consequence of childhood obesity may have lasting effects; overweight kindergarten and first graders reported more feelings of sadness, loneliness and anxiety in third grade than children who were never overweight (Gable, et al., 2008).

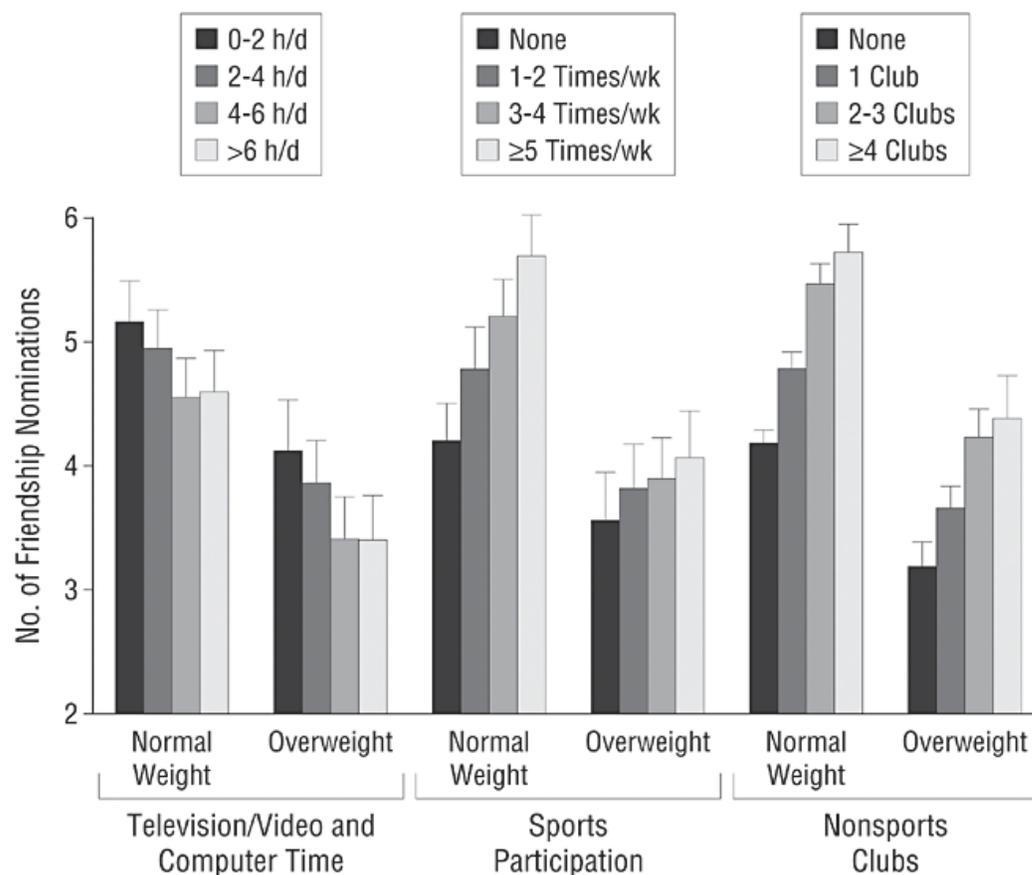


Figure 1. Impact of television, video, and computer time, sports participation, and number of non-sports clubs on the number of friendship nominations received by overweight and normal-weight adolescents ($p < .001$). In all cases, both main effects were independently correlated with the number of friendship nominations (Strauss & Pollack, 2003).

Adult Health Impact

Ultimately, overweight youth have an increased likelihood of becoming overweight adults. Research evaluating long-term weight status of youth found 55-77% of overweight or obese children (6-17 years) became overweight or obese adults (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Similar results suggest the majority of overweight and obese male and female youth (16/17 years) have a high probability of becoming overweight (62% male, 73% female) and obese (80% male, 92% female) at 37/38 years of age (Wang, Chyen, Lee, & Lowry, 2008). Therefore, obesity interventions targeted at youth would be beneficial since adult body weight is rooted in adolescence (Kvaavik, Tell, & Klepp, 2003). Such

interventions would not only improve the quality of life of America's youth, but also decrease the prevalence of adult chronic diseases. If steps are not taken to diminish the prevalence of childhood overweight and obesity, today's children are likely to live shorter, less healthy lives than their parents (Olshansky et al., 2005).

Etiologic Factors Related to Overweight and Obesity

Excess weight results from a chronic consumption of excess calories (foods and beverages) and/or lack of physical activity, which leads to energy imbalance. Over time, the accumulation of even small amounts of energy imbalance can result in overweight and obesity (Ebbeling, Pawlak, & Ludwig, 2002).

The American diet increased daily calorie consumption approximately 12% (300 calories) between 1985 and 2000 (Putnam, Allshouse, & Kantor, 2002). Consumption increased in almost all food groups from the 1970s to 2000; total flour and cereal products by 48%, fats and oils by 38%, added sugars by 20%, total meat, poultry and fish by 10%, fruit by 17%, vegetables by 27%, and cheese by 61% (Putnam, et al., 2002). Conversely, a decrease of 24% in milk consumption was noted.

While calorie consumption increased during this time period, physical activity levels decreased. Results from the Minnesota Heart Survey reported a decrease in the proportion of the adult population regularly participating in physical activity between 1990-92 and 1995-97 (Arnett et al., 2002). Although increases in physical activity were observed in the 1980's, the reverse occurred in the 1990's; activity levels declined from the early to late 90's.

It is impossible to pinpoint a single factor responsible for the obesity epidemic. A multitude of social, behavioral, cultural, environmental, physiological, and genetic factors have contributed to the development of obesity (HHS, 2000a). Collectively, these factors constitute an 'obesogenic environment' that promotes obesity through "influences of surroundings, opportunities, or conditions of life on individuals or populations" (Swinburn, Egger, & Raza, 1999). The 'obesogenic environment' is an outgrowth of the Ecological Systems Theory. This theory recognizes the relationship between the individual and their environment from interactions of intercultural, community, organizational, and interpersonal or individual aspects (Bronfenbrenner, 1979). While individuals are responsible for

instituting and maintaining lifestyle changes, individual behavior is determined to a large extent by the social and physical environment. An adaptation of this theory is the ecological model of predictors of childhood overweight, which has been modified to guide further discussion (Figure 2).

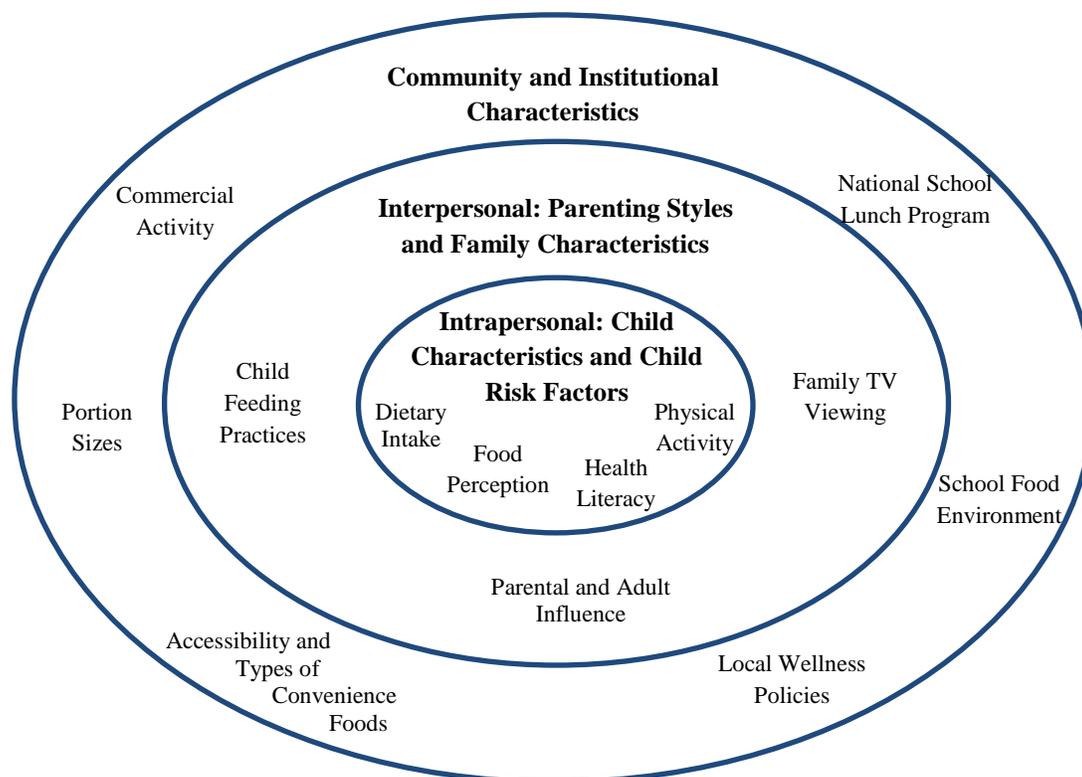


Figure 2. Ecological model of predictors of childhood overweight with factors contributing to childhood weight status modified from (Davison & Birch, 2001; Fitzgerald & Spaccarotella, 2009).

Community and Institutional Characteristics

Commercial Activity

Youth prove to be an important target population for advertising and have the greatest marketing potential (McNeal, 1999). Youth have been shown to acquire brand preferences at an early age and companies are recognizing the potential of youth to develop into consumers of all commodities. A longitudinal study of children revealed the base for food preferences can be established as early as 2-3 years and changed very little through age 8 (Skinner,

Carruth, Wendy, & Ziegler, 2002). Teens' brand loyalty is strongest for health and beauty aids. Food items identified by teens as eliciting the greatest brand loyalty were soft drinks and fast food (Zollo, 1999).

Evidence suggests that roughly 60% of established retail companies have made strides to target youth as a market, up from approximately 30% in the 1980s. The Center for Science in the Public Interest (CSPI) reports the most common foods and beverages marketed on TV to children were yogurt, fruit flavored snacks, frozen treats, juice drinks, 100% juice, and sports drinks (Batada & Wootan, 2009). Companies marketing these foods pledged that they met the company's nutrition standards for TV marketing to children. While these 'approved' products met each manufacturing company's own standards, 59% of did not meet a single third-party nutrition standard (Batada & Wootan, 2009). Interestingly, none of these pledge-approved products were fruits or vegetables. In addition, 58% of approved foods and 64% of approved beverages did not meet nutrition standards adopted from the Dietary Guidelines for Americans recommendations.

More than a 500% increase in purchasing ability in youth (ages 4-12) has occurred in the past 20 years. An estimated \$6.1 billion spent in 1990 increased to \$35.6 billion in 2000 (McNeal, 1999). In the same year, U.S. adolescents (12-19 years) spent roughly \$170 million or about \$100 per week (Teen Research Unlimited [TRU], 2002). More recently, national teen spending hovered at over \$90 per week or \$169 billion in 2004 (TRU, 2004). Adolescents also influence food purchasing and consumption in the home with over half of New York City high school students (60%) reporting grocery shopping for themselves or family and a majority (83%) cooking at home (Bissonnette & Contento, 2001).

Marketing to youth has greatly expanded the last twenty years and has become common place in schools. Direct advertising to youth within schools has been seen in various venues: billboards, buses, school equipment such as scoreboards, assignment book covers, posters, yearbooks, school newspapers, Channel One, free samples, and internet sites (United States Government Accountability Office [GAO], 2004). Some indirect marketing has also occurred in the form of contests, incentives, grants, or gifts. Marketing research in the form of surveys, polls, and tracking of internet behavior has also been reported in schools. Advertising avenues have increased relative to dollars spent on marketing. Funds

for marketing to youth have increased 150-fold since 1983 when \$100 million was spent on television advertising to roughly \$15 billion spent today on a variety of methods targeting youth (Schor, 2004). This marketing can and does influence students' food choices.

Accessibility and Types of Convenience Foods

Students have access to foods and beverages in a variety of venues including restaurants and convenience stores. Fast food restaurants and convenience stores have strategically places themselves in close proximity to schools; roughly one-third of U.S. schools were found to be within half a mile of a fast food restaurant or convenience store (Zenk & Powell, 2008). Also, low-income neighborhoods have a greater density of convenience stores, which likely influences youth purchasing (Powell, Auld, Chaloupka, O'Malley, & Johnston, 2007). Students (4th- 6th grade) often purchased foods from convenience stores in close proximity to their schools even though $\geq 50\%$ of students were eligible for free or reduced-price meals (Borradaile et al., 2009). The most frequently purchased items were chips, candy, and sugar sweetened beverages. Approximately \$1.07 was spent per purchase providing roughly 356 calories. Interestingly, over half of these students reported shopping at a convenience store once daily (5 times/wk) and 29% reported shopping twice daily.

Associations between convenience store and supermarket prevalence with body weight and obesity have been examined. For every convenience store added per 10,000 capita, an increase in BMI of 0.03 units and an increase in the prevalence of obesity by 0.2 percentage points was estimated (Powell, et al., 2007). Conversely, for every chain supermarket added per 10,000 capita, a reduction in BMI of 0.11 units and a decrease in the prevalence of obesity by 0.6 percentage points would be expected in a national sample of 8th-10th graders.

The availability and accessibility of convenience foods near schools may contradict school food policies, especially in schools where students can leave campus during the school day such as the lunch hour (open-campus) (Sturm, 2008). Sturm stated, "Surrounding food outlets could also lower the effectiveness of health education in the classroom by setting a highly visible example that counters educational messages."

Portion Sizes

Portion sizes are another environmental factor affecting energy intake and may play more of an influential role as children grow older. When three and a half year old preschool children were offered small, medium and large amounts of food they ate roughly the same amount regardless of the amount provided (Rolls, Engell, & Birch, 2000). Conversely, five year old children ate progressively larger amounts of food when offered larger portion sizes.

In 2003, fifth graders from Nova Scotia reported eating more than the recommended portion size for French fries (64%), meat (78%), and potato chips (78%) (Colapinto, Fitzgerald, Taper, & Veugelers, 2007). Children reporting larger French fry portions consumed approximately 243 more calories than those who ate less than or equal to recommended amounts. Approximately half of these children also reported eating portion sizes of vegetables less than or equal to recommended sizes.

Adults also consume more calories when given larger portion sizes; those served a large lunch (1,528 calories) ate 332 more calories than those served a small lunch (767 calories), which resulted in 278 more calories consumed over the course of the day (Jeffery et al., 2007). In another study, adults served a self-refilling bowl of soup ate 73% more soup, but did not report greater satiation ratings or perceived consumption than those eating from the normal bowl (Wansink, Painter, & North, 2005).

Food and beverage portion sizes began to increase in the 1970s and many foods available today greatly exceed the USDA and Food and Drug Administration (FDA) portion size recommendations (Young & Nestle, 2002). Previous research has shown the actual portion size of a standard cookie currently available exceeds the USDA recommended size by an astonishing 700%, cooked pasta exceeds by 480%, muffins by 333%, and steak by 224%. These increasing portion sizes have also been a concern in schools.

Portion size changes within the school nutrition environment (i.e. vending machines, snack bars, ALC) have been shown to impact student caloric consumption (Cullen & Thompson, 2005). In middle schools, an average of 111 calories per student per day was purchased through snack bars, but when portion sizes were reduced, calories purchased decreased to 63 per student per day. These results suggest reducing portion sizes could be an effective intervention to combat overweight and obesity. Research by Hill and colleagues

(2003) suggests a reduction of 100 calories per day from calorie restriction and/or increased physical activity could prevent weight gain.

In contrast, research by Jahns and colleagues (2001) report that from 1977 to 1996 average snack size and calories per snack remained fairly stable. However, an increase in the number of snacks consumed per day increased total energy intake in 2-5 year olds from 19% to 24%, 6-11 year olds from 18% to 24%, and 12-18 year olds from 21% to 25%.

Ultimately, portion sizes and/or snack consumption frequency has contributed to excess calorie consumption. These results suggest nutrition recommendations with calorie and portion size restrictions are needed for competitive foods available in schools and should be incorporated into school policy.

Local Wellness Policies

A federal requirement through the Child Nutrition and WIC Reauthorization Act mandated that all schools participating in the NSLP develop a local wellness policy (LWP). The mandate was effective July 1, 2006 for implementation in the 2006-07 academic year (Child Nutrition and WIC Reauthorization Act of 2004, 2004). The LWP encompasses goals for nutrition education, physical activity and other school-based activities, *goals for nutrition guidelines for all foods available at the school during the school day*, assurance that guidelines for reimbursable school meals would be not less restrictive than USDA regulations, and a plan for measuring the implementation of the LWP. Each school district was required to form a committee to develop the LWP which included parents, students, school board members, school administrators, members of the public, and the school food authority. The current research focuses on the LWP aspect of creating *goals for nutrition guidelines for all foods available at the school during the school day*.

Local Wellness Policies facilitate the opportunity to regulate policy at the local level to provide and maintain healthy school environments. Schools can implement policies, which establish nutrition standards for competitive foods, influence food and beverage items offered, and regulate school campuses as open (students can leave during lunch and eat at home, convenience stores, or fast food restaurants) or closed (students must eat lunch on campus).

School policies have been shown to influence student food behaviors. Students attending schools with an open-campus policy during lunch were more likely to purchase foods from convenience stores and fast food restaurants than those with closed-campus (Neumark-Sztainer, French, Hannan, Story, & Fulkerson, 2005). The open- or closed-campus policy did not influence frequency of eating from the main lunch line, ALC, or bringing a lunch from home. Also, students purchased less soda from vending machines when they were turned off during the lunch period, and snack purchases decreased when school policies were in place for what could be sold in vending machines (Neumark-Sztainer, et al., 2005).

In 2005, snack food and soda consumption behaviors of 12th grade Los Angeles students were evaluated after a soda (13-14 months duration) and junk food ban (7-8 months duration) at school (Vecchiarelli, Takayanagi, & Neumann, 2006). Students reported the bans impacted their soda (55.5%) and snack (52.6%) consumption at school; whereas, fewer students reported the bans impacting their consumption at home (16.2%, 20.2%, respectively). The majority of those who felt the soda ban had an impact on consumption at school (72%) or at home (56.1%) reported consuming less soda. These students were also more likely to agree with the policy.

While policy has shown to elicit positive behavior changes in schools, implementation of LWPs may be slowed by actual and perceived barriers of school staff. District school foodservice directors reported the implementation and evaluation of the LWP to be more difficult than development of the policy (Longley & Sneed, 2009). Two main perceived barriers for development and implementation of LWPs were identified: 1. competitive foods were needed for fundraising; and 2. time demands of the No Child Left Behind Act were of higher priority than the LWP. Unfortunately, competitive foods sold through fundraising endeavors may be profitable, but tend to be energy dense, nutrient poor (EDNP) options high in fat and added sugars (Kubik, Lytle, Farbaksh, Moe, & Samuelson, 2009).

Many schools have struggled to fully implement the LWP mandate. A study evaluating 256 LWP from 49 U.S. states (excluding Hawaii) from 2006-07 found that 32% of LWPs did not address one or more goal areas required by the federal mandate (Moag-

Stahlberg, Howley, & Luscri, 2008). Almost half (46%) of the LWPs did not have guidelines in place for the type, nutritional value, or hours of availability for foods and beverages accessible to students. A smaller percentage of LWPs (22%) did not have nutrition standards in place for foods and beverages offered in ALC, vending, student stores, and concessions stands. A smaller study of St. Paul/Minneapolis schools revealed high schools had a low agreement rate (15%) for healthful policies and practices regarding fundraising activities (Kubik, et al., 2009). Clubs and sports teams fundraising were shown to be particularly problematic and high schools showed lower agreement rates and healthful policy/practice scores than middle schools. These findings suggest need for improved LWP development and implementation for successful strides to be made in childhood obesity treatment and prevention.

Presently, schools are sending youth mixed messages between what is taught about healthy eating in the classroom and what is provided in the school nutrition environment. Nutrition standards for competitive food venues are needed in schools to promote a school health environment that encourages healthy eating practices and aids in the prevention of childhood obesity.

School Food Environment

Schools provide an ideal setting to influence student health and behavior with roughly 95% of U.S. children (5-17 years) enrolled in school and spending over half of their waking hours at school (CDC, 2008b; Koplan, et al., 2005). The USDA describes a healthy school food environment as providing students with consistent and reliable health information as well as adequate opportunities for students to utilize the information (USDA, n.d.). Healthy school food environments should also encompass a commitment to nutrition and physical activity, provide quality meals and other healthy food options, pleasant eating experiences, adequate nutrition education, and promotion of healthy behaviors (USDA, 2000).

National School Lunch Program

The federally funded NSLP operates in over 101,000 public and non-profit private schools and residential child care institutions to supply nutritious, reduced-price or free

lunches to almost 31 million children per school day (USDA, 2008c). Schools are eligible for federal reimbursement for student meals if the meals contain no more than 30% of calories from fat and meet one third of the Recommended Dietary Allowances (RDAs) for protein, Vitamin A, Vitamin C, iron, calcium, and calories (USDA, 2009a). For the 2009-2010 academic year, each school participating in the NSLP providing free, reduced price, or full price meals to students received \$2.68, \$2.28, and \$0.25 respectively per meal in federal reimbursements (Iowa Department of Education [IDE], 2009). Additionally, schools received \$0.195 per reimbursable meal to purchase commodity foods and Iowa schools receive an extra \$0.04 per reimbursable meal from the state government (IDE, 2009). Maintaining or increasing student participation in the NSLP not only increases cash flow to the school from state and federal reimbursements, but also impacts student health because of the nutrition standards required of these meals.

Previous investigations report students participating in the NSLP eat lunches with higher nutrient density with higher intakes of meat and beans than those not participating (USDA, 2008a). Students participating in the NSLP were twice as likely to consume milk and dairy products at lunch than non-participants (Burghardt, Devaney, & Gordon, 1995). They were also more likely to consume vegetables and fruits, and less likely to consume added sugars, salty snacks and other beverages (not including milk and juice) such as soda and fruit drinks (USDA, 2001a, 2008a). High school students participating in the NSLP were more likely to meet recommended intakes of Vitamin A, C, B₆, iron, thiamin, phosphorus, and folate (Gordon & Fox, 2007). Gleason and Sutor (2003) reported similar results in youth 6-18 years; NSLP participants consumed a higher percentage of food energy, protein, dietary fat, thiamin, riboflavin, Vitamins B₆ and B₁₂, calcium, phosphorus, magnesium, zinc, and lower intakes of added sugars than non-participants.

Defining Competitive Foods

Presently, there are no federal regulations for the sale of competitive foods (foods outside of the school meals programs) in schools except the restriction of a small number of items termed Foods of Minimal Nutritional Value (FMNV) (GAO, 2005). Competitive foods sold in the cafeteria during meal service must contain at least 5% of the Reference Daily

Intakes (RDI) for protein, vitamin A, vitamin C, niacin, riboflavin, thiamine, calcium, or iron per serving (USDA, 2002). FMNV, foods not meeting these criteria, cannot be served in the cafeteria during meal service, but can be served at other times or other locations. They include carbonated beverages, certain candies, water ices, and chewing gum (USDA, 2002). In conjunction with setting standards for competitive foods, LWPs allow for schools to influence classroom treats/rewards and parties.

The USDA describes competitive foods as those sold in areas of service during meal hours, which compete with the NSLP (USDA, 2002). The current project encompasses a broader view of competitive foods and includes those sold outside the areas of service. As such, competitive foods have been defined as all foods regularly sold in the school environment (i.e. vending machines, ALC, snack carts, and school stores) outside of school meals programs (i.e. NSLP, School Breakfast Program, and After School Snack Program). While various food modalities exist inside and outside of the school food environment and influence student consumption behaviors, the current project will focus on venues within the school environment.

Availability of Competitive Foods

During the 2003-04 academic year an evaluation of a stratified random sample from 80,000 public elementary, middle, and high schools nationwide participating in the national school lunch program revealed 90% of schools selling competitive foods; 75% of schools had ALC, 63% had vending, and 25% had a school store (GAO, 2005). The prevalence of venues increased from elementary through high school with 97% of middle schools and 99% of high schools having on or more available competitive food venues. Between 1991-92 and 2004-05, vending machine prevalence nearly doubled in middle schools (42% to 82%) and increased by 21% in high schools (76% to 97%) (Gordon & Fox, 2007).

Foods offered in competitive food venues tend to be EDNP and promote unhealthy food choices. A study performed across 24 states with 251 middle and high schools revealed vending machines provide a high percentage of unhealthy food options and a low percentage of healthy food options (CSPI, 2004). Beverage vending machine slots were comprised of: 36% regular soda, 13% fruit drink (less than 50% real juice), 13% sports drinks, 12% water,

6% diet soda, and 2% low fat or fat free plain or flavored milk. Food vending machines contained: 42% candy, 25% regular chips, 13% cookies/snack/cakes/pastries, 5% low fat chips/pretzels, 2% low-fat cookies/baked goods, and less than 0.5% fruits or vegetables (CSPI, 2004). The items most commonly purchased from competitive food venues were candy, cookies, cakes, and brownies (Gordon & Fox, 2007), which suggests competitive food availability influences consumption. Yet, students continue to purchase disproportionately more unhealthy competitive food items when both nutritious and less nutritious items are available (Snelling, Korba, & Burkey, 2007). In any case, competitive foods do not encourage healthy food consumption practices.

The school budget also appears to influence competitive food availability (Anderson & Butcher, 2005). Financially stressed schools were more likely to sell junk food in competitive food venues, have pouring rights contracts with beverage companies, and allow food and beverage advertising to students in school.

Effect of Competitive Foods on Nutrient Intake

The availability of competitive foods can negatively affect student consumption of healthy foods. When fourth grade students with access only to foods through the NSLP advanced to fifth grade and gained access to a competitive foods snack bar in conjunction with the NSLP, intakes of fruit (33%), regular vegetables (42%), and milk (35%) decreased (Cullen & Zakeri, 2004). In addition, intakes of high fat vegetables (68%) and sweetened beverages (62%) increased.

Sixth grade students consuming meals from the NSLP as well as competitive foods consumed 634 calories at lunch (400 calories from NSLP and 234 calories from competitive foods) while students who ate lunch from only the NSLP consumed 530 calories (Templeton, Marlette, & Panemangalore, 2005). Additionally, students consuming competitive foods had more plate waste, consumed more total fat and saturated fat, and less protein than those who ate only the school lunch. Gordon and Fox (2007) compared calorie intake from competitive foods of NSLP participants and non-participants and found that NSLP participants consumed an average of 218 calories from competitive foods (159 calories from energy dense, nutrient

poor choices) while non-participants consumed 411 calories from competitive foods (210 calories from EDNP choices).

Similar results have been reported among seventh grade students; students without access to ALC foods consumed, on average, one additional serving of fruits and veggies daily (Kubik, Lytle, Hannan, Perry, & Story, 2003). The average percent of daily calories from total fat were slightly higher in students with ALC access and exceeded USDA dietary recommendations, while students without ALC access had total fat intakes that fell within recommendations. Finally, for every food vending machine available to students, average fruit intake decreased by 11%.

Competitive Foods Revenue

Unfortunately, health and dietary implications of competitive foods in schools is just part of the picture. Revenues generated from competitive food venues can play a major role in a school budget creating a challenge to provide students with healthy options while generating revenue. During the 2003-04 academic year, approximate annual revenues from schools varied from \$5,000 (roughly 30% of elementary schools) to \$125,000 (roughly 30% of high schools) (GAO, 2005). Additionally, most schools utilized competitive food revenues to maintain food service operation budgets; only 40% of school foodservice departments generated revenue in 2003-04 (20% broke even and 40% lost money). Funds generated through ALC sales surpassed all other competitive food venues run by other/student groups (i.e. school stores, vending machines, concessions, etc.) (GAO, 2005).

Competitive food venues do provide revenue to schools, but may also result in decreased school meals reimbursement from decreased NSLP participation (Texas Department of Agriculture, 2003). Texas school food service departments lost approximately \$60 million annually due to vending machine sales and nearly 60% of the state's food service operations had negative earnings in 2001. These results were not comprehensive and researchers only investigated one area of competitive foods, but vending operations, which brought in \$54,000,000 in revenue for Texas schools, may have played a substantial role in decreased NSLP participation and revenue. These results shed light on the financial impact of competitive foods, which do not provide schools with 100% revenue

without loss. Finally, federal meal reimbursements may have been offsetting the extra cost of preparing ALC and non-reimbursable items; many schools serve extra servings of NSLP menu items as an ALC option (USDA, 2008b)

Concerns of monetary losses from the regulation of competitive food may not be warranted. A pilot study of 16 middle and high schools representing nine school districts examined the financial impact of implementing Senate Bills 19 and 56 (SB 19/56; encompassing nutrition standards of competitive foods sold on school grounds starting 30 minutes before the school day starts and 30 minutes after the school day ends) (Woodward-Lopez et al., 2005). The nutrition standards of SB 19/56 for foods and beverages included no more than 35% total calories from fat (excluding nuts and seeds), no more than 10% total calories from saturated fat, no more than 35% of total weight from sugar (excluding fruits and vegetables), portion sizes no larger than those served in NSLP, fruit and non-fried vegetables offered at any location where food is sold, fruit-based drinks with at least 50% fruit juice and no added sweeteners, sport drinks with no more than 42 grams of added sweetener per 20 ounces, fruit juices and fruit drinks no larger than 12 ounces, and sport drinks no larger than 20 ounces. Of the 16 participating schools, 13 saw increases in food service per capita gross revenues (NSLP reimbursements with ALC sales) during the study. Decreases in revenues from ALC sales were seen in 11 of those 13 schools, but revenues from NSLP reimbursements and meal sales compensated for those losses.

A San Francisco middle school saw similar results when implementing nutrition standards for competitive foods in the 2003-04 school year (Wojcicki & Heyman, 2006). Nutrition standards included: 30% or less calories from fat, 10% or less calories from saturated fat plus trans fat, no more than 35% sugar by weight, fruits and vegetables offered everywhere foods are sold, peanut allergy labeling, and strict beverage and portion size standards. One month before the study period the school foodservice saw a loss of nearly \$1,000 which contributed to an initial reluctance for project implementation. Gradually, foods not meeting the nutrition standards were phased out, new items were added, and portion sizes were reduced. Two months later (after implementation) the foodservice department made a profit of \$2,000 which was primarily attributed to increase in NSLP participation (Wojcicki & Heyman, 2006). As a result, additional middle and high schools

throughout the district implemented nutrition standards and 67.5% experienced an increase in NSLP participation resulting in an average increase in sales of \$1,706 per school.

Promotion of healthy food choices in vending machines relative to revenues has also been examined. A sample of 12 secondary schools and 12 worksites were used to evaluate the effects of reducing the cost of low-fat snacks by 0%, 10%, 25%, and 50% (French et al., 2001). Not surprisingly, increasing low-fat snack sales were observed with increasing price reduction. Significantly more total low-fat snacks were sold with 25% and 50% price-reduced vending machines than 0% and 10% price-reduced machines. Furthermore, profits per vending machine did not significantly differ between the machines with no price reduction (0%) and machines with 50% price reduction on low-fat items (\$494 and \$480 respectively) due to changes in sales volume. Interestingly, revenues per machine were higher for schools (\$684) than worksites (\$257) (French, et al., 2001). Promotion of price-reduced and non-price-reduced low-fat snacks with signage in addition to labeling the items on the vending machines resulted in a significantly greater percentage of low-fat snacks sold (15.4%) compared to the labeling (14.5%) or no-labeling (14.3%) only conditions.

The community's family financial status may also play a role in competitive food sales in a school. In Pennsylvania, the strongest predictor of ALC sales per school was the percent of students eligible for free and reduced price (FRP) lunches (Probart, McDonnell, Hartman, Weirich, & Bailey-Davis, 2006). An inverse relationship was observed between eligibility for FRP lunches and ALC sales. Conversely, a positive relationship was observed between increased eligibility and NSLP participation. The second strongest predictor of ALC sales was lunch time; lunch times before 10:30am resulted in greater ALC sales than those after 10:30 am (Probart, et al., 2006).

In summary, the school nutrition environment provides a unique opportunity to impact student health behaviors. Competitive foods sold within the school environment are typically EDNP options, contribute to decreased consumption of healthy foods and compete with the NSLP. Maintaining the school budget is a perceived barrier to making healthy changes in competitive food venues, but research has shown positive financial effects of improving these venues via increased NSLP participation. Collectively, these results indicate

positive changes made to improve the healthfulness of competitive food options in schools results in improved diet quality and contribute to strong financial school budgets.

Implications of Competitive Foods

The increasing prevalence of competitive foods in schools is likely a contributing factor to childhood obesity rates. In the past 18 years obesity rates in youth (2-19 years) have gradually increased along with the prevalence of school vending machines (Gordon & Fox, 2007; Hedley et al., 2004; Ogden, et al., 2008; Ogden, Flegal, Carroll, & Johnson, 2002). The correlation of childhood obesity and vending machines appears in Figure 3. While a causal relationship cannot be drawn from these results, competitive foods within the school nutrition environment do influence youth health behaviors and weight status.

Competitive foods also contribute to peer pressure and social stigmatism for children from low-income families. Only students with money are able to purchase from competitive food venues and students perceive school meals as primarily for 'poor' children (Stein, 2008; USDA, 2001b). Competitive food venues are usually separate from the school meal lunch line and thus, students can visually identify students purchasing from competitive food venues and those only consuming school meals. Consequently, students eligible for free or reduced price lunches choose to go hungry rather than risk being identified as 'poor' by their peers. This is evident as school meal participation has decreased by 1.2% in the past 20 years while school enrollment increased by 6.8% (USDA, 2001b).

Additional School Food Practices

Other school practices and policies also have the potential to impact student behavior. For every additional school wide food practice available, (food and beverages allowed in the classroom/hallway, food/food coupons as a reward/incentive, classroom/school wide fundraising with food sales) the BMI of eighth grade students increased by 10% (Kubik, Lytle, & Story, 2005a). These research findings are cause for concern because many of these practices are common in U.S. schools. For example, foods or beverages used as an incentive/reward among middle school teachers tend to be EDNP. Foods and beverages most commonly used included: candy (73%), cookies/doughnuts (37%), sweetened drinks (35%),

and pizza (28%) (Kubik, Lytle, Hannan, Story, & Perry, 2002). Nutrient rich items such as bagels/pretzels (20%), water/fruit juice/low fat milk (11%) and fruits/veggies (9%) were used less often.

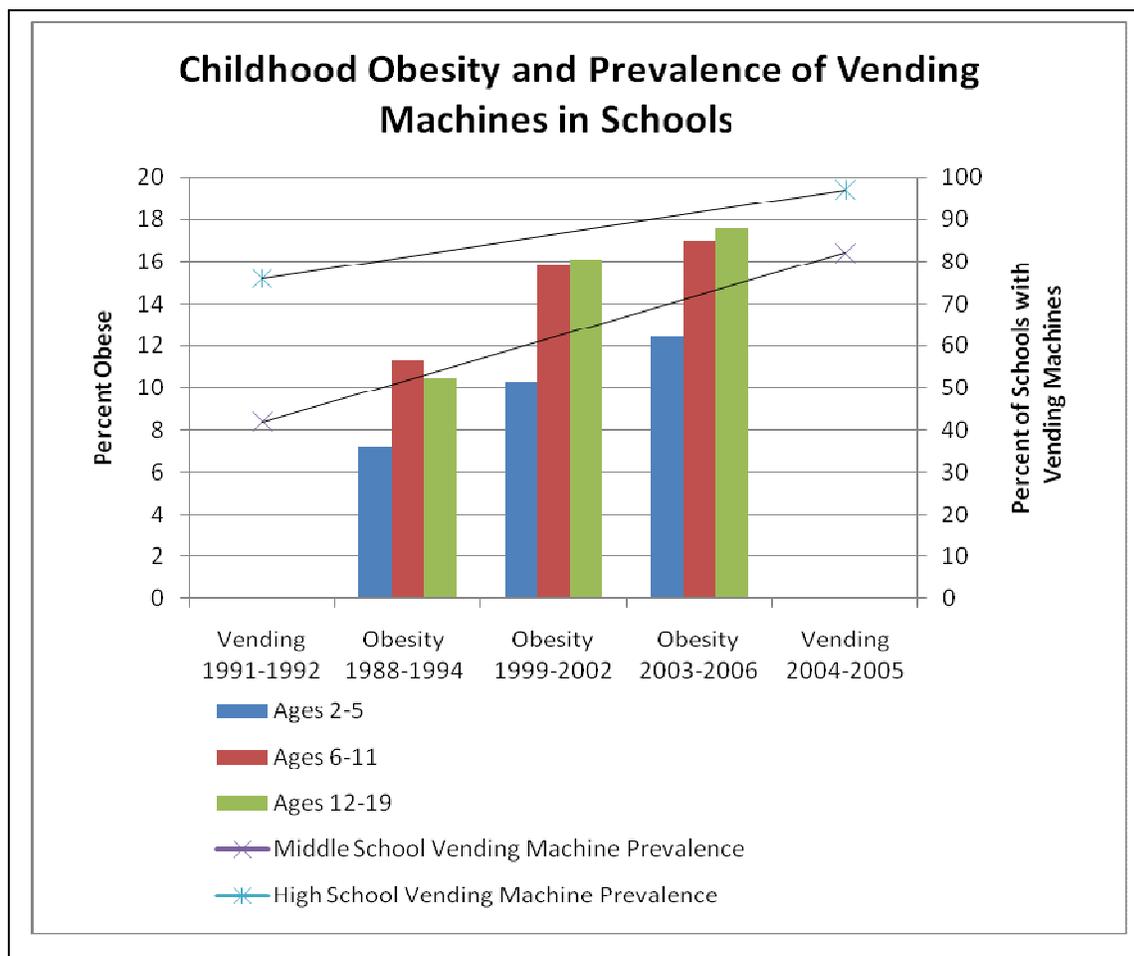


Figure 3. Childhood obesity rates (using NHANES data) and school vending machine prevalence. Adopted from (Gordon & Fox, 2007; Hedley, et al., 2004; Ogden, et al., 2008; Ogden, et al., 2002).

Parenting Styles and Family Characteristics

Child Feeding Practices

The home environment also impacts youth weight status. Preschool age children who experienced a family meal five or more times per week were 25% less likely to be obese (Anderson & Whitaker, 2010). As children progressed from kindergarten through third

grade, the risk of becoming overweight increased 9% for every family meal missed per week (Gable, et al., 2008). Adolescents (9-14 years) participating in family meals most or all days of the week had a 15% lower prevalence of overweight (Taveras et al., 2005).

Nutrient intakes among youth participating in family meals are also more nutrient dense. Adolescents had higher intakes of fiber, calcium, folate, iron, vitamins, B₆, B₁₂, C, and E and lower intakes of saturated and trans fats (as a percentage of energy) when consuming family dinners (Gillman et al., 2000).

On the other hand, the home environment can also exert a negative impact. Increased maternal restriction of access to foods has been linked to increased snack intake when exposed to an unrestricted environment in young girls (Fisher & Birch, 1999). Highly restrictive parental feeding practices were also associated with higher BMIs in females (5-15 years) (Anzman & Birch, 2009). Restriction of appetizing foods from children (3-5 years) resulted in more requests, comments, and attempts to obtain the restricted food than when the food was unrestricted (Fisher & Birch, 1999). This research highlights the importance of parental guidance and role modeling in the development of healthy youth eating behaviors.

Family TV Viewing

Television viewing is a sedentary activity that contributes to the development of overweight and obesity. In 2009, youth (8-18 years) watched approximately 4.5 hours of TV on a typical day; a 30 minute increase from 2004 (Rideout, Foehr, & Roberts, 2010). New platforms of TV viewing such as the internet, cell phones, iPods, and MP3 players have contributed to this increase in TV time. Middle school students watching two or more hours of television per night were 80% more likely to be overweight and have 5% more body fat than students watching less than two hours per night (Giammattei, Blix, Marshak, Wollitzer, & Pettitt, 2003). Gable and colleagues (2008) suggest a child's risk of becoming overweight increases by 3% for every hour of television watched per week.

Research also suggests TV viewing influences food intake. Elementary school children watching a cartoon with food advertising consumed 45% more snack crackers than children watching the same cartoon without food advertising (Harris, Bargh, & Brownell, 2009). Other factors including weight status, gender, TV in the child's bedroom, race, time

since child last ate, age, parents' estimate of child's appetite, snacking while watching TV in the past week, and weekly TV viewing, were not found to predict snack cracker consumption. A positive relationship has been found between children and young adolescents' TV viewing and consumption of commonly advertised foods such as soft drinks, fruit drinks, potato chips, chocolate sweets, biscuits, hamburgers and French fries (Utter, Scragg, & Schaaf, 2006). An inverse relationship between TV viewing and fruit and vegetable consumption was also observed.

Adolescents watching more than 2 hours of TV per day were more likely to consume less fruits and vegetables, be less physically active, and consequently be overweight (Lowry, Wechsler, Galuska, Fulton, & Kann, 2002). Taveras and colleagues (2007), on the other hand, found no relationship between changes in TV viewing and leisure-time moderate/vigorous physical activity in young adolescents. Regardless, the general consensus is that sedentary activities, such as TV viewing, do influence energy balance, weight status, and ultimately health.

Parent and Adult Influence

American adults tend to consume an overabundance of EDNP foods, which constitutes approximately 27% of adult energy intake (Kant, 2000). In fact, one-third of adults consume 45% of their calories from EDNP choices. Increased consumption of EDNP foods has decreased consumption from the five nutrient dense food groups. Consuming more calories from EDNP foods has led to a population of overweight, yet undernourished individuals. These behaviors also model inappropriate dietary behaviors among youth.

Parents are aware that their dietary intake patterns influence youth intake behaviors. The majority of middle school parents (86%) in Minnesota reported what they ate influenced what their children eat (Kubik, Lytle, & Story, 2005b). Children (8-13 years) whose parents regularly consumed soft drinks were over 2.8 times more likely to consume soft drinks on five or more occasions per week than children of parents who did not regularly consume these beverages (Grimm, Harnack, & Story, 2004).

Teachers also serve as role models for youth. Unfortunately, a recent sample of elementary school teachers reported diets high in fat (45%) and low in whole grains (45%),

in addition to consuming insufficient amounts of milk/dairy (86%) and fruits/vegetables (93%) (Hartline-Grafton, Rose, Johnson, Rice, & Webber, 2009).

Although adults may not always model the most desirable eating behaviors, they do understand that dietary intake impacts health status. The majority of middle school parents (95%) and teachers (87%) felt healthy eating should be a priority addressed in adolescents; however, few believed adolescents ate healthily (12% and 11%, respectively) (Kubik, et al., 2005b). Additionally, over 75% of middle school parents believed the food options available at school were impacting what students ate. The majority of parents and teachers (85%) believed what students were eating impacted their readiness to learn. These parents (77%) and teachers (90%) agreed that healthier options should be available in vending machines and ALC lines in schools.

While parents have positive beliefs regarding child eating behavior, their perceptions of where and how often children access food are inaccurate. Parents tend to underestimate how often children purchase from vending machines/snack bars (8%), convenience stores (4%), and fast food restaurants (3%) (Moag-Stahlberg, Miles, Marcello, & Study, 2003). They also overestimate the frequency of their children eating from the school lunch line (13%).

Collectively, the home environment as well as the school environment, influences youth food consumption and behavior. Adults serve as role models and their behaviors are reflected in youth behavior. Parents and teachers may not always model healthy habits to children, but they do support a healthy school nutrition environment.

Child Characteristics and Child Risk Factors

Dietary intake

U.S. students, 3rd through 12th grade, consumed an average 111% of the RDA for calories and exceeded the recommended amounts of saturated fat, sodium, iron, phosphorus, and Vitamins C, B-6, B-12, folate, niacin, riboflavin, and thiamin in 1995 (Devaney, Gordon, & Burghardt, 1995). Similar results were found during the 2004-05 academic year; students of all ages consumed on average an excess amount of daily calories (about 70 calories per day), but total fats, carbohydrates, and proteins in were consumed in appropriate proportions

(Clark & Fox, 2009). These results suggest that even though students meet recommended intakes of most vitamins and minerals, they may be consuming more food energy than optimal. Two nutrients, fiber and potassium, were below recommended amounts in all age groups.

The nutrient quality of foods likely influences weight status. Previous research with middle school students found a positive association between the consumption of fruits, vegetables and milk with a healthy weight status (Roseman, Yeung, & Nickelsen, 2007). Conversely, consumption of sweetened beverages (particularly soft drinks), sweets, meats, low-quality foods, and total weight of foods/beverages (particularly from snacks) have been associated with overweight status in ten-year-old youth (Nicklas, Yang, Baranowski, Zakeri, & Berenson, 2003).

Physical Activity

In coordination with dietary intake or behaviors, physical activity also influences weight status in youth. A positive relationship has been found between the amount of time spent in sedentary activities and fat mass percentage in nine-year-old boys (Maffeis, Zaffanello, & Schutz, 1997). Unfortunately, as children progress through adolescence, participation in sedentary activities increases and moderate to vigorous activity decreases (McMurray, Harrell, Creighton, Wang, & Bangdiwala, 2008; Nelson, Neumark-Stzainer, Hannan, Sirard, & Story, 2006). McMurray and colleagues (2008) reported physical activity to be of particular importance for young girls. Females transitioning from normal weight to overweight over a five year period during adolescence had greater decreases in moderate and vigorous physical activity than those transitioning from overweight to normal weight.

Adolescent physical activity at school has been decreasing. Daily physical education (PE) attendance decreased from 42% to 25% between 1991 and 1995, and continues to remain low (CDC, 2007a). Data from the 2007 YRBSS suggest that only 35% of high school students achieve the physical activity recommendation of 60 minutes of activity on five or more days per week, and only 50% attend PE classes one or more days per week (CDC, 2007b). Federal programs such as the No Child Left Behind Act, the 2001 reauthorization of the Elementary and Secondary Education Act, has contributed to decreased

PE participation. This law focuses on student achievement in ‘core subjects’ (i.e. English, reading or language arts, mathematics, science, foreign languages, civics and government, economics, arts, history, and geography) and has resulted in decreased time and resources available for PE (National Association for Sport and Physical Education & American Heart Association, 2006). Increases in dietary intake and decreased physical activity are two physiological factors influencing youth weight status, but psycho-social factors such as health literacy (HL) and food perceptions may also play important roles.

Health Literacy

HL is the degree to which individuals have “the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions” (HHS, 2008b). The most recent evaluation of HL in U.S. adults (≥ 16 years) revealed 14% have below basic HL, 22% basic HL, 53% intermediate HL, and 12% have proficient HL (Kutner, Greenberg, & Paulsen, 2006; HHS, 2007). HL was examined relative to an individual’s familiarity with health-related words and ability to interpret information from written materials. Yet, a 2007 report from the United States Department of Health and Human Services states that approximately 9 out of 10 adults may lack the ability to manage their health and prevent disease (HHS, 2008a). Additionally, the IOM (2004) reported nearly 50% of American adults have trouble understanding and utilizing health information. Ultimately, the inability to adequately access and interpret health information likely influences healthy choices and behaviors. Research has found associations between HL and knowledge of health problems, reported health outcomes, and healthcare costs.

Adults with decreased HL are more likely to have less education, live below the poverty threshold, be of a certain racial or ethnic group, report more food stamp use, less likely to vote in a recent election, and less likely to be employed (Kirsch, Jungeblut, Jenkins, & Kolstad, 2002; Kutner, et al., 2006).

Youth with decreased HL tend to be of African-American or Latino decent, live in a home where the first language is not English, and live in poverty (Snow & Biancarosa, 2003). HL has been established as an issue of concern for adolescents with almost half (46%) of 10-19 year olds reading below their grade level and 9% (4.7 million) of 5-17 year

olds having some level of cognitive difficulty (Davis et al., 2006; Pastor, Reuben, & Loeb, 2009). Adolescence serves as an opportune age to establish adequate HL as youth move from concrete reasoning to more abstract reasoning (Piaget, 1977).

Measures of Health Literacy

Adult HL studies have commonly used the Test of Functional Health Literacy in Adults (TOFHLA), or the Rapid Estimate of Adult Literacy in Medicine (REALM). The TOFHLA takes approximately 22 minutes to complete and tests an individual's numeric abilities and reading comprehension, categorizing their HL as inadequate, marginal, or adequate (Parker, Baker, Williams, & Nurss, 1995). A shortened version, the s-TOFHLA, was developed and requires about 12 minutes or less to complete (Baker, Williams, Parker, Gazmararian, & Nurss, 1999). The REALM takes about three minutes to administer and uses medical word recognition to classify individuals into grade-level reading abilities, which can facilitate tailored communication and care in medical settings (Davis et al., 1993).

Reading level is commonly used as a proxy for HL in research and medical arenas and will be the term used in regards to literacy and health throughout the remainder of this review. However, education or reading level as a proxy for HL should be done cautiously, education is only a measure of the number of years an individual attended school or a grade level of reading. In fact, a survey from the United States Department of Education reports approximately 25% of those in the lowest HL category were high school graduates (Kirsch, et al., 2002). Other assessments, which measure reading ability include the Wide-Range Achievement Test Revised (WRAT-R), the Slosson Oral Reading Test-Revised (SORT-R), the Fry Readability Scale, and the Flesch-Kincaid Reading Grade Level scale (Flesch, 1974; Fry, 1977; Jastak & Wilkinson, 1984; Slosson, 1990).

While the majority of HL research has investigated adults, a reliable tool for measuring adolescent HL has been recently developed based on the REALM; the Rapid Estimate of Adolescent Literacy in Medicine (REALM-Teen) (Davis, et al., 2006). This tool categorizes youth into five reading levels; 3rd grade and below, 4th-5th, 6th-7th, 8th-9th, and 10th grade and above and takes an average of three minutes to complete.

The TOFHLA and REALM continue to be widely used in HL research, but need to be interpreted cautiously. They are both measures of basic print literacy using health-related terms, and to some degree texts and numeracy skills in the clinical setting, failing to include oral language skills and application outside of the clinical setting (Nielsen-Bohlman, Panzer, & Kindig, 2004). This suggests that a tool capturing the complexity of HL does not currently exist.

A more recent measure of HL is the Newest Vital Sign which takes approximately three minutes to complete and uses a food label to categorize individuals as having almost always adequate, possibly limited, and likely limited HL (Weiss et al., 2005). The use of a nutrition facts label places a greater emphasis on the ability to use numbers and mathematical concepts, in addition to reading, to accurately interpret information. The Newest Vital Sign asks six questions about the food label related to servings, portion size, percent daily value, ingredients, and allergies. This tool has been validated against the TOFHLA, must be verbally administered, and is readily available in English and Spanish through Pfizer Inc. at <http://www.pfizerhealthliteracy.com/physicians-providers/newest-vital-sign.html> (Pfizer Inc., 2008). In summary, the Newest Vital Sign encompasses reading, math, and oral language skills necessary for adequately evaluating HL outside of the clinical setting.

Health Literacy and Knowledge of Health

Individuals with disease and inadequate HL may have decreased knowledge about their disease and proper disease management. Adults with diabetes or hypertension who had inadequate HL scores (TOFHLA) performed worse on a questionnaire regarding each disease. Questions included information about the disease state, lifestyle modifications, and self-management skills (Williams, Baker, Parker, & Nurss, 1998). Similar results were found in 2000 with HIV/AIDS patients; those with higher HL were twice as likely to know their viral load and CD4 counts and understand their meaning (Kalichman et al., 2000). Similar associations between disease knowledge and HL have been found with asthma, diabetes, congestive heart failure, and HTN patients (Gazmararian, Williams, Peel, & Baker, 2003). Over half of low literate asthma patients (< 3rd grade reading level; REALM) did not correctly answer questions about the importance of seeing a physician routinely, when to take

“as needed meds”, and the importance of properly using an inhaler (Williams, Baker, Honig, Lee, & Nowlan, 1998). Also, asthma patients with low HL were more likely to exhibit poor technique when using a metered-dose inhaler than those with higher HL.

HL has also been associated with disease prevention knowledge. A major indicator of women’s knowledge of cervical cancer prevention was HL; higher HL was the only variable independently associated with knowledge regarding the purpose of a Pap test (Lindau et al., 2002).

Individuals with low HL may have trouble understanding self-care instructions from medical providers. Those with low HL living in a high poverty area of Philadelphia had a poor understanding of emergency department discharge instructions (Spandorfer, Karras, Hughes, & Caputo, 1995). Conversely, a study evaluating parental knowledge of child medical treatment found no association between parental HL level and understanding of medical information about their child’s medical issue (Moon, Cheng, Patel, Baumhaft, & Scheidt, 1998). Yet, parents with low HL considered their children sicker for the same severity of illness when compared to parents with higher HL.

Research investigating adolescent HL and knowledge of health is inadequate, but examining youth’s perceptions of health information may be useful in understanding their level of health knowledge and HL. Results from the 2004 U.S. KidsHealth KidsPoll suggest that 78% of adolescents (9-13 years) find that what they hear about health is easy to understand and 66% try to follow what they are taught about health at least most of the time (Brown, Teufel, & Birch, 2007). Additionally, 80% of youth thought they could do some or a lot to be a healthy adult, 80% were sort of or very interested in learning about health, and 93% considered themselves sort of or very healthy. Interestingly, this poll showed that interest and motivation to follow what was taught about health decreased with age (from 9-13 years).

California teenagers (12-17 years) reported little peer concern for healthy eating (8.5%), but high peer concern regarding weight control (85%) (Evans, Gilpin, Farkas, Shenassa, & Pierce, 1995). National teen data reported similar results; adolescents described components of healthy eating to be moderation, balance, and variety. They thought eating better, increasing physical activity, and drinking fewer pop/‘slurpees’ were important health

goals (Croll, Neumark-Sztainer, & Story, 2001; Groft, Hagen, Miller, Cooper, & Brown, 2005).

Health Literacy and Behavior

While adolescents may have a significant amount of knowledge regarding healthy eating behaviors, implementing this knowledge into behavior can be difficult. Youth identified lack of time, limited availability of healthy food options in school, and lack of concern as obstacles for following nutrition guidelines (Croll, et al., 2001).

A number of factors, including HL, impact all health behaviors. Socio-economic status, family structure, community environment and income can present challenges and barriers to positive health behaviors. Youth with low HL tend to engage in negative behaviors compared to those with higher HL. Young boys and girls (11-12 years) with low HL regarding health/drug knowledge were four times more likely to have smoked in the past month than those with high HL (Hawthorne, 1997). Adolescents (11-18 years) with low HL attending a track/field and literacy summer program had an increased likelihood of carrying a weapon, missing days of school because they felt unsafe, being threatened with a weapon at school, and being involved in a physical fight inside/outside of school (Davis, Byrd, Arnold, Auinger, & Bocchini, 1999).

Barriers and challenges to performing desirable health behaviors persist into adulthood. Pregnant women with higher HL levels (reading at the 9th grade or higher) knew more about the effects of smoking and expressed more concern for the negative health effects smoking could have on their baby (Arnold et al., 2001). Yet, these women continued to smoke at the same rate as women with low HL (reading levels) and in fact, tended to have increased smoking prevalence. Individuals with HIV/AIDS and low HL were about three to four times more likely to miss a dose of medication in the past two days compared to those with higher HL (Kalichman, Ramachandran, & Catz, 1999). However, another study found no association with HL level and HIV antiretroviral medication adherence (Golin et al., 2002). Gonorrhea testing has also been associated with HL; those with higher HL (reading at a 9th grade level or higher) were 10% more likely to have been tested for gonorrhea in the past year (Fortenberry et al., 2001). In addition, those with lower HL perceived themselves

to be at higher risk for acquiring the disease in the next year compared to those with higher HL.

Health Literacy and Health Outcomes

An individual's degree of HL is not only associated with health knowledge and health behaviors, but also health outcomes. The National Center for Education Statistics and the U.S. Department of Education assessed the HL of 19,000 American adults (≥ 16 years) (Kutner, et al., 2006); lower HL was accompanied by a lower assessment of self-reported overall health (Figure 4). While individuals with low HL are more likely to report their health as poor, the association was not explained by differences in barriers to healthcare access, self-reported ambulatory care, insurance status, difficulty in paying for medical care, getting time off work, or getting child care (Baker, Parker, Williams, Clark, & Nurss, 1997).

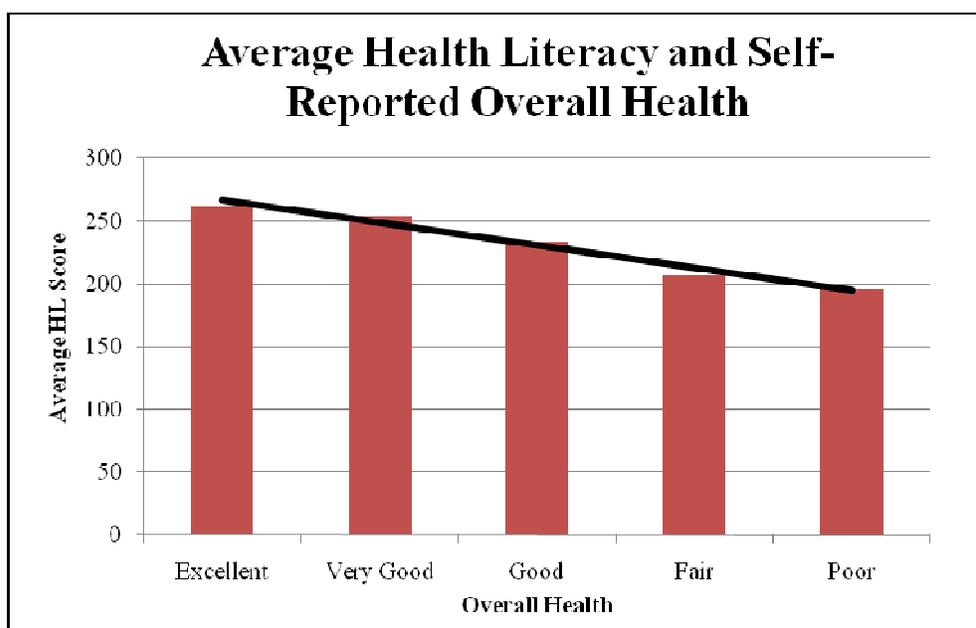


Figure 4. Relationship between average health literacy (HL) scores of American adults (≥ 16 years) and self-reported overall health modified from (Kutner, et al., 2006).

Objective measures of health outcomes have also been associated with HL. For every 1 point decrease on the s-TOFHLA (HL measure) among type 2 diabetics, a 0.02 increase in HbA_{1C} (health outcome measure) was observed (Schillinger et al., 2002). Not only did low

HL correspond with poorer glycemic control, but also increased self-report of retinopathy. Similarly, type 2 diabetics with lower s-TOFLA (~45%) scores had HbA_{1C} levels above the sample mean compared to those with higher s-TOFLA scores (~29%) (Schillinger et al., 2003).

African American or Black adults with lower HL scores had increased reports of history of heart disease, hospitalizations for heart conditions, less healthy diets, and higher depression scores (TenHave et al., 1997). HL has also been correlated with prostate cancer. Men with metastatic cancer were one and a half times more likely to have HL scores less than a 6th grade reading level (Bennett et al., 1998). Yet some suggest disease outcome measures of hypertension (HTN) and diabetes (HbA_{1C}) are not significantly associated with HL (Williams, Baker, Parker, et al., 1998).

Health Literacy and Healthcare Costs

Individuals with low HL may inadequately make use of medical preventive services. Older adults (65-79 years) with inadequate HL were more likely to have never received an influenza vaccine (29% vs. 19%), or pneumonia vaccine (65% vs. 54%) than those with adequate HL (Scott, Gazmararian, Williams, & Baker, 2002). Also, women with inadequate HL were more likely to never had a pap smear (10% vs. 5%) or receive a mammogram in the past two years (24% vs. 17%). This lower use of preventive services may actually increase healthcare costs over time.

HL has also been associated with increased medical service use and subsequent increased healthcare costs. Patients with HIV and lower HL were more likely to visit a doctor once a month, report greater optimism regarding HIV treatment and cure, but practiced more unprotected sex because of new HIV treatments (Kalichman, et al., 2000). Patients with rheumatoid arthritis and low HL had three times as many out-patient hospital visits and went to twice as many different departments as a matched high HL group (Gordon, Hampson, Capell, & Madhok, 2002). Low HL individuals were more likely to be hospitalized one or more times in a three year period than those with marginal or adequate HL regardless of age, self-reported health, or insurance status (Baker, Parker, Williams, & Clark, 1998). Similar results were found among Medicare enrollees (Baker et al., 2002).

Medicare enrollees with lower HL used inpatient emergency room services with significantly higher emergency room costs than those with adequate HL; however, overall medical services use and costs was not significant (Howard, Gazmararian, & Parker, 2005). These studies highlight the relationship between poor HL, decreased health knowledge, and understanding of disease state and treatment. Ultimately, inadequate HL leads to higher health care costs and poorer health outcomes.

Health Literacy and Shame

Low HL individuals may also have shame associated with their low reading and comprehension abilities. Over half (67%) of acute care patients with low HL reported difficulty reading and understanding what they read (Parikh, Parker, Nurss, Baker, & Williams, 1996). Of these patients, 40% admitted shame regarding their reading abilities. Over two thirds (67%) of those admitting shame had never told their spouses, over half had never told their children, relatives, or friends (53.4%, 56.9%, 62.1% respectively), and 19% had never told anyone about their reading problem. Low literate individuals report difficulty navigating the location of health facilities as well as reading signs within them, completing medical forms, communicating with their healthcare provider, and following medication instructions (Baker et al., 1996). In contrast, they did not report difficulty with appointment slips especially if dates were written.

Health Literacy and Healthcare Communication

Focus group discussions and interviews with low literate individuals have indicated that the sense of shame accompanying low HL may have developed from, and is reinforced by undesirable interactions with medical personnel (Baker, et al., 1996). Low literate individuals may also feel intimidated and embarrassed and less likely to ask their healthcare provider questions or admit they do not understand. Patient-provider interactions have also been shown to differ by HL classification. Diabetic patients with inadequate HL reported significantly worse quality of physician-patient communication regarding general clarity, explanation of condition, and explanation how to care for the condition compared to those with adequate HL (Schillinger, Bindman, Wang, Stewart, & Piette, 2004). Low literate

persons tend to have difficulty understanding clinical language resulting in patients feeling confused and under-informed. These studies indicate that standard healthcare communication is not effective for all individuals, especially those with low levels of HL. The American Dietetic Association (ADA) suggests the use of visuals to improve health communication as long as they are clear, easy-to-understand, concise, and uncluttered (Peregrin, 2010).

Health Literacy and Health Information Sources

The HL of individuals appears to influence the mode of how they prefer to access and receive information. Individuals (≥ 16 years) with below basic or basic HL were more likely to receive nutrition information from non-print media sources such as television and radio; those with higher levels of HL receive health information from printed media such as magazines, internet, books/brochures, or newspapers (Kutner, et al., 2006).

Parents, schools, medical professionals, and the internet have been shown to be the main sources of health information utilized by youth. Adolescents report learning the most about health from school (40%), medical professionals (29%), and parents (12%) (Brown, et al., 2007). Youth go to their parents (31%), medical professionals (29%), and school (21%) when they have a health question for the most accurate information; they believe friends (36%), TV (36%), and the internet (6%) give the most inaccurate health information. In fact, 16-17 year old students reported going to a health professional (74%), internet (66%), and parents (54%) to make sure their health information is correct and reliable (Wharf Higgins, Begoray, & MacDonald, 2009). However, almost half of 15-24 year olds have been found to go online at least once a day and over 65% have gotten health information from the internet (Rideout, 2001). A more recent study found that half of 8-18 year olds report looking for health information online and spend an average of six and a half hours per day with media sources (Rideout, Roberts & Foehr, 2005).

Parental knowledge of positive health behaviors has been shown to correlate with youth knowledge of positive health behaviors; parental knowledge related to energy intake and expenditure was a significant predictor of adolescent knowledge (Nelson, Lytle, & Pasch, 2009). Interestingly, adolescent knowledge was higher with increased amounts of

moderate physical activity and less television-viewing. Unfortunately, adolescent knowledge was not associated with sweetened beverage consumption, fast food intake, weight status, or body fat.

Schools have the opportunity to improve student HL and maximize learning outcomes by adopting a whole school approach or a ‘coordinated school health’ approach (St Leger, 2001). It has been proposed that these health promoting schools promote four outcomes fundamental to HL: 1. lifelong learning skills, 2. competencies and behaviors, 3. specific cognate knowledge and skills, and 4. self-attributes (St Leger & Nutbeam, 2000). By adopting this whole school approach to promote health, schools can attain all three levels of HL: basic/functional HL, communication/interactive HL, and critical HL (Nutbeam, 2000; St Leger, 2001). However, St Leger (2001) indicates that evidence for the ‘coordinated school health’ approach serving as the ‘gold standard’ for school programs is lacking and three challenges prevent schools from achieving critical HL: 1. the traditional structure and function of schools, 2. teachers’ practices and skills, and 3. time and resources.

The CDC’s Coordinated School Health Program model may serve to fill this void and encompasses eight components: 1. health education, 2. physical education, 3. health services, 4. nutrition services, 5. counseling and psychological services, 6. healthy school environment, 7. health promotion for staff, and 8. family/community involvement (CDC, 2008a). This model suggests that “schools could provide a critical facility in which many agencies might work together to maintain the well-being of young people”. ‘Health-promoting schools’ report better health policies, increased community participation, a more hygienic environment, and students with increased positive health behavior profiles (Lee, 2009).

Incorporating health education to improve student HL in the academic curriculum can be challenging for many schools. Schools requiring health education increases from kindergarten to 5th grade (36-60%), but declines significantly thereafter to just 12% and 9% in 11th and 12th grades, respectively (Kann, Brener, & Wechsler, 2007). Additionally, only 13% of elementary teachers and 37% of middle and high school teachers in schools requiring health education had an undergraduate minor, major, or graduate degree in health education. On a more positive note, 68% of elementary and 67% of middle and high school health

instructors were certified, endorsed, or licensed by the state to teach grade appropriate health education.

Recently, a National Action Plan to improve HL has been proposed engaging organizations, professionals, policymakers, communities, individuals, and families (HHS, 2010a). One goal of the action plan is to incorporate appropriate health and science information into child care and education. A strategy proposed to meet this goal is to incorporate health education into existing curricula (grades K-12) by embedding health-related tasks, skills, and examples into lesson plans. A second goal for improving HL is to continue research relative to development, implementation, and evaluation of practices and interventions. Expanding research endeavors beyond the clinical setting into the community was identified as a strategy for meeting this goal.

The Iowa Department of Education (IDE) recently identified HL as an essential skill through the Iowa Core Curriculum which identifies academic expectations for K-12 students (IDE, n.d.-c). Essential concepts and/or skills identified by the IDE to enhance HL for grades 9-12 are to: 1. demonstrate functional HL skills to obtain, interpret, understand and use basic health concepts to enhance personal, family, and community health; 2. synthesize interactive HL and social skills to establish and monitor personal, family and community goals related to all aspects of health; 3. apply critical literacy/thinking skills to personal, family and community wellness; 4. use media HL skills to analyze media and other influences to effectively manage health risk situations and advocate for self and others; and 5. demonstrate behaviors that foster healthy, active lifestyles for individuals and the benefit of society (Iowa Department of Education, n.d.-b). The 2008 legislative session, through Senate File 2216, requires all school districts and accredited nonpublic schools to implement the Iowa Core Curriculum (July 1, 2012 for grades 9 through 12) (IDE, n.d.-c). HL has also been identified as a national objective for Healthy People 2010. Objective 11-2 aims to 'improve HL of persons with inadequate or marginal HL skills' and acknowledges the need to support HL skill development across the lifespan (HHS, 2003).

HL is important for knowledge of and participation in healthy behaviors, which decreases healthcare costs. Establishing adequate HL in youth can enhance the probability of a greater quality of life and lower healthcare costs now and in the future.

Food Perceptions

Food Perceptions Definition and Development

Food perception is a critical component of food selection. Understanding the food selection process is necessary for the implementation of nutrition recommendations, dietary guidelines, and subsequent modification of eating behavior (Kronl & Coleman, 1988).

Perception is defined as the attainment of awareness or understanding through the senses (Simpson & Weiner, 2009). Thus, food perceptions can be thought of as views or beliefs about food determined by past experiences, which influence food choices and consumption patterns (Solms & Hall, 1981). A schemata-knowledge structure has been proposed for how food perceptions are cognitively developed leading to the selection of foods (Figure 5). Each stage of this model is considered to receive information from the preceding stage, process the information, and send the information to subsequent stages for further processing (Olson, 1981). Based upon previous encounters with a food, the individual assigns meaning to the food based upon sensations received from a sensory receptor. These incoming sensations must interact with existing knowledge or memory for comprehension of a food attribute to occur and impact food selection. Stored knowledge of foods may be used automatically to deal with everyday life situations or stored in memory for later use (Olson, 1981).

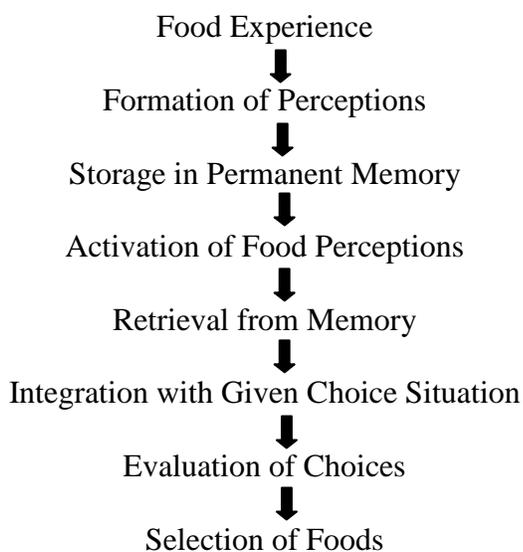


Figure 5. Cognitive processes of food selection in a schemata-knowledge structure (Kronl & Coleman, 1988)

A wide variability in sensory ratings and food evaluations of an individual food exists among populations. This variability may be due to faulty sensory receptors or asking subjects to rate attributes about foods in which they have had no previous experience or knowledge of, and also differences in knowledge structures and perceptual processing (Olson, 1981). While there is variability among populations, individuals generally produce consistent responses over multiple evaluations.

Food perceptions have been described as a continuum of barriers between available foods and food choices (Figure 6). This model is a bit more detailed to address the factors influencing food perceptions, choices and ultimately consumption. Figure 6 illustrates how physiological and psychological needs influence food choice. Food choice motives can be either “acquired” (driven by satiety, tolerance, and taste) or “learned” (driven by price, convenience, health belief, and health knowledge) (Kronl & Lau, 1978; Lau, 2008). Familiarity and prestige represent an overlap between acquired and learned motives as well as societal and cultural systems. Only learned motives (health belief and health knowledge) influence food choice at the personal systems level.

Others have developed similar food selection models and incorporated additional factors; endogenous factors (i.e. heredity, sex, age, activity) and exogenous factors (i.e. culture, society, economy) (Barker, 1982). Better understanding of food choice motives leads to more realistic nutrition standards and recommendations based not only on an individual’s physiological needs, but also on psychological needs and influences (Kronl & Lau, 1978; Lau, 2008).

Youth and Adolescent Food Perceptions

Physical properties of foods (taste, texture, appearance, and smell) appear to be the most potent motivators of food choice among adolescents (Stevenson, Doherty, Barnett, Muldoon, & Trew, 2007). Youth (12-15 years) prefer sweets, chocolate and other energy dense foods while describing more healthful foods as tasteless. These focus group discussion findings suggest taste is of higher importance for youth than healthfulness when selecting foods. Another focus group study of 11-12 year old youth reported taste was negatively associated with healthy foods and was the largest barrier to more healthful food choices

(McKinley et al., 2005). Second to taste, appearance was the next largest barrier to healthful food choices. Finally, cost, filling power, and risk were inter-related barriers. Students were less likely to risk purchasing a food if it was not guaranteed to taste good. Healthful foods were also perceived as taking too much time to prepare and cook. In this school, the lack of variety of healthful food choices was identified as a barrier and rebellion against 'preached' healthy food behaviors was noted by researchers.

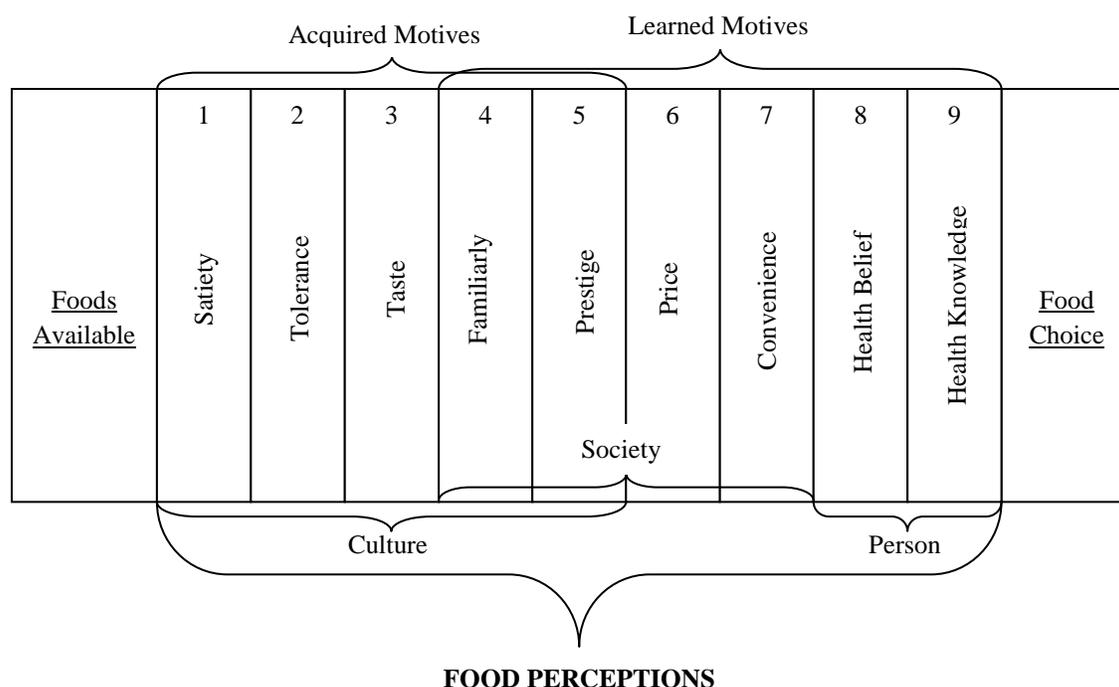


Figure 6. Food perceptions or motives that influence food choice. Figure modified from (Kronld & Lau, 1978; Lau, 2008).

Focus groups of 9-11 year olds identified the following themes determining food choices: proximity and convenience, taste and preferences, choice (i.e. availability, variety), social influences, parental influences, and familiarity (Pearce et al., 2009). Cost was not identified as a theme contributing to food choices. This may be because this age group did not regularly purchase food; they identified neighborhoods and homes as major food sources.

Conversely, cost did influence high school students' food choices; 72% reported it was important to get more for their money (Shannon, Story, Fulkerson, & French, 2002). In

addition, 27% of the high schoolers always/often thought about their health and 19% thought about their weight when deciding what to eat. Girls were significantly more likely to think about their weight and agree that 'eating healthy' was important, while boys were more likely to agree that getting the most food for their money was most important (Shannon, et al., 2002). These students also reported 'eating healthy' (61%) was important as well as fat content (31%) and taste (94%) (Shannon, et al., 2002). Bissonnette and colleagues (2001) also surveyed high school students and reported safety (93.9%), taste (93.0%), healthfulness (83.9%), cost (78.7%), and appearance (75.3%) of food to be most the important attributes when making food choices. Other factors have also been suggested as possible motivators of students' food choices including increased energy, improved appearance, academics, and/or sports performance (Shannon, et al., 2002). Focus group discussions with children and adolescents (7-17 years) have reported other motivators to more healthful eating including: improved cognitive function and school performance, positive physical sensations, increased self esteem, decreased guilt and anxiety, increased energy production, and increased physical performance (O'dea, 2003). Food preferences of college students appear to be driven by similar motives, including hunger/taste followed by time sufficiency/convenience, and value/budget (Horacek & Betts, 1998).

Barriers to more healthful eating identified by focus group participants (7-17 years of age) included convenience of less healthful foods, aesthetic appeal and taste of less healthy foods, peer pressure or parental control, reward driven or mood enhancing effects of unhealthy foods, stress relief, and increased excitement with unhealthy foods. However, students were able to identify strategies to prevail over barriers to healthy eating; decreasing the availability of 'junk food' at home and school, increasing the availability of 'healthy foods', increasing education about healthy eating in school, and increasing advertisement of 'healthy foods' (O'dea, 2003).

In summary, younger students are more likely to report taste as an important motivator whereas older students are more likely to report getting a lot for their money (Shannon, et al., 2002). Food perception research has shown mixed results on various aspects, but taste consistently appears to be an important factor in food choice and convenience of 'unhealthy foods' as a common barrier. Youth seem to understand the

benefits of eating healthy and have also been able to identify solutions for overcoming barriers; yet, students still have difficulty making the ‘healthy’ choice. Horacek and Betts (1998) suggest effective student messaging should include a blend of budget, convenience, taste, and social aspects, and focus less on nutrition.

Perceptions of ‘Healthy’ and ‘Unhealthy’ Foods

Differences also appear to exist in the perceived ‘healthfulness’ of food. Adolescents tended to polarize foods into ‘good’ or ‘bad’, which in itself is a barrier to healthy eating and inhibits an accurate understanding of dietary balance (Stevenson, et al., 2007). This suggests adolescents view ‘healthy eating’ as located within particular foods rather than in the diet as a whole. The negative association of ‘unhealthy food’ as ‘bad’ is related to a negative self-image in some adolescents and a lack of belief in one’s ability to eat healthfully (Stevenson, et al., 2007). Undergraduate college students are also inclined to placing foods in categories of healthy/unhealthy and weight loss/weight gain (Carels, Konrad, & Harper, 2007). Young people fail to understand that ‘bad’ or ‘forbidden’ foods can be included in a balanced diet which may contribute to the belief that following a healthy diet is impossible or more trouble than it is worth (Stevenson, et al., 2007).

Food Perceptions and Weight

Weight status may be influenced by perceived healthiness of foods. Interestingly, adolescents perceive healthy eating as being useful for a ‘quick-fix solution’ to obesity rather than a long term health behavior approach (Stevenson, et al., 2007). Dieting college students more accurately estimated the calorie content of foods than those who were not dieting and seemed to be more in tune with the fat, calorie, and sugar content of food (Carels, et al., 2007). Overweight students were also more likely to mention high fat when describing weight gain foods and high sugar when describing weight loss foods compared to normal weight students. Undergraduate college students, as well as adults, tend to overestimate calories in unhealthy/weight gain foods and to underestimate calories in healthy/weight loss foods (Carels, Harper, & Konrad, 2006; Carels, et al., 2007).

Conversely, Drewnowski (1985) reported obese adults participating in a behavior-orientated therapeutic weight loss program had similar perceptions of calorie density and overall nutritional value of foods as normal weight adults. However, normal weight individuals reported liking nutritious and low calorie foods while obese persons reported no such relationship and actually reported a preference for less nutritious or 'junk food' items and snack foods. These findings were similar to another study where adults participating in a weight loss program with higher baseline BMI estimated caloric values less accurately; however, this association was not seen at the end of treatment (Carels, et al., 2006).

In general, individuals tend to classify foods into categories of healthy/unhealthy and/or good/bad. Underestimating the calorie content of healthy foods and overestimating the calorie content of unhealthy foods also seems to be an issue for both normal and overweight persons. However, some differences by weight status do appear to exist. Overweight individuals tend to report a preference for junk/snack food and may have less accuracy with calorie estimation than normal weight persons. These results highlight a few interesting differences in food perceptions by weight status, but further research in this area is warranted.

Youth Consumption Patterns

Food perceptions do influence and are associated with food consumption patterns. When adolescents are subdivided into groups based on food motivations, the 'hedonistic' group (highly motivated by food that is tasty) had the least healthful eating patterns while the parent-supported group (motivated by food served by parents) had the most healthful eating patterns (Contento, Michela, & Goldberg, 1988). The 'hedonistic' group exhibited positive correlations with food attributes typically considered negative (i.e. causes heart disease, contains sugar, is fattening) whereas the parent-supported group had inverse correlations. When comparing mean nutrient intakes, the 'hedonistic group' consumed significantly more sugar and significantly less potassium and vitamin C than the parent-supported group.

It is evident that food perceptions influence student food and beverage consumption. Gaining a better understanding of food perceptions will help tailor nutrition interventions and messaging for effective childhood obesity prevention and treatment strategies.

Summary

In summary, childhood obesity is a problem. If steps are not taken to address this issue, today's children are likely to live shorter, less healthy lives than their parents. It is impossible to pinpoint a single cause or solution to the obesity epidemic, but the school nutrition environment provides ample opportunity for steps to be made in the right direction.

Unfortunately, schools are sending youth mixed messages between what is being taught about healthy eating in the classroom and what is being provided in the school nutrition environment. Competitive foods and beverages sold in vending machines, ALC, and school stores are generally EDNP and widely accessible to students. Nutrition standards for competitive food venues are needed in schools to promote a school health environment that encourages healthy eating practices. Local Wellness Policies may aid in solving this problem. Schools can establish and maintain healthy school environments by implementing nutrition standards at the local level through LWPs. In addition to the school nutrition environment, HL and food perceptions also impact student consumption.

HL is the degree to which individuals have “the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions.” Adolescence serves as an opportune age to influence HL and foster the development of adults who are able to make healthy choices and engage in healthy behaviors for improved quality of life. Research has found associations between HL and knowledge of health problems, reported health outcomes, and healthcare costs. Schools have the opportunity to improve student HL and maximize learning outcomes by promoting health inside and outside the classroom.

Food perceptions are views or beliefs about food determined by past experiences, which influence food choices and consumption patterns and are components of the whole food selection process. Understanding this process is necessary for the implementation of nutrition recommendations, dietary guidelines, and subsequent modification of eating behavior. Youth perceive taste and cost as important factors when choosing food and report convenience of unhealthy foods as a common barrier to healthy eating. Students seem to understand the benefits of ‘eating healthy’; yet, they still have difficulty making the ‘healthy’

choice. School nutrition environments promoting healthy behaviors can motivate students to make healthy choices.

The combined effects of the school nutrition environment, HL, and food perceptions influence student consumption. Overtime, these factors impact weight status and ultimately health. Additional research on student HL and food perceptions is needed such that steps for effective interventions can be developed and implemented to improve student health and conquer obesity.

CHAPTER III: METHODS

Introduction

This thesis is comprised of a school nutrition study with data collected fall 2008 and spring 2010. Six rural Iowa high schools voluntarily participated in the study. Competitive food venues (i.e. vending machines, ALC, and school stores) were inventoried at each school in addition to student assessments of HL and food perceptions. Eight to ten students from each school participated in a baseline focus group discussion; an additional focus group discussion was conducted at the intervention schools at endpoint. Intervention schools received nutrition messaging, technical assistance, and were asked to make three changes relative to competitive foods. HL, food perceptions, and competitive food options in control and intervention schools were examined at baseline and endpoint.

Schools

Smaller, typically rural, schools with one high school building per district with a minimum of one competitive food venue (vending, ALC, school store) were selected for this study. A previous study (Wenz, Litchfield) suggested that although LWPs were established at the district level and applied to all buildings in the district, differences between buildings existed relative to interpretation and implementation. Therefore, this study elected to narrow the focus to examine the influence of the LWP in districts with just one high school, which is the predominant setting of competitive foods in the K-12 educational setting. High schools interested in the school nutrition environment were recruited for participation in one of two ways: 1. schools were contacted after exclusion from participation in the previous school nutrition environment study; or, 2. schools contacted the research team following promotion of the project at a state school nutrition conference. Schools were selected to geographically represent all areas of Iowa (Figure 7). Demographic profiles of the six communities appear in Table 1. Schools were randomly assigned to either the control (n=3) or intervention (n=3) group by the researchers. Baseline school visits occurred in September or October, 2008 and endpoint school visits occurred in March, 2010. Schools were required to contribute 140 match hours and were compensated \$10,000 for participation (\$5,000 after the initial school

visit and \$5,000 after the final school visit). Schools were encouraged to utilize these funds to support the school nutrition environment through various avenues (i.e. purchase equipment, offer taste-testing, promotions, increasing competitive food variety, etc.). Contracts were established with each participating school and were signed by a school district representative. All study protocols were approved by the Iowa State University Human Subjects Review Board.

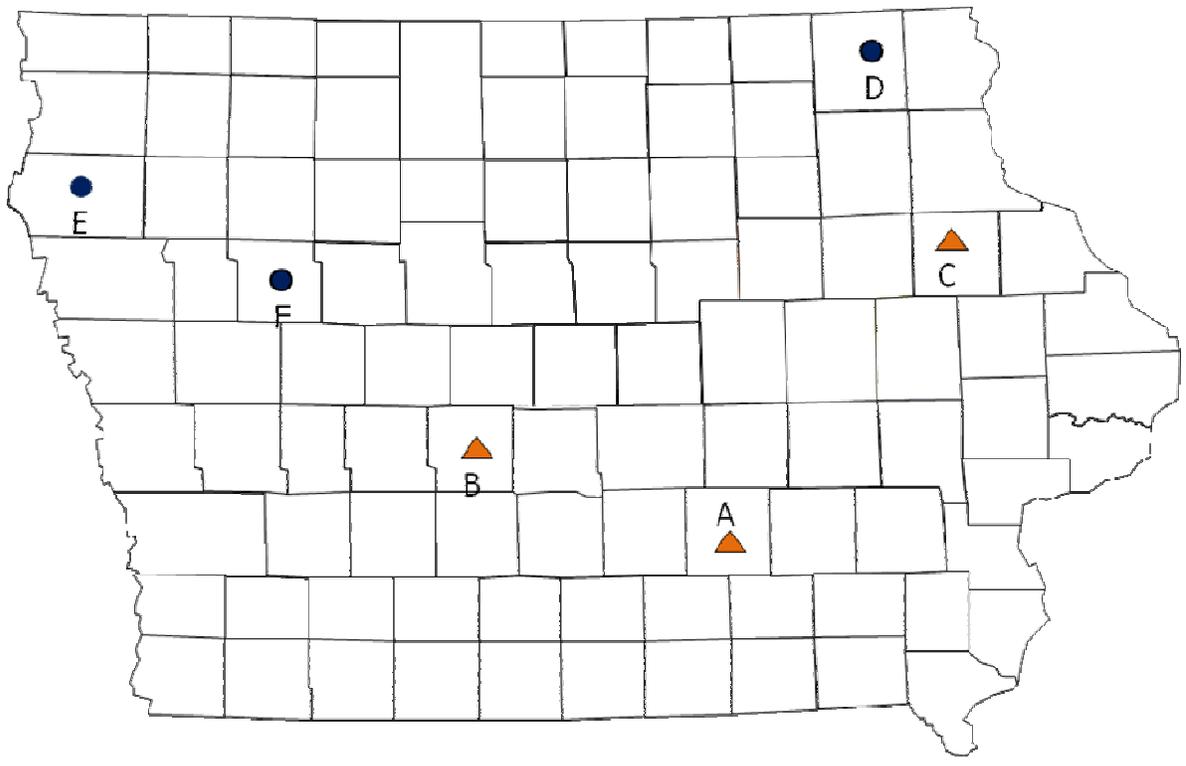


Figure 7. Location of Schools throughout Iowa

-  Intervention Schools
-  Control Schools

Table 1. Community Demographics of Participating Schools

	Intervention			Control		
High School	A	B	C	D	E	F
Population ^c	10,938	7,633	5,257	8,172	9,237	605
Median Age (years) ^c	36.4	34.6	38.0	29.8	36.9	37.3
Mean Family Size ^c	2.9	3.1	3.0	2.8	3.1	3.0
Median Family Income (\$) ^c	42,138	41,771	39,219	49,668	47,409	40,521
Families below poverty (%) ^c	10.6	8.9	8.4	2.7	4.5	8.1
High School Enrollment 2008-09/ 2009-10 ^b	778/728	566/532	589/549	581/578	675/666	113/106
High School Graduates (% >25 yrs) ^c	81.2	75.5	84.7	84.7	85.7	84.2
BS degrees (% >25 yrs) ^c	19.2	10.4	19.1	30.6	21.3	11.9
High School Eligible Free/ Reduced Lunch (%) 2008-09/2009-10 ^a	32.1/37.9	54.1/61.1	18.2/17.5	15.3/17.1	14.8/17.6	38.9/30.2

^a Iowa Department of Education (2010a)

^b Iowa Department of Education (2010b)

^c United States Census Bureau (n.d.)

Procedures

A research team of seven individuals (2 faculty, 4 graduate students, and 1 undergraduate student) were trained on gathering and documenting data. All research staff

were trained on how to administer the HL and food perceptions assessment tools to students. They were also trained on using the competitive foods inventory forms by practicing with campus vending machines and one non-participating high school. One faculty member administered all interviews and one graduate student administered all student focus groups. Research staff measuring unstructured line scales of food perceptions were trained to measure similarly by comparing measurements from various unstructured line scale examples.

Schools were contacted by phone to schedule the initial school visit. Foodservice personnel, principals, or teachers served as the primary contact at each school and were responsible for recruiting and scheduling student subjects and scheduling interviews with wholesale food providers.

Each school contact was instructed to recruit 50 freshman and/or sophomore students from their school to participate in HL and food perceptions assessments. They were also required to recruit 8-10 freshman and/or sophomore students to participate in the focus group discussion.

Baseline School Visit

A consent form signed by the student and parent/guardian was required for participation in student assessments and the focus group (Appendix A). Many school contacts used incentives (i.e. ALC coupons, chips, pizza) for recruiting students to increase the likelihood of consent forms being signed and returned. Research staff collected student consent forms on the day of the initial school visit.

Student Health Literacy Assessment

Student HL and food perceptions assessments were conducted in a semi-private to private location in the school. Researchers collected the student's signed informed consent and seated the student facing the research staff member. The researcher administered the HL assessment, the Newest Vital Sign (Appendix B); (Pfizer Inc., 2008), a tool composed of a written script consisting of six questions about the Nutrition Facts Panel of a pint of ice cream. Students utilized the Nutrition Facts Panel to answer six verbally administered

questions regarding calories, servings and portion size, saturated fat, percent daily value, ingredients, and allergies. Students' response to each question was coded as correct or incorrect. The sixth question was asked only if the student correctly answered the fifth question, as the tool instructed. Questions could be repeated as often as necessary and research staff provided no additional guidance other than what was included in the tool script. If students did not know the answer or asked to skip a question, it was marked as incorrect. The Newest Vital Sign classifies students as: 1. high likelihood of limited literacy; 2. possibility of limited literacy; or 3. almost always adequate literacy, which corresponded with 0-1, 2-3, and 4-6 correct answers, respectively. Students were given the Nutrition Facts Panel and paper and pencil for any necessary math calculations. Used paper was discarded immediately after each HL assessment such that successive students would not see others' calculations or answers.

The Newest Vital Sign has been validated against the TOFHLA in a population of adults 18 years of age or older (Weiss, et al., 2005). To ensure appropriateness for the current study population, the reading level and math skills required were examined by the research team. Flesch-Kincaid reading grade level of the Newest Vital Sign questions and Nutrition Facts Panel was 7.2. Mathematics standards and benchmarks established by the IDE (2008) suggested the math skills were appropriate for those completing the eighth grade; a veteran math teacher (H. Lester, personal communication) agreed the mathematical concepts required by the tool were appropriate for freshman and/or sophomore students.

Student Food Perceptions Assessment

After completing the Newest Vital Sign, the student was sent to a nearby desk or table to complete the food perceptions assessment (Appendix C). An unstructured line scale (American Society for Testing and Materials, 1968) (0-15 cm) was used to gather students' perceptions on six items typically sold in competitive food venues (Baked Lays[®], Gatorade[®], NutriGrain bar[®], Chex Mix[®], Snickers[®], and ice cream sandwich). The unstructured line was chosen to examine even slight changes in students' food perceptions and are commonly used in food sensory research. Students' perceptions of six attributes previously identified by adolescents as influencing food choices (expensive, tastes good, healthy, boosts energy,

improves mental performance, and improves physical performance) (O'dea, 2003; Shannon, et al., 2002) were explored. The line scales were labeled with agree or disagree at polar ends. Written instructions as well as a picture of each product appeared at the top of each page. Students were verbally instructed to place a mark clearly on the unstructured line for each attribute indicating their perception. Food perceptions were measured to the nearest tenth of a centimeter with a constant wood ruler.

Each student's HL and food perceptions assessment was labeled with the same three number code for identification purposes. The HL and food perceptions assessment took approximately 5-10 minutes per student and 1-2 hours per school (total of ~50 students).

Student Focus Groups

Student focus groups were administered in a private setting and audio-recorded. Freshman and/or sophomore students (n=8-10) who returned signed informed consents were allowed to participate. The same researcher led all discussions using a tailored script (Appendix D); both the researcher and students wore nametags displaying first names. Students were asked to share their thoughts and opinions about competitive foods and competitive food venues in their school. Questions probed for information relative to the locations of venues, factors influencing purchasing (i.e. size, price, taste, and nutritional value of products), advertisement, and possible changes and/or improvements. No questions were asked about particular competitive food venues if they were not available in a school (i.e. ALC, school store). One baseline student focus group was repeated with a different sample of students. A school authority member was present during the initial discussion, which could influence/alter student responses. Each student focus group took approximately 30-45 minutes to complete.

School Food Service and Wholesale Food Provider Interviews

Wholesale food providers and school food service personnel were required to sign an informed consent for participation in a structured interview (Appendix A). Interviews were administered in a private setting and audio-recorded. The number of wholesale food providers participating in each discussion varied depending on the number of providers

utilized by each school district. The same researcher led all interviews using a tailored script (Appendix D). Wholesale food providers were asked to share their thoughts and opinions about competitive foods and current school practices. Questions probed for information related to competitive food venues, past changes observed, changes they would like to see, future projections, food and beverage choices offered, factors influencing options offered, use/dispersement of revenues, and components of contractual agreements with wholesale providers. Phone interviews with wholesale food providers were conducted when necessary with notes taken during the interview by the researcher. Interviews took approximately 30-45 minutes to complete.

Inventory of Competitive Foods

Locations of all venues selling competitive foods to high school students during the school day were made known to the researchers by school personnel. All competitive food and beverage venues were inventoried including vending machines, ALC, and school stores. Data of all food and beverages offered in these venues was documented using the assessment tools developed by Dr. Robert C. and Veronica Atkins Center for Weight and Health, University of California, Berkeley (2007). Researchers listed all vending machines, ALC lines, and school stores on the cover sheet (Appendix E). This form allowed researchers to list and describe each venue, identify the venue location and the group/program operating the venue, the days and hours of operation, and school personnel contact information.

Researchers inventoried beverage vending machines available to students using beverage vending machine instruments (Appendix F). This form included characteristics of each vending machine such as: location, advertising, number of slots, if the machine was on or off during the observation, and who the machine was accessible to (staff or students). Only vending machines available to students were used for data analysis. Beverage inventory included type, number of slots, range of sizes, and additional comments for each item. A list of common beverage categories by nutrient criteria was included on this form. Grams of sugar per serving for flavored milks was also recorded.

Food vending instruments were used to inventory food and food/beverage vending machines available to students (Appendix G). Similar to the form for beverage vending, this

instrument collected information on the location, advertising, number of slots, availability to staff and students, and whether the machine was on or off during the observation. A list of common food categories, categorized by nutrient criteria as meeting or not meeting California SB-12 law (California Senate Bill 12, 2005) was included.

An ALC/school store form was used to gather data on competitive food and beverage items not sold in vending (Appendix H). This instrument included the same venue characteristics as the food and beverage vending instruments and also included a place to indicate the specific type of venue inventoried. However, instead of recording the number of slots occupied by foods or beverages in vending machines, the number of varieties was recorded for ALC and school stores. For example, four slots may be occupied by various flavors of sports drinks in a vending machine (recorded as four slots) whereas six different flavors of sports drinks may be available in ALC (recorded as six varieties).

When a food or beverage product did not easily fit within a pre-determined category provided on the forms, it was written in with the full product name, product type, weight or volume, number of calories, number of slots or varieties, if prepared in-house, and any special formulations for further analysis and later categorization. If required information was missing for products identified or written in, researchers contacted schools to gather needed information or utilized various internet sources for nutrient information on specific or like items.

Competitive food inventory data was entered by venue. Food items were categorized as meeting or not meeting California SB-12 standards and beverage items according to the IOM standards (IOM, 2007).

Local Wellness Policies

Each school's LWP nutrition guidelines for competitive foods sold in the school were examined and scored (Appendix I). These policies were gathered from school websites or emailed/faxed to research personnel from the school. Schools were given a score of 0-1 (0= not addressed in policy, 0.5= somewhat addressed in policy, or 1= adequately addressed in policy) on 19 attributes. A point was awarded for each venue (i.e. vending, ALC, concessions, school stores, fundraising, parties, rewards, and snacks) and time of day (i.e. the

school day, part of the school day, and after school events) covered by the nutrition guidelines. In addition, a point was awarded for each nutrient criteria included in the wellness policy (i.e. portion size, calorie limit, fat limit, saturated fat limit, trans fat limit, sugar limit, and sodium limit). These points were tallied and a total LWP score was given (total score range 0-19 points). The same researcher scored all LWPs at baseline and endpoint.

Intervention

Intervention schools received nine nutrition social marketing messages from January-May and August-December, 2009. Messages included a blend of budget, convenience, and social aspects, previously suggested to be effective in student messaging (Horacek & Betts, 1998). Areas where students performed poorly on the HL assessment (i.e. portion sizes, % Daily Value) and information gathered from focus group discussion were incorporated into the messages (Table 2). For example, when asked about food and/or beverage advertising, students from each participating school identified Gatorade® as a common brand. This information suggested the use of brand name products in nutrition messaging could be effective to influence food choices and/or perceptions.

Intervention schools also received technical assistance in the form of two webinars. The first webinar educated school contact personnel on promotion of healthy food and beverage options using the six P's of marketing including person #1 (the customer), product, price, place, promotion, and person #2 (the seller). The second provided an update on the Healthy Kids Act effective for the 2010-11 academic year. This state legislation established nutrition standards for competitive food and beverages sold during the school day (first bell to last bell) (IDE, n.d.-a).

Letters were drafted explaining the duties of the intervention and control schools (Appendix J). Intervention schools were required to commit to a minimum of three changes in their school nutrition environment and were provided suggestions for changes based on information gathered during the baseline visit in their letter. Intervention schools could also request one additional site visit during the course of the study for additional assistance if desired. Follow-up calls and emails were used to check the status of the three identified

changes throughout the study. Control schools received all components of the intervention (i.e. nutrition messages, webinar access, and technical assistance) after project completion.

Table 2. Nutrition messaging topics and Media

Month	Topic	Media
January	Servings and Portion Sizes	Poster
February	Sugar in Valentine Candy	Poster
March	March Madness Bracket: Pick the Healthiest Food/Beverage	Interactive Poster
April	April Fools: Fact or Fiction Nutrition Topics	Interactive Poster
May	How to interpret the % Daily Value on a Food Label	Poster
August-September	Use the Stoplight Method to Rate Various Beverages	Display
September-October	How to Read a Food Label, Soda Consumption, Breakfast, Fruits & Vegetables, Physical Activity	Weekly Videos (N=4)
October-November	Use a Food Label to Make a Healthy Food or Beverage Choice	Poster
November-December	Amount of Different Winter Activities Needed to Burn Favorite Winter Foods	Poster

Endpoint School Visit

All schools were contacted by phone to schedule the final school visit. School contact personnel were required to identify and locate the same 50 (now sophomore/junior) students from baseline assessments to perform the HL and food perceptions assessments.

Intervention schools were also required to recruit 8-10 sophomores/juniors for participation in a focus group discussion. Finally, school contact personnel were queried regarding the success and/or failure of the three required changes to their school nutrition environment.

Student Health Literacy Assessment and Food Perceptions Assessment

Health literacy and food perceptions assessments were completed with the same students from baseline using the same protocols previously described. Consent forms signed at baseline included consent for the endpoint assessment measurements. An example of how to properly place a mark on the unstructured lines of the food perceptions assessment was provided to facilitate ease in measuring responses. Using the example, students were instructed to place a single vertical mark on the unstructured line. Students not completing endpoint assessments (HL and/or food perceptions) were not included in statistical analysis.

Student Focus Groups

A final student focus group discussion was conducted at each intervention school and was administered in a private setting and audio-recorded. A consent form signed by the student and parent/guardian to participate which was collected by the researcher prior to participation (Appendix A). The same researcher led all discussions using a tailored script (Appendix D) and both the researcher and students wore nametags displaying first names. Students were asked to share their thoughts and opinions regarding nutrition messaging and change in competitive food venues. Questions probed for information related to general nutrition messaging in their school, contents or attributes of the messages provided through the project, recommended modifications to the messages, and recent changes observed in vending machines, ALC, and school store venues at their school. Each focus group discussion took approximately 30-45 minutes to complete.

Inventory of Competitive Foods and Local Wellness Policies

All competitive food venues (i.e. vending machines, ALC, and school stores) were inventoried at endpoint using the same protocols and tools as previously described. Local Wellness Policies were also evaluated and scored with the same procedures as previously noted.

Data Analysis

Analysis of data was conducted using the Statistical Package for Social Sciences for Windows (SPSS for Windows, version 18.0, 2009). The level of significance used for all statistical analysis was $p < 0.05$.

Statistical Analysis for Manuscript 1 (Chapter IV)

Student Health Literacy Assessment

Chi Square and Independent samples t-tests were used to examine performance at baseline and endpoint on individual questions and total score between control and intervention groups as well as the total sample. Paired samples t-tests and repeated measures ANOVA examined the change in performance from baseline to endpoint. Dependent factors using the repeated measures ANOVA model were the six HL questions and total score (baseline and endpoint). Independent factors included in the model were gender and group designation (control/intervention) while FRP and average enrollment of schools were entered as covariates.

Wilcoxon Signed Ranks Test was used to examine the change in HL classification in control and intervention groups at baseline and endpoint. Multinomial Logistic Regression was used to predict change in HL performance by question. Independent factors were gender, group designation (control/intervention), and baseline score for each question (correct/incorrect), with FRP and enrollment as covariates. To predict change in HL total score a General Linear Model (Univariate ANOVA) was used with gender and group (control/intervention) as independent factors, and FRP, enrollment and baseline total score as covariates.

Student Food Perceptions Assessment

Two new variables were created to capture the perception of food items perceived by students as 'healthy' or 'unhealthy.' Means of each food item on the attribute 'healthy' were calculated and rank ordered. One sample t-tests indicated the means of all six food and/or beverage items on the attribute 'healthy' were significantly different from each other. The two food and/or beverage items perceived as most 'healthy' by the students were Baked

Lays[®] and Gatorade[®] while the two perceived as most ‘unhealthy’ were ice cream sandwich and Snickers[®]. The means for each of the remaining attributes (expensive, tastes good, boosts energy, improves mental performance and improves physical performance) were averaged from the two items perceived as most ‘healthy’ and ‘unhealthy’ for further analysis by student perception of ‘healthiness.’

Unstructured line scale responses ranged from 0-15 cm with agree and disagree labeled at polar ends. Because a response of 7.5 was considered neutral, mean unstructured line scale responses were modified such that the scale’s zero value was set at the line’s midpoint instead of the line’s endpoint. Modified mean values ranged from -7.5 and 0 (indicating disagree), or 0 and 7.5 (indicating agree). Mean values were divided by 7.5 to reflect proportional agreement or disagreement at baseline and endpoint.

Independent samples t-tests were used to examine differences in food perceptions (attributes including expensiveness, tastes good, boosts energy, improves mental performance and improves physical performance) by control/ intervention groups and gender. Repeated measures ANOVA explored change in food perceptions from baseline to endpoint. Baseline and endpoint perceptions were dependent variables in the model, while group designation (control/intervention) and gender were entered as independent variables, FRP and enrollment were entered as covariates. A General Linear Model (Univariate ANOVA) examined factors influencing students’ perceptions of the five attributes for the ‘healthy’ and ‘unhealthy’ variables at endpoint. The dependent variable was endpoint food attribute, gender and group designation (control/intervention) were independent variables, and FRP, enrollment and baseline food perceptions were entered as covariates in the model.

Table 3. Baseline Means (\pm SD) of the Six Food/Beverage Items

Food/Beverage Item	Baseline Mean (\pm SD)
Nutrigrain Bar®	3.2 (2.3)
Gatorade®	5.6 (3.4)
Chex Mix®	6.7 (3.1)
Baked Lays®	8.6 (3.7)
Ice Cream Sandwich	10.1 (2.6)
Snickers®	10.9 (2.3)

Focus Group Discussions

Focus group analysis was performed using a previously established method (Krueger, 1988). All focus group discussions were transcribed and read by members of the research team. Notes were made about each school as well as overall themes and patterns of all schools. After individually reading the focus group discussions the research team collectively discussed findings and came to a consensus on final interpretations. Descriptive phrases or words were identified as well as interesting quotes from participants. Brief summary reports were developed encompassing the main ideas and themes. Results from the focus groups were used to support or negate quantitative findings.

Statistical Analysis for Manuscript 2 (Chapter V)

Analysis of data was conducted using the Statistical Package for Social Sciences for Windows (SPSS for Windows, version 18.0, 2009). The level of significance used for all statistical analysis was $p \leq 0.05$. Competitive foods and food perceptions quantitative data was analyzed with descriptive statistics including frequencies and Chi-square analysis as well as paired samples and independent samples t-tests. A General Linear Model (Repeated Measures ANOVA) was used to examine change in and factors influencing food perceptions by gender. Qualitative data analysis of focus groups was performed using a previously established method (Krueger, 1988).

CHAPTER IV: CAN SOCIAL MARKETING NUTRITION MESSAGING INFLUENCE ADOLESCENT HEALTH LITERACY AND FOOD PERCEPTIONS?

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Abstract

Health literacy and food perceptions influence health knowledge, behaviors, and subsequent health status. Improving health literacy and modifying food perceptions through social marketing nutrition messaging may prove beneficial, particularly in youth. Therefore, the purpose of this study was to examine the impact of social marketing nutrition messaging on health literacy and food perceptions in high school adolescents. Students completed health literacy (N=255) and food perception assessments (N=253) in fall 2008 and spring 2010. Social marketing nutrition messages were displayed in intervention schools (n=3) over the course of the study. The Newest Vital Sign assessment includes questions about a Nutrition Facts Panel and categorizes individuals into three health literacy categories. The food perceptions assessment consisted of an unstructured line (0-15 cm) gathering students' perceptions on six items typically sold in vending machines, ala carte, and school stores relative to six food attributes (expensive, tastes good, healthy, boosts energy, improves mental performance and improves physical performance). Few changes were seen from the intervention, indicating health literacy and food perceptions may be difficult to change through social marketing nutrition messaging. Interestingly, gender appears to play a role in food perceptions, understanding these gender differences may help to create more effective gender-specific messaging.

Introduction

Approximately nine out of 10 adults lack the ability to manage their health and prevent disease (United States Department of Health and Human Services [HHS], 2008a).

The Institute of Medicine (IOM) (2004) reports nearly 50% of American adults have trouble understanding and utilizing health information. In contrast, evaluation of health literacy (HL) among U.S. adults (≥ 16 years) suggests only 12% are proficient, 53% intermediate, and the remaining 36% are basic or below basic HL (Kutner, et al., 2006; HHS, 2007). Tools commonly used to assess adult HL are fundamentally based on reading ability. However, HL encompasses more than reading ability including writing, numeracy, listening, and speaking skills (Nielsen-Bohlman, et al., 2004). A more recent measure of HL, the Newest Vital Sign, utilizes a food label to categorize individual HL and incorporates listening, reading, numeracy, and speaking skills (Weiss, et al., 2005).

HL is the degree to which individuals have “the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions” (HHS, 2008b). HL has been identified as an issue of concern for adolescents because half (46%) of 10-19 year olds read below their grade level and 9% (4.7 million) of 5-17 year olds have some level of cognitive difficulty (Davis, et al., 2006; Pastor, et al., 2009). Adolescence is as an opportune age to foster HL as youth move from concrete to more abstract reasoning (Piaget, 1977).

Ultimately, the inability to adequately assess and interpret health information likely influences health choices and behaviors. As HL decreases, knowledge of health problems and disease prevention/management also decreases (Gazmararian, et al., 2003; Lindau, et al., 2002). Reports of poor health outcomes and increasing healthcare costs are associated with decreasing HL (Baker, et al., 1998; M. Gordon, et al., 2002; Kutner, et al., 2006; Schillinger, et al., 2003).

HL likely influences food choices and behaviors; however, food perceptions are also important. Perception is defined as the attainment of awareness or understanding through the senses (Simpson & Weiner, 2009). Food perceptions can be thought of as views or beliefs about food determined by past experiences, which influence food choices and consumption patterns (Solms & Hall, 1981). Previous research suggests that gender may influence food behaviors (Harnack, Story, Martinson, Neumark-Sztainer, & Stang, 1998; Levi, Chan, & Pence, 2006; Shannon, et al., 2002). Food perceptions are part of the food selection process and understanding this process is necessary for the implementation of nutrition

recommendations, dietary guidelines, and subsequent modification of eating behavior (Kronl & Coleman, 1988).

Adolescents tend to describe foods as ‘good’ or ‘bad’, which is a barrier to healthy eating and inhibits an accurate understanding of dietary balance (Stevenson, et al., 2007). Adolescents have also identified obstacles for following nutrition guidelines including lack of time, limited availability of healthy food options in school, and lack of concern (Croll, et al., 2001). Yet, youth have identified strategies for overcoming barriers to more healthful eating including increasing education about ‘healthy eating’ in school and increasing advertisement of ‘healthy foods’ (O’dea, 2003). This suggests nutrition messaging in schools may be an effective method for modifying adolescent food perceptions and behavior. Nutrition messaging using a social marketing approach has been proposed as necessary for promoting nutrition to youth (Horacek & Betts, 1998).

Recently, a national action plan to improve HL has been proposed including goals for improving HL through school curricula (K-12) and outside the clinical setting (HHS, 2010a). Yet, research investigating adolescent HL is inadequate; the majority of HL studies have investigated adults. Food perceptions are an important component of HL related to food choices, behaviors, and subsequent health status. Social marketing nutrition messaging has been suggested by both adolescents and researchers for promoting nutrition and health. Thus, the purpose of this study was to examine the influence of social marketing nutrition messaging on HL and food perceptions in a sample of high school adolescents.

Methods

Schools

Smaller, typically rural, schools in one Midwest state with one high school building per district were selected for this study. High schools were recruited for participation in one of two ways: 1. schools were contacted after exclusion from participation in a previous school nutrition study; or, 2. schools contacted the research team following promotion of the project at a state school nutrition conference. Schools were selected to geographically represent all areas of Iowa and were randomly assigned to either the control (n=3) or intervention (n=3) group by the researchers. Enrollment and free and reduced price meals

participation (FRP) rate of the six participating schools ranged from 110-753 students and 16.2%-57.6%, respectively, throughout the course of the study.

Baseline school visits occurred in September or October, 2008 and endpoint school visits occurred in March, 2010. Schools were required to contribute 140 match hours and were financially compensated for participation.

A research team of seven individuals (two faculty, four graduate students, and one undergraduate student) were trained on gathering and documenting data. All research staff were trained on administration of the HL and food perceptions assessment tools. To ensure consistency and inter-researcher reliability, research staff were trained on measuring unstructured line scales of food perceptions. All study protocols were approved by the University Human Subjects Review Board.

Baseline School Visit

Schools were contacted by phone to schedule the initial school visit. Foodservice personnel, principals, or teachers served as the primary contact at each school and were responsible for recruiting and scheduling student subjects. Each school contact was instructed to recruit 50 freshman and/or sophomore students from their school to participate in HL and food perceptions assessments.

Student Health Literacy and Food Perceptions Assessments

An informed consent signed by the student and parent/guardian was required for participation in HL and food perceptions assessments, conducted in a semi-private to private location in the school. The researcher administered the HL assessment, the Newest Vital Sign (Pfizer Inc., 2008), a tool composed of a written script consisting of six questions about the Nutrition Facts Panel of a pint of ice cream. Students utilized the Nutrition Facts Panel to answer six verbally administered questions regarding calories, servings and portion size, saturated fat, percent daily value, ingredients, and allergies (Table 1). Students' response to each question was coded as correct or incorrect. The sixth question was asked only if the student correctly answered the fifth question, as the tool instructed. The Newest Vital Sign classifies students as: 1. high likelihood of limited literacy; 2. possibility of limited literacy;

or 3. almost always adequate literacy, which corresponded with 0-1, 2-3, and 4-6 correct answers, respectively. Students were provided paper and pencil for any necessary math calculations.

The Newest Vital Sign has been validated against the Test Of Functional Health Literacy in Adults (TOFHLA) in a population of individuals 18 years of age or older (Weiss, et al., 2005). To ensure appropriateness for the current study population, reading and math skills required for this tool were assessed. Flesch-Kincaid reading grade level of the Newest Vital Sign questions and Nutrition Facts Panel was 7.2. Mathematics standards and benchmarks established by the Iowa Department of Education (2008) suggested the math skills were appropriate for those completing the eighth grade; a veteran math teacher (H. Lester, personal communication) agreed the mathematical concepts required by the tool were appropriate for freshman and/or sophomore students.

After completing the Newest Vital Sign, the student completed the food perceptions assessment. An unstructured line scale (American Society for Testing and Materials, 1968) (0-15 cm) was used to gather students' perceptions on six items typically sold in vending machines, ala carte (ALC), and school stores (Baked Lays[®], Gatorade[®], Nutrigrain bar[®], Chex Mix[®], Snickers[®], and ice cream sandwich). Students' perceptions of six attributes previously identified by adolescents as influencing food choices (expensive, tastes good, healthy, boosts energy, improves mental performance and improves physical performance) were explored (Bissonnette & Contento, 2001; O'dea, 2003; Shannon, et al., 2002). Line scales were labeled with agree or disagree at polar ends. Written instructions as well as a picture of each product appeared at the top of each page. Students were verbally instructed to place a mark clearly on the unstructured line for each attribute indicating their perception. Food perceptions were measured to the nearest millimeter with a constant wood ruler. Each student's HL and food perceptions assessment was labeled with the same three number code for identification purposes. The HL and food perceptions assessment took approximately 5-10 minutes per student and 1-2 hours per school (~50 students each).

Intervention

Intervention schools received nine social marketing nutrition messages throughout the course of the study. Messages included a blend of budget, convenience, and social aspects, previously suggested to be effective in student messaging (Horacek & Betts, 1998). Areas where students performed poorly on the HL assessment (i.e. portion sizes, % Daily Value) were also incorporated into the messages, which were presented in a blend of interactive and visual media (i.e. posters, displays, and videos) (Table 2).

Letters were drafted explaining the duties of the intervention and control schools. Researchers noted potential changes schools could make from the baseline school visit and provided intervention schools with suggestions to help them identify three changes to make over the course of the study. Intervention schools were required to display the social marketing nutrition messages for approximately one month each in the cafeteria or areas where competitive foods in vending machines, ALC, and school stores were sold. Intervention schools could also request one additional site visit during the course of the study for additional assistance if desired. Control schools received all components of the intervention after project completion.

Endpoint School Visit

All schools were contacted by phone to schedule the final school visit. School contact personnel were required to identify and locate the same 50 (now sophomore/junior) students from baseline assessments to perform the HL and food perceptions assessments.

Student Health Literacy Assessment and Food Perceptions Assessment

HL and food perceptions assessments were completed using the same protocols previously described. Students not completing endpoint assessments (HL and/or food perceptions) were not included in statistical analysis.

Data Analysis

Analysis of data was conducted using the Statistical Package for Social Sciences for Windows (SPSS for Windows, version 18.0, 2009). The level of significance used for all statistical analysis was $p \leq 0.05$.

Student Health Literacy Assessment

Chi Square and Independent samples t-tests were used to examine performance at baseline and endpoint on individual questions and total score between control and intervention groups as well as the total sample. Paired samples t-tests and repeated measures ANOVA examined the change in performance from baseline to endpoint. Dependent factors using the repeated measures ANOVA model were the six HL questions and total score (baseline and endpoint). Independent factors included in the model were gender and group designation (control/intervention) while school FRP was entered as a covariate.

Wilcoxon Signed Ranks Test was used to examine the change in HL classification in control and intervention groups at baseline and endpoint. Multinomial Logistic Regression was used to predict change in HL performance by question. Independent factors were gender, group designation (control/intervention), and baseline score for each question (correct/incorrect), with FRP as a covariate. To predict change in HL total score a General Linear Model (Univariate ANOVA) was used with gender and group (control/intervention) as independent factors, and FRP and baseline total score as covariates.

Student Food Perceptions Assessment

Two new variables were created to capture the perception of food items perceived by students as 'healthy' or 'unhealthy.' Means of each food item on the attribute 'healthy' were calculated and rank ordered. One sample t-tests indicated the means of all six food and/or beverage items on the attribute 'healthy' were significantly different from each other. The two food and/or beverage items perceived as most 'healthy' by the students were Baked Lays® and Gatorade® while the two perceived as most 'unhealthy' were ice cream sandwich and Snickers®. The means for each of the remaining attributes (expensive, tastes good, boosts energy, improves mental performance and improves physical performance) were

averaged from the two items perceived as most ‘healthy’ and ‘unhealthy’ for further analysis by student perception of ‘healthiness.’

Unstructured line scale responses ranged from 0-15 cm with agree and disagree labeled at polar ends. Because a response of 7.5 was considered neutral, mean unstructured line scale responses were modified such that the scale’s zero value was set at the line’s midpoint instead of the line’s endpoint. Modified mean values ranged from -7.5 and 0 (indicating disagree), or 0 and 7.5 (indicating agree). Mean values were divided by 7.5 to reflect proportional agreement or disagreement at baseline and endpoint.

Independent samples t-tests were used to examine differences in food perceptions (attributes including expensiveness, tastes good, boosts energy, improves mental performance and improves physical performance) by control/ intervention groups and gender. Repeated measures ANOVA explored change in food perceptions from baseline to endpoint. Baseline and endpoint perceptions were dependent variables in the model, while group designation (control/intervention) and gender were entered as independent variables, FRP and enrollment were entered as covariates. A General Linear Model (Univariate ANOVA) examined factors influencing students’ perceptions of the five attributes for the ‘healthy’ and ‘unhealthy’ variables at endpoint. The dependent variable was endpoint food attribute, gender and group designation (control/intervention) were independent variables, and FRP, enrollment and baseline food perceptions were entered as covariates in the model.

Results

Health Literacy

Approximately 85% of student subjects were retained from baseline to endpoint for a total of 255 students (118 males, 137 females; 130 control, 125 intervention) completing the HL assessment. Loss of subjects was experienced equally among schools and was primarily the result of students moving out of the district. Classification of HL using the Newest Vital Sign at baseline and endpoint appear in Figure 1. Questions missed most frequently on the HL assessment were #1 and #4 addressing portion size and percent daily value (%DV), respectively (Table 1).

The proportion of students in each HL category by control and intervention groups at baseline and endpoint appear in Figure 2. The shift from lower HL categories at baseline to higher HL categories at endpoint was significant in the intervention group ($p < 0.001$) and a trend ($p = 0.056$) in the control group. The total sample of students ($N = 255$) improved significantly on HL questions #1 through #5 and total score from baseline to endpoint (Table 2). In addition, the intervention group exhibited significantly greater improvement from baseline to endpoint on questions #4 and #5 relative to the control group. Chi Square analysis revealed there was a significant difference between groups (control/intervention) on questions #3, #4, and #5 at baseline, but only the significant difference on question #3 between groups persisted to endpoint.

The Multinomial Logistic Regression model for predicting change in performance on individual questions was significant ($p < 0.001$); data not shown. The Nagelkerke Pseudo R-Square ranged from 0.5-0.7 for each question. Results from General Linear and Multinomial Logistic Regression models revealed the only factor significantly predicting performance on each HL question and total score was the baseline score for each question and total score. The repeated measures ANOVA results; which adjusted baseline and endpoint responses for FRP, gender and group (control/intervention) revealed significant improvement on question #5 and total score for the total sample (Table 2). This model suggests gender significantly influenced the change in total HL score, though the amount of change was not significant. Further investigation using independent samples t-test revealed that males exhibited more improvement from baseline to endpoint, but not significantly.

Food Perceptions

A total of 253 students (117 male, 136 females; 130 control, 123 intervention) successfully completed the food perceptions assessment at baseline and endpoint. Over the course of the study the total sample was significantly more likely to disagree that 'healthy' and 'unhealthy' foods taste good and that 'healthy' foods boost energy (data not shown). Conversely, the total sample was significantly more likely to agree that 'unhealthy' foods improve mental and physical performance over the course of the study (data not shown). Significant changes in students' perceptions of 'healthy' and 'unhealthy' food attributes by

control/intervention are illustrated by Figure 3. The intervention and control groups' perception of 'healthy' foods improving physical performance and expensiveness moved significantly in opposite directions over the course of the study. The control group was more likely to disagree that 'healthy' foods improve physical performance and were expensive whereas the intervention group favored 'healthy' foods as improving physical performance and being expensive (Panel A and B). Further examination of the data revealed the intervention group had a significantly higher FRP rate than the control group (38.8% and 20.6%, respectively). A similar perception was observed between groups relative to the expensiveness of 'unhealthy' foods, but was not significant ($p=0.085$) (Panel B).

Results of the repeated measures ANOVA suggested that gender significantly influenced the amount of change and overall perception (averaged perception of baseline and endpoint) of multiple 'healthy' and 'unhealthy' food attributes. Change in food perceptions was examined in more depth by gender using independent samples t-tests. The only significant change in food perception by gender was males were more likely to significantly disagree that 'unhealthy' foods were expensive (data not shown). However, a number of interesting differences existed in overall perception of 'healthy' and 'unhealthy' foods by gender (Figure 4).

General directions of agreement and disagreement of 'healthy' and 'unhealthy' foods was similar for both genders on most attributes at baseline and endpoint. Both genders believed 'healthy' foods were less tasty, boost energy more, and improve mental and physical performance more than 'unhealthy' foods. Little difference was seen in the perception of expensiveness of 'healthy' and 'unhealthy' foods (Panel E). However, males were significantly more likely than females to agree that 'healthy' foods boost energy; a difference which persisted from baseline to endpoint (Panel B). Females on the other hand, were more likely to disagree that 'unhealthy' foods boost energy at baseline, but this difference did not persist at endpoint (Panel B). Females were significantly less likely to agree that 'healthy' foods improve physical performance at baseline and more likely to disagree that 'unhealthy' foods improve physical and mental performance at endpoint (panel C and D). Males were significantly more likely to agree that 'unhealthy' foods taste good at endpoint and more likely to disagree that they were expensive at baseline (Panel A and E).

The Univariate ANOVA results, which adjusted for gender, group designation (control/intervention), FRP, enrollment and baseline food perception, suggest the primary factor significantly influencing change in food perceptions of 'healthy' and 'unhealthy' was baseline food perception.

Discussion

The main objective of this study was to examine the influence of social marketing nutrition messaging on HL and food perceptions in a sample of adolescents. The total sample improved significantly on the HL assessment from baseline to endpoint. This was not unexpected since students likely experienced increased nutrition awareness and knowledge over the course of the study from academic curricula and overall maturity.

A significant and surprising finding was the majority (64.1%) of adolescents in the sample had adequate levels of HL at baseline. This likely decreased the possibility of significant improvement from the intervention due to a ceiling effect. However, results did demonstrate a significant shift ($p < 0.001$) in the intervention group from lower HL categories to higher HL categories over the course of the study. The control group also exhibited a trend towards higher levels of HL ($p = 0.056$) over the course of the study. The intervention group improved significantly more on two HL questions compared to the control. This improvement was likely due to the intervention as a nutrition message was tailored specifically for one question (%DV) and multiple messages addressed the Nutrition Facts Panel. Overall, the intervention did not influence change in student HL as much as hoped.

Repeated measures ANOVA results suggest gender significantly influenced the amount of change in total HL score. Further analysis revealed males improved more over the course of the study, but not significantly. One plausible explanation is that females were more familiar with reading a food label at baseline, therefore exhibited less improvement. Previous studies have reported a stronger desire for nutrition labeling information (Shannon, et al., 2002) and attention to nutrient quality among females (Levi, et al., 2006).

A second important finding was adolescents' food perceptions do change, even over a short time frame. For example, the total sample was more likely to disagree that both 'healthy' and 'unhealthy' foods taste good over the course of the project. A plausible

explanation for this difference is related to when the data was collected; data was collected at two different time points during the school year. Final data collection took place in the spring (end of school year) whereas baseline data collection took place in the fall (beginning of school year). At the end of the school year students' food perceptions and attitudes are likely influenced by the fact that they have been exposed to the same competitive foods for the past nine months. Students were also one year older at final data collection and thus, may have accrued more overall exposure to these types of foods compared to baseline. Ultimately, the repetitive exposure to competitive foods in schools may have contributed to the less favorable perception of 'tastes good' for all foods at endpoint.

Students were also more likely to disagree that 'healthy' foods boost energy over the course of the study and were more likely to agree that 'unhealthy' foods improve mental and physical performance more. Adolescents may perceive low fat, low calorie foods as 'healthy' and high fat, high calorie foods as 'unhealthy' (Croll, et al., 2001). It is possible that students perceive 'healthy' foods as providing less energy while 'unhealthy' foods provide longer-lasting, sustainable energy.

Youth prove to be an important target population for advertising and have tremendous marketing potential (McNeal, 1999). Marketing to youth has greatly increased in the past 25 years amounting to roughly \$15 billion spent annually using a variety of methods (Schor, 2004). Youth (8-18 years) watched approximately 4.5 hours of TV, a primary marketing venue, on a typical day in 2009 (V. J. Rideout, Foehr, U.G., Roberts, D.F., 2010), a primary marketing venue. Marketing strategies, including commercial activities, occurring during the study time period may have influenced food perceptions. Commercials promoting 'unhealthy' foods (i.e. Snickers[®]) as improving physical performance may explain why students agreed that 'unhealthy' foods improve physical performance over the course of the study. However, 'healthy' foods (i.e. Gatorade[®]) were also marketed as improving physical performance during this time and were not perceived as improving physical performance in the total sample. Multiple environmental factors make examination of food perceptions among adolescents challenging.

A third finding was that few differences in food perceptions were observed between control and intervention groups, suggesting little impact from the social marketing nutrition

messages. Brand names were incorporated into some of the nutrition messages based on previous research suggesting brand loyalty and awareness are well established by adolescence (Zollo, 1999). Gatorade[®] was used in messaging to promote proper hydration for active individuals and may have contributed to the intervention group being more likely to agree at endpoint that ‘healthy’ foods (Gatorade[®] and Nutrigrain bar[®]) improve physical performance. Additionally, healthy eating and physical activity were also promoted in video messaging which may have also contributed to this change in perception. Quick and healthy snack ideas were presented along with the promotion of fruit and vegetable consumption as well as label reading. Ideas for participating in physically activity were incorporated into the videos such as sports, interactive video gaming, and easy activities students could do at home. These videos promoted a positive association between ‘healthy eating’ and physical activity and likely contributed to this difference observed between control and intervention groups. More appropriate nutrition social marketing efforts may need to incorporate more popular social media technology such as email, internet networking sites (i.e. twitter, Facebook, blogs) and text messaging.

The economic downturn that occurred during this study was a concern of the researchers relative to data interpretation of the food attribute ‘expensive.’ It was expected that students would agree more that all foods were expensive. Surprisingly, little change occurred regarding the perception of expensiveness for the total sample over the course of the study. However, the intervention group was significantly more likely to agree that ‘healthy’ foods were more expensive. Further analysis found a significantly higher FRP rate among intervention (38.8%) compared to control (20.6%). The intervention group FRP rate increased over the course of the study (4.0%) while the control group decreased (1.4%). Previous research has investigated the relationship between a school’s FRP rate and competitive food sales. An inverse relationship has been reported with increase in FRP rate coinciding with decrease in ALC sales (Probart, et al., 2006). This is attributable to family financial status, but can also be influenced by peer pressure and social stigmatism experienced by children from low-income families (Stein, 2008; USDA, 2001b). Ultimately, family financial status likely plays a significant role in some food perceptions of adolescents.

Exploring differences in food perceptions by gender was not originally intended, but provided some interesting results. Males were more likely to have favorable perceptions with a number of food attributes (tastes good, boosts energy, improves mental performance, and improves physical performance) compared to females. It is possible since females pay more attention to the nutrient quality and composition of foods (Levi, et al., 2006), they exhibit more pragmatic and critical food perceptions compared to males. Female adolescents have reported thinking about their weight and agreeing more that ‘eating healthy’ is important compared to males who were less likely to report eating low-fat foods as ‘cool’ (Shannon, et al., 2002). Males were significantly ($p \leq 0.05$) more likely to disagree at endpoint that ‘unhealthy’ foods were expensive compared to females. This result may have occurred because females generally do more food purchasing than males (Harnack, et al., 1998) and may be more aware of foods costs. Conversely, males food choices have been found to be more strongly influenced by “getting more for their money” (Shannon, et al., 2002).

Despite some gender differences, overall perceptions of ‘healthy’ and ‘unhealthy’ foods were similar. In general, adolescents believed ‘healthy’ foods were less tasty, boost energy more, and improve mental and physical performance more than ‘unhealthy’ foods. These findings agree with previous studies as students have reported preferring sweets, chocolate and other energy dense foods and describe healthy foods as tasteless, increasing energy, and improving sports performance (Harrison & Jackson, 2009; Stevenson, et al., 2007).

Limitations

A significant limitation of this study was the short time frame. Changing behavior and particularly perceptions, which are the accumulations of months if not years of prior experience is difficult. Data collection took place at two different time points of the school year, which could influence perceptions; this should be controlled for, or at a minimum taken into consideration in future studies of this kind. Consistent use of the nutrition messages was also a limitation. Schools were instructed on proper placement and duration of each nutrition message. At least one school reported not displaying a nutrition message for the designated

period. This may have influenced the effectiveness of the intervention and impacted results. However, inconsistencies such as this are common in real-world situations and may contribute to increased applicability of social marketing nutrition messages of this kind. Additionally, other environmental factors students were exposed to (i.e. home, commercials/marketing, community, economics etc.) could not be controlled for and likely influenced student HL and food perceptions during this study.

Some of the change in food perceptions may have been influenced by pending state legislation, instituting nutrition standards on the sale of competitive foods in schools. Although final rules were not published until the end of this project, it was on the minds of food service personnel as well as students.

Finally, HL research should be interpreted with caution. HL describes an individual's ability to apply basic literacy skills (i.e. reading, writing, numeracy, etc.) to health-related knowledge and behavior. It is well known that knowledge does not ultimately lead to desired behavior. In addition, many evaluations of HL are based solely on reading skill or ability. In such cases, students with poor reading skills influenced their performance on HL assessment. The researchers propose the Newest Vital Sign may be a more accurate measure of HL by encompassing reading skills in addition to numeracy and oral language skills.

Conclusions

In summary, the social marketing nutrition messaging intervention did not impact HL to the degree expected. Results indicate improving HL through nutrition messaging may be difficult, particularly in populations where the majority of adolescents already possess adequate levels of HL. Interventions such as this may be more effective in populations with low levels of HL such as socio-economically depressed populations, minority groups, and those with learning disabilities. It is likely that improving HL requires a collective effort including classroom curricula, competitive food availability, and nutrition message marketing in the school environment.

This research supports the most recent Dietary Guidelines for Americans (2010) which states any and all systems-based strategies must include a focus on children as a primary preventative strategy for obesity (United States Department of Agriculture, 2010).

The guidelines also recommend that improvements made to the overall school food environment are needed to support implementation of these guidelines including areas of nutrition literacy, comprehensive health, nutrition, and physical education.

Social marketing nutrition messaging also had little influence on food perceptions. Food perceptions can and do change over time; however, numerous factors including the environment, commercial/marketing activity, and gender influence these perceptions. Gender appears to have a fairly influential role in food perceptions. Understanding these gender differences can help create more effective messaging to students for influencing food perceptions, successive food choice, and ultimately health. Future social marketing efforts to promote nutrition or healthy lifestyle behaviors among adolescents need to consider gender-specific messages.

Table 1. Student Health Literacy Assessment Questions

Health Literacy Question	Newest Vital Sign Food Label ^a																														
1. If you eat the entire container, how many calories will you eat?	<table border="1"> <thead> <tr> <th colspan="2">Nutrition Facts</th> </tr> </thead> <tbody> <tr> <td>Serving Size</td> <td>½ cup</td> </tr> <tr> <td>Servings per container</td> <td>4</td> </tr> <tr> <td colspan="2">Amount per serving</td> </tr> <tr> <td>Calories</td> <td>250</td> </tr> <tr> <td></td> <td>Fat Cal 120</td> </tr> <tr> <td></td> <td>%DV</td> </tr> <tr> <td>Total Fat</td> <td>13g 20%</td> </tr> <tr> <td>Sat Fat</td> <td>9g 40%</td> </tr> <tr> <td>Cholesterol</td> <td>28mg 12%</td> </tr> <tr> <td>Sodium</td> <td>55mg 2%</td> </tr> <tr> <td>Total Carbohydrate</td> <td>30g 12%</td> </tr> <tr> <td>Dietary Fiber</td> <td>2g</td> </tr> <tr> <td>Sugars</td> <td>23g</td> </tr> <tr> <td>Protein</td> <td>4g 8%</td> </tr> </tbody> </table> <p><small>*Percentage Daily Values (DV) are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.</small></p> <p>Ingredients: Cream, Skim Milk, Liquid Sugar, Water, Egg Yolks, Brown Sugar, Milkfat, Peanut Oil, Sugar, Butter, Salt, Carrageenan, Vanilla Extract.</p>	Nutrition Facts		Serving Size	½ cup	Servings per container	4	Amount per serving		Calories	250		Fat Cal 120		%DV	Total Fat	13g 20%	Sat Fat	9g 40%	Cholesterol	28mg 12%	Sodium	55mg 2%	Total Carbohydrate	30g 12%	Dietary Fiber	2g	Sugars	23g	Protein	4g 8%
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Total Carbohydrate	30g 12%																														
Dietary Fiber	2g																														
Sugars	23g																														
Protein	4g 8%																														
2. If you are allowed 60 grams of carbohydrates as a snack, how much ice cream could you have?																															
3. Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42 grams of saturated fat each day, which includes one serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day?																															
4. If you usually eat 2500 calories in a day, what percentage of our daily value of calories will you be eating if you eat one serving?																															
5. Pretend that you are allergic to the following substances: Penicillin, peanuts, latex gloves, and bee stings. Is it safe for you to eat this ice cream?																															
^b 6. Why not?																															

^a With permission from Pfizer, Inc. (2008)^b Question 6 asked only if question five is answered correctly.

Table 2. Social marketing nutrition messaging topics and Media (N=9)

Month	Topic	Media
January	Servings and Portion Sizes	Poster
February	Sugar in Valentine Candy	Poster
March	March Madness Bracket: Pick the Healthiest Food/Beverage	Interactive Poster
April	April Fools: Fact or Fiction Nutrition Topics	Interactive Poster
May	How to interpret the % Daily Value on a Food Label	Poster
August-September	Use the Stoplight Method to Rate Various Beverages	Display
September-October	How to Read a Food Label, Soda Consumption, Breakfast, Fruits & Vegetables, Physical Activity	Weekly Videos (N=4)
October-November	Use a Food Label to Make a Healthy Food or Beverage Choice	Poster
November-December	Amount of Different Winter Activities Needed to Burn Favorite Winter Foods	Poster

Table 3. Student Health Literacy Scores by Control (n=130), Intervention (n=125), and Total (N=255)

Question	Control (% correct)		Intervention (% correct)		Total (% correct)	
	Baseline	Endpoint	Baseline	Endpoint	Baseline	Endpoint
1	60.0	67.7	52.8	63.2	56.5	65.5*
2	70.8	79.2	62.4	78.4	66.7	78.8*
3	64.6	78.5	52.0	66.4	58.4	72.5*
4	53.1	56.2	40.8	57.6‡	47.1	56.9 *
5	90.0	93.8	77.6	92.0‡	83.9	92.9*†
6	96.6	98.4	91.9	97.4	94.4	97.9
^aTotal Score Mean (±SD)	4.25 (1.41)	4.68 (1.32)	3.59 (1.72)	4.49 (1.44)	3.93 (1.60)	4.59 (1.38)*†
%	70.8	78.0	59.8	74.8	65.5	76.5

^a total score reflects mean number of correct responses and mean percent correct responses

* p≤0.05 significant difference between baseline and endpoint (Paired Samples t-test)

† p≤0.05 significant change from baseline to endpoint (Repeated Measures ANOVA)

‡ p≤0.05 significant difference in change from baseline to endpoint between control and intervention (Independent Samples t-test)

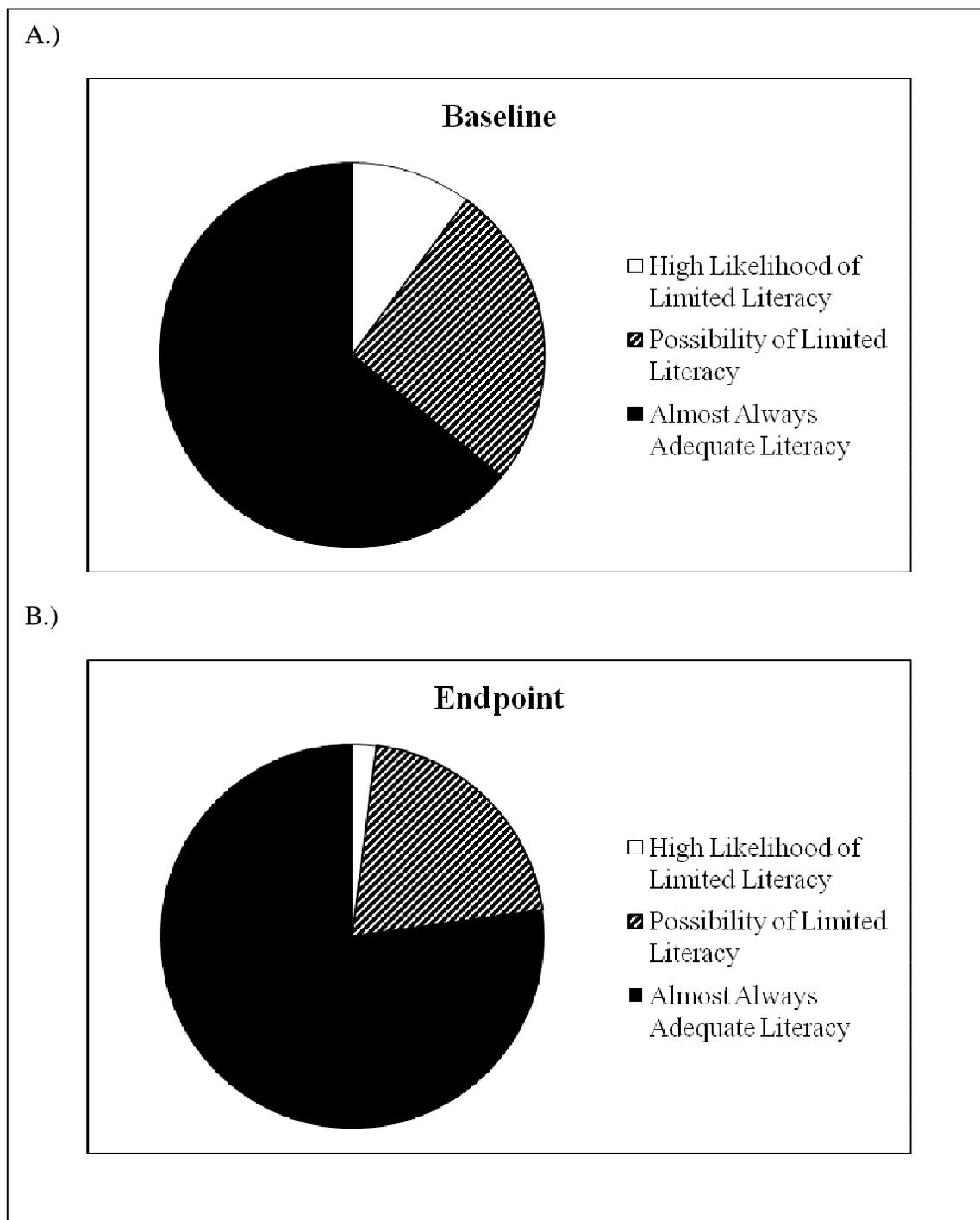


Figure 1. Proportions of student (N=255) in each health literacy category at baseline and endpoint.

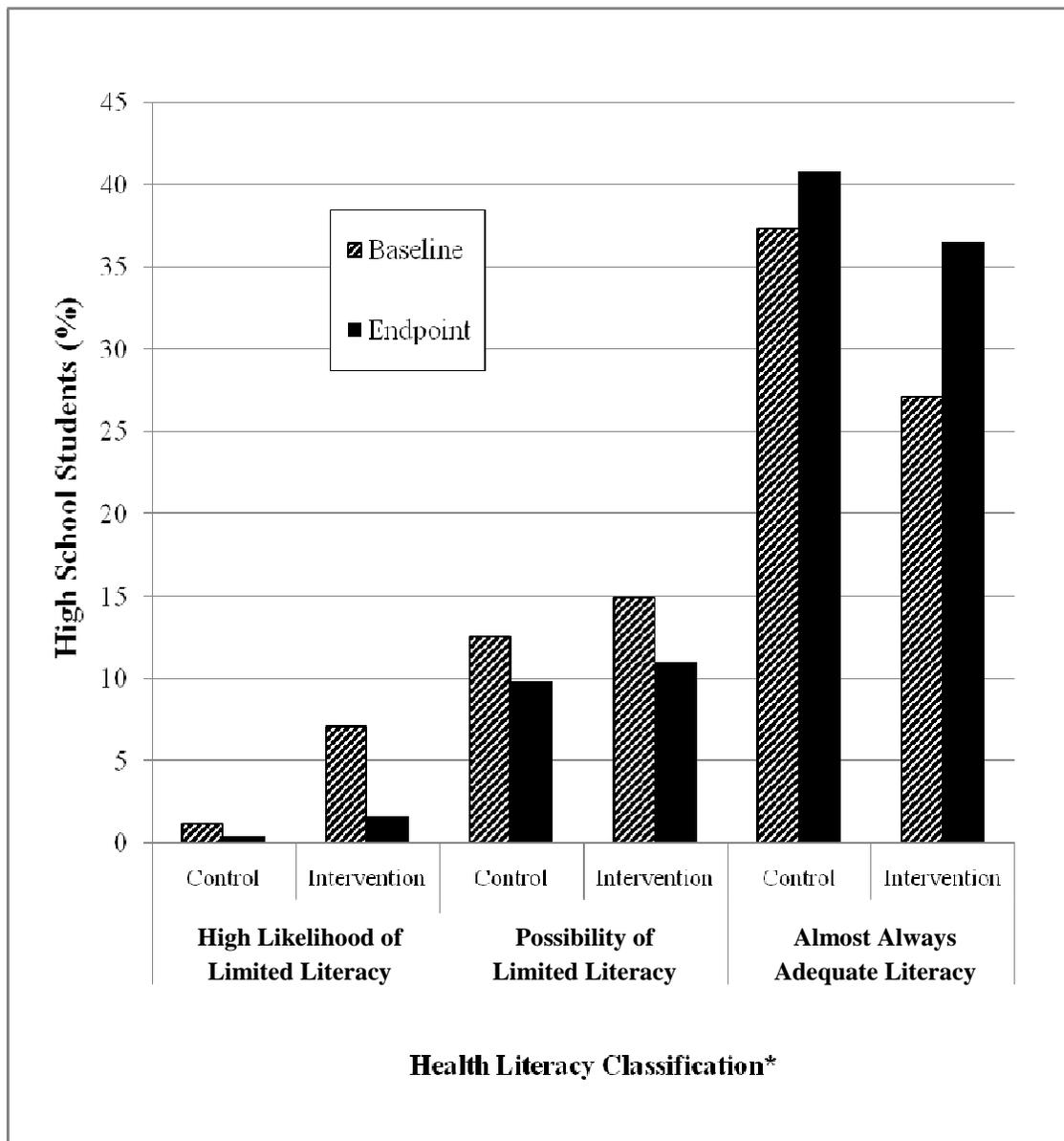


Figure 2. Health literacy classification by control (n=130) and intervention (n=125).

* $p < 0.001$ significant change of classification in intervention group (Wilcoxon Signed Ranks Test)

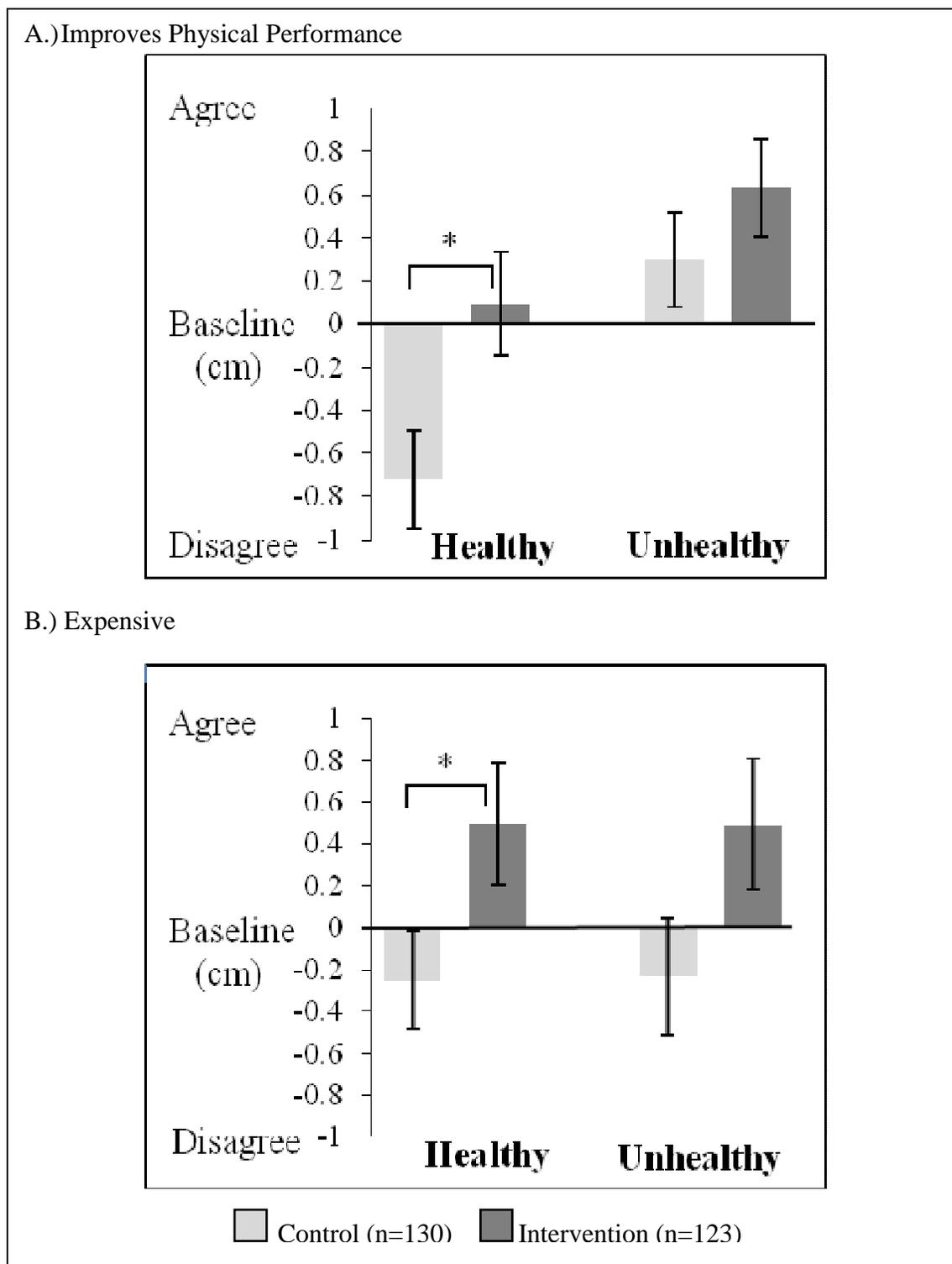


Figure 3. Change in students' mean (\pm SEM) food perceptions

* $p < 0.05$ significant difference between control and intervention (Independent Samples t-test)

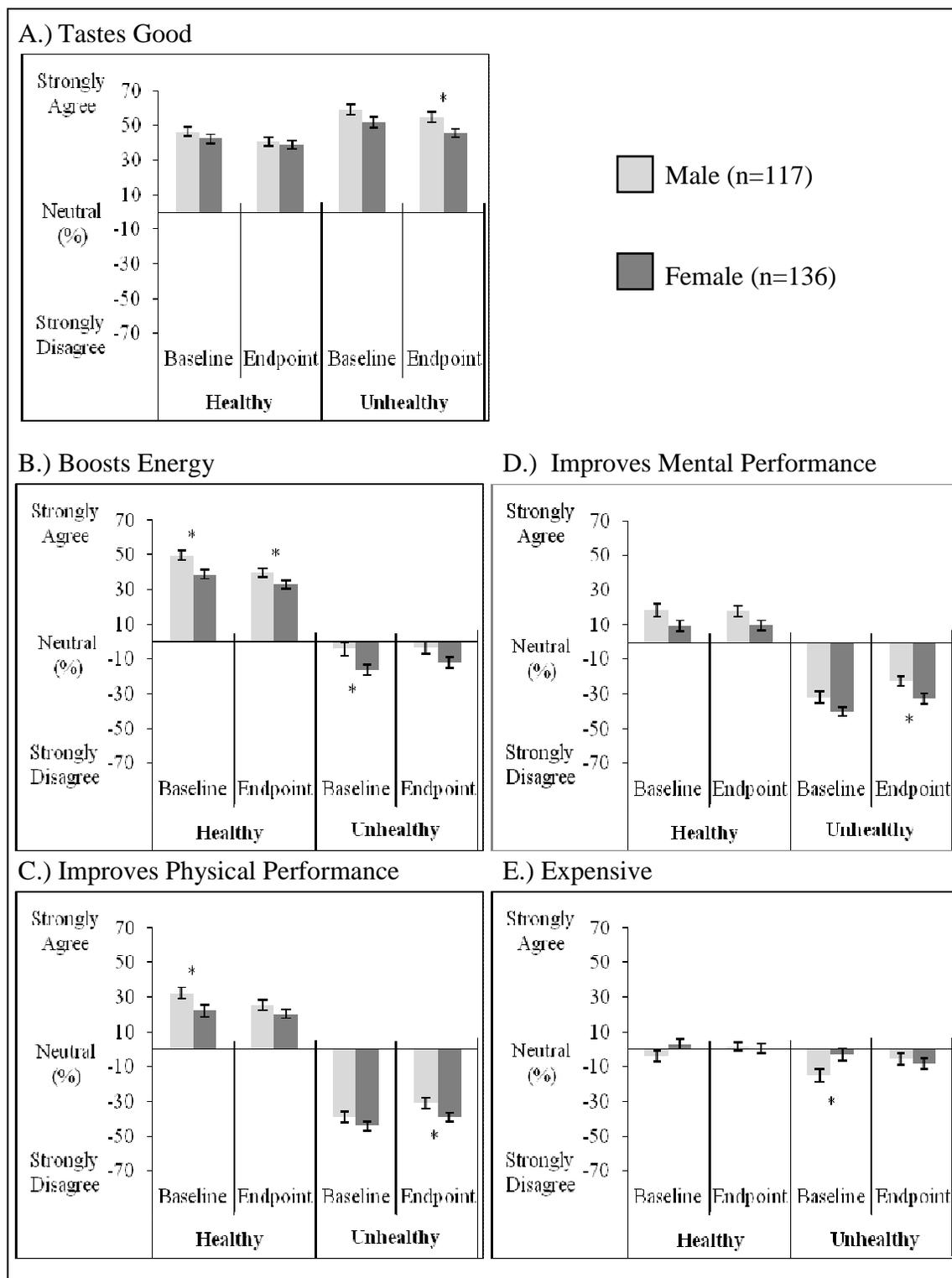


Figure 4. Students' food perceptions at baseline and endpoint by gender

* p<0.05 significant difference by gender (Independent Samples t-test)

References

- American Society for Testing and Materials. (1968). *Manual on Sensory Testing Methods*. Philadelphia, PA: American Society for Testing and Materials.
- Baker, D., Parker, R., Williams, M., & Clark, W. (1998). Health literacy and the risk of hospital admission. *J Gen Intern Med*, 13(12), 791-798.
- Bissonnette, M., & Contento, I. (2001). Adolescents' perspectives and food choice behaviors in terms of the environmental impacts of food production practices: application of a psychosocial model. *J Nutr Educ*, 33(2), 72-82.
- Croll, J., Neumark-Sztainer, D., & Story, M. (2001). Healthy eating: what does it mean to adolescents? *J Nutr Educ*, 33(4), 193-198.
- Davis, T., Wolf, M., Arnold, C., Byrd, R., Long, S., Springer, T., et al. (2006). Development and validation of the Rapid Estimate of Adolescent Literacy in Medicine (REALM-Teen): a tool to screen adolescents for below-grade reading in health care settings. *Pediatrics*, 118(6), e1707-1714.
- Gazmararian, J., Williams, M., Peel, J., & Baker, D. (2003). Health literacy and knowledge of chronic disease. *Patient Educ Couns*, 51(3), 267-275.
- Gordon, M., Hampson, R., Capell, H., & Madhok, R. (2002). Illiteracy in rheumatoid arthritis patients as determined by the Rapid Estimate of Adult Literacy in Medicine (REALM) score. *Rheumatology (Oxford)*, 41(7), 750-754.
- Harnack, L., Story, M., Martinson, B., Neumark-Sztainer, D., & Stang, J. (1998). Guess who's cooking? The role of men in meal planning, shopping, and preparation in US families. *J Am Diet Assoc*, 98(9), 995-1000.
- Harrison, M., & Jackson, L. (2009). Meanings that youth associate with healthy and unhealthy food. *Can J Diet Pract Res*, 70(1), 6-12.
- Horacek, T., & Betts, N. (1998). Students cluster into 4 groups according to the factors influencing their dietary intake. *J Am Diet Assoc*, 98(12), 1464-1467.
- Institute of Medicine. (2004). Health Literacy: A Prescription to End Confusion. Retrieved March 18, 2009, from <http://www.iom.edu/?id=32784>
- Iowa Department of Education. (2008). Standards, Benchmarks & Grade Level Indicators: Grade 8. Retrieved June 8, 2010, from http://www.iowa.gov/educate/index.php?option=com_content&view=article&id=1350&Itemid=2287
- Kronl, M., & Coleman, P. (1988). The Role of Food Perceptions in Food Use. *Curr Concepts Nutr*, 16, 53-78.

- Kutner, M., Greenberg, E., & Paulsen, C. (2006). United States Department of Education, Institute of Education Sciences, National Center for Education Statistics: The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy. Retrieved November 16, 2009, from <http://nces.ed.gov/pubs2006/2006483.pdf>
- Lester, H. (2008). Personal Communication.
- Levi, A., Chan, K., & Pence, D. (2006). Real men do not read labels: the effects of masculinity and involvement on college students' food decisions. *J Am Coll Health*, 55(2), 91-98.
- Lindau, S., Tomori, C., Lyons, T., Langseth, L., Bennett, C., & Garcia, P. (2002). The association of health literacy with cervical cancer prevention knowledge and health behaviors in a multiethnic cohort of women. *Am J Obstet Gynecol*, 186(5), 938-943.
- McNeal, J. U. (1999). *The Kids Market: Myths and Realities*. Ithica, NY 14850: Paramount Market Publishing, Inc.
- Nielsen-Bohlman, N., Panzer, A. M., & Kindig, D. A. (2004). Institute of Medicine of the National Academies: Health Literacy: A Prescription to End Confusion. Retrieved November 25, 2009, from http://books.nap.edu/openbook.php?record_id=10883
- O'dea, J. (2003). Why do kids eat healthful food? Perceived benefits of and barriers to healthful eating and physical activity among children and adolescents. *J Am Diet Assoc*, 103(4), 497-501.
- Pastor, P. N., Reuben, M. A., & Loeb, M. (2009). National Health Statistics Reports: Functional Difficulties Among School-Aged Children: United States, 2001-2007. Retrieved November 30, 2009, from <http://www.cdc.gov/nchs/data/nhsr/nhsr019.pdf>
- Pfizer Inc. (2008). The Newest Vital Sign: A New Health Literacy Assessment Tool for Health Care Providers. Retrieved August 12, 2009, from <http://www.pfizerhealthliteracy.com/physicians-providers/newest-vital-sign.html>
- Piaget, J. (1977). *The development of thought: Equilibration of cognitive structures*: New York: Viking Press.
- Probart, C., McDonnell, E., Hartman, T., Weirich, J., & Bailey-Davis, L. (2006). Factors associated with the offering and sale of competitive foods and school lunch participation. *J Am Diet Assoc*, 106(2), 242-247.
- Rideout, V. J., Foehr, U.G., Roberts, D.F. (2010). GENERATION M2: Media in the Lives of 8- to 18-Year-Olds. Retrieved May 16, 2010, from <http://www.kff.org/entmedia/upload/8010.pdf>

- Schillinger, D., Piette, J., Grumbach, K., Wang, F., Wilson, C., Daher, C., et al. (2003). Closing the loop: physician communication with diabetic patients who have low health literacy. *Arch Intern Med*, 163(1), 83-90.
- Schor, J. B. (2004). *Born to Buy: The Commercialized Child and the New Consumer Culture*. New York: Scribner.
- Shannon, C., Story, M., Fulkerson, J., & French, S. (2002). Factors in the school cafeteria influencing food choices by high school students. *J Sch Health*, 72(6), 229-234.
- Simpson, J., & Weiner, E. (2009). Oxford English Dictionary. Retrieved December 3, 2009, from <http://www.oed.com/>
- Solms, J., & Hall, R. L. (1981). *Criteria of Food Acceptance: The Aquisition of Likes and Dislikes for Foods*. Zurich: Forster Verlag.
- SPSS for Windows. (2009). Version 18.0: Chicago, IL: SPSS Inc.
- Stein, K. (2008). Erasing the stigma of subsidized school meals. *J Am Diet Assoc*, 108(12), 1980-1983.
- Stevenson, C., Doherty, G., Barnett, J., Muldoon, O., & Trew, K. (2007). Adolescents' views of food and eating: identifying barriers to healthy eating. *J Adolesc*, 30(3), 417-434.
- United States Department of Agriculture. (2001). Foods Sold in Competition with USDA School Meal Programs. Retrieved June 10, 2010, from http://www.cspinet.org/nutritionpolicy/Foods_Sold_in_Competition_with_USDA_School_Meal_Programs.pdf
- United States Department of Agriculture. (2010). Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010: Part A: Executive Summary. Retrieved June 23, 2010, from <http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/DGAC/Report/A-ExecSummary.pdf>
- United States Department of Health and Human Services. (2007). Healthy People 2010: Health Communication Focus Area: Progress Review. Retrieved March 18, 2009, from <http://www.healthypeople.gov/data/2010prog/focus11/>
- United States Department of Health and Human Services. (2008a). Agency for Healthcare Research and Quality: 2007 National Healthcare Disparities Report. Retrieved March 18, 2009, from <http://www.ahrq.gov/qual/nhdr07/nhdr07.pdf>
- United States Department of Health and Human Services. (2008b). Health Communication Activities: Health Literacy Improvement. Retrieved March 18, 2009, from <http://www.health.gov/communication/literacy/default.htm>
- United States Department of Health and Human Services. (2010). National Action Plan to Improve Health Literacy. Retrieved June 10, 2010, from

http://www.health.gov/communication/HLActionPlan/pdf/Health_Literacy_Action_Plan.pdf

Weiss, B., Mays, M., Martz, W., Castro, K., DeWalt, D., Pignone, M., et al. (2005). Quick assessment of literacy in primary care: the newest vital sign. *Ann Fam Med*, 3(6), 514-522.

Zollo, P. (1999). *Wise Up to Teens: Insight into Marketing and Advertising to Teenagers* (2 ed.). Ithica, NY: New Strategist Publications, Inc.

CHAPTER V: DOES COMPETITIVE FOOD AVAILABILITY INFLUENCE ADOLESCENT FOOD PERCEPTIONS?

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Abstract

Purpose/Objectives

Presently, schools are sending youth mixed messages. Healthful eating behaviors are taught and promoted in the classroom, but not modeled in the school nutrition environment; items sold in competitive food venues (i.e. vending, ala carte, school stores) are typically energy dense, nutrient poor. Food perceptions are part of the food selection process and important for modifying eating behaviors. The purpose of this study was to examine competitive food venues relative to student food perceptions.

Methods

High school students (N=253) participated in food perceptions assessments using unstructured line scales. Food perceptions of items typically sold in competitive food venues were examined relative to six attributes. All competitive food venues available to students were inventoried at baseline and endpoint. Intervention schools (n=3) were provided training and technical assistance and were required to make three changes relative to competitive foods.

Results

Few changes were seen from the intervention, indicating competitive foods and food perceptions are difficult to change. Taste was identified as a potent motivator in student food selection, while nutrition was a low motivator. Lastly, gender appeared to play a prominent role in food perceptions.

Application to Child Nutrition Professionals

Foodservice directors should focus on taste in marketing 'healthy' items to adolescents and less on nutrition. Free taste-testing of 'healthy' items in the cafeteria will likely influence students' perception and is encouraged. A focus for competitive food venues should be incorporating novel, 'healthy' options rather than solely focusing on removing 'unhealthy' items. School nutrition professionals should also consider gender differences to create more effective gender-specific marketing of nutrition programs. Finally, school foodservice directors have an important role to ensure their school's nutrition guidelines are rigorous and adequately implemented.

Introduction

Over one-third of U.S. adolescents are overweight (BMI \geq 85th percentile) and an alarming 18% are obese (BMI \geq 95th percentile) (Ogden, et al., 2008). A national objective of Healthy People 2010 is to reduce the prevalence of obese adolescents to 5% (HHS, 2000b). Unfortunately, this goal will not be reached; research suggests little sign of decreasing overweight and obesity trends in any U.S. age group (Ogden, et al., 2006).

Schools provide an ideal setting to influence student health behavior and weight status with roughly 95% of U.S. children (5-17 years) enrolled in, and spending over half of their waking hours at school (Centers for Disease Control and Prevention [CDC], 2008b; Koplan, et al., 2005). Environmental school food policies have been shown to influence student BMI status (Anderson & Butcher, 2006; Kubik, et al., 2005a). Competitive food venues (i.e. vending machines), a major component of environmental school food policy, have been increasing along with obesity rates in youth (Gordon & Fox, 2007; Hedley, et al., 2004; Ogden, et al., 2008; Ogden, et al., 2002).

Students have access to foods/beverages at school through a variety of competitive food venues (i.e. vending machines, school stores, and ala carte [ALC]). Generally, food options provided through these venues are energy dense, nutrient poor (EDNP) and widely accessible, promoting poor food choices and consumption practices (Center for Science in the Public Interest, 2004; Gordon & Fox, 2007; United States Government Accountability Office [GAO], 2005).

Presently, federal regulations for the sale of competitive foods in schools exist only for a few items termed foods of minimal nutritional value (FMNV) including carbonated beverages, certain candies, water ices, and chewing gum (United States Department of Agriculture [USDA], 2002; GAO, 2005). This regulation only applies to competitive foods sold in the cafeteria during the lunch hour. The Child Nutrition and WIC Reauthorization Act mandated all schools participating in the NSLP develop a local wellness policy (LWP), for implementation in the 2006-07 academic year (Child Nutrition and WIC Reauthorization Act of 2004, 2004). One requirement of this federal mandate was nutrition guidelines for all foods available at school during the school day (i.e. competitive foods). LWPs provided the opportunity to regulate policy at the local level to facilitate and maintain healthy school environments.

The presence of competitive foods in the school environment likely influences student food perceptions, impacting food choices and ultimately behavior. Perception is the attainment of awareness or understanding through the senses (Simpson & Weiner, 2009). Food perceptions can be thought of as views or beliefs about food determined by past experiences, which influence food choices and consumption patterns (Solms & Hall, 1981). Previous research suggests that gender influences food behaviors (Harnack, et al., 1998; Levi, et al., 2006; Shannon, et al., 2002). Food perceptions are part of the food selection process and understanding this process is necessary for the implementation of nutrition recommendations, dietary guidelines, and subsequent modification of eating behavior (Kronld & Coleman, 1988).

Adolescents have identified limited availability of healthy food options in school as a barrier to following nutrition guidelines (Croll, et al., 2001). In fact, students identified decreasing the availability of 'junk food' at school and increasing the availability of 'healthy foods' as strategies to promote more healthful eating (O'dea, 2003). Therefore, increasing the availability of foods/beverages with desirable nutrient profiles in competitive food venues within schools may improve student consumption behaviors, ultimately impacting weight status and health.

Presently, schools are sending youth mixed messages. Healthful eating behaviors taught and promoted in the classroom are not modeled in the school nutrition environment as

competitive food venues typically offer EDNP options. Schools can provide a health promoting environment, which encourages healthy eating practices by implementing nutrition guidelines through LWPs. A positive school health environment is important to foster healthy lifestyle behaviors among students. The purpose of this study was to improve the quality and composition of competitive foods available in schools and explore their influence on student food perceptions.

Methods

Six high schools from one Midwestern state were recruited for participation in one of two ways: 1. schools were contacted after exclusion from participation in a previous school nutrition environment study; or, 2. schools contacted the research team following promotion of the project at a state school nutrition conference. Schools were selected to geographically represent all areas of the state. Schools were randomly assigned to either the control (n=3) or intervention (n=3) group. Baseline school visits occurred in September or October, 2008 and endpoint school visits occurred in March, 2010. All study protocols were approved by the University Human Subjects Review Board.

Data Collection

Informed consents were signed by all subjects with parent consent required for student participation. Freshman and/or sophomore students (n=50) were recruited at each school for participation in a food perceptions assessment at baseline and endpoint. An unstructured line scale (American Society for Testing and Materials, 1968) (0-15 cm) was used to gather students' perceptions on six items typically sold in competitive food venues (Baked Lays[®], Gatorade[®], Nutrigrain bar[®], Chex Mix[®], Snickers[®], and ice cream sandwich) at baseline and endpoint. Students' perceptions of six attributes previously identified by adolescents as influencing food choices (expensive, tastes good, healthy, boosts energy, improves mental performance, and improves physical performance) were explored (O'dea, 2003; Shannon, et al., 2002). The line scales were labeled with agree or disagree at polar ends. Written instructions and a picture of each product appeared at the top of each page.

Student focus groups (n=8-10 students each) and foodservice director/wholesale food provider interviews at each school were administered at baseline in a private setting and were audio-recorded. Students were asked to share their thoughts and opinions about competitive foods and venues in their school while wholesale food providers were asked about competitive foods and current school practices.

Competitive venues were inventoried (vending machines, ALC, and school stores) at baseline and endpoint using a tool (Center for Weight and Health, 2007) including a list of common food categories, categorized by nutrient criteria as meeting or not meeting California SB-12 law (California Senate Bill 12, 2005). Items from vending machines were recorded relative to the number of slots occupied whereas ALC and school store items were recorded by the number of varieties available. Beverage items were categorized as meeting or not meeting Institute of Medicine (IOM) standards (IOM, 2007). Products not easily fitting within pre-determined categories were written in with the full product name and additional pertinent information for further analysis and later categorization.

Each school's LWP nutrition guidelines for competitive foods were examined and scored at baseline and endpoint. Schools were given a score of 0, 0.5, or 1 on 19 attributes relative to nutrient criteria (i.e. calories, fat, sodium, etc.) as well as the venues and hours where criteria were imposed.

Intervention

Intervention schools received technical assistance in the form of two webinars; one on the six P's of marketing for more healthful food options, the other on the Healthy Kids Act. The Healthy Kids Act established nutrition standards for competitive food and beverages sold in schools beginning in the 2010-2011 academic year (Iowa Department of Education, n.d.-a). A technical assistance site visit was also offered to each intervention school.

Intervention schools were required to make a minimum of three changes in their school nutrition environment and were provided suggestions for changes based on information gathered during the baseline visit (i.e. adding fruit & yogurt parfaits, pre-made salads/subs, baked potato bar to ALC, posting ALC menu, etc). Control schools received all components of the intervention after project completion.

Data Analysis

Analysis of data was conducted using the Statistical Package for Social Sciences for Windows (SPSS for Windows, version 18.0, 2009). The level of significance used for all statistical analysis was $p \leq 0.05$. Quantitative data was analyzed with descriptive statistics including frequencies, Chi-square, paired samples t-tests, and independent samples t-tests. A General Linear Model (Repeated Measures ANOVA) was used to examine change in and factors influencing food perceptions. Qualitative data analysis of focus groups was performed using a previously established method (Krueger, 1988).

Results/Discussion

Competitive Foods

Few changes in competitive food venues were observed in the total sample during the study time frame, none were statistically significant. The proportion of total items meeting nutritional standards (MNS) remained relatively unchanged in the total sample and did not differ by control/intervention (Figure 1). No significant change was observed when the data was examined by venue (vending or ALC) for both the total sample and by control/intervention (data not shown). The brief study period likely contributed to the lack of change in competitive foods, as well as barriers perceived by the schools.

However, some trends were observed between control/intervention. The control group decreased the total number of competitive food items ($\bar{x} = 39$) while the intervention group increased ($\bar{x} = 9$). This finding was not surprising; the intervention group received training and technical assistance encouraging offering more 'healthful' options in competitive food venues. They were also required to identify three changes to make in their competitive foods environment, some of which included adding more 'healthy' options to venues. Unfortunately, the addition of items did not improve the proportion of items MNS.

Surprisingly, a high proportion of competitive food and beverage items not meeting nutritional standards (NMNS) was observed in the total sample ranging from 64.6%-84.6% at baseline to 53.2%-94.5% at endpoint. This was unexpected since nutrition guidelines for all foods and beverages available on the school campus were required in the federally-mandated LWP. Foodservice personnel may have been reluctant to make changes due to pending final

rules for state regulation of competitive food items sold in schools. Additionally, the nutrition standards (SB-12 and IOM) for categorizing items as MNS or NMNS in this study were rigorous. Yet, utilizing these guidelines explores the current status of competitive food venues in schools relative to nutrition guidelines, which may be incorporated into a federal mandate currently under debate.

Interestingly, three schools (2 control, 1 intervention) experienced an increased proportion of total competitive food items MNS, just one school was significant (data not shown; $p \leq 0.05$). These schools shared two common characteristics: 1. proportion of items MNS increased in both ALC and vending; and 2. the foodservice director managed at least one vending machine. Conversely, none of schools experiencing a decrease in items MNS had any vending machines managed by foodservice. Interestingly, four out of five schools with ALC also experienced a non-significant increase in the proportion of ALC items MNS. This suggests that competitive food venues managed by foodservice directors may be more likely to successfully implement rigorous nutrition guidelines.

Food Perceptions

Approximately 85% of student subjects (N=253; 117 male, 136 female) were retained from baseline to endpoint. Loss of subjects was equally distributed among schools and was primarily due to students moving out of the district. Minimal differences in food perceptions were seen between control (n=130) and intervention groups (n=123), suggesting the intervention did not influence students' food perceptions.

Results from student focus group discussions revealed food perceptions, particularly taste, exerted the most influence on students' competitive food purchases. Conversely, nutritional value was identified as least influential. When asked about factors influencing purchasing students were quoted saying:

“Taste, because if it doesn't taste good you probably wouldn't have bought it anyway.”

“I don't pay attention to nutritional value.”

“Nutritional value doesn't really mean anything to me.”

This finding supports previous research where adolescents identified taste as a potent motivator in food choice and described healthy foods as ‘bland’ and a barrier to more healthful food choices (McKinley, et al., 2005; Stevenson, et al., 2007). Adolescents’ food perceptions also appear to drive items provided in competitive food venues. A major theme of interviews with school personnel managing competitive food venues was that student preferences drove competitive food options evidenced by the following quotes:

“Some of it was history...what was previously sold and did well.”

“They [students] are consumers and what we are trying to do is make them happy...”

“I try to go with the products that are most sellable.”

Researchers examined items offered in competitive food venues relative to student food perceptions in the total sample by plotting availability of each of the six competitive food/beverage items (% of all competitive foods available) against the mean agreement/disagreement (% of line scale towards agree or disagree) of each food attribute. Trend lines were included to visually depict relationships. Results suggest as perception of ‘tastiness’ decreased for the six items; the availability of those items also decreased (Figure 2, Panel A). Conversely, as the perception ‘healthiness’ increased, availability decreased (Figure 2, Panel B). The remaining attributes (expensive, boosts energy, improves mental and physical performance) did not exhibit any consistent relationship with availability. These results suggest competitive food availability may be influenced by students’ food perceptions, particularly ‘tastiness’ and ‘healthiness.’

These findings led researchers to further explore the reverse relationship, whether availability of competitive foods influences student food perceptions. Schools were divided into two groups relative to the extent of variety available in ALC; vending machines were not included due to the limited amount of variety they contributed. Two schools were identified as having limited or no ALC (0-10 options; low variety) and four schools were identified as having an extensive ALC (52-96 options; high variety). Students’ food perceptions for all items and attributes for each group were plotted against the availability (% of all competitive foods available in low/high variety schools) of the six competitive food items. Results of

schools with high ALC variety were similar to the total sample; as availability increased the perception of ‘tastiness’ increased (Figure 2, Panel C). Interestingly, students’ perception of ‘tastiness’ in schools with limited ALC variety did not change with availability (Figure 2, Panel D). These results suggest that students’ perception of ‘tastiness’ may be influenced by the availability of competitive foods. However, researchers are very cautious when interpreting this data due to the small sample size and absence of statistical significance.

Finally, interesting food perception differences by gender were observed over the course of the study (Figure 3). Males were significantly more likely to rate foods in a positive light than females. For example, males were more likely to agree that Gatorade® was ‘healthy’ and less likely to ‘disagree’ that Snickers® improves physical performance. Others have reported female adolescents think about their weight and agree more that ‘eating healthy’ is important compared to males (Shannon, et al., 2002) and females have been shown to pay more attention to the nutrient quality composition of foods (Levi, et al., 2006). Conversely, males were more strongly influenced by ‘getting more for their money’ (Shannon, et al., 2002); however, no significant differences by gender were observed on perceived expensiveness of items in this study, which others have reported (Levi, et al., 2006). Interestingly, the majority of food perception differences observed by gender were with two items Gatorade® and Snickers®. Results from the General Linear Model found gender significantly ($p \leq 0.05$) influenced overall food perception where significant change was observed in Figure 3. Although results suggest food perceptions are influenced by gender, multiple environmental factors (i.e. home, commercial/marketing activity, community, economics, etc.) likely influence food perceptions and should be considered in future endeavors of this kind.

Foodservice Director Qualifications

One interview of a wholesale food provider suggested qualifications of a school foodservice director may influence the quality of the school nutrition program.

“[Name] is interested in nutrition. It is different when they [schools] don’t have an RD [registered dietitian] or someone with a nutritional background.”

To explore this further the researchers examined the competitive food data by educational qualifications of foodservice personnel. Coincidentally, all foodservice directors at intervention schools had post-secondary training or degrees whereas control schools had none. Thus, prior results comparing competitive food availability and composition between control and intervention suggest academic background of foodservice director did not influence competitive foods. This is in contrast to previous research where advanced education of foodservice directors was associated with successful adherence to school nutrition guidelines (Thornton, 2007). Despite technical assistance and advanced training, the intervention group was unable to change competitive food availability and composition.

Conclusions/Application

A significant limitation of this study was the short time frame. Changing behavior, particularly perceptions, which are the accumulations of months if not years of prior experience, is challenging. In addition, data collection took place at two different time points of the school year; final data collection took place in the spring (end of school year) whereas baseline data collection took place in the fall (beginning of school year). At the end of the school year students' food perceptions and attitudes are likely different as the appeal of competitive foods likely decreases from repetitive exposure over the course of the school year. Students were also one year older at final data collection and had accrued more overall exposure to these foods compared to baseline. These time points likely influenced perceptions and should be controlled for, or at a minimum taken into consideration in future studies of this kind. Finally, competitive food data was collected by school (N=6), a small sample size limiting data interpretation.

Results indicate the study intervention did not significantly influence the availability of competitive food items or student food perceptions. Change in competitive food availability among the total sample and between groups (control/intervention) was insignificant. In addition, a large proportion of the competitive foods items available were those not NMNS. The researchers have proposed a few probable explanations for why changes in competitive food availability and composition were not occurring.

First and foremost, lack of change may have been influenced by pending state legislation, which would institute nutrition standards on the sale of competitive foods in schools. Although final rules were not published until the end of this project, school staff and possibly students were aware of the impending implications. Foodservice staff were likely hesitant to make any significant change knowing additional change was imminent; many commented on pending state legislation in interviews. Secondly, one control school where competitive food availability and composition did change had a staff member whom was a strong advocate for good nutrition and encouraged students to voice their opinions to foodservice staff regarding the items offered in competitive food venues. While this finding was encouraging, it may have influenced results of the current study. In addition, this particular school was participating in a multi-county initiative promoting nutrition and physical activity within local communities. As a result, this control school received additional technical assistance and resources other schools in the project did not receive.

Another key finding was perceived ‘tastiness’ of items was a potent motivator in adolescent food selection. The positive relationship with competitive food availability suggests student perceptions influence the availability of items offered in competitive food venues. School nutrition professionals need to use this motivator (taste) to promote ‘healthy’ food choices to students by providing free taste-testing to positively influence students’ perception of these items. Subsequent provision of these items in competitive food venues would reinforce and encourage student purchasing. Conversely, perceived ‘healthiness’ of items exhibited an inverse relationship with competitive food availability and was a low motivator of student food selection. Ultimately, school nutrition professionals should focus on taste in marketing ‘healthy’ items to adolescents, rather than nutrition, a finding suggested by others (Horacek & Betts, 1998).

From study results, researchers propose that increasing variety of competitive foods may increase enticement and desirability of these foods. Therefore, schools should focus on incorporating novel, ‘healthy’, options into venues (i.e. fruit & yogurt parfaits, steamed bagels, 100% juice smoothies, etc) instead of solely focusing on removing ‘unhealthy’ items (i.e. candy, regular chips, nachos, etc). A wider variety of items in competitive food venues

may benefit schools when ‘phasing-out’ of ‘unhealthy’ items occurs to comply with upcoming state standards and regulations.

A number of gender differences among food perceptions were also observed in the current study. Understanding these gender differences can help create more effective gender specific marketing strategies in schools to influence food perceptions, successive food choice, and ultimately health. Industry has been successful in using gender differences in marketing food products (i.e. Gatorade[®], Snickers[®]) and school foodservice programs may need to do the same to successfully market their nutrition programs.

Some foodservice directors in the current project managed at least one vending machine in their school. Interestingly, these schools had a higher proportion of competitive food options MNS. Unfortunately, school foodservice personnel do not typically manage vending in many schools. However, it should be noted the majority of vendors will stock machines as requested; it takes only an assertive voice from the school to make that happen. Foodservice directors are encouraged to take this proactive role in communicating with vendors and initiating positive change.

Foodservice employees may perceive the risk of incorporating new or ‘healthy’ items into their competitive food venues as outweighing the benefits. Schools, particularly small schools, may be challenged by the sales volume required to order, cash flow, and prevent spoilage of more healthful items. For example, one foodservice director from a small school stated:

“...there is stuff like apple slices and ...baby carrot packs, but you have to take them in such a large quantity it is hard for us to move [sell] that. So, I think manufacturing needs to keep in mind the smaller schools... and put them in a 25 pack case instead of a 200 pack case.”

Wholesale food providers should be aware of this burden in small schools and make strides to solve this issue.

Currently, there are no consequences for schools not implementing nutrition standards relative to competitive foods despite the requirement that LWP include nutrition guidelines for all foods available during the school day. Nutrition standards for competitive foods available in schools may be federally mandated in the near future; school foodservice directors should take a proactive role now by ensuring their school's LWP nutrition standards are rigorous and adequately implemented.

Finally, financial stability of the school foodservice department is perceived as an overwhelming barrier for modifying the composition (MNS vs. NMNS) of competitive food venues by school foodservice directors. Schools, particularly large schools, may generate a substantial amount of revenue from competitive food venues (GAO, 2005). As a result, schools are reluctant to make changes in fear of losing revenue. Many schools are under pressure to maintain operating budgets and some rely heavily on revenues from competitive foods. However, these concerns of monetary losses from the regulation of competitive foods may not be warranted; competitive foods can negatively impact a school's foodservice budget by decreasing National School Lunch Program (NSLP) participation (Texas Department of Agriculture, 2003). Previous research has observed increased revenues from increased NSLP participation, compensating for decreases in revenue from competitive food sales when nutrition standards for competitive foods were implemented (Wojcicki & Heyman, 2006; Woodward-Lopez, et al., 2005). Additionally, incorporating nutrition policies for all items available during the lunch hour has been associated with reductions in energy density coupled with increased consumption of foods from the NSLP (Mendoza, Watson, & Cullen, 2010).

The school nutrition environment provides a unique opportunity to impact student health behaviors. Results of the present study suggest schools are struggling to modify competitive food venues. Maintaining the school budget is a perceived barrier to making healthy changes in competitive food venues; however, research has shown positive financial effects of improving these venues via increased NSLP participation. Collectively, previous reports suggest positive changes made to improve the nutrient quality of competitive food options in schools can contribute to strong financial school budgets. Results also suggest the need to tailor marketing of NSLP and competitive food venues, which acknowledge student

perceptions. Taste-testing opportunities are important to appeal to students' primary motivation of food selection. In addition, marketing should be gender-specific; while females may respond to marketing relative to the perception of healthiness, males may respond more favorably to perceptions of physical performance (i.e. boosting energy, improving physical performance, and improving mental alertness). School foodservice directors can use these study results to more effectively market their programs in the school environment.

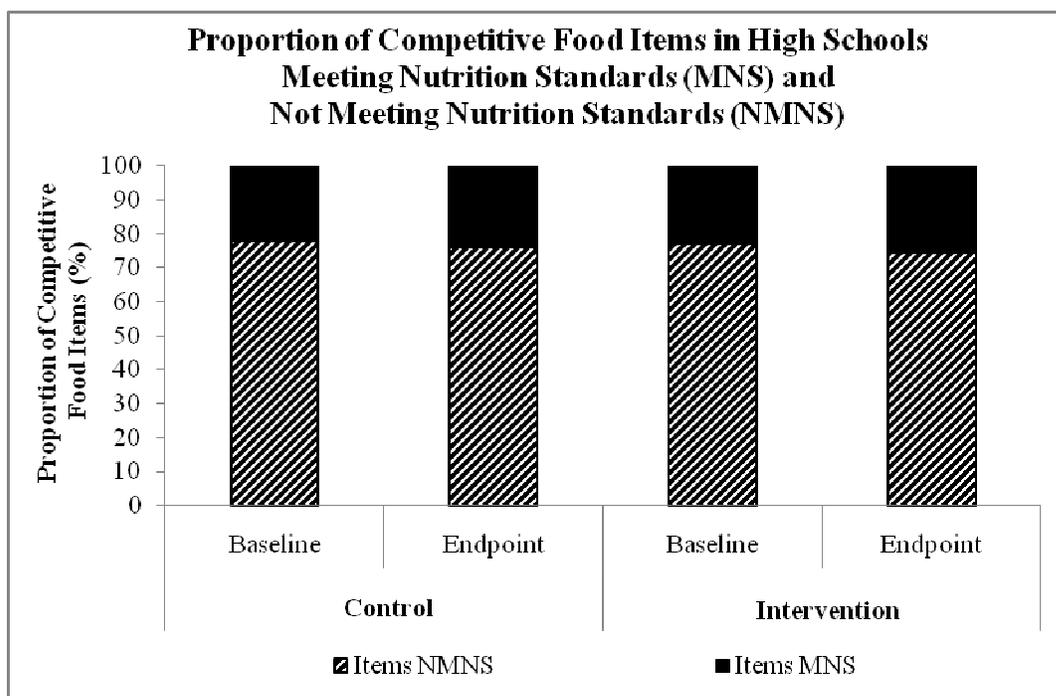


Figure 1. Proportion of competitive food items available in high schools meeting nutrition standards (MNS) and not meeting nutrition standards (NMNS) at baseline and endpoint by group (control [n=3], intervention [n=3]).

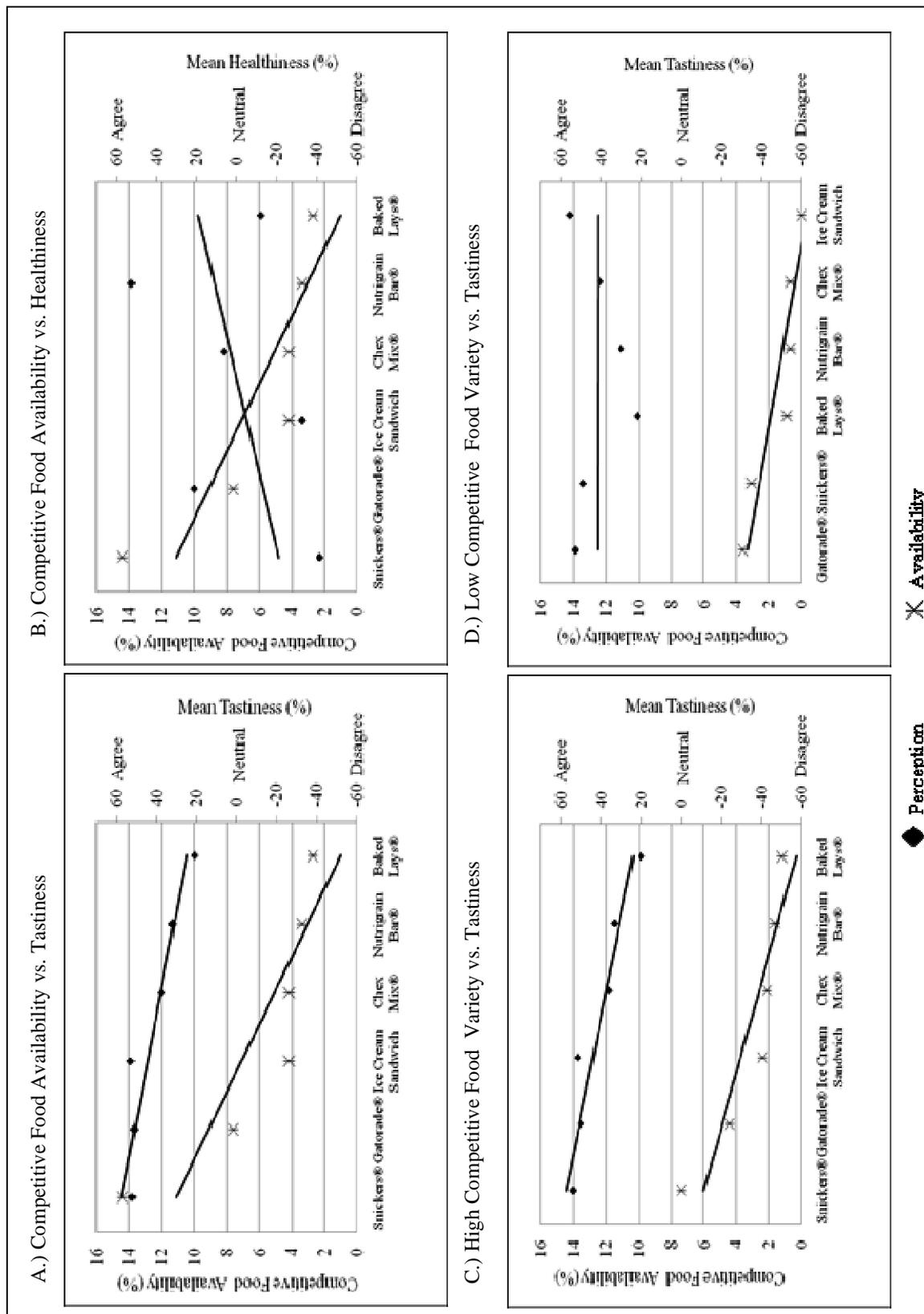


Figure 2. High school students' food perceptions relative to competitive food availability.

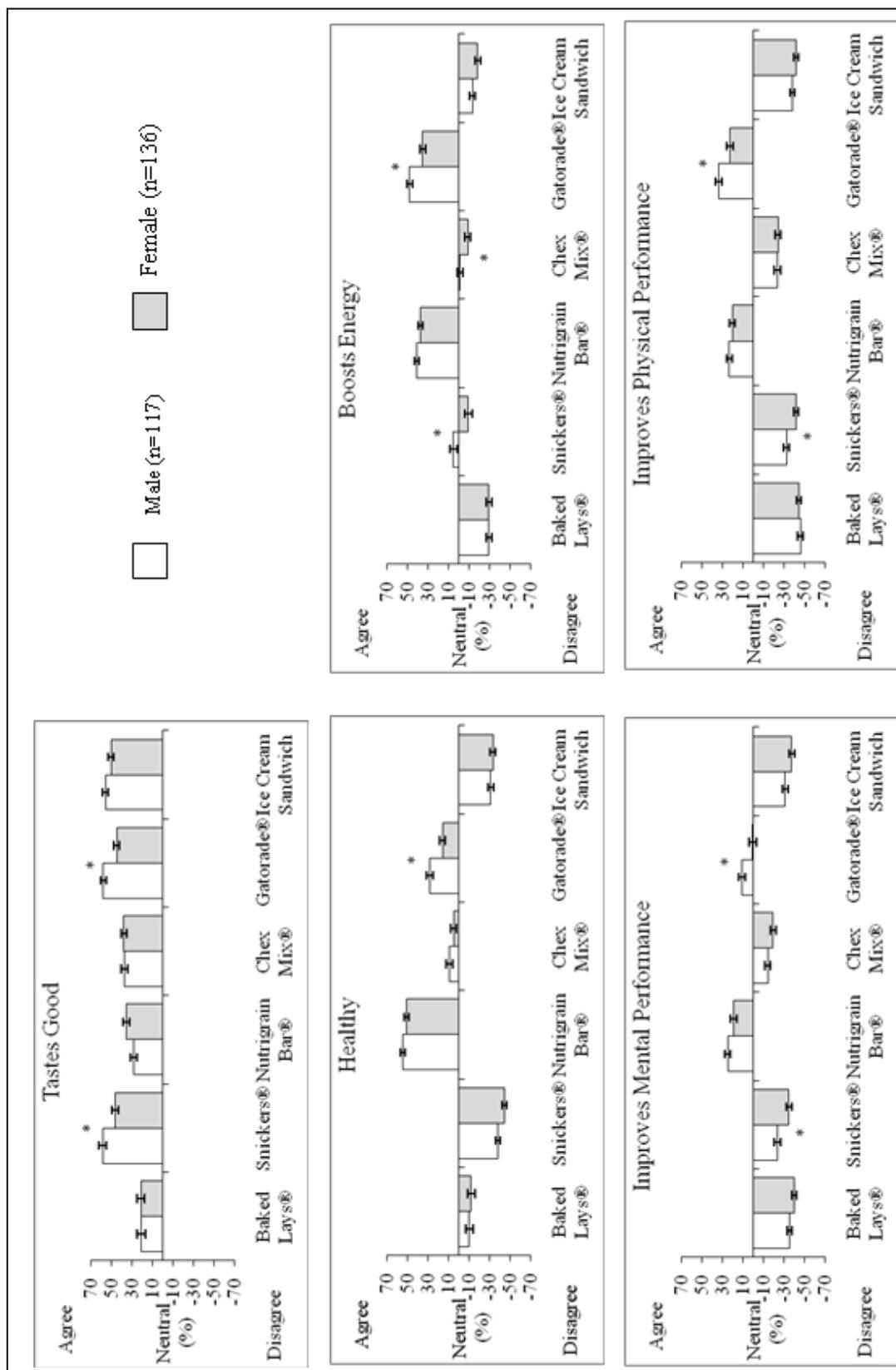


Figure 3. Student (N=253) food perceptions of competitive foods by gender
 * Significant difference by gender in overall perception (Independent Samples t-test)

References

- American Society for Testing and Materials. (1968). *Manual on Sensory Testing Methods*. Philadelphia, PA: American Society for Testing and Materials.
- Anderson, P. M., Butcher, K.F. (2006). Reading, writing, and refreshments: are school finances contributing to children's obesity? *Journal of Human Resources*, 41(3), 467-494.
- California Senate Bill 12. (2005). School Food Nutrition. Retrieved June 10, 2010, from http://info.sen.ca.gov/pub/05-06/bill/sen/sb_0001-0050/sb_12_bill_20050915_chaptered.html
- Center for Science in the Public Interest. (2004). Dispensing Junk: How School Vending Undermines Efforts to Feed Children Well. Retrieved November 3, 2009, from http://www.cspinet.org/new/pdf/dispensing_junk.pdf
- Center for Weight and Health. (2007). University of California, Berkeley.
- Centers for Disease Control and Prevention. (2008). Healthy Youth!: Nutrition: School Health Guidelines: Summary. Retrieved April 2, 2009, from <http://www.cdc.gov/healthyYouth/nutrition/guidelines/summary.htm>
- Child Nutrition and WIC Reauthorization Act of 2004, -. P. L. (2004).
- Croll, J., Neumark-Sztainer, D., & Story, M. (2001). Healthy eating: what does it mean to adolescents? *J Nutr Educ*, 33(4), 193-198.
- Fisher, J., & Birch, L. (1999). Restricting access to foods and children's eating. *Appetite*, 32(3), 405-419.
- Gordon, A., & Fox, M. K. (2007). School Nutrition Dietary Assessment Study-III: Summary of Findings. Retrieved March 18, 2009, from <http://www.fns.usda.gov/ora/MENU/published/CNP/FILES/SNDIII-SummaryofFindings.pdf>
- Hedley, A., Ogden, C., Johnson, C., Carroll, M., Curtin, L., & Flegal, K. (2004). Prevalence of overweight and obesity among US children, adolescents, and adults, 1999-2002. *JAMA*, 291(23), 2847-2850.
- Horacek, T., & Betts, N. (1998). Students cluster into 4 groups according to the factors influencing their dietary intake. *J Am Diet Assoc*, 98(12), 1464-1467.
- Institute of Medicine. (2007). *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*. Washington, DC: The National Academies Press.
- Iowa Department of Education. (n.d.). Healthy Kids Act. Retrieved June 4, 2010, from http://www.iowa.gov/educate/index.php?option=com_content&view=article&id=1769&Itemid=2545

- Koplan, J., Liverman, C., & Kraak, V. (2005). Preventing childhood obesity: health in the balance: executive summary. *J Am Diet Assoc*, *105*(1), 131-138.
- Kronl, M., & Coleman, P. (1988). The Role of Food Perceptions in Food Use. *Curr Concepts Nutr*, *16*, 53-78.
- Krueger, R. A. (1988). *Focus Groups: A practical Guide for Applied Research*. Newbury Park, Calif.: Sage Publications.
- Kubik, M., Lytle, L., & Story, M. (2005). Schoolwide food practices are associated with body mass index in middle school students. *Arch Pediatr Adolesc Med*, *159*(12), 1111-1114.
- Levi, A., Chan, K., & Pence, D. (2006). Real men do not read labels: the effects of masculinity and involvement on college students' food decisions. *J Am Coll Health*, *55*(2), 91-98.
- Levi, J., Vinter, S., Richardson, L., St. Laurent, R., & Segal, L. M. (2009). F as in Fat: How Obesity Policies are Failing in America 2009. Retrieved June 23, 2010, from <http://healthyamericans.org/reports/obesity2009/Obesity2009Report.pdf>
- Mann, T., & Ward, A. (2001). Forbidden fruit: does thinking about a prohibited food lead to its consumption? *Int J Eat Disord*, *29*(3), 319-327.
- McKinley, M., Lowis, C., Robson, P., Wallace, J., Morrissey, M., Moran, A., et al. (2005). It's good to talk: children's views on food and nutrition. *Eur J Clin Nutr*, *59*(4), 542-551.
- O'dea, J. (2003). Why do kids eat healthful food? Perceived benefits of and barriers to healthful eating and physical activity among children and adolescents. *J Am Diet Assoc*, *103*(4), 497-501.
- Ogden, C., Carroll, M., Curtin, L., McDowell, M., Tabak, C., & Flegal, K. (2006). Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA*, *295*(13), 1549-1555.
- Ogden, C., Carroll, M., & Flegal, K. (2008). High body mass index for age among US children and adolescents, 2003-2006. *JAMA*, *299*(20), 2401-2405.
- Ogden, C., Flegal, K., Carroll, M., & Johnson, C. (2002). Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA*, *288*(14), 1728-1732.
- Olshansky, S., Passaro, D., Hershow, R., Layden, J., Carnes, B., Brody, J., et al. (2005). A potential decline in life expectancy in the United States in the 21st century. *N Engl J Med*, *352*(11), 1138-1145.
- Shannon, C., Story, M., Fulkerson, J., & French, S. (2002). Factors in the school cafeteria influencing food choices by high school students. *J Sch Health*, *72*(6), 229-234.

- Simpson, J., & Weiner, E. (2009). Oxford English Dictionary. Retrieved December 3, 2009, from <http://www.oed.com/>
- Solms, J., & Hall, R. L. (1981). *Criteria of Food Acceptance: The Aquisition of Likes and Dislikes for Foods*. Zurich: Forster Verlag.
- SPSS for Windows. (2009). Version 18.0: Chicago, IL: SPSS Inc.
- Stevenson, C., Doherty, G., Barnett, J., Muldoon, O., & Trew, K. (2007). Adolescents' views of food and eating: identifying barriers to healthy eating. *J Adolesc*, 30(3), 417-434.
- Texas Department of Agriculture. (2003). School District Vending Contract Survey. Retrieved October 17, 2008, from http://www.squaremeals.org/fn/render/channel/items/0,1249,2348_2515_0_0,00.html.
- Thornton, J. (2007). School Foodservice Programs' Effectiveness: Influence of Directors' Education Background and Time Spent on Foodservice Tasks. Unpublished dissertation. Available from Iowa State University Library.
- United States Department of Agriculture. (2002). Food and Nutrition Service: National School Lunch Program: State Competitive Food Policies. Retrieved March 18, 2009, from http://www.fns.usda.gov/cnd/lunch/_private/CompetitiveFoods/state_policies_2002.htm
- United States Department of Health and Human Services. (2000). *Tracking Healthy People 2010*. Washington, D.C.: U.S. Government Printing Office.
- United States Government Accountability Office. (2005). School Meal Programs: Competitive Foods Are Widely Available and Generate Substantial Revenues for Schools. Retrieved November 2, 2009, from <http://www.gao.gov/new.items/d05563.pdf>
- Wojcicki, J., & Heyman, M. (2006). Healthier choices and increased participation in a middle school lunch program: effects of nutrition policy changes in San Francisco. *Am J Public Health*, 96(9), 1542-1547.
- Woodward-Lopez, G., Vargas, A., Kim, S., Proctor, C., Hiort-Lorenzen Diemoz, L., & Crawford, P. (2005). LEAF Cross-Site Evaluation: Fiscal Impact Report: Center for Weight and Health, University of California, Berkeley. Retrieved November 5, 2009, from www.cnr.berkeley.edu/cwh/activities/LEAF.shtml

CONCLUSIONS

This research project sought to examine the influence of improving the school nutrition environment on adolescent HL and food perceptions. An intervention was implemented encompassing social marketing nutrition messaging and positive changes made in competitive food venues. Student focus group discussions and interviews with wholesale food providers were also incorporated to explore motives driving student food selection and factors influencing the availability of competitive foods.

The intervention did not significantly impact HL, food perceptions, or competitive food availability as much as hoped with little differences observed between control and intervention groups. Surprisingly, a majority of adolescents in the sample had adequate levels of HL at baseline. The ceiling effect for HL performance likely decreased the possibility of significant improvement from the intervention. Results suggest influencing HL through nutrition messaging may be difficult, particularly in populations where the majority of adolescents already possess adequate levels of HL. Interventions such as this may be more effective in populations with low levels of HL such as socioeconomically depressed populations, ethnic minorities, or those with learning disabilities. It is likely that improving HL requires a collective effort including classroom curricula, competitive food availability, and nutrition messaging/marketing in the school environment.

Social marketing nutrition messaging also had little influence on food perceptions; however, gender appeared to have a fairly influential role. Understanding gender differences can help create more effective messaging to students for influencing food perceptions, successive food choice, and ultimately health. Future social marketing efforts to promote nutrition or healthy lifestyle behaviors among adolescents need to consider genders specific messaging.

Results also suggested that schools are struggling to modify competitive food venues as little change was seen by group (control/intervention). Taste was found to be an important motivator of student food selection and taste-testing opportunities are suggested in schools to appeal to students and encourage 'healthy' food choices. School foodservice directors can use these study results to more effectively market their programs in the school environment. However, additional research on student HL and food perceptions is needed such that steps

for effective interventions can be developed and implemented to improve student health and conquer obesity.

APPENDIX A: INFORMED CONSENT DOCUMENTS

Consent Form

Title: Promoting Health Literacy through the School Nutrition Environment

Investigators: Ruth Litchfield, PhD, RD, LD

Amber Appleton

Extension Specialist/Assistant Professor

Graduate Student

Iowa State University

Iowa State University

INTRODUCTION:

Your child is invited to share their thoughts and opinions about foods offered through their school's vending, school store and a la carte venues.

What will your child be asked to do?

If you consent to your child's participation, your child will be asked to participate in a focus group discussion consisting of 8-10 freshman/sophomore students. Students will be asked to discuss their thoughts and opinions about foods offered at various venues in their school. The focus group discussion will last approximately 45-60 minutes, depending on the responses of the participants.

Does this study involve risks?

There is a slight risk that your child may not understand a question or that answering a question in a group of people may make them feel uneasy.

What are the benefits to being a part of this study?

There are no direct benefits to you/your child from taking part in this study. By allowing your child to participate in the study you will help examine the impact of the school nutrition environment on students' health literacy and perceptions and beliefs.

What are you and your child's rights?

Your child's participation in the study is completely voluntary. As a parent or guardian you have the right to remove your child from this project at any time. Your child has the right to not answer a question at any time and may also remove themselves from the study at any time.

Choosing not to participate or stopping participation at any time does not result in any penalty. Participation or lack of participation in this study does not impact any of your child's rights or benefits at school.

We will make every effort to protect all information about your child and their participation in the study. Members of the research team are not allowed to share information about your child with anyone that does not work with the study. Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government agencies, Wellmark Foundation (the study's sponsor), and the Institutional Review board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

We will make reports and write articles about this study so others can learn from us. You or your child's name will not be used in any of these reports or articles. The responses gathered from your child will be combined with other responses gathered from high school students and shared only as compiled responses where individual responses cannot be linked to the individual.

You are encouraged to ask questions about the study. If you have questions, you may contact Ruth Litchfield at (515) 294-9484 or Amber Appleton at (563) 608-1394.

If you have questions about the rights of research subjects please contact the IRB Administration, (515) 294-4566, IRB@iastate.edu, or Director (515) 294-3115, Office of Research Assurances, Iowa State University, Ames, Iowa 50011.

SIGNATURE

Signing this form means that you consent to the participation of your child in the project, that the project has been explained to you and your child, that you have been given time to read the consent form, and that your questions have been answered. Upon request, you will be provided a copy of this consent form for your records.

Signature of Parent/Guardian

Date

Printed Name of Child/Student

Date

Signature of Child/Student

Date

Project Staff Signature

Date

Consent Form

Title: Promoting Health Literacy through the School Nutrition Environment

Investigators: Ruth Litchfield, PhD, RD, LD

Amber Appleton

Extension Specialist/Assistant Professor

Graduate Student

Iowa State University

Iowa State University

INTRODUCTION:

Your child is invited to participate in a study aimed at promoting health literacy (knowledge) in the school environment.

What will your child be asked to do?

If you consent to your child's participation in this study, your child will be asked to participate in a verbally administered health literacy assessment and a survey indicating their perceptions of various food products. The assessment will be conducted twice, once each in Fall 2008 and Spring 2010. The assessment and survey will take approximately 15 minutes to complete.

Does this study involve risks?

There is a slight risk that your child may not understand a question or that answering a question in front of someone may make them feel uneasy.

What are the benefits to being a part of this study?

There are no direct benefits to you/your child from taking part in this study. By allowing your child to participate in the study you will help examine the impact of the school nutrition environment on students' health literacy and perceptions of foods.

What are you and your child's rights?

Your child's participation in the study is completely voluntary. As a parent or guardian you have the right to remove your child from this project at any time. Your child has the right to not answer a question at any time and may also remove themselves from the study at any time.

Choosing not to participate or stopping participation at any time does not result in any penalty. Participation or lack of participation in this study does not impact any of your child's rights or benefits at school.

We will make every effort to protect all information about your child and their participation in the study. Members of the research team are not allowed to share information about your child with anyone that does not work with the study. Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government agencies, Wellmark Foundation (the study's sponsor), and the Institutional Review board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

We will make reports and write articles about this study so others can learn from us. You or your child's name will not be used in any of these reports or articles. The responses gathered from your child will be combined with other responses gathered from high school students and shared only as compiled responses where individual responses cannot be linked to the individual.

Consent Form

Title: Promoting Health Literacy through the School Nutrition Environment

Investigators: Ruth Litchfield, PhD, RD, LD

Amber Appleton

Extension Specialist/Assistant Professor

Graduate Student

Iowa State University

Iowa State University

INTRODUCTION:

You are asked to participate in a study examining the school nutrition environment. As a person involved with the school's vending and/or a la carte, you are invited to share your thoughts and opinions regarding foods offered in these venues.

What will you be asked to do?

If you consent participate in this study, you will be asked to participate in an interview about the food offered outside of the school meals program. This interview will last approximately 30-45 minutes.

Does this study involve risks?

There is a slight risk that you may not understand a question or that answering a question in front of someone may make you feel uneasy.

What are the benefits to being a part of this study?

There are no direct benefits to you from taking part in this study. By your involvement in this study you will help examine the impact of the school nutrition environment on student health literacy and perceptions of food products.

What are your rights?

Your participation is completely voluntary. You have the right to not answer any questions at any time or remove yourself from the study at any time.

Choosing not to participate or stopping participation at any times does not result in any penalty. Participation or lack of participation in this study does not impact any of your rights or benefits.

Members of the research team are not allowed to share information about you with anyone that does not work with the study. Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government agencies, Wellmark Foundation (the study's sponsor), and the Institutional Review Board (a committee that reviews and approves human research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

We will make reports and write articles about this study so others can learn from us. Your name will not be used in any of these reports or articles. The information gathered from your interview will be combined with others such that individual responses cannot be linked to an individual.

You are encouraged to ask questions about the study. If you have questions, you may contact Ruth Litchfield at (515) 294-9484 or Amber Appleton at (563) 608-1394.

If you have questions about the rights of research subjects please contact the IRB Administration, (515) 294-4566, IRB@iastate.edu, or Director (515) 294-3115, Office of Research Assurances, Iowa State University, Ames, Iowa 50011.

SIGNATURE

Signing this form means that you consent to participate in this study, that the study has been clearly explained to you, that you have been given time to read the consent form, and that your questions have been answered. Upon request, you will be provided a copy of this consent form for your records.

Signature of Interviewee

Date

Project Staff Signature/Interviewer

Date

Consent Form

Title: Promoting Health Literacy through the School Nutrition Environment

Investigators: Ruth Litchfield, PhD, RD, LD

Amber Appleton

Extension Specialist/Assistant Professor

Graduate Student

Iowa State University

Iowa State University

INTRODUCTION:

Your child is invited to share their thoughts and opinions about nutrition messaging they received through posters, displays, and videos throughout the cafeteria area since January 2009.

What will your child be asked to do?

If you consent to your child's participation, your child will be asked to participate in a focus group discussion consisting of 8-10 junior/senior students. Students will be asked to discuss their thoughts and opinions about nutrition messaging and the messages displayed at their school. The focus group discussion will last approximately 30-45 minutes, depending on the responses of the participants.

Does this study involve risks?

There is a slight risk that your child may not understand a question or that answering a question in a group of people may make them feel uneasy.

What are the benefits to being a part of this study?

There are no direct benefits to you/your child from taking part in this study. By allowing your child to participate in the study you will help examine the effectiveness of nutrition messaging to adolescents in the school nutrition environment.

What are you and your child's rights?

Your child's participation in the study is completely voluntary. As a parent or guardian you have the right to remove your child from this project at any time. Your child has the right to not answer a question at any time and may also remove themselves from the study at any time.

Choosing not to participate or stopping participation at any time does not result in any penalty. Participation or lack of participation in this study does not impact any of your child's rights or benefits at school.

We will make every effort to protect all information about your child and their participation in the study. Members of the research team are not allowed to share information about your child with anyone that does not work with the study. Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government agencies, Wellmark Foundation (the study's sponsor), and the Institutional Review board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

We will make reports and write articles about this study so others can learn from us. You or your child's name will not be used in any of these reports or articles. The responses gathered from your child will be combined with other responses gathered from high school students and shared only as compiled responses where individual responses cannot be linked to the individual.

You are encouraged to ask questions about the study. If you have questions, you may contact Ruth Litchfield at (515) 294-9484 or Amber Appleton at (563) 608-1394.

If you have questions about the rights of research subjects please contact the IRB Administration, (515) 294-4566, IRB@iastate.edu, or Director (515) 294-3115, Office of Research Assurances, Iowa State University, Ames, Iowa 50011.

SIGNATURE

Signing this form means that you consent to the participation of your child in the project, that the project has been explained to you and your child, that you have been given time to read the consent form, and that your questions have been answered. Upon request, you will be provided a copy of this consent form for your records.

Signature of Parent/Guardian

Date

Signature of Child/Student

Date

Project Staff Signature

Date

Nutrition Facts

Serving Size ½ cup

Servings per container 4

Amount per serving

Calories 250 Fat Cal 120

%DV

Total Fat 13g 20%

Sat Fat 9g 40%

Cholesterol 28mg 12%

Sodium 55mg 2%

Total Carbohydrate 30g 12%

Dietary Fiber 2g

Sugars 23g

Protein 4g 8%

*Percentage Daily Values (DV) are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Ingredients: Cream, Skim Milk, Liquid Sugar, Water, Egg Yolks, Brown Sugar, Milkfat, Peanut Oil, Sugar, Butter, Salt, Carrageenan, Vanilla Extract.

APPENDIX C: FOOD PERCEPTIONS ASSESSMENT



Date: _____ School: _____ Name: _____

PRODUCT: BAKED LAYS POTATO CHIPS

Instructions: For each characteristic below place a vertical line on the corresponding scale to indicate your opinion relative to the product shown and named above. For each characteristic the vertical line represents your opinion on a scale of strongly agree to strongly disagree.

1.) Expensive

Strongly Agree Strongly Disagree

2.) Tastes Good

Strongly Agree Strongly Disagree

3.) Healthy

Strongly Agree Strongly Disagree

4.) Boosts Energy

Strongly Agree Strongly Disagree

5.) Improves Mental Performance

Strongly Agree Strongly Disagree

6.) Improves Physical Performance

Strongly Agree Strongly Disagree



Date: _____ School: _____ Name: _____

PRODUCT: CHEX MIX

1.) Expensive

Strongly Agree

Strongly Disagree

2.) Tastes Good

Strongly Agree

Strongly Disagree

3.) Healthy

Strongly Agree

Strongly Disagree

4.) Boosts Energy

Strongly Agree

Strongly Disagree

5.) Improves Mental Performance

Strongly Agree

Strongly Disagree

6.) Improves Physical Performance

Strongly Agree

Strongly Disagree



Date: _____ School: _____ Name: _____

PRODUCT: SNICKERS BAR

1.) Expensive

Strongly Agree

Strongly Disagree

2.) Tastes Good

Strongly Agree

Strongly Disagree

3.) Healthy

Strongly Agree

Strongly Disagree

4.) Boosts Energy

Strongly Agree

Strongly Disagree

5.) Improves Mental Performance

Strongly Agree

Strongly Disagree

6.) Improves Physical Performance

Strongly Agree

Strongly Disagree



Date: _____ School: _____ Name: _____

PRODUCT: GATORADE

1.) Expensive

Strongly Agree

Strongly Disagree

2.) Tastes Good

Strongly Agree

Strongly Disagree

3.) Healthy

Strongly Agree

Strongly Disagree

4.) Boosts Energy

Strongly Agree

Strongly Disagree

5.) Improves Mental Performance

Strongly Agree

Strongly Disagree

6.) Improves Physical Performance

Strongly Agree

Strongly Disagree



Date: _____ School: _____ Name: _____

PRODUCT: ICE CREAM SANDWICH

1.) Expensive

Strongly Agree

Strongly Disagree

2.) Tastes Good

Strongly Agree

Strongly Disagree

3.) Healthy

Strongly Agree

Strongly Disagree

4.) Boosts Energy

Strongly Agree

Strongly Disagree

5.) Improves Mental Performance

Strongly Agree

Strongly Disagree

6.) Improves Physical Performance

Strongly Agree

Strongly Disagree



Date: _____ School: _____ Name: _____

PRODUCT: NUTRIGRAIN BAR

1.) Expensive

Strongly Agree

Strongly Disagree

2.) Tastes Good

Strongly Agree

Strongly Disagree

3.) Healthy

Strongly Agree

Strongly Disagree

4.) Boosts Energy

Strongly Agree

Strongly Disagree

5.) Improves Mental Performance

Strongly Agree

Strongly Disagree

6.) Improves Physical Performance

Strongly Agree

Strongly Disagree

APPENDIX D: FOCUS GROUP & INTERVIEW SCRIPTS

Baseline Focus Group Questions:

Background Info:

Your school is one of 6 schools across the state chosen to participate in a project examining high school students' opinions about vending, a la carte and school store food choices. Discussions like this one will be performed at each school to gather your opinions about vending, a la carte and school store foods available to you. I am collecting your opinions and will be recording our discussions. You are not required to respond to each and every question and may leave the focus group discussion at any time if you are uncomfortable.

Opening:

Tell me your name and your favorite hobby?

This first set of questions is about the food and beverages offered in vending machines at school.

Introduction:

Where are food or beverage machines located in your school?

Do you have any thoughts about your schools' vending machines?

Do you purchase food or beverages from the vending machines in your school?

If so, approximately how often (times per week or month)?

Think of your favorite vending machine food or beverage (pause):

Why would you purchase this item?

-Probes: do the events during your day affect your choice such as a test, a game, your stress level, emotions?

What time of day do you typically purchase this item?

Why do you think most students buy food or beverages from vending machines?

Do any of the following features of a food or beverage influence whether you purchase the item and how?

-Size of product

-Price of product

-Nutritional Value

-Taste/Flavor

Which of these attributes is most important?

Does the item you purchase have any promotional 'jingle' or advertisement that you can recall?

On a scale of 1-10 how would you rate the options available in vending machines in your school?

Why did you give it that rating?

If there was one thing you could change about the options available in the vending machines at your school what would it be? Why?

This next set of questions is about the a la carte food and beverages offered at your school. The a la carte line are those foods and beverages that cost extra compared to the cafeteria line. (i.e. snacks/extra cookies/ little Debbie snacks/ice cream etc...)

Do you have any thoughts about your schools' a la carte line?

Do you purchase food or beverages from the a la carte line in your school?

If so, estimate how often (times per week or month)?

Think of your favorite a la carte line food or beverage (pause).

Why do you purchase this item?

Does the lunch menu for that day influence your choice to purchase from the a la carte line?

Why do you think most students buy food or beverages from the a la carte line?

Do you think the a la carte line is a popular choice at your school?

Do any of the following features of a food or beverage influence whether you purchase the item and how?

-Size of the product

-Price of the product

-Nutritional Value

-Taste/Flavor

Which of these attributes is most important?

On a scale of 1-10 how would you rate the options available in the a la carte line at your school?

Why did you give it that rating?

If there was one thing you could change about the options available in the a la carte line at your school what would it be? Why?

This next set of questions is about the food and beverages offered in the school store.

Introduction:

Where is the school store located in your school?

Do you have any thoughts about your schools' store?

Do you purchase food or beverages from the store in your school?

If so, approximately how often (times per week or month).

Think of your favorite school store food or beverage (pause).

Why do you purchase this item?

What time of day do you typically purchase this item?

Why do you think most students buy food or beverages from the store?

Do any of the following features of a food or beverage influence whether you purchase the item and how?

-Size of the product

-Price of the product

-Nutritional Value

-Taste/Flavor

Which of these attributes is most important?

Does the item you purchase have any promotional 'jingle' or advertisement that you can recall?

On a scale of 1-10 how would you rate the food options available in the store in your school?

Why did you give it that rating?

If there was one thing you could change about the food options available in the store at your school what would it be?

Why?

Give a short oral summary of the discussion and the big ideas that emerged.

Does that sound right to you?

Final Questions:

Have we missed anything or is there anything anyone else would like to add?

Baseline Interview Questions

In general, what changes have you seen in vending and a la carte options in schools over the past two years?

Probes:

- Prevalence in schools?
- Popularity?
- Number of options?
- Cost of items?
- Nutritional value of options?

What changes have occurred at this school?

Probes:

- Popularity?
- Number of options?
- Cost of items?
- Nutritional value of options?

What changes would you like to see in vending and a la carte?

Do you have any thoughts about the future of vending and a la carte programs at schools?

Probe: What are some trends you see in other schools?

How would you describe the food and beverage choices you offer?

Probes:

- Healthy/Not healthy
- Expensive/Not expensive
- Limited/Wide variety

Do you feel limited in the items you can offer?

Probe: Are there items you would like to offer that you don't have access to?

Why do you feel limited?

How does the school decide what to offer in vending and a la carte?

Probes:

-Popularity of items?

-Nutrition value?

-Cost/Profit margin?

Describe how revenues from vending and a la carte are utilized/dispersed.

Is there a contractual agreement between the school and the vendor/wholesaler?

If so, what are the components of that contract?

Probes: Are there any aspects of this process you would like to see changed or improved?

If so, how would you change those aspects?

Give a short summary of the interview and the big ideas that emerged.

Does that sound right to you?

Final Question:

Have we missed anything or is there anything anyone else would like to add?

Endpoint Focus Group Questions:

Hi my name is Amber Appleton and I am here from Iowa State University to talk to you today about your school's nutrition environment. I will be asking for your opinions, comments, and suggestions regarding nutrition messaging that were displayed in your school. We want to gather information about the effectiveness of nutrition messaging to high school students and generate new ideas. I will also be asking your opinions, comments and suggestions about your school's a la carte, vending and school store options. You do not have to respond to any question you don't want to and you are free to leave the discussion at any time. Our discussion today will be recorded for further research assessment.

Appreciate and respect all opinions

No right or Wrong Answers

No judging or making fun of others opinions

Not to interrupt while someone is speaking

Participation greatly appreciated

Any questions at this time

Tell name, favorite school subject/activity. ****Start Recorder****

- Tell me about any food or nutrition messages you have seen in your school (i.e. handouts, posters, announcements, advertisements, etc...)
 - What do you remember about those messages? Please describe anything you can remember about them.
 - Do you recall a topic or piece of information they covered?
 - What did you like or not like about those messages?

Your school received 9 nutrition messages since January of last year. These messages were in the form of posters, displays, and a video and were generally displayed in the cafeteria area. To refresh your memory, these were the nutrition topics covered and what the messages looked like:... (show visuals of the messages and describe what topic each one covered)

-January: portion sizes

-February: Valentine Candy

-March: March Madness Bracket to find the healthiest food

-April: April Fools Fact or Fiction

-May: % Daily Value

-August: Rate Your Beverage

-October: Videos (label reading/soda and bone health/fruits and vegetables/breakfast

-November: Primary nutrients you are paying for in snacks (“What’s in your wrapper?”)

-December: not developed yet

After seeing the messages,

- What do you remember about those messages? Please describe anything you can remember about them.
- Can you talk about whether the messages were noticed or not? Did you or other students go and look at them? Did students talk about these messages?
- What do you think would help students to notice messages like these?
 - How would you change the current messages?

How would you promote messages like these in your school?

- Which message was or would be your favorite? Why?

Are there nutrition topics would you be most interested in learning more about that weren’t included?

Lets change topics a little and talk about food options available in you’re a la carte, vending and school store (not including foods sold through the lunch line).

What changes have you seen in you’re a la carte options over the past year?

Have you noticed changes in the vending machine options? If so, what changes have you seen?

Tell me about changes you have seen in your school store options?

What are your thoughts about these changes?

Any final comments on the messages or anything else you would like to add?

Summarize

Any other questions or comments?

Thank you!

APPENDIX F: BEVERAGE VENDING INVENTORY FORM

2C. Middle/High School Competitive Food & Beverage Assessment Tool

Beverage Vending Machine ___ of ___ (#)

Description of machine:	Accessibility:
Location:	<input type="checkbox"/> Accessible to students <input type="checkbox"/> Accessible ONLY to staff <input type="checkbox"/> Turned off/not in use
Advertising on Machine:	On during observation? Y/N
	Total # slots in machine:

BEVERAGES SOLD:

Item	Portion size (range)	# of slots	Comments
EMPTY SLOTS			
<i>100% juice* and/or water mixes, no added sweetener</i>			
<i>Water, unsweetened, plain</i>			
<i>Water, unsweetened, flavored or</i>			

<i>carbonated</i>			
<i>Sports drink</i>			
<i>Sports drink, reduced-calorie</i>			
Soda			
Diet Soda			
Other artificially sweetened drinks (≤ 10 kcal per serving)			
Any other drink with added sweetener			
<i>Milk: 0-1%, plain</i>			
<i>Milk: 0-1%, flavored</i>			___ g sug/ ___ oz ___ g sug/ ___ oz ___ g sug/ ___ oz
Milk: 2% or more, plain			
Milk: 2% or more, flavored			___ g sug/ ___ oz ___ g sug/ ___ oz ___ g sug/ ___ oz

* Categories in *italics* indicate compliance with SB 965, categories in regular font indicate non-compliance with SB 965

APPENDIX G: FOOD VENDING INVENTORY FORM

2D. Middle/High School Competitive Food & Beverage Assessment Tool

Food Vending Machine ___ of ___ (#)

Description of machine:	
Location:	Accessibility: <input type="checkbox"/> Accessible to students <input type="checkbox"/> Accessible ONLY to staff <input type="checkbox"/> Turned off/not in use
Advertising on Machine:	On during observation? Y Total # slots in machine:

FOOD SOLD:

Item Category	Item Type *Categories in <i>italics</i> indicate compliance with SB 12, categories in regular font indicate non-compliance with SB 12	Kcal restriction	# of SLOTS
EMPTY SLOTS			
Candy & Fruit Snacks	<i>Sugarless gum, mints, and hard candies; Tic Tacs</i>	<i>AND ≤250</i>	
	<i>WRITE IN other types of sugarless candies and Generation Max brand candy</i>		

Item Category	Item Type *Categories in <i>italics</i> indicate compliance with SB 12, categories in regular font indicate non-compliance with SB 12	Kcal restriction	# of SLOTS
	All other candy, candy bars, fruit snacks, fondant, gum or mints		
Chips	<i>Baked chips</i> ≤ 1.4 oz (39g)	<i>OR ≤250</i>	
	<i>Reduced fat cheese puffs, bagel chips, soy crisps</i>	<i>AND ≤250</i>	
	Regular chips (including potato skins, bugles, puffed wheat snacks, Sun Chips, Cheetos); tortilla chips	OR > 250	
Cookies and Pastries	<i>Animal crackers and graham crackers--flavored and plain—but NOT iced or coated</i>	<i>AND ≤250</i>	
	<i>WRITE IN fat/sugar modified cookies, rice krispie-type treats, and Generation Max brand cookies</i>		
	Cookies (sugar-free or regular); brownies, cakes, cake products, cupcakes, danishes, donuts, pastries, pie		
Crackers	<i>WRITE IN all Goldfish crackers</i>		
	Cheese and/or peanut butter-flavored varieties, except Goldfish crackers, not fat modified	OR > 250	
	<i>Triscuits (any kind), reduced-fat crackers (not cheese/peanut butter-flavored varieties)</i>	<i>AND ≤250</i>	
Jerky	<i>Beef jerky & Enjoy brand jerky products</i>	<i>AND ≤250</i>	
Nuts and Seeds	Corn nuts, all flavors, >1.7 oz (48g)	OR > 250	
	<i>Corn nuts, all flavors, ≤1.7 oz (48g)</i>	<i>OR ≤250</i>	
	<i>Nuts & seeds, uncoated, w/out added sweeteners, ≤1.5 oz (43g)</i>	<i>OR ≤250</i>	
Pretzels	<i>Hard non-coated, ≤1.5 oz (43g), Soft, plain ≤2.6 oz (74g)</i>	<i>OR ≤250</i>	

Item Category	Item Type *Categories in <i>italics</i> indicate compliance with SB 12, categories in regular font indicate non-compliance with SB 12	Kcal restriction	# of SLOTS
Snack mix	<i>Chex Mix (not choc turtle flavor or flavors w/ nuts), Generation Max snack clusters or Reduced fat snack mix</i>	AND ≤250	
	Regular snack mix or Chex Mix that is choc turtle, or flavors with nuts	OR > 250	
	<i>Trail mix made with only fruit, nuts, and seeds, w/out added sweeteners or oils</i>		
	Trail mix with candies		
	All other trail mix without candies		
Toaster Pastries	Frosted (reg or low-fat)		
	Unfrosted		

APPENDIX H: ALA CARTE/SCHOOL STORE INVENTORY FORM
2B. Middle/High School Competitive Food & Beverage Assessment Tool

Cafeteria a la carte/ Snack bar/ Snack cart/ School store ___ of ___ (#)

(check one)

Venue Information:	Accessibility:
Describe location:	<input type="checkbox"/> Accessible to students <input type="checkbox"/> Accessible ONLY to staff Open during observation?

BEVERAGES SOLD:

Item	# of kinds/flavors	Portion size (range)	Comments
<i>100% juice* and/or water mixes, no added sweetener</i>			
<i>Water, unsweetened, plain</i>			
<i>Water, unsweetened, flavored or carbonated</i>			
<i>Sports drink</i>			
<i>Sports drink, reduced-calorie</i>			
Soda			
Diet Soda			
Other artificially sweetened drinks (≤ 10 kcal per serving)			

Any other drink with added sweetener			
<i>Milk: 0-1%, plain</i>			
<i>Milk: 0-1%, flavored</i>			___ g sug/___ oz ___ g sug/___ oz ___ g sug/___ oz
Milk: 2% or more, plain			
Milk: 2% or more, flavored			___ g sug/___ oz ___ g sug/___ oz ___ g sug/___ oz

* Categories in *italics* indicate compliance with SB 965, categories in regular font indicate non-compliance with SB 965

FOOD SOLD:

Item Category	Item Type *Categories in <i>italics</i> indicate compliance with SB 12, categories in regular font indicate non-compliance with SB 12	Kcal restriction	# of diff kinds/ flavors
Bagels	1. <i>Bagel with real cream cheese*</i>	AND ≤400	
Candy & Fruit Snacks	2. <i>Sugarless gum, mints, and hard candies; Tic Tacs</i>	AND ≤250	
	<i>WRITE IN other types of sugarless candies and Generation Max brand candy</i>		
	3. All other candy, candy bars, fruit snacks, fondant, gum or mints		
Cereals	4. <i>Unfrosted, unflavored</i>	AND ≤400	
	5. <i>Frosted or flavored</i>	AND ≤400	
Chips	6. <i>Baked chips ≤ 1.4 oz (39g)</i>	OR ≤250	
	7. <i>Reduced fat cheese puffs, bagel chips, soy crisps</i>	AND ≤250	
	8. Regular chips (including potato skins, bugles, puffed wheat snacks, Sun Chips, Cheetos), tortilla chips	OR >250	
Cookies and Pastries	9. <i>Animal crackers and graham crackers—flavored and plain—but NOT iced or coated)</i>	AND ≤250	
	<i>WRITE IN fat/sugar modified cookies, rice krispie-type treats, and Generation Max brand cookies</i>		
	10. Cookies (sugar-free or regular); brownies, cakes, cake products, cupcakes, danishes, donuts, pastries, pie (NOT fat/sugar modified)		
Crackers	<i>WRITE IN all Goldfish crackers</i>		
	11. Cheese and/or peanut butter-flavored varieties , not fat modified	OR >250	
	12. <i>Triscuits (any kind), reduced-fat crackers (not cheese/peanut butter-flavored varieties)</i>	AND ≤250	
Frozen desserts	13. Ice cream (bars, cups, sandwiches, sundaes) NOT fat/sugar modified		
	14. <i>Popsicles, fudgsicles/fudge pops</i> (not creamsicles)	AND ≤250	
	15. <i>Non-fat, frozen yogurt</i>	AND ≤250	
Fruits	16. <i>Fruit without added sweeteners</i>		

Item Category	Item Type *Categories in <i>italics</i> indicate compliance with SB 12, categories in regular font indicate non-compliance with SB 12	Kcal restriction	# of diff kinds/ flavors
	<i>(fresh, whole, sliced, 100% dried, canned or packaged w/out syrup)</i>		
	17. 100% fruit leathers & rolls, w/o added sweeteners		
Nuts and Seeds	18. Corn nuts, all flavors, >1.7 oz (48g)	OR >250	
	19. <i>Corn nuts, all flavors, ≤1.7 oz (48g)</i>	OR ≤250	
	20. <i>Nuts & seeds, uncoated, w/out added sweeteners, ≤1.5 oz (43g)</i>	OR ≤250	
Pizza	21. Pizza, pizza products, cheese breads (NOT fat modified)		
Pretzels	22. <i>Hard non-coated, ≤1.5 oz (43g), Soft, plain ≤2.6 oz (74g)</i>	OR ≤250	
Snack mix	23. <i>Chex Mix (not choc turtle flavor or flavors w/ nuts), Generation Max snack clusters or Reduced fat snack mix</i>	AND ≤250	
	24. Regular snack mix or Chex Mix that is choc turtle, or flavors with nuts	OR >250	
	25. <i>Trail mix made with only fruit, nuts, and seeds, w/out added sweeteners or oils</i>		
	26. Trail mix with candies		
	27. All other trail mix without candies		
Toaster Pastries	28. Frosted (reg or low-fat)		
	29. Unfrosted		
Vegetables	30. Chef salad (entrée-sized)	OR > 400	
	31. <i>Fresh vegetables or side salads (± dip/dressing)</i>	AND ≤250	
Yogurt (not frozen)	32. <i>Fat-free or low-fat plain</i>	AND ≤250	
	33. <i>Fat-free or low-fat flavored</i>	AND ≤250	
	34. Not fat modified	OR >250	

APPENDIX I: LOCAL WELLNES POLICY SCORING FORM

Local Wellness Policy Scoring

(0=not addressed, 0.5=somewhat addressed, 1=adequately addressed)

- Does the LWP address competitive foods? (1pt)
- Does the policy apply to:
 - vending? (1pt)
 - ALC? (1pt)
 - concessions? (1pt)
 - school stores? (1pt)
 - fundraising? (1pt)
 - parties? (1pt)
 - rewards? (1pt)
 - snacks? (1pt)
 - the school day? (1pt)
 - part of the school day? (1pt)
 - after school events? (1pt)
 - portion sizes? (1pt)
 - calorie limits? (1pt)
 - fat limits? (1pt)
 - saturated fat limits? (1pt)
 - trans fat limits? (1pt)
 - sugar limits? (1pt)
 - sodium limits? (1pt)

Total points possible: 19 pts

November 25, 2008

APPENDIX J: CONTROL AND INTERVENTION EXAMPLE LETTERS

Control School

School Contact (Name)

High School (Name)

High School Address

Dear (Name),

A sincere thank you for your participation in the Wellmark funded project “Promoting Health Literacy through the School Nutrition Environment.” Your time and effort put into the school site visit this fall is greatly appreciated, as well as the cooperation of school staff and students.

Each school has been randomly assigned as an intervention or control school. Your school has been assigned to the control group. As such, the research team will not have scheduled communication or visits with your school until spring of 2010. At the spring 2010 visit the student assessments will be performed on the same 50 students as the fall 2008 visit (a list of students is included). In addition, the a la carte and vending machines will be inventoried again. The focus group and interviews will not be completed at spring 2010 visit.

After the completion of data collection in the spring of 2010, your school will be provided the same intervention that intervention schools were provided. This includes education messages for use in the school including posters, displays, announcements, channel messages. Any technical support or training developed for the intervention schools will also be provided to your school.

If your school has not yet submitted the invoice for compensation since the completion of the first school visit you can send it in at this time. Send the invoice to:

University Address

Again, thank you for your participation and cooperation in this exciting research endeavor and feel free to contact us with any questions or concerns.

Sincerely,

Name

Graduate Student

Number

Email address

Name

Assistant Professor

Number

Email address

November 25, 2008

School Contact (Name)

High School (Name)

High School Address

Dear (Name),

A sincere thank you for your participation in the Wellmark funded project “Promoting Health Literacy through the School Nutrition Environment.” Your time and effort put into the school site visit is greatly appreciated, as well as the cooperation of school staff and students.

Each school has been randomly assigned as an intervention or control school. Your school has been assigned to the intervention group. One component of the intervention is a monthly educational message beginning January, 2009. Your school will receive an educational message monthly from January-May and August-December, 2009 (total of 10 messages). The monthly message will include some type of poster or display to be used in the cafeteria, a la carte or vending area and intercom announcements, message board announcements, channel messages, school newspaper ideas for the school to use to support the educational message in the poster/display. These messages will cover topics such as portion sizes, tips to reading food label reading, evaluating snack foods and other health-related topics. .

As part of the contractual agreement each intervention school is required to identify and change a minimum three changes in their school nutrition environment. The monthly educational messages that each school will be receiving will not count toward these three changes. These changes could include items such as: 1. Changing some a la carte options; 2. Changing some vending options; 3. Implementing marketing strategy for a la carte; 4. Implementing marketing strategy for vending; 5. Altering physical space of a la carte; 6. Altering physical space of vending; 7. Implementing promotions/incentives relative to a la

carte; 8. Implementing promotions/incentives relative to vending. This is just a sample of ideas, the research team would like you to identify areas of priority specific to your school keeping in mind your resources and challenges. The three changes need to be shared with the research team by January 15, 2009.

Changes identified during your site visit that you might consider include:

- Posting an a la carte menu
- Offering pre-made packaged salads to a la carte
- Offering pre-made sub sandwiches to a la carte
- Offering yogurt/Go-gurt to chilled vending
- Limiting cracker options on a la carte
- Offering fruit/yogurt parfaits on a la carte
- Possibility of sharing any of the concession space for a la carte?

As an intervention school you will also be required to participate in two Iowa Communications Network (ICN) sessions. One will take place in the spring of 2009 to update your school on the state legislation relative to nutrition standards. The second session will take place in the late spring or early fall of 2009 to discuss marketing strategies for a la carte and vending machine venues. The times and dates of these sessions have not been determined and will be shared with you shortly. Finally, if your school would like, on site technical assistance (maximum of two visits) can be provided at your school's request.

Our second school visit will take place during the spring of 2010. During this visit the student assessments will be performed on the same 50 students as the previous visit (a list of students is included). The a la carte and vending machines will be inventoried once again and the focus group and interviews will not need to be completed at this second visit.

If your school has not yet submitted the invoice for compensation since the completion of the first school visit you can send it in at this time. Send the invoice to:

University Address

Again, thank you for your participation and cooperation in this exciting research endeavor.

Sincerely,

Name

Graduate Student

Number

Email address

Name

Assistant Professor

Number

Email address

REFERENCES

- American Society for Testing and Materials. (1968). *Manual on Sensory Testing Methods*. Philadelphia, PA: American Society for Testing and Materials.
- Anderson, P. M., & Butcher, K. F. (2005). Reading, Writing, and Raisinets: Are School Finances Contributing to Children's Obesity? [Electronic Version]. National Bureau of Economic Research. Retrieved June 19, 2009, from <http://www.nber.org/papers/w11177.pdf>
- Anderson, P. M., Butcher, K.F. (2006). Reading, writing, and refreshments: are school finances contributing to children's obesity? *Journal of Human Resources*, 41(3), 467-494.
- Anderson, S., & Whitaker, R. (2010). Household routines and obesity in US preschool-aged children. *Pediatrics*, 125(3), 420-428.
- Anzman, S., & Birch, L. (2009). Low inhibitory control and restrictive feeding practices predict weight outcomes. *J Pediatr*, 155(5), 651-656.
- Arnett, D., McGovern, P., Jacobs, D. J., Shahar, E., Duval, S., Blackburn, H., et al. (2002). Fifteen-year trends in cardiovascular risk factors (1980-1982 through 1995-1997): the Minnesota Heart Survey. *Am J Epidemiol*, 156(10), 929-935.
- Arnold, C., Davis, T., Berkel, H., Jackson, R., Nandy, I., & London, S. (2001). Smoking status, reading level, and knowledge of tobacco effects among low-income pregnant women. *Prev Med*, 32(4), 313-320.
- Baker, D., Gazmararian, J., Williams, M., Scott, T., Parker, R., Green, D., et al. (2002). Functional health literacy and the risk of hospital admission among Medicare managed care enrollees. *Am J Public Health*, 92(8), 1278-1283.
- Baker, D., Parker, R., Williams, M., & Clark, W. (1998). Health literacy and the risk of hospital admission. *J Gen Intern Med*, 13(12), 791-798.
- Baker, D., Parker, R., Williams, M., Clark, W., & Nurss, J. (1997). The relationship of patient reading ability to self-reported health and use of health services. *Am J Public Health*, 87(6), 1027-1030.
- Baker, D., Parker, R., Williams, M., Pitkin, K., Parikh, N., Coates, W., et al. (1996). The health care experience of patients with low literacy. *Arch Fam Med*, 5(6), 329-334.
- Baker, D., Williams, M., Parker, R., Gazmararian, J., & Nurss, J. (1999). Development of a brief test to measure functional health literacy. *Patient Educ Couns*, 38(1), 33-42.
- Barker, L. M. (1982). *The Psychobiology of Human Food Selection: Social Determinants in Human Food Selection*. Westport, Connecticut: The Avi Publishing Company, Inc.
- Batada, A., & Wootan, M. G. (2009). Center for Science in the Public Interest: Better for Who? Revisiting Company Promises on Food Marketing to Children. Retrieved December 3, 2009, from <http://cspinet.org/new/pdf/pledgereport.pdf>
- Bennett, C., Ferreira, M., Davis, T., Kaplan, J., Weinberger, M., Kuzel, T., et al. (1998). Relation between literacy, race, and stage of presentation among low-income patients with prostate cancer. *J Clin Oncol*, 16(9), 3101-3104.
- Bissonnette, M., & Contento, I. (2001). Adolescents' perspectives and food choice behaviors in terms of the environmental impacts of food production practices: application of a psychosocial model. *J Nutr Educ*, 33(2), 72-82.

- Borradaile, K., Sherman, S., Vander Veur, S., McCoy, T., Sandoval, B., Nachmani, J., et al. (2009). Snacking in children: the role of urban corner stores. *Pediatrics*, *124*(5), 1293-1298.
- Bronfenbrenner, U. (1979). *The Ecology of Human Development*. Cambridge, MA: Harvard University Press.
- Brown, S., Teufel, J., & Birch, D. (2007). Early adolescents perceptions of health and health literacy. *J Sch Health*, *77*(1), 7-15.
- Burghardt, J., Devaney, B., & Gordon, A. (1995). The School Nutrition Dietary Assessment Study: summary and discussion. *Am J Clin Nutr*, *61*(1 Suppl), 252S-257S.
- California Senate Bill 12. (2005). School Food Nutrition. Retrieved June 10, 2010, from http://info.sen.ca.gov/pub/05-06/bill/sen/sb_0001-0050/sb_12_bill_20050915_chaptered.html
- Carels, R., Harper, J., & Konrad, K. (2006). Qualitative perceptions and caloric estimations of healthy and unhealthy foods by behavioral weight loss participants. *Appetite*, *46*(2), 199-206.
- Carels, R., Konrad, K., & Harper, J. (2007). Individual differences in food perceptions and calorie estimation: an examination of dieting status, weight, and gender. *Appetite*, *49*(2), 450-458.
- Center for Science in the Public Interest. (2004). Dispensing Junk: How School Vending Undermines Efforts to Feed Children Well. Retrieved November 3, 2009, from http://www.cspinet.org/new/pdf/dispensing_junk.pdf
- Center for Weight and Health. (2007). University of California, Berkeley.
- Centers for Disease Control and Prevention. (2007a). Trends in the Prevalence of Physical Activity National YRBS: 1991—2007. Retrieved June 29, 2009, from http://www.cdc.gov/HealthyYouth/yrbs/pdf/yrbs07_us_physical_activity_trend.pdf
- Centers for Disease Control and Prevention. (2007b). YRBSS: 2007 National Youth Risk Behavior Survey Overview. Retrieved June 29, 2009, from http://www.cdc.gov/HealthyYouth/yrbs/pdf/yrbs07_us_overview.pdf
- Centers for Disease Control and Prevention. (2008a). Healthy Youth!: Coordinated School Health Program. Retrieved May 16, 2010, from <http://www.cdc.gov/HealthyYouth/CSHP/>
- Centers for Disease Control and Prevention. (2008b). Healthy Youth!: Nutrition: School Health Guidelines: Summary. Retrieved April 2, 2009, from <http://www.cdc.gov/healthyYouth/nutrition/guidelines/summary.htm>
- Centers for Disease Control and Prevention. (2008c). National Center for Health Statistics: Prevalence of Overweight Among Children and Adolescents: United States, 2003-2004. Retrieved April 2, 2009, from http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overweight/overwght_child_03.htm
- Centers for Disease Control and Prevention. (2008d). Preventing Chronic Diseases: Investing Wisely in Health. Retrieved March 20, 2009, from <http://www.cdc.gov/nccdphp/publications/factsheets/Prevention/pdf/obesity.pdf>
- Centers for Disease Control and Prevention. (2008e). Youth Risk Factor Surveillance System. Youth Online: Comprehensive Reults. Retrieved September 22, 2009, from

- <http://apps.nccd.cdc.gov/yrbss/CompTableTwoLoc.asp?X=1&Loc1=IA&Loc2=XX&Year1=2007&Year2=2007>
- Centers for Disease Control and Prevention. (2009a). Chronic Disease Prevention and Health Promotion. Retrieved April 2, 2009, from <http://www.cdc.gov/nccdphp/>
- Centers for Disease Control and Prevention. (2009b). Healthy Weight-It's Not a Diet, It's a Lifestyle!: About BMI for Children and Teens. Retrieved May 14, 2010, from http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html
- Centers for Disease Control and Prevention. (2009c). National Center for Health Statistics: National Health and Nutrition Examination Survey: Clinical Growth Charts. Retrieved June 18, 2009, from http://www.cdc.gov/growthcharts/clinical_charts.htm
- Child Nutrition and WIC Reauthorization Act of 2004, -. P. L. (2004).
- Clark, M., & Fox, M. (2009). Nutritional quality of the diets of US public school children and the role of the school meal programs. *J Am Diet Assoc*, 109(2 Suppl), S44-56.
- Colapinto, C., Fitzgerald, A., Taper, L., & Veugeliers, P. (2007). Children's preference for large portions: prevalence, determinants, and consequences. *J Am Diet Assoc*, 107(7), 1183-1190.
- Contento, I. R., Michela, J. L., & Goldberg, C. J. (1988). Food Choice Among Adolescents: Population Segmentation by Motivations. *Nutrition Education*, 20(6), 289-298.
- Croll, J., Neumark-Sztainer, D., & Story, M. (2001). Healthy eating: what does it mean to adolescents? *J Nutr Educ*, 33(4), 193-198.
- Cullen, K., & Thompson, D. (2005). Texas school food policy changes related to middle school a la carte/snack bar foods: potential savings in kilocalories. *J Am Diet Assoc*, 105(12), 1952-1954.
- Cullen, K., & Zakeri, I. (2004). Fruits, vegetables, milk, and sweetened beverages consumption and access to à la carte/snack bar meals at school. *Am J Public Health*, 94(3), 463-467.
- Daniels, S. (2006). The consequences of childhood overweight and obesity. *Future Child*, 16(1), 47-67.
- Davis, T., Byrd, R., Arnold, C., Auinger, P., & Bocchini, J. J. (1999). Low literacy and violence among adolescents in a summer sports program. *J Adolesc Health*, 24(6), 403-411.
- Davis, T., Long, S., Jackson, R., Mayeaux, E., George, R., Murphy, P., et al. (1993). Rapid estimate of adult literacy in medicine: a shortened screening instrument. *Fam Med*, 25(6), 391-395.
- Davis, T., Wolf, M., Arnold, C., Byrd, R., Long, S., Springer, T., et al. (2006). Development and validation of the Rapid Estimate of Adolescent Literacy in Medicine (REALM-Teen): a tool to screen adolescents for below-grade reading in health care settings. *Pediatrics*, 118(6), e1707-1714.
- Davison, K., & Birch, L. (2001). Childhood overweight: a contextual model and recommendations for future research. *Obes Rev*, 2(3), 159-171.
- Devaney, B., Gordon, A., & Burghardt, J. (1995). Dietary intakes of students. *Am J Clin Nutr*, 61(1 Suppl), 205S-212S.
- Dr. Robert C. and Veronica Atkins Center for Weight and Health. (2007). University of California, Berkeley.

- Drewnowski, A. (1985). Food perceptions and preferences of obese adults: a multidimensional approach. *Int J Obes*, 9(3), 201-212.
- Ebbeling, C., Pawlak, D., & Ludwig, D. (2002). Childhood obesity: public-health crisis, common sense cure. *Lancet*, 360(9331), 473-482.
- Evans, N., Gilpin, E., Farkas, A., Shenassa, E., & Pierce, J. (1995). Adolescents' perceptions of their peers' health norms. *Am J Public Health*, 85(8 Pt 1), 1064-1069.
- Falkner, N., Neumark-Sztainer, D., Story, M., Jeffery, R., Beuhring, T., & Resnick, M. (2001). Social, educational, and psychological correlates of weight status in adolescents. *Obes Res*, 9(1), 32-42.
- Falkstedt, D., Hemmingsson, T., Rasmussen, F., & Lundberg, I. (2007). Body mass index in late adolescence and its association with coronary heart disease and stroke in middle age among Swedish men. *Int J Obes (Lond)*, 31(5), 777-783.
- Finkelstein, E., Fiebelkorn, I., & Wang, G. (2004). State-level estimates of annual medical expenditures attributable to obesity. *Obes Res*, 12(1), 18-24.
- Fisher, J., & Birch, L. (1999). Restricting access to foods and children's eating. *Appetite*, 32(3), 405-419.
- Fitzgerald, N., & Spaccarotella, K. (2009). Barriers to a healthy Lifestyle: From Individuals to Public Policy-An Ecological Perspective. Retrieved November 3, 2009, from <http://www.joe.org/joe/2009february/a3.php>
- Flegal, K., Tabak, C., & Ogden, C. (2006). Overweight in children: definitions and interpretation. *Health Educ Res*, 21(6), 755-760.
- Flesch, R. (1974). *The Art of Readable Writing*. New York: Harper and Row.
- Florence, M., Asbridge, M., & Veugelers, P. (2008). Diet quality and academic performance. *J Sch Health*, 78(4), 209-215; quiz 239-241.
- Fortenberry, J., McFarlane, M., Hennessy, M., Bull, S., Grimley, D., St Lawrence, J., et al. (2001). Relation of health literacy to gonorrhoea related care. *Sex Transm Infect*, 77(3), 206-211.
- Freedman, D., Dietz, W., Srinivasan, S., & Berenson, G. (1999). The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics*, 103(6 Pt 1), 1175-1182.
- French, S., Jeffery, R., Story, M., Breitlow, K., Baxter, J., Hannan, P., et al. (2001). Pricing and promotion effects on low-fat vending snack purchases: the CHIPS Study. *Am J Public Health*, 91(1), 112-117.
- Friedlander, S., Larkin, E., Rosen, C., Palermo, T., & Redline, S. (2003). Decreased quality of life associated with obesity in school-aged children. *Arch Pediatr Adolesc Med*, 157(12), 1206-1211.
- Fry, E. B. (1977). *Elementary Reading Instruction*. New York: McGraw-Hill.
- Fu, M., Cheng, L., Tu, S., & Pan, W. (2007). Association between unhealthy eating patterns and unfavorable overall school performance in children. *J Am Diet Assoc*, 107(11), 1935-1943.
- Gable, S., Britt-Rankin, J., & Krull, J. L. (2008). United States Department of Agriculture: Ecological Predictors and Developmental Outcomes of Persistent Childhood Overweight. Retrieved October 13, 2009, from <http://www.ers.usda.gov/publications/ccr42/ccr42.pdf>

- Gazmararian, J., Williams, M., Peel, J., & Baker, D. (2003). Health literacy and knowledge of chronic disease. *Patient Educ Couns*, 51(3), 267-275.
- Giammattei, J., Blix, G., Marshak, H., Wollitzer, A., & Pettitt, D. (2003). Television watching and soft drink consumption: associations with obesity in 11- to 13-year-old schoolchildren. *Arch Pediatr Adolesc Med*, 157(9), 882-886.
- Gillman, M., Rifas-Shiman, S., Frazier, A., Rockett, H., Camargo, C. J., Field, A., et al. (2000). Family dinner and diet quality among older children and adolescents. *Arch Fam Med*, 9(3), 235-240.
- Gleason, P. M., & Sutor, C. W. (2003). Eating at School: How the National School Lunch Program Affects Children's Diets. [Electronic Version]. *Amer. J. Agr. Econ.*, 85(4), 1047-1061.
- Golin, C., Liu, H., Hays, R., Miller, L., Beck, C., Ickovics, J., et al. (2002). A prospective study of predictors of adherence to combination antiretroviral medication. *J Gen Intern Med*, 17(10), 756-765.
- Gordon, A., & Fox, M. K. (2007). School Nutrition Dietary Assessment Study-III: Summary of Findings. Retrieved March 18, 2009, from <http://www.fns.usda.gov/ora/MENU/published/CNP/FILES/SNDIII-SummaryofFindings.pdf>
- Gordon, M., Hampson, R., Capell, H., & Madhok, R. (2002). Illiteracy in rheumatoid arthritis patients as determined by the Rapid Estimate of Adult Literacy in Medicine (REALM) score. *Rheumatology (Oxford)*, 41(7), 750-754.
- Grimm, G., Harnack, L., & Story, M. (2004). Factors associated with soft drink consumption in school-aged children. *J Am Diet Assoc*, 104(8), 1244-1249.
- Groft, J., Hagen, B., Miller, N., Cooper, N., & Brown, S. (2005). Adolescent health: a rural community's approach. *Rural Remote Health*, 5(2), 366.
- Harnack, L., Story, M., Martinson, B., Neumark-Sztainer, D., & Stang, J. (1998). Guess who's cooking? The role of men in meal planning, shopping, and preparation in US families. *J Am Diet Assoc*, 98(9), 995-1000.
- Harris, J., Bargh, J., & Brownell, K. (2009). Priming effects of television food advertising on eating behavior. *Health Psychol*, 28(4), 404-413.
- Harrison, M., & Jackson, L. (2009). Meanings that youth associate with healthy and unhealthy food. *Can J Diet Pract Res*, 70(1), 6-12.
- Hartline-Grafton, H., Rose, D., Johnson, C., Rice, J., & Webber, L. (2009). Are school employees role models of healthful eating? Dietary intake results from the ACTION worksite wellness trial. *J Am Diet Assoc*, 109(9), 1548-1556.
- Hawthorne, G. (1997). Preteenage drug use in Australia: the key predictors and school-based drug education. *J Adolesc Health*, 20(5), 384-395.
- Hedley, A., Ogden, C., Johnson, C., Carroll, M., Curtin, L., & Flegal, K. (2004). Prevalence of overweight and obesity among US children, adolescents, and adults, 1999-2002. *JAMA*, 291(23), 2847-2850.
- Hill, J., Wyatt, H., Reed, G., & Peters, J. (2003). Obesity and the environment: where do we go from here? *Science*, 299(5608), 853-855.
- Horacek, T., & Betts, N. (1998). Students cluster into 4 groups according to the factors influencing their dietary intake. *J Am Diet Assoc*, 98(12), 1464-1467.

- Howard, D., Gazmararian, J., & Parker, R. (2005). The impact of low health literacy on the medical costs of Medicare managed care enrollees. *Am J Med*, 118(4), 371-377.
- Institute of Medicine. (2004). *Health Literacy: A Prescription to End Confusion*. Retrieved March 18, 2009, from <http://www.iom.edu/?id=32784>
- Institute of Medicine. (2007). *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*. Washington, DC: The National Academies Press.
- Iowa Department of Education. (2008). Standards, Benchmarks & Grade Level Indicators: Grade 8. Retrieved June 8, 2010, from http://www.iowa.gov/educate/index.php?option=com_content&view=article&id=1350&Itemid=2287
- Iowa Department of Education. (2009). Assigned Rates of Reimbursement July 1, 2009 through June 30, 2010.
- Iowa Department of Education. (2010a). 2009-2010 Iowa Public School PK-12 Students Eligible for Free and Reduced-Price Lunch by School. Retrieved May 1, 2010, from http://www.iowa.gov/educate/index.php?option=com_docman&task=cat_view&gid=514&Itemid=1507
- Iowa Department of Education. (2010b). 2009-2010 Iowa Public School PreK-12 Enrollments by School, Race, and Gender. Retrieved May 1, 2010, from http://www.iowa.gov/educate/index.php?option=com_docman&task=cat_view&gid=513&Itemid=1507
- Iowa Department of Education. (n.d.-a). Healthy Kids Act. Retrieved June 4, 2010, from http://www.iowa.gov/educate/index.php?option=com_content&view=article&id=1769&Itemid=2545
- Iowa Department of Education. (n.d.-b). Iowa Core Curriculum: Health Literacy Grades 9-12. Retrieved April 2, 2009, from <http://www.corecurriculum.iowa.gov/Discipline.aspx?C=21st+Century+Skills&D=Health+Literacy&ESkillId=259&LookUp=health%20literacy&GradeBand=Grades%209-12>
- Iowa Department of Education. (n.d.-c). Iowa Core Curriculum: Highlights. Retrieved April 2, 2009, from <http://www.corecurriculum.iowa.gov/Home.aspx>
- Iowa Department of Public Health. (2000). *Healthy Iowans 2010: Iowa's Health Agenda for the New Millennium* (pp. 5).
- Iowa Department of Public Health. (2008). Pediatric Nutrition Surveillance System. Iowa Summary of Demographic Indicators. Children aged <5 years. Retrieved June 18, 2009, from http://www.idph.state.ia.us/wic/common/pdf/2008_pednss_iowa.pdf
- Jahns, L., Siega-Riz, A., & Popkin, B. (2001). The increasing prevalence of snacking among US children from 1977 to 1996. *J Pediatr*, 138(4), 493-498.
- Jastak, S., & Wilkinson, G. S. (1984). *Wide Range Achievement Test-Revised (WRAT-R)*: Jastak Assessment Systems.
- Jeffery, R., Rydell, S., Dunn, C., Harnack, L., Levine, A., Pentel, P., et al. (2007). Effects of portion size on chronic energy intake. *Int J Behav Nutr Phys Act*, 4, 27.
- Kalichman, S., Benotsch, E., Suarez, T., Catz, S., Miller, J., & Rompa, D. (2000). Health literacy and health-related knowledge among persons living with HIV/AIDS. *Am J Prev Med*, 18(4), 325-331.

- Kalichman, S., Ramachandran, B., & Catz, S. (1999). Adherence to combination antiretroviral therapies in HIV patients of low health literacy. *J Gen Intern Med*, 14(5), 267-273.
- Kann, L., Brener, N., & Wechsler, H. (2007). Overview and summary: School Health Policies and Programs Study 2006. *J Sch Health*, 77(8), 385-397.
- Kant, A. (2000). Consumption of energy-dense, nutrient-poor foods by adult Americans: nutritional and health implications. The third National Health and Nutrition Examination Survey, 1988-1994. *Am J Clin Nutr*, 72(4), 929-936.
- Kirsch, I. S., Jungeblut, A., Jenkins, L., & Kolstad, A. (2002). United States Department of Education: National Center for Education Statistics: Adult Literacy in America: A First Look at the Findings of the National Adult Literacy Survey. Retrieved November 25, 2009, from <http://nces.ed.gov/pubs93/93275.pdf>
- Koplan, J., Liverman, C., & Kraak, V. (2005). Preventing childhood obesity: health in the balance: executive summary. *J Am Diet Assoc*, 105(1), 131-138.
- Kronld, M., & Coleman, P. (1988). The Role of Food Perceptions in Food Use. *Curr Concepts Nutr*, 16, 53-78.
- Kronld, M., & Lau, D. (1978). Food habit modification as a public health measure. *Can J Public Health*, 69(1), 39-43, 48.
- Krueger, R. A. (1988). *Focus Groups: A practical Guide for Applied Research*. Newbury Park, Calif.: Sage Publications.
- Kubik, M., Lytle, L., Farbakhsh, K., Moe, S., & Samuelson, A. (2009). Food use in middle and high school fundraising: does policy support healthful practice? Results from a survey of Minnesota school principals. *J Am Diet Assoc*, 109(7), 1215-1219.
- Kubik, M., Lytle, L., Hannan, P., Perry, C., & Story, M. (2003). The association of the school food environment with dietary behaviors of young adolescents. *Am J Public Health*, 93(7), 1168-1173.
- Kubik, M., Lytle, L., Hannan, P., Story, M., & Perry, C. (2002). Food-related beliefs, eating behavior, and classroom food practices of middle school teachers. *J Sch Health*, 72(8), 339-345.
- Kubik, M., Lytle, L., & Story, M. (2005a). Schoolwide food practices are associated with body mass index in middle school students. *Arch Pediatr Adolesc Med*, 159(12), 1111-1114.
- Kubik, M., Lytle, L., & Story, M. (2005b). Soft drinks, candy, and fast food: what parents and teachers think about the middle school food environment. *J Am Diet Assoc*, 105(2), 233-239.
- Kutner, M., Greenberg, E., & Paulsen, C. (2006). United States Department of Education, Institute of Education Sciences, National Center for Education Statistics: The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy. Retrieved November 16, 2009, from <http://nces.ed.gov/pubs2006/2006483.pdf>
- Kvaavik, E., Tell, G., & Klepp, K. (2003). Predictors and tracking of body mass index from adolescence into adulthood: follow-up of 18 to 20 years in the Oslo Youth Study. *Arch Pediatr Adolesc Med*, 157(12), 1212-1218.
- Lau, D. (2008). Role of food perceptions in food selection of the elderly. *J Nutr Elder*, 27(3-4), 221-246.

- Lee, A. (2009). Health-promoting schools: evidence for a holistic approach to promoting health and improving health literacy. *Appl Health Econ Health Policy*, 7(1), 11-17.
- Lester, H. (2008). Personal Communication.
- Levi, A., Chan, K., & Pence, D. (2006). Real men do not read labels: the effects of masculinity and involvement on college students' food decisions. *J Am Coll Health*, 55(2), 91-98.
- Li, T., Rana, J., Manson, J., Willett, W., Stampfer, M., Colditz, G., et al. (2006). Obesity as compared with physical activity in predicting risk of coronary heart disease in women. *Circulation*, 113(4), 499-506.
- Lindau, S., Tomori, C., Lyons, T., Langseth, L., Bennett, C., & Garcia, P. (2002). The association of health literacy with cervical cancer prevention knowledge and health behaviors in a multiethnic cohort of women. *Am J Obstet Gynecol*, 186(5), 938-943.
- Longley, C., & Sneed, J. (2009). Effects of federal legislation on wellness policy formation in school districts in the United States. *J Am Diet Assoc*, 109(1), 95-101.
- Lowry, R., Wechsler, H., Galuska, D., Fulton, J., & Kann, L. (2002). Television viewing and its associations with overweight, sedentary lifestyle, and insufficient consumption of fruits and vegetables among US high school students: differences by race, ethnicity, and gender. *J Sch Health*, 72(10), 413-421.
- Maffeis, C., Zaffanello, M., & Schutz, Y. (1997). Relationship between physical inactivity and adiposity in prepubertal boys. *J Pediatr*, 131(2), 288-292.
- McKinley, M., Lewis, C., Robson, P., Wallace, J., Morrissey, M., Moran, A., et al. (2005). It's good to talk: children's views on food and nutrition. *Eur J Clin Nutr*, 59(4), 542-551.
- McMurray, R., Harrell, J., Creighton, D., Wang, Z., & Bangdiwala, S. (2008). Influence of physical activity on change in weight status as children become adolescents. *Int J Pediatr Obes*, 3(2), 69-77.
- McNeal, J. U. (1999). *The Kids Market: Myths and Realities*. Ithica, NY 14850: Paramount Market Publishing, Inc.
- Mendoza, J., Watson, K., & Cullen, K. (2010). Change in dietary energy density after implementation of the Texas Public School Nutrition Policy. *J Am Diet Assoc*, 110(3), 434-440.
- Moag-Stahlberg, A., Howley, N., & Luscri, L. (2008). A national snapshot of local school wellness policies. *J Sch Health*, 78(10), 562-568.
- Moag-Stahlberg, A., Miles, A., Marcello, M., & Study, A. K. N. F. N. a. P. A. (2003). What kids say they do and what parents think kids are doing: The ADAF/Knowledge Networks 2003 Family Nutrition and Physical Activity Study. *J Am Diet Assoc*, 103(11), 1541-1546.
- Mokdad, A., Marks, J., Stroup, D., & Gerberding, J. (2004). Actual causes of death in the United States, 2000. *JAMA*, 291(10), 1238-1245.
- Moon, R., Cheng, T., Patel, K., Baumhaft, K., & Scheidt, P. (1998). Parental literacy level and understanding of medical information. *Pediatrics*, 102(2), e25.
- Murray, A. W., & Wilson, N. I. L. (2008). Changing incidence of slipped capital femoral epiphysis. *The Journal of Bone and Joint Surgery*, 90-B(1), 92-94.
- Must, A., & Strauss, R. (1999). Risks and consequences of childhood and adolescent obesity. *Int J Obes Relat Metab Disord*, 23 Suppl 2, S2-11.

- National Association for Sport and Physical Education & American Heart Association. (2006). 2006 Shape of the nation report: Status of physical education in the USA. Reston, VA: National Association for Sport and Physical Education. Retrieved May 16, 2010, from <http://www.aahperd.org/naspe/publications/upload/ShapeOfTheNation.pdf>
- Nelson, M., Lytle, L., & Pasch, K. (2009). Improving literacy about energy-related issues: the need for a better understanding of the concepts behind energy intake and expenditure among adolescents and their parents. *J Am Diet Assoc*, 109(2), 281-287.
- Nelson, M., Neumark-Stzainer, D., Hannan, P., Sirard, J., & Story, M. (2006). Longitudinal and secular trends in physical activity and sedentary behavior during adolescence. *Pediatrics*, 118(6), e1627-1634.
- Neumark-Sztainer, D., French, S., Hannan, P., Story, M., & Fulkerson, J. (2005). School lunch and snacking patterns among high school students: associations with school food environment and policies. *Int J Behav Nutr Phys Act*, 2(1), 14.
- Nicklas, T., Yang, S., Baranowski, T., Zakeri, I., & Berenson, G. (2003). Eating patterns and obesity in children. The Bogalusa Heart Study. *Am J Prev Med*, 25(1), 9-16.
- Nielsen-Bohlman, N., Panzer, A. M., & Kindig, D. A. (2004). Institute of Medicine of the National Academies: Health Literacy: A Prescription to End Confusion. Retrieved November 25, 2009, from http://books.nap.edu/openbook.php?record_id=10883
- Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*, 15, 259-268.
- O'dea, J. (2003). Why do kids eat healthful food? Perceived benefits of and barriers to healthful eating and physical activity among children and adolescents. *J Am Diet Assoc*, 103(4), 497-501.
- Ogden, C., Carroll, M., Curtin, L., Lamb, M., & Flegal, K. (2010). Prevalence of high body mass index in US children and adolescents, 2007-2008. *JAMA*, 303(3), 242-249.
- Ogden, C., Carroll, M., Curtin, L., McDowell, M., Tabak, C., & Flegal, K. (2006). Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA*, 295(13), 1549-1555.
- Ogden, C., Carroll, M., & Flegal, K. (2008). High body mass index for age among US children and adolescents, 2003-2006. *JAMA*, 299(20), 2401-2405.
- Ogden, C., Flegal, K., Carroll, M., & Johnson, C. (2002). Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA*, 288(14), 1728-1732.
- Olshansky, S., Passaro, D., Hershow, R., Layden, J., Carnes, B., Brody, J., et al. (2005). A potential decline in life expectancy in the United States in the 21st century. *N Engl J Med*, 352(11), 1138-1145.
- Olson, J. C. (1981). *Criteria of Food Acceptance: The Importance of Cognitive Processes and Existing Knowledge Structures for Understanding Food Acceptance*. Zurich: Forster Verlag.
- Parikh, N., Parker, R., Nurss, J., Baker, D., & Williams, M. (1996). Shame and health literacy: the unspoken connection. *Patient Educ Couns*, 27(1), 33-39.

- Parker, R., Baker, D., Williams, M., & Nurss, J. (1995). The test of functional health literacy in adults: a new instrument for measuring patients' literacy skills. *J Gen Intern Med*, *10*(10), 537-541.
- Pastor, P. N., Reuben, M. A., & Loeb, M. (2009). National Health Statistics Reports: Functional Difficulties Among School-Aged Children: United States, 2001-2007. Retrieved November 30, 2009, from <http://www.cdc.gov/nchs/data/nhsr/nhsr019.pdf>
- Pearce, A., Kirk, C., Cummins, S., Collins, M., Elliman, D., Connolly, A., et al. (2009). Gaining children's perspectives: a multiple method approach to explore environmental influences on healthy eating and physical activity. *Health Place*, *15*(2), 614-621.
- Peregrin, T. (2010). Picture this: visual cues enhance health education messages for people with low literacy skills. *J Am Diet Assoc*, *110*(5 Suppl), S28-32.
- Pfizer Inc. (2008). The Newest Vital Sign: A New Health Literacy Assessment Tool for Health Care Providers. Retrieved August 12, 2009, from <http://www.pfizerhealthliteracy.com/physicians-providers/newest-vital-sign.html>
- Piaget, J. (1977). *The development of thought: Equilibration of cognitive structures*: New York: Viking Press.
- Powell, L., Auld, M., Chaloupka, F., O'Malley, P., & Johnston, L. (2007). Associations between access to food stores and adolescent body mass index. *Am J Prev Med*, *33*(4 Suppl), S301-307.
- Probart, C., McDonnell, E., Hartman, T., Weirich, J., & Bailey-Davis, L. (2006). Factors associated with the offering and sale of competitive foods and school lunch participation. *J Am Diet Assoc*, *106*(2), 242-247.
- Putnam, J., Allshouse, J., & Kantor, L. S. (2002). U.S. Per Capita Food Supply Trends: More Calories, Refined Carbohydrates, and Fats. Retrieved October 13, 2008, from <http://www.docstoc.com/docs/8357211/US-Per-Capita-Food-Supply-Trends-More-Calories-Refined-Carbohydrates-and-Fats>
- Rideout, V. (2001). Generation Rx.com: How Young People Use the Internet for Health Information. Retrieved November 25, 2009
- Rideout, V., Roberts, D. F., & Foehr, U. G. (2005). Generation M: Media in the Lives of 8-18 Year Olds: Executive Summary. Retrieved November 25, 2009, from <http://www.kff.org/entmedia/upload/Executive-Summary-Generation-M-Media-in-the-Lives-of-8-18-Year-olds.pdf>
- Rideout, V. J., Foehr, U.G., Roberts, D.F. (2010). GENERATION M2: Media in the Lives of 8- to 18-Year-Olds. Retrieved May 16, 2010, from <http://www.kff.org/entmedia/upload/8010.pdf>
- Rolls, B., Engell, D., & Birch, L. (2000). Serving portion size influences 5-year-old but not 3-year-old children's food intakes. *J Am Diet Assoc*, *100*(2), 232-234.
- Roseman, M., Yeung, W., & Nickelsen, J. (2007). Examination of weight status and dietary behaviors of middle school students in Kentucky. *J Am Diet Assoc*, *107*(7), 1139-1145.
- Saxena, R., Borzekowski, D., & Rickert, V. (2002). Physical activity levels among urban adolescent females. *J Pediatr Adolesc Gynecol*, *15*(5), 279-284.

- Schillinger, D., Bindman, A., Wang, F., Stewart, A., & Piette, J. (2004). Functional health literacy and the quality of physician-patient communication among diabetes patients. *Patient Educ Couns*, 52(3), 315-323.
- Schillinger, D., Grumbach, K., Piette, J., Wang, F., Osmond, D., Daher, C., et al. (2002). Association of health literacy with diabetes outcomes. *JAMA*, 288(4), 475-482.
- Schillinger, D., Piette, J., Grumbach, K., Wang, F., Wilson, C., Daher, C., et al. (2003). Closing the loop: physician communication with diabetic patients who have low health literacy. *Arch Intern Med*, 163(1), 83-90.
- Schor, J. B. (2004). *Born to Buy: The Commercialized Child and the New Consumer Culture*. New York: Scribner.
- Schwimmer, J., Burwinkle, T., & Varni, J. (2003). Health-related quality of life of severely obese children and adolescents. *JAMA*, 289(14), 1813-1819.
- Scott, T., Gazmararian, J., Williams, M., & Baker, D. (2002). Health literacy and preventive health care use among Medicare enrollees in a managed care organization. *Med Care*, 40(5), 395-404.
- Shannon, C., Story, M., Fulkerson, J., & French, S. (2002). Factors in the school cafeteria influencing food choices by high school students. *J Sch Health*, 72(6), 229-234.
- Simpson, J., & Weiner, E. (2009). Oxford English Dictionary. Retrieved December 3, 2009, from <http://www.oed.com/>
- Skinner, J., Carruth, B., Wendy, B., & Ziegler, P. (2002). Children's food preferences: a longitudinal analysis. *J Am Diet Assoc*, 102(11), 1638-1647.
- Slosson, R. J. L. (1990). *Slosson Oral Reading Tests—Revised*. East Aurora, NY: Slosson Educational Publishers.
- Snelling, A., Korba, C., & Burkey, A. (2007). The national school lunch and competitive food offerings and purchasing behaviors of high school students. *J Sch Health*, 77(10), 701-705.
- Snow, C. E., & Biancarosa, G. (2003). Adolescent Literacy and the Achievement Gap: What Do We Know and Where Do We Go From Here? Retrieved November 25, 2009, from <http://www.carnegie.org/literacy/pdf/ALFF1.pdf>
- Solms, J., & Hall, R. L. (1981). *Criteria of Food Acceptance: The Acquisition of Likes and Dislikes for Foods*. Zurich: Forster Verlag.
- Spandorfer, J., Karras, D., Hughes, L., & Caputo, C. (1995). Comprehension of discharge instructions by patients in an urban emergency department. *Ann Emerg Med*, 25(1), 71-74.
- SPSS for Windows. (2009). Version 18.0: Chicago, IL: SPSS Inc.
- St Leger, L. (2001). Schools, health literacy and public health: possibilities and challenges. *Health Promot Int*, 16(2), 197-205.
- St Leger, L., & Nutbeam, D. (2000). A model for mapping linkages between health and education agencies to improve school health. *J Sch Health*, 70(2), 45-50.
- Stein, K. (2008). Erasing the stigma of subsidized school meals. *J Am Diet Assoc*, 108(12), 1980-1983.
- Stevenson, C., Doherty, G., Barnett, J., Muldoon, O., & Trew, K. (2007). Adolescents' views of food and eating: identifying barriers to healthy eating. *J Adolesc*, 30(3), 417-434.
- Strauss, R., & Pollack, H. (2003). Social marginalization of overweight children. *Arch Pediatr Adolesc Med*, 157(8), 746-752.

- Sturm, R. (2008). Disparities in the food environment surrounding US middle and high schools. *Public Health*, 122(7), 681-690.
- Swinburn, B., Egger, G., & Raza, F. (1999). Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Prev Med*, 29(6 Pt 1), 563-570.
- Taveras, E., Field, A., Berkey, C., Rifas-Shiman, S., Frazier, A., Colditz, G., et al. (2007). Longitudinal relationship between television viewing and leisure-time physical activity during adolescence. *Pediatrics*, 119(2), e314-319.
- Taveras, E., Rifas-Shiman, S., Berkey, C., Rockett, H., Field, A., Frazier, A., et al. (2005). Family dinner and adolescent overweight. *Obes Res*, 13(5), 900-906.
- Teen Research Unlimited. (2002). Press: Teens Spent \$170 Billion in 2002. Retrieved June 25, 2009, from http://www.teenresearch.com/pressrelease.cfm?page_id=152
- Teen Research Unlimited. (2004). Press: TRU Projects Teens Will Spend \$169 Billion in 2004. Retrieved June 25, 2009, from http://www.teenresearch.com/pressrelease.cfm?page_id=287
- Templeton, S., Marlette, M., & Panemangalore, M. (2005). Competitive foods increase the intake of energy and decrease the intake of certain nutrients by adolescents consuming school lunch. *J Am Diet Assoc*, 105(2), 215-220.
- TenHave, T., Van Horn, B., Kumanyika, S., Askov, E., Matthews, Y., & Adams-Campbell, L. (1997). Literacy assessment in a cardiovascular nutrition education setting. *Patient Educ Couns*, 31(2), 139-150.
- Texas Department of Agriculture. (2003). School District Vending Contract Survey. Retrieved October 17, 2008, from http://www.squaremeals.org/fn/render/channel/items/0,1249,2348_2515_0_0,00.html.
- Thornton, J. (2007). School Foodservice Programs' Effectiveness: Influence of Directors' Education Background and Time Spent on Foodservice Tasks. Unpublished dissertation. Available from Iowa State University Library.
- United States Census Bureau. (n.d.). 2006-2008 American Community Survey. Retrieved May 1, 2010, from http://factfinder.census.gov/servlet/ACSSAFFacts?_submenuId=factsheet_0&_sse=on
- United States Department of Agriculture. (2000). Food and Nutrition Services: Changing the Scene: Improving the School Nutrition Environment: A Guide to Local Action. Retrieved November 2, 2009, from <http://www.fns.usda.gov/tn/Resources/guide.pdf>
- United States Department of Agriculture. (2001a). Food and Nutrition Service: Children's Diets in the Mid-1990's: Dietary Intake and Its Relationship with School Meal Participation. Retrieved October 15, 2009, from <http://www.fns.usda.gov/oane/MENU/Published/CNP/FILES/ChilDietsum.htm>
- United States Department of Agriculture. (2001b). Foods Sold in Competition with USDA School Meal Programs. Retrieved June 10, 2010, from http://www.cspinet.org/nutritionpolicy/Foods_Sold_in_Competition_with_USDA_School_Meal_Programs.pdf
- United States Department of Agriculture. (2002). Food and Nutrition Service: National School Lunch Program: State Competitive Food Policies. Retrieved March 18, 2009, from

- http://www.fns.usda.gov/cnd/lunch/_private/CompetitiveFoods/state_policies_2002.htm
- United States Department of Agriculture. (2008a). Food and Nutrition Service: Diet Quality of American School-Age Children By School Lunch Participation Status: Data from the National Health and Nutrition Examination Survey, 1999-2004. Retrieved October 15, 2009, from <http://www.fns.usda.gov/ora/MENU/Published/CNP/cnp.htm>
- United States Department of Agriculture. (2008b). Food and Nutrition Service: School Lunch and Breakfast Cost Study-II Final Report. Retrieved November 10, 2009, from <http://www.fns.usda.gov/oane/MENU/Published/CNP/FILES/MealCostStudy.pdf>
- United States Department of Agriculture. (2008c). Food and Nutrition Services: National School Lunch Program. Retrieved July 13, 2009, from <http://www.fns.usda.gov/cnd/lunch/AboutLunch/NSLPFactSheet.pdf>
- United States Department of Agriculture. (2009a). Food and Nutrition Services: National School Lunch Program. Retrieved July 13, 2009, from <http://www.fns.usda.gov/cnd/lunch/AboutLunch/NSLPFactSheet.pdf>
- United States Department of Agriculture. (2009b). Obesity and Healthy Weight. Retrieved June 30, 2009, from <http://www.csrees.usda.gov/obesityhealthyweight.cfm>
- United States Department of Agriculture. (2010). Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010: Part A: Executive Summary. Retrieved June 23, 2010, from <http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/DGAC/Report/A-ExecSummary.pdf>
- United States Department of Agriculture. (n.d.). Food and Nutrition Services: Healthy Schools: What is a Healthy School Nutrition Environment? Retrieved November 2, 2009, from <http://www.fns.usda.gov/tn/Healthy/what.html>
- United States Department of Health and Human Services. (2000a). Healthy People 2010: Leading Health Indicators. Retrieved March 20, 2009, from http://www.healthypeople.gov/Document/html/uih/uih_bw/uih_4.htm#overandobese
- United States Department of Health and Human Services. (2000b). *Tracking Healthy People 2010*. Washington, D.C.: U.S. Government Printing Office.
- United States Department of Health and Human Services. (2001). The Surgeon General's Call to Action to Prevent and to Decrease Overweight and Obesity. Retrieved June 25, 2009, from <http://www.surgeongeneral.gov/topics/obesity/>
- United States Department of Health and Human Services. (2003). Communicating Health: Priorities and Strategies for Progress. Retrieved November 25, 2009, from <http://odphp.osophs.dhhs.gov/projects/HealthComm/objective2.htm>
- United States Department of Health and Human Services. (2007). Healthy People 2010: Health Communication Focus Area: Progress Review. Retrieved March 18, 2009, from <http://www.healthypeople.gov/data/2010prog/focus11/>
- United States Department of Health and Human Services. (2008a). Agency for Healthcare Research and Quality: 2007 National Healthcare Disparities Report. Retrieved March 18, 2009, from <http://www.ahrq.gov/qual/nhdr07/nhdr07.pdf>
- United States Department of Health and Human Services. (2008b). Health Communication Activities: Health Literacy Improvement. Retrieved March 18, 2009, from <http://www.health.gov/communication/literacy/default.htm>

- United States Department of Health and Human Services. (2009). Childhood Overweight. Retrieved June 30, 2009, from http://www.obesity.org/information/childhood_overweight.asp
- United States Department of Health and Human Services. (2010a). National Action Plan to Improve Health Literacy. Retrieved June 10, 2010, from http://www.health.gov/communication/HLActionPlan/pdf/Health_Literacy_Action_Plan.pdf
- United States Department of Health and Human Services. (2010b). Statistics Related to Overweight and Obesity. Retrieved May 16, 2010, from <http://www.win.niddk.nih.gov/statistics/index.htm#treating>
- United States Government Accountability Office. (2004). Commercial Activities in Schools. Retrieved October 13, 2009, from <http://www.gao.gov/new.items/d04810.pdf>
- United States Government Accountability Office. (2005). School Meal Programs: Competitive Foods Are Widely Available and Generate Substantial Revenues for Schools. Retrieved November 2, 2009, from <http://www.gao.gov/new.items/d05563.pdf>
- Utter, J., Scragg, R., & Schaaf, D. (2006). Associations between television viewing and consumption of commonly advertised foods among New Zealand children and young adolescents. *Public Health Nutr*, 9(5), 606-612.
- Vecchiarelli, S., Takayanagi, S., & Neumann, C. (2006). Students' perceptions of the impact of nutrition policies on dietary behaviors. *J Sch Health*, 76(10), 525-531; quiz 540-522.
- Wang, L., Chyen, D., Lee, S., & Lowry, R. (2008). The association between body mass index in adolescence and obesity in adulthood. *J Adolesc Health*, 42(5), 512-518.
- Wang, Y., Beydoun, M., Liang, L., Caballero, B., & Kumanyika, S. (2008). Will all Americans become overweight or obese? estimating the progression and cost of the US obesity epidemic. *Obesity (Silver Spring)*, 16(10), 2323-2330.
- Wansink, B., Painter, J., & North, J. (2005). Bottomless bowls: why visual cues of portion size may influence intake. *Obes Res*, 13(1), 93-100.
- Weiss, B., Mays, M., Martz, W., Castro, K., DeWalt, D., Pignone, M., et al. (2005). Quick assessment of literacy in primary care: the newest vital sign. *Ann Fam Med*, 3(6), 514-522.
- Wenz, E. A., Litchfield, R.E. (2009). School nutrition environments since local wellness policies. Iowa State University.
- Wharf Higgins, J., Begoray, D., & MacDonald, M. (2009). A Social Ecological Conceptual Framework for Understanding Adolescent Health Literacy in the Health Education Classroom. *Am J Community Psychol*.
- Whitaker, R., Wright, J., Pepe, M., Seidel, K., & Dietz, W. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*, 337(13), 869-873.
- Williams, M., Baker, D., Honig, E., Lee, T., & Nowlan, A. (1998). Inadequate literacy is a barrier to asthma knowledge and self-care. *Chest*, 114(4), 1008-1015.
- Williams, M., Baker, D., Parker, R., & Nurss, J. (1998). Relationship of functional health literacy to patients' knowledge of their chronic disease. A study of patients with hypertension and diabetes. *Arch Intern Med*, 158(2), 166-172.

- Wojcicki, J., & Heyman, M. (2006). Healthier choices and increased participation in a middle school lunch program: effects of nutrition policy changes in San Francisco. *Am J Public Health, 96*(9), 1542-1547.
- Woodward-Lopez, G., Vargas, A., Kim, S., Proctor, C., Hiort-Lorenzen Diemoz, L., & Crawford, P. (2005). LEAF Cross-Site Evaluation: Fiscal Impact Report: Center for Weight and Health, University of California, Berkeley. Retrieved November 5, 2009, from www.cnr.berkeley.edu/cwh/activities/LEAF.shtml
- Young, L., & Nestle, M. (2002). The contribution of expanding portion sizes to the US obesity epidemic. *Am J Public Health, 92*(2), 246-249.
- Zenk, S., & Powell, L. (2008). US secondary schools and food outlets. *Health Place, 14*(2), 336-346.
- Zollo, P. (1999). *Wise Up to Teens: Insight into Marketing and Advertising to Teenagers* (2 ed.). Ithica, NY: New Strategist Publications, Inc.

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