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NUTRITION RELATED HEALTH BEHAVIORS:
PREVALENCE AND ASSOCIATION WITH OVERWEIGHT AMONG
ADOLESCENTS, GRADES 9-12, IN MICHIGAN, 2001 YRBS

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RACHEL A. ROSENBAUM, R.D.

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By

Rachel A. Rosenbaum, R.D.

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ABSTRACT

NUTRITION RELATED HEALTH BEHAVIORS:
PREVALENCE AND ASSOCIATION WITH OVERWEIGHT AMONG
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By

Rachel A. Rosenbaum, R.D.

Pediatric overweight is currently one of the leading health issues among youth in the United States. The National Health and Nutrition Examination Survey identified 34% of adolescents aged 12-19 years to be either overweight or at-risk of overweight in 2003-2004. Few studies have examined the association between overweight and nutrition-related health behaviors (NRHB) simultaneously among adolescents. The objectives of this study were to examine adherence to national health recommendations regarding NRHB (fruit and vegetable intake, physical activity, television viewing, and no risky dieting behaviors), and the association between these behaviors and overweight among Michigan youth. Data is from the Michigan Youth Risk Behavior Survey (YRBS) 2001, a representative sample of publicly educated high school youth, grades 9-12 (n=2,891). Results were weighted using stratum and individual weights. In the state of Michigan, 9.4% of adolescents participated in all four defined NRHB, and only 7.7% participated in all four NRHB and maintained a healthy body weight (BMI-for-age 5^{th}-85^{th} percentile). Girls who participated in 3-4 NRHB were significantly more likely to maintain a healthy body weight than girls with only 0-1 NRHB (84.8%, 95% CI: 81.9-87.8 compared to 72.8%, 95% CI: 67.2-78.5, respectively). A similar trend was noted among boys. In conclusion, < 10% of adolescents adhered to national recommendations regarding NRHB and youth that did not adhere to recommendations were more likely to be overweight.

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CHAPTER 1: INTRODUCTION

1.1 Overview:

Pediatric overweight is currently one of the leading health issues among youth in the United States[1]. In 2003-2004, 18% of children aged 6-17 were considered overweight[2], and among adolescents aged 12-19 years, 34.3% were either overweight or at-risk of overweight[3]. There has been a continued upward trend, where in 1988-1994 11% of children aged 6-17 years were considered overweight[4], and in 1999-2000 15.5 % of children aged 12-19 were overweight[5]. Health behaviors such as dietary intake, physical activity, and time spent in leisure activities have been associated with overweight in children and adolescents[6].

Childhood overweight has many possible consequences, some with a short-term impact, others which stretch across the lifespan[6-8]. Childhood overweight can have both physiological and psychological effects, from diseases like sleep apnea and cholelithiasis, to emotional outcomes like a negative self-esteem[9,10]. Overweight or obesity as a child or adolescent is a predictor of adult overweight and obesity, and childhood overweight can also affect adult morbidity and mortality[11]. Long-term childhood overweight results in an increased risk for high blood pressure (HTN), hyperlipidemia, and Type 2 Diabetes Mellitus (T2DM)[12].

Risk factors for overweight and obesity include both genetic and environmental influences[6], including socio-economic status, education level, and the built / food environments in which people live[13-16]. Individual-level risk factors include dietary intake, physical activity, and leisure time spent in sedentary activities[1].

National recommendations therefore address these modifiable risk factors[17-19]. The 2005 Dietary Guidelines for Americans, jointly issued by the United States Department of Agriculture and the United States Department of Health and Human Services, recommends maintaining a healthy weight, daily physical activity, and increased fruit and vegetable intake[19]. For children, they also recommend limiting the amount of time spent being sedentary, and increasing physical activity[19]. Physical activity should be undertaken by children and adolescents on a daily or near-daily basis[19-21]. Based on the guidelines set by the International Consensus Conference on Physical Activity Guidelines for adolescents, it is recommended by the CDC that adolescents should participate in moderate or vigorous physical activity for at least twenty minutes at least three times per week[20,21]. The American Academy of Pediatrics recommends television viewing for children to be no more than one or two hours per day[22]. Fruit and vegetable intake is recommended to be at least five servings per day, and is marketed nationally as the "5-A-Day for Better Health" program, administered by the U.S. Department of Health and Human Services and the CDC[23].

Data will be analyzed from the 2001 Michigan Youth Risk Behavior Survey (YRBS), a survey that examines the behaviors of publicly educated adolescents in the state of Michigan, grades 9-12. This study seeks to determine the prevalence of nutrition-related health behaviors in youth, and to describe the demographics of students who are compliant with these recommendations in relationship to normal weight and overweight / at-risk of overweight. This study also seeks to examine the association between these nutrition-related health behaviors with overweight / at-risk of overweight among adolescents. Nutrition-related health behaviors to be examined are fruit and vegetable

intake, level of physical activity, television viewing, and having no risky dieting behaviors, which include no laxative or diet pill use, no starvation, and no vomiting to lose weight.

The Youth Risk Behavior Surveillance System (YRBSS) was developed by the Centers for Disease Control and Prevention (CDC) to monitor behaviors that relate to premature morbidity and mortality among adolescents[24]. The YRBSS has five components, including state and national school-based surveys, called the Youth Risk Behavior Survey (YRBS), of publicly educated adolescents, grades 9 -12[24]. The other three components include a household survey of youth 12-21 years, a special population survey, and a survey mailed to college students[24]. Behaviors that the YRBS are focused on assessing include behaviors related to violence, tobacco and drug use, risky sexual behaviors, unhealthy dietary behaviors and inadequate physical activity[24].

1.2 Rationale:

The goals of this study are to determine the adherence of 9-12th grade publicly educated Michigan youth, in 2001, to national recommendations regarding modifiable lifestyle factors. Individual behaviors to be evaluated are fruit and vegetable intake, physical activity, television watching, and no risky dieting practices. I will examine the prevalence of each individual behavior, and the prevalence of students participating in at least one, at least two, at least three and all four nutrition-related health behaviors. The association of these behaviors to overweight / at-risk of overweight will also be assessed.

Several studies have examined the prevalence of individual nutrition-related health behaviors among adolescents. Using data from the 1999 national YRBS, Lowry et al

reported that 76.1% of students ate less than five servings of fruits and vegetables per day[25]. They also found that 30.5% of students did not meet the recommendations for physical activity, defined as 30 minutes of moderate physical activity at least 5 times per week or 20 minutes of vigorous physical activity at least 3 times per week, and that 42.8% watched television for more than two hours per day[25]. In a study examining dieting behaviors of adolescents from the 1993 YRBS, Story et al reported that 5.5% of girls and 1.5% of boys had either used vomiting or diet pills to control their weight[26].

Research involving the prevalence of television viewing, fruit and vegetable intake, physical activity, risky dieting behaviors, and their individual association to BMI-for-age among children and adolescents are abundant. No studies to my knowledge, however, combine all four nutrition-related health behaviors in an attempt to describe compliance to multiple national recommendations regarding health in adolescents. Television viewing, diet, and physical activity were examined together in studies examining their association with BMI-for-age[27-29]. In the Framingham Children's study, researchers found that increased television viewing, defined as more than 3 hours per day, when combined with either a high fat diet (≥34% total calories from fat) or a low level of physical activity (determined by using an electronic motion sensor), was associated with an increased risk of having excess body fat in early adolescence[27]. Anderson et al found that children who watched more television (≥4 hours per day) and had lower levels of participation in vigorous physical activity (≤3 times per week vigorous) had higher BMI's than children who exercised more and watched less television[28]. Using data from the YRBS, Eisenmann found that increased physical activity was associated with less television viewing and a lower BMI[29]. In research examining the association of physical

activity with other health behaviors, low activity levels were found to be associated with lower fruit and vegetable intake and greater television viewing, among others[30]. Risky dieting behaviors have been found to be associated both with an increased risk of developing a serious eating disorder[31-33], and with a lower diet quality and decreased intake of fruits and vegetables[34]

Several studies have examined the prevalence of combinations of modifiable lifestyle factors among adults[35-37]. In a study published in 2001, Ford et al examined four health behaviors in adults: fruit and vegetable intake (≥5 per day), adequate physical activity, no smoking, and body mass index (<25)[35]. Study participants were from NHANES III (1988-1994). They found that 6.8% of adults in the U.S. had all four healthy behaviors. Women had a higher prevalence than men (8.0% compared to 5.5%, and whites had a higher prevalence than African-Americans and Mexican-Americans (7.2% compared to 3.4% and 4.0%, respectively)[35]. Kim et al also assessed the prevalence of health behaviors of adults in 2004, using diet quality (Diet Quality Index – International, used to measure and quantify diet quality), physical activity (Physical Activity Index), no tobacco use, and alcohol use (Alcohol Consumption Index) as lifestyle indicators[36]. The authors compared behavior patterns of people living in China to those of people living in the U.S. Overall, they reported that people living in the U.S. had both a lower diet quality and lower physical activity levels than those of the comparison group in China[36]. Reeves and Rafferty also completed a study on lifestyle factors of U.S. adults, using the 2000 BRFSS. The health behaviors used in that study were also used by Ford et al, and included fruit and vegetable intake (≥5 per day), regular physical activity (≥30 minutes ≥5 times per week), no tobacco use, and maintaining a healthy body weight (BMI ≤25)[37].

They found that the prevalence of U.S. adults with all four defined healthy behaviors was only 3%[37].

This study seeks to contribute to the current knowledge regarding the associations of multiple health-related behaviors among adolescents and their relationship with overweight / at-risk overweight among that population. Results can hopefully assist policy-makers and educators in their continuing efforts to address the epidemic of overweight / at-risk overweight among Michigan youth.

1.3 Study Aims:

The specific aims of this study are:

1. To determine both the prevalence of individual and combined nutrition-related behaviors, and the adherence to national recommendations regarding modifiable lifestyle factors, among a population-based sample of publicly educated Michigan youth, grades 9-12, as reported in the 2001 Michigan YRBS.
   Nutrition-related behaviors include: fruit and vegetable intake, physical activity, television viewing, and not participating in risky dieting behaviors. The four variables will be combined to determine the prevalence of students participating in all four defined nutrition-related health behaviors.

2. To examine the association between nutrition-related health behaviors and overweight / at-risk for overweight, based on BMI-for-age calculated from self-reported height and weight, among Michigan youth.

1.4 Organization of paper

This thesis includes a separate paper for publication in Chapter 4, thus there will be some redundancy between chapters. Chapters 1, 2, 3 and 5 represent typical thesis chapters of an introduction, background, methods and discussion. Chapter 4 is a stand-alone paper which includes all the results.

CHAPTER 2: BACKGROUND

2.1 Definition of Overweight among Children and Adolescents

Childhood overweight is usually defined using the CDC's BMI-for-age growth charts[38]. BMI is calculated using a child's height and weight, and used as an indicator of body fatness[38]. The growth charts are both gender- and age-specific for children aged 2-19 years[38]. Using the BMI-for-age charts, overweight is defined as $\geq 95^{th}$ percentile, and at-risk of overweight is defined as $\geq 85^{th} - 95^{th}$ percentile[38]. Normal weight is defined as $\geq 5^{th} - 85^{th}$ percentile, and underweight is defined as $< 5^{th}$ percentile[38]. There is no definition of childhood obesity when using the CDC's growth charts. However, current literature uses the word "overweight" for children in the $\geq 85^{th} - 95^{th}$ percentile, and "obese" for children $\geq 95^{th}$ percentile[6,10,11].

2.2 Prevalence of Overweight among Children and Adolescents

There has been a significant increase in the prevalence of childhood and adolescent overweight in the United States[39,40]. Among children aged 6-17 years of age, the prevalence of overweight has increased from 6% in 1976-1980 to 18% in 2003-2004[2]. Using data from NHANES from 1971-2000, Jolliffe found that overweight among children aged 2-19 years had increased from 10% in 1988-1994 to 14.4% in 1999-2000[12]. The study also reported that children who are overweight are getting heavier. The number of overweight youth increased by 182% between 1971 to 1999-2000, and they are getting heavier, indicated by the extent of overweight, which increased by 247% during the same time frame[12]. Ogden et al found similar increases in overweight prevalence among children and adolescents using NHANES 1999-2000[5], and current

rates reported from NHANES 2003-2004 data show that 17.1% of children and adolescents aged 2-19 years are overweight[3]. It has also been estimated, using current overweight prevalence rates, that there is now a 30-40% lifetime risk of children in the United States to develop Type II Diabetes Mellitus[39].

Strong differences exist with respect to overweight among adolescents of different racial and ethnic groups[41]. African-American and Hispanic children and adolescents have higher prevalence rates of overweight and obesity when compared to white children and adolescents[41]. By gender, in 1999-2000, Black non-Hispanic girls, aged 6-18 years, had the highest prevalence of overweight at 24%, and Mexican-American boys, aged 6-18 years, had the highest prevalence at 29%[41]. The rates for white, non-Hispanic girls and boys aged 6-18 were 11% and 12%, respectively[41]. In 2003-2004, among adolescents aged 12-19 years, non-Hispanic white girls had a prevalence rate of 15.4%, non-Hispanic black girls were at 25.4%, and Mexican-American girls were at 14.1%[40]. Among adolescent boys of the same age range, non-Hispanic white boys had a prevalence rate of 19.1%, non-Hispanic black boys were at 18.5%, and Mexican-American boys were at 18.3%[40].

2.3 Health Consequences of Childhood and Adolescent Overweight

There are a number of health risks associated with childhood and adolescent overweight and overweight[1,6]. Physical health consequences include glucose intolerance, insulin resistance and Type 2 Diabetes Mellitus, hypertension, hyperlipidemia [defined by increased low-density lipoproteins (LDL) and triglycerides with decreased high-density lipoproteins (HDL)], cholelithiasis and hepatic steatosis, pseudotumor cerebri, sleep apnea, polycystic ovary disease (PCOD), and orthopedic complications[1,6,42].

Obesity, elevated plasma insulin, systolic blood pressure, and total / LDL cholesterol tend to cluster in studies of children, and track into adulthood[43]. In a study investigating the prevalence of metabolic syndrome in children, researchers found a 4.2% prevalence of the indicators (defined as having at least 3 of the 5: increased triglycerides, blood pressure, fasting glucose, waist circumference and decreased HDL) among adolescents 12-19 years of age[44]. The study also found a 29% prevalence of the indicators among overweight adolescents, and 7% prevalence among adolescents at-risk of overweight[44]. Criteria were based on modifying the National Cholesterol Education Program's (NCEP) definition of the metabolic syndrome for adults for use with an adolescent population.

Several studies have looked at the relationship between obesity and health-related quality of life (QOL)[45,46]. The QOL includes physical, emotional, social, and school functioning. In a study of 106 children and adolescents, aged 5-18 years, researchers found that severely obese children (average BMI=34.7 kg/m2) reported significant impairment in the physical, psychosocial, emotional, social, school functioning and total score when compared to healthy children and adolescents[45]. Using the same QOL assessment tool, Williams et al found that overweight and obese children, ages 9-12 years, differed most strongly in physical and social functioning from their normal weight peers, with obese children having the lowest scores[46]. They also reported a trend of decreasing QOL scores as weight increased[46]. Among females who were overweight or obese during adolescence, rates of poverty are higher than those of normal-weight females; years of advanced education, family income, and marriage rates are lower among females who were obese in late adolescence than those of a normal weight[6,43]. Studies have also found that when presented with drawings of obese figures, children

associate the heavier figures with lower academic and social success[47]. Children described the heavier figures in the drawings as "lazy", "stupid", "sloppy", and "ugly"[6]. Emotionally, there are associated risks of developing low self-esteem, a negative body image, and depression[9,10]. Children are also at risk from the stigmatization that occurs from being obese, which can also carry into adulthood[9,10].

2.4 Tracking of Childhood and Adolescent Overweight into Adulthood

Overweight in childhood and adolescence is a predictor of adult obesity[11,48,49]. The risk of being an overweight adult doubles for children who were overweight when compared to normal weight kids[49]. Various stages of growth have been associated with an increased risk of overweight and obesity in adulthood. During the toddler years, obesity is related to body fat and parental weight[49]. Bray reports a four-fold risk of obesity in adulthood for children ages 1-3 years who are greater than the eighty-fifth percentile weight-for-height and have at least one parent who is also overweight[49]. The period of adiposity rebound, defined as weight gain between the ages of 5 to 7, has been suggested to play a role in the development of obesity[49]. An early adiposity rebound is associated with both parental obesity and the persistence of obesity into adulthood[6,49,50]. Obesity as an adolescent is associated with adverse health outcomes later in life[49]. The likelihood of being overweight in adulthood is greatly increased for overweight or obese adolescents[49]. Teens with a BMI-for-age at or greater than the ninety-fifth percentile have a 5-20 fold chance of being overweight as an adult[49]. In the Fels Longitudinal Study, Guo et al found that of the 347 participants, those overweight or obese at aged 35 years had significantly higher BMI in childhood or adolescence than those who were not overweight or obese[51]. Freedman et al, using data from the Bogalusa heart study, also

reported that childhood BMI was associated with adult adiposity[52]. They also speculated that the magnitude of this relationship was dependent on the level of overweight during childhood[52].

The burden of obesity and its related co-morbidities do not end in childhood or adolescence. Risk factors for adult diseases like increased blood pressure, dyslipidemia, and associated factors of insulin resistance continue from childhood to adulthood, and can increase with increased weight gain over the lifespan[11,48]. Research using data from the Harvard Growth Study of 1922-1935 found that overweight in adolescence increased the risk of several diseases, in both male and female participants[53]. The follow-up time was 55 years, and the 508 participants were divided into two study groups: overweight, defined as >75th percentile BMI, and lean, defined as 25-50th percentile BMI[53]. The study found that in both genders, among the group defined as overweight during adolescence, the risk of atherosclerosis and coronary heart disease was increased by 7.3 and 1.8 fold, respectively[53]. Arthritis was higher among women in the overweight group, and colorectal cancer and gout were higher among men[53].

2.5 Risk Factors for Childhood and Adolescent Overweight

Risk factors for childhood and adolescent overweight include a complex balance of genetics and environmental factors[6,15,49,54,55]. The underlying theory of weight regulation is one of energy balance: energy intake must equal energy expenditure[47]. One of the basic concepts of weight regulation is that of "set point" maintenance[56]. This set point refers to the body's ability to maintain a weight given the variations of energy intake and expenditure that fluctuate on a day-to-day basis. Total energy expenditure is calculated using three factors: resting metabolic rate, thermogenesis, and physical activity[47]. Total

energy expenditure tends to be lower in obese individuals, though the role of resting metabolic rate in the development of obesity is unresolved[6,47]. The other half of the energy balance equation involves energy intake: if the body takes in more energy in the form of calories that it can expend, energy will be stored as fat.

The family environment plays a large role in the development of childhood obesity[6]. Studies documenting the activity levels, eating patterns, and relative adiposity of parents have all shown a relationship with childhood obesity[57]. Eating habits and food preferences are developed in children at a very young age[58]. Patterns of eating higher fat or sweetened foods seen in children comes from the exposure to these foods in their home environment[59]. These eating patterns also track from childhood to adulthood[6]. Overweight or obese parents are also more likely to have overweight children[57,59]. This effect is more likely to be seen in children under the age of ten. After this age, adiposity of a parent is less likely to be a factor in predicting adult obesity[50]. Physical activity patterns of adults affect their offspring. Studies have shown that activity levels of parents can influence both childhood activity patterns and the development of obesity in adolescence[6].

Socio-economic status has also been associated with obesity among both adolescents and adults[13-15]. Miech et al reported that among adolescents aged 15-17, poverty status was associated with overweight; among poor students the prevalence of overweight was 50% higher than non-poor students[13]. Built and social environments may play a role in this relationship[15,16]. Studies have shown that areas with a higher poverty rate have less access to healthy food than do areas that are more prosperous[15,16].

2.5.1 Individual Lifestyle Factors

Individual lifestyle factors that are associated with overweight and obesity include physical activity and leisure time spent in sedentary activities, television viewing, dietary intake including fruit and vegetable intake, and dieting behaviors[58,60-63].

2.5.1.1 Physical Activity

Physical activity plays a large role in the relationship of energy balance. Physical activity levels have been shown to track across the lifespan, and are associated at an early age with levels of parental physical activity[6,64,65]. Positive benefits of physical activity include increased aerobic and cardiovascular fitness, increased bone mass, increased levels of HDL cholesterol, and decreased risk of diseases including hypertension and Type 2 Diabetes Mellitus[65]. Children who have lower levels of physical activity have the potential for increased blood pressure, insulin levels and abnormal lipid profiles, and are more likely to be overweight[54]. Childhood activity levels have also been shown to track into adulthood[64,65].

Activity levels vary for children of different gender, grade, and race[28,29,65]. The Bogalusa Heart Study, found that boys, aged 9-15 years, participated in more vigorous physical activity, while girls of the same age participated in more moderate and light activities[65]. Lower levels of physical activity were reported among students without a school-based physical education class[65]. Anderson et al found that 65% of girls aged 14-16 years participated in vigorous physical activity three or more times per week, compared to 80% of boys in the same age bracket[28]. By grade, activity levels decreased as grade increased from fifth to eighth grade[65]. Differences in trends are also seen by race and gender, where 87.9% of non-Hispanic white boys, 77.6% of non-Hispanic black boys, and 80.2% of Hispanic boys reported participating in vigorous exercise $\geq$3 times

per week. Among girls, 77.1% of non-Hispanic white girls, 69.4% of non-Hispanic black girls, and 72.6% of Hispanic girls reported participating in vigorous exercise ≥3 times per week[65]. These race and gender trends were also noted by Eisenmann et al, who found that, among adolescents aged 14-18 years, participation in vigorous physical activity ≥3 times per week was higher among boys than girls (72.3% compared to 57.1%, respectively); and higher among whites than African American and Hispanic subjects (67.4% compared to 55.6% and 51.0%, respectively)[29].

Physical activity is associated with BMI among children[28,29,60]. In a study comparing children, aged 11-15 years, of normal weight (BMI-for-age < eighty-fifth percentile), to overweight children (BMI-for-age ≥ eighty-fifth percentile), vigorous physical activity was the only risk factor related to an increased BMI[60]. The study also found that overweight students had decreased fiber intake and decreased time spent in vigorous physical activity when compared to normal weight children[60].

2.5.1.2 Television Viewing

Television viewing among children and adolescents is a common leisure-time activity[22,27,28,62]. The American Academy of Pediatrics recommends limiting total television viewing (and other entertainment media) time as ≤2 hours per day[22]. Prevalence rates of television viewing differ by gender and race. Using data from NHANES 1988-1994, it was reported that 24.3% of non-Hispanic white boys, aged 8-16 years, watched ≥4 hours of television per day, while rates among non-Hispanic black boys and Mexican-American boys were much higher (42.8% and 33.3%, respectively)[28]. Among girls of the same age, 15.6% of non-Hispanic white girls reported watching ≥4 hours of television per day, compared to 43.1% of non-Hispanic black girls and 28.3% of

Mexican-American girls[28] Results from the 1999 YRBS showed similar trends: among boys aged 14-18 years, 18.1% of white boys reported watching television ≥4 hours per day, compared to 54.7% of African-American boys and 30.6% of Hispanic boys[29]. The prevalence rates by race among girls aged 14-18 years were 12.9% for white girls, 53.7% for African-American girls, and 28.3% for Hispanic girls[29].

In a policy statement issued in 2003, the American Academy of Pediatrics reported that children who watched television less than two hours per day had significantly lower BMI's than those children who watched television for four or more hours per day[54]. Television viewing has been associated with an increased BMI among children, and has a positive relationship with intake of less nutrient-dense foods, including an inverse association with fruit and vegetable intake[6,27,61-63]. Children who watched ≥3 hours of television per day, when combined with either a lower level of physical activity or a high fat diet, had the greatest risk of increased adiposity as adolescents[27]. In the Framingham Longitudinal Study, Proctor et al reported that adolescents who watched television for 1.75 hours per day had a lower BMI, triceps, and sum of skin-folds when compared to adolescents who watched for more than 3.75 hours per day[27]. Analyzing data from NHANES 1988-1994, Andersen et al reported that 26% of the 4,063 children participating in the study watched more than four hours of television per day, and children with two hours per day or less television time had less body fat and lower BMI's than their peers who watched more television[28]. Among children aged 14-18, from the 1999 YRBS, researchers found that 25% of participants watched television for four or more hours per day, and that obesity prevalence among children aged 12-18 years increased 2% with every additional hour of television viewed per day[29]. A positive linear

relationship between BMI and hours of television viewed was also reported in the California Teen Longitudinal Study[62]. Results from the Framingham Children's Study found that children with the most television viewing had higher BMI's at follow-up, and showed the greatest increases in mean BMI from ages 4-11 years[27].

2.5.1.3 Fruit and Vegetable Intake

Fruit and vegetable intake is encouraged for all age groups. The protective benefits of increased intake of fruits and vegetables for adults include a decreased risk of cardiovascular disease, Type 2 Diabetes Mellitus, and some cancers[61]. The National 5-A-Day for Better Health Initiative was created to help promote the recommendation of consumption of ≥5 servings per day of fruits and vegetables[66]. Studies have shown that a large percentage of children and adults do not meet this recommendation[23,61]. In the 5-A-Day Baseline Survey, researchers found that the median fruit and vegetable intake for adults was only 3.4 servings per day[23]. Krebs-Smith et al, using the Continuing Surveys of Food Intake by Individuals (CSFII) from 1989-1991, found that only one in five children aged 2-18 years had consumed five or more servings of fruits and vegetables per day, and 25% of vegetables consumed were French fries[67]. Fruit and vegetable intake is increasing among children in the United States[61]. Using data from the (CSFII) from 1989-1991 and 1994-1996, researchers found an increase in fruit and vegetable intake in both boys and girls, where boys aged 12-19 years increased from 3.4 to 3.7 servings per day of vegetables, compared to 2.7 to 2.8 servings per day for girls of the same age[61]. Fruit intake for all children aged 6-19 years increased from 1.1 to 1.5 servings per day over the same time period[61]. Even accounting for the increases, children are not meeting the recommended intake of ≥5 servings of fruits and vegetables per day.

Fruit and vegetable intake has been shown to be associated with other health behaviors, like television viewing and risky dieting behaviors[25,26,61]. Among public school children in the 6th and 7th grade in a study in Massachusetts, researchers found an inverse relationship between fruit and vegetable consumption and hours of television viewed per day[61]. Using data from the 1999 YRBS, Lowry et al reported that among adolescents, grades 9-12, television viewing was associated with insufficient fruit and vegetable intake in both male and female subjects[25]. In a study examining dieting behaviors, researchers reported that extreme dieting was associated with decreased intake of fruits and vegetables among girls, grades 9-12[26]. Neumark-Sztainer et al reported a similar trend among middle- and high-school girls in the Project EAT study, conducted in Minneapolis, Minnesota[34].

2.5.1.4 No Risky Dieting Behaviors

Dieting is a concern among adolescents for a variety of reasons. Dieting has been associated with a decreased intake of nutrient-dense foods, which may affect growth and development[34]. High-risk dieting behaviors, like meal skipping, laxative use, and vomiting may be associated with the development of eating disorders, like anorexia nervosa, bulimia, or binge eating[58]. Long term health consequences of dieting include increased weight gain and possible nutrient deficiencies, and may contribute to the development of bulimia or other eating disorders[32,68]. Using a cohort of children from the Nurses Health Study, Field et al found that 4.5% of girls and 2.2% of boys aged 9-14 years were frequent dieters[68]. Binge eating was more prevalent among girls, and was associated with dieting for weight control among both sexes[68]. Dieters were also reported to have gained more weight than non-dieters during the survey[68]. In a cohort study of

adolescents aged 14-15 years, completed in Victoria, Australia, it was reported that females who were dieting at a severe level (assessed using the Adolescent Dieting Scale) were 18 times more likely to develop an eating disorder than non-dieters[31]. Authors concluded that moderate dieting and weight control behaviors like exercise carry a lower risk of developing an eating disorder than behaviors that severely restrict dietary intake[31].

Unhealthy dieting practices are prevalent among U.S. youth. Studies of adolescents have shown that 57.2% of females and 31.6% of boys have used at least one unhealthy dieting behavior (defined as skipping meals, fasting, diet pill use, laxative use, tobacco use, or vomiting) in attempts to lose weight[34]. Using data from the1999 YRBSS, Lowry et al found that one in four students (32.5% for females and 17.1% of males, combined 27% overall) were using unhealthy dieting practices while trying to either maintain or lose weight[69]. Girls in the 6-8th grades have been found to use methods like vomiting, laxatives, or diet pills to lose weight[32]. In the Project EAT survey, a cross-sectional survey of 5,144 middle school students in the St. Paul/Minneapolis area, 52.7% of girls and 31.6% of boys reported using at least one unhealthy dieting behavior to lose weight[34]. In a study of 10th graders in Los Angeles, of students who reported they were attempting to diet, 44% were skipping meals[33]. Lowry et al reported that of the students attempting to lose weight in the 1999 national YRBS survey, 27% of students were using unhealthy weight control behaviors, while 54% of students trying to maintain or lose weight were using exercise and a modified fat and calorie diet[69].

CHAPTER 3: METHODS

3.1 Youth Risk Behavior System

3.1.1 Background of the YRBSS

The Youth Risk Behavior Surveillance System (YRBSS) was developed by the Centers for Disease Control and Prevention (CDC) to monitor health-risk behaviors among adolescents in the United Sates. The survey design is a complex cluster design. Students in grades 9-12 are surveyed at the local level and are aggregated to the state and national levels. The survey is representative of students both publicly and privately educated in the United States. The samples are weighted to adjust for both non-response and demographic characteristics. The survey is collected every other year, in odd-numbered years[70].

3.1.2 Michigan 2001 YRBS

The state-level 2001 Michigan Youth Risk Behavior Survey (YRBS) is part of the national effort to assess health risks among adolescents. In 2001, 43 public schools (88%) participated in the survey, and 3,630 students (83%) completed the survey. The overall response rate for the state of Michigan in 2001 was 73%, calculated by multiplying the school participation rate (88%) by the student participation rate (83%)[71].

3.2 Definition of Outcome, Nutrition-Related Health Behaviors, and Covariates

3.2.1 Outcome

3.2.1.1 Body Mass Index (BMI)

To assess the outcome of overweight or obesity among our sample, self-reported height and weight were used to obtain each individual's body mass index [BMI: weight in kg / (height in m)^2]. The CDC's Growth Charts were used to assess BMI-for-age based on percentile height and weight cut-offs[72]. The 2000 CDC Growth Charts are gender-specific and age-specific. They were developed from national data sets (NHANES I-III, but weight was not used from NHANES III for children over the age of 6[73]), and are recommended to be used as a screening tool to identify overweight children and adolescents[74]. The questions on the survey were:

"Q. 5 How tall are you without your shoes on?
Q. 6 How much do you weigh without your shoes on?"

Self-reported height and weight were converted to kilograms and centimeters for analysis. In order to use the CDC's SAS program for Growth Chart percentiles, age was specified in months.

The CDC defines overweight based on BMI-for-age as: BMI $\geq 95^{th}$ percentile overweight, and at-risk for overweight as BMI $\geq 85^{th}$ - 95^{th} percentile. We also used the definition of underweight, BMI-for-age $\leq 5^{th}$ percentile, and examined this group separately, as this may be indicative of disordered eating or other health problems[75].

3.2.1.2 Validity and Reliability of BMI-for-age, and self-reported height and weight

BMI-for-age has been found to be an acceptable index to use for detecting overweight among children in several studies, and has been found to be more accurate than both the Rohrer Index (weight/height^3) and the Benn Index (weight/height^p, where p is minimizing the association with height)for assessing body fatness, using averaged skin-folds as a standard(correlations of r =0.47, r =0.39, and r =0.38, respectively)[76,77]. BMI-for-age has also been associated with total and percent body fat, and is an acceptable

measure of fatness in children and adolescents[78]. Self-reported height and weights have been shown to be reliable among adolescents when compared to actual height and weight (correlation range 0.87-0.94)[72], with the caveat that girls are more likely to underreport weight than boys, and overweight subjects are more likely to underreport weight than those of a normal weight[72,79,80].

3.2.2 Nutrition-Related Health Behaviors

Nutrition-related health behaviors were defined based on current national guidelines or were developed by this author based on other scientific work using similar nutrition-related health behaviors or data sets. Categorical cut-off points for variables are defined as 'healthy' based on public health recommendations from Healthy People 2010, the American College of Sports Medicine (ACSM), and a priori designation based on prior work examining health behaviors among adolescents.

Table 1: Nutrition-Related Health Behaviors; Michigan YRBS, 2001

Nutrition-Related Health Behaviors:	*Definitions:*
Fruit and Vegetable intake	≥5 servings per day [a]
Dieting behaviors	No laxative/diet pills/emesis/fasting [b]
Television viewing	≤2 hours per day [c]
Physical Activity	≥3 times per week "vigorous" [d] ≥5 times per week "moderate" ≥5 times per week "vigorous" + "moderate"

[a] Dietary intake of fruits and vegetables will be based on five questions regarding the intake of 100% fruit juice, fruits, carrots, green salad, and other vegetables.[81] The question regarding potato intake was not used in the variable because it did not address fried potato products separately. A dichotomous variable will be created based on the national Five-a-Day recommendations, where any combination of answers was accepted. Five servings per day or more was considered adequate.

[b] Dieting behaviors will be considered as acceptable for exercise or eating less, but as not acceptable for fasting, diet pill use, or vomiting/laxative use.[81,82]

[c] Television viewing will be considered acceptable for less than or equal to 2 hours per day, based on national recommendations.

[d] Physical activity cut-offs will be determined based on a combination of questions. The ACSM guidelines were set at 20 minutes of vigorous activity three times per week, but new guidelines promote activity daily.[83,84] A thorough literature review has shown that several studies use different cut-off points for the determination of "active".[30,82,85-87] Our a priori designations are based on those established be Berrigan et al: (3x/wk vigorous or a combo of 5/wk moderate) = adherent.[88]

3.2.2.1 Physical Activity

Physical activity was categorized based on questions assessing both vigorous and moderate activity levels. The American College of Sports Medicine (ACSM) guidelines suggest adequate physical activity as 20 minutes of vigorous activity three times per week. However, new national guidelines like Healthy People 2010 promote activity daily[83,84,89,90]. A thorough literature review has shown that several studies used different cut-off points for the determination of 'active'[30,82,85-87]. Our a priori designations were based on previous research using similar cut-off points[88] and guidelines set by the International Consensus conference on Physical Activity[21]. Other studies using data from the YRBS also used the same categorization values for analysis[25,69,87,88].

The questions pertaining to vigorous and moderate activity are:

> "On how many of the past 7 days did you:
>
> Q. 80 exercise or participate in physical activity for at least 20 minutes that made you sweat and breathe hard, such as basketball, soccer, running, swimming laps, fast bicycling, fast dancing, or similar aerobic activities?
>
> Q. 81 participate in physical activity for at least 30 minutes that did not make you sweat or breathe hard, such as fast walking, slow bicycling, skating, pushing a lawn mower, or mopping floors?"

Answers were coded as: "0-7 days/week". I then created a dichotomous variable that was defined as meeting criteria for physical activity for vigorous ≥3 times per week (Q. 80), moderate ≥5 times per week (Q. 81), or a combination of vigorous and moderate for ≥5 times per week.

3.2.2.2 Television Viewing

Television viewing was included in this study due to the well-documented relationship between sedentary behaviors including television viewing, exercise, and BMI[22,25,30,86].

The American Academy of Pediatrics recommends "limiting children's total media time (with entertainment media) to no more than 1-2 hours of quality programming per day"[22]. Television viewing was assessed using the following question:

"Q. 83 On an average school day, how many hours do you watch TV?

1. No TV on average school day
2. Less than 1 hour per day
3. 1 hour per day
4. 2 hours per day
5. 3 hours per day
6. 4 hours per day
7. 5 hours per day"

I then created a dichotomous variable, and television viewing was considered acceptable for less than or equal to two hours per day based on the guidelines set by the American Academy of Pediatrics[22].

3.2.2.3 Fruit and Vegetable Intake

Dietary intake of fruits and vegetables was based on five questions regarding the intake of 100% fruit juice, fruit, carrots, green salad, and other vegetables[81]. In the Michigan data set, the question regarding potato intake (Q. 76) was not used because it did not address fried potato products separately.

The questions, as they appeared on the MI YRBS, were:

"During the past 7 days, how many times did you eat/drink:

Q. 73 100% fruit juices such as orange juice, apple juice, or grape juice?
Q. 74 fruit?
Q. 75 green salad?
Q. 77 carrots?
Q. 78 other vegetables?"

Responses were coded as:

"1. Did not eat/drink
2. 1-3 times
3. 4-6 times
4. 1 time per day
5. 2 times per day

6. 3 times per day
7. 4 or more times per day"

In order to assess fruit and vegetable intake, all responses were converted to times per week. A response of '4 or more times per day' was coded as 28 times per week. Based on National Five-per-day recommendations, any combination of answers where the student had an intake of at least five servings of any fruit or vegetable met the recommendation of five fruits and vegetables per day[23].

In a review of the current literature, we found that many studies also defined adequate intake at five or more servings per day[25,88]. Many studies allowed 100% juice to be included in the total count of five servings per day that also used data from the YRBS[26,69,81]. Using questions such as the five on the YRBS are acceptable to assess fruit and vegetable intake, as established by Serdula et al, who compared similar questions from the Behavioral Risk Factor Surveillance System (BRFSS) to other diet records[91].

3.2.2.4 Dieting Behaviors

Dieting behaviors were included in our study to identify students with potential eating disorders.

Questions regarding dieting behaviors are:

"During the past 30 days, did you:

Q. 68 exercise to lose weight or keep from gaining weight?
Q. 69 eat less food, fewer calories, or foods lower in fat to lose weight or keep from gaining weight?
Q. 70 go without eating for 24 hours or more (also called fasting) to lose weight or keep from gaining weight?
Q. 71 take any diet pills, powders, or liquids without a doctor's advice to lose weight or keep from gaining weight?
Q. 72 vomit or take laxatives to lose weight or keep from gaining weight?"

Answers were coded for all five questions as "yes or no". The students who answered 'no' to all five questions regarding dieting were considered to have no risky dieting

behaviors. For questions regarding exercise (Q. 68) or eating less (Q. 69), a response of 'yes' was also considered as having no risky dieting behaviors. For the questions regarding fasting (Q. 70), diet pills / powders (Q. 71), and vomiting / laxative use (Q. 72), a response of 'yes' to any one of these questions was considered a risky dieting behavior. Other studies that have assessed dieting behaviors have also included fasting, diet pills, and vomiting as extreme or unhealthy dieting behaviors[26,34,69,81,82].

3.2.3 Covariates

3.2.3.1 Sports Participation

Participation on sports teams was not used to determine compliance in physical activity recommendations, however all health behaviors were stratified by sports team participation to determine the relationship between the defined healthy behaviors and BMI in students who did and did not participate on sports teams.

Sports team participation was defined by the question:

"Q. 86 During the past 12 months, on how many sports teams did you play?

1. 0 teams
2. 1 team
3. 2 teams
4. 3 or more teams"

I defined a sports team participant as a student who had participated on one or more teams in the last twelve months[81].

3.2.3.2 Race

Race was determined by self-report as follows:

"Q. 4 How do you describe yourself?

1. American Indian / Alaska Native
2. Asian
3. Black or African American
4. Hispanic or Latino
5. Native Hawaiian / other Pacific Islander
6. White

7. Multiple – Hispanic
8. Multiple – Non-Hispanic"

For data analysis, we combined the groups to white (response #6), Black or African American (response #3), Hispanic (responses #4 & #7), and other (responses #1, #2, #5, & #8). All analyses were then stratified by race.

3.2.3.3 Grade in School

Grade in school was assessed as:

"Q. 3 In what grade are you?

1. 9^{th}
2. 10^{th}
3. 11^{th}
4. 12^{th}
5. ungraded or other grade"

Responses for 9-12^{th} grades were included in the final analysis. Participants with the response 'ungraded' (response #5) were excluded from analyses, and then all analyses were stratified by grades 9-12.

3.3 Sample Characteristics

3.3.1 Description of Sample

The original data file contained observations from 3,630 participants from 43 Michigan schools. Students who reported having been pregnant were excluded from analysis (n=131). The question was asked as "how many times have you been pregnant or gotten someone pregnant?" I excluded any female participants that answered "1 time" or "2 times", as I had no way of identifying if they were currently pregnant. A total of 608 students (16.7%) were also excluded from further analysis due to missing exposures or outcomes of interest.

Table 2: Sample Selection and Exclusion Criteria;
Michigan YRBS, 2001

Sample Selection:	N
Number of schools participating in state survey	43
Number of students who completed questionnaire	3630
Number of students excluded for pregnancy [a]	131
Number missing by variables of interest	608
Sex	0
Grade	47
Race	36
Sports Team Participation	108
Fruit / Vegetable Intake	154
Physical Activity	110
Dieting Behaviors	189
Television Viewing	92
BMI [b]	157
Number of students who completed all questions of interest	2891
TOTAL	2891

[a] pregnancy determined by females responding that they had ever been pregnant

[b] BMI calculated using self-reported height and weight

Adolescents who were missing information on any of the variables were compared to those who completed all questions of interest. Statistically significantly more ninth graders were missing variables than completed the survey (39.8% compared to 27.9%, respectively), and statistically significantly more black students were missing variables than those that completed the survey (24.8% compared to 11.4%, respectively). Differences were also noted between males and females, which approached statistical significance.

Table 3: Population Demographics of Sample Analyzed compared to adolescents with missing variables, Michigan YRBS, 2001, weighted data

	Sample used in Analysis (n=2,891)			Adolescents with Missing Variables (n=608)		
Independent Variables	n	%	95% CI[a]	n	%	95% CI
Sex:						
Male	1436	51.4	49.4-53.3	337	55.6	51.3-59.9
Female	1455	48.6	46.7-50.6	271	44.4	40.1-48.7
Grade:						
9	703	27.9	26.2-29.8	188	39.8	35.3-44.2
10	855	26.3	24.8-27.9	162	24.0	20.4-27.6
11	775	23.5	22.0-25.1	135	20.9	17.4-24.4
12	558	22.2	20.5-23.9	76	15.3	11.9-18.7
Race:						
White	2191	83.7	82.5-85.0	328	66.3	62.8-69.8
Black	323	11.4	10.3-12.6	125	24.8	21.5-28.0
Hispanic	89	1.1	0.9-1.4	25	2.1	1.2-3.1
Other	288	3.7	3.2-4.1	94	6.8	5.3-8.3
School Sports:						
Participant	1774	61.4	59.5-63.3	300	58.5	53.7-63.3
Non-participant	1117	38.6	36.7-40.5	200	41.5	36.7-46.3

Column percents add to 100% with missing variables removed

[a]95% CI = Confidence Intervals

3.4 Statistical Analysis

3.4.1 Software Used in Analysis

SAS statistical software packages 8.1 and 9.1 were used for all data analysis. Due to the complex cluster sampling design, weights and stratum were taken into account for final data analyses in SAS 9.1.3.

3.4.2 Weighting Factors

The YRBS is weighted to allow the sample to be representative of the entire population of publicly educated students, grades 9-12, in the state of Michigan. The weighting factors are assigned based on a complex formula of base weights and adjustments for non-responses[92]. The decision to use the weights is determined by three factors: proper documentation, legitimate sampling methods, and an overall response rate of ≥60%[92] (Michigan's overall response rate for 2001 = 73%).

3.4.3 Data Analysis by Aim

3.4.3.1 Aim 1

To determine both the prevalence of individual and combined nutrition-related behaviors, and the adherence to national recommendations regarding modifiable lifestyle factors, self-reported, among a population-based sample of publicly educated Michigan youth, grades 9-12.

Prevalence and 95% confidence intervals were determined for each nutrition-related health behavior, and stratified by grade, gender, race, and sports team participation. Prevalence and 95% confidence intervals were then determined for students having at least one, at least two, at least three, and all four nutrition-related health behaviors, also stratified by grade, gender, race and sports team participation.

3.4.3.2 Aim 2

To examine the association between nutrition-related health behaviors and overweight / at-risk for overweight, based on BMI calculated from self-reported height and weight, among a population-based sample of publicly educated Michigan youth, grades 9-12.

BMI-for-age was applied to all subjects using a SAS program provided for public use by the Centers for Disease Control and Prevention (CDC). Prevalence and 95%

confidence intervals were determined for zero, one, two, three, and four nutrition-related health behaviors by BMI-for-age, and stratified by gender, grade, race, and sports team participation. BMI-for-age was then categorized into normal weight (BMI 5^{th}-85^{th} percentile) and overweight / at-risk overweight (BMI $\geq 85^{th}$ percentile). Nutrition-related health behaviors (NRHB) were then combined into two groups: 0-1 NRHB and 3-4 NRHB, and the prevalence of normal weight or overweight / at-risk overweight within each group were then examined. Results were then sub-classed by gender, due to differences between BMI-for-age among males and females, and stratified by grade, race, and sports team participation.

CHAPTER 4:RESULTS

4.1 Paper for Publication

4.1.1 Abstract

Purpose: To examine the adherence to national health recommendations regarding fruit and vegetable intake, physical activity, television viewing, and no risky dieting behaviors, as well as the relationship between these lifestyle behaviors and the prevalence of overweight / at-risk of overweight among Michigan high school students.

Methods: Data is from the Michigan Youth Risk Behavior Survey (YRBS), 2001, a representative sample of publicly educated high school youth in the state, grades 9-12 (n=2,891). Nutrition-related health behaviors were self-reported, and body mass index-for-age (BMI) was calculated based on national CDC growth charts. Results were weighted using stratum and individual weights, allowing prevalence estimates and 95% confidence intervals to be generalized.

Results: In the state of Michigan, 9.4% (n=276) of adolescents participated in all four defined nutrition-related health behaviors (NRHB), and 7.7% (n=222) participated in all four NRHB and maintained a healthy body weight (BMI-for-age 5^{th}-85^{th} percentile). Girls who participated in 3-4 NRHB were significantly more likely to maintain a healthy body weight than girls with only 0-1 NRHB (84.8%, 95% CI: 81.9-87.8 compared to 72.8%, 95% CI: 67.2-78.5, respectively). A similar trend was noted among boys (70.2% compared to 59.4%, respectively).

Conclusion: Less than 10% of adolescents, grades 9-12, were adhering to national recommendations regarding healthy lifestyle choices. Students who were adhering to 3-4

nutrition-related health behaviors were more likely to be maintaining a healthy body weight than those only participating in 0-1 health behaviors.

KEY WORDS:

Adolescent overweight

Fruit and vegetable intake

Physical activity

Television viewing

Multiple health behaviors

4.1.2 Introduction

Pediatric overweight is currently one of the leading health issues among youth in the United States[1]. In 1999-2000, among adolescents aged 12-19 years, 15.5% were considered overweight[5]. In 2003-2004, 18% of children aged 6-17 were overweight[2]; and among adolescents aged 12-19 years, 34.3% were either overweight, or at-risk of overweight[3]. Childhood overweight has many possible consequences, both short-term and across the lifespan[6-8]. Overweight in adolescence is associated with an increased risk of developing pseudotumor cerebri, sleep disorders, and cholelithiasis[1,6]. Overweight / obesity as a child or adolescent is also a predictor of adult overweight and obesity, and can affect adult mortality and morbidity[11], such as an increased risk for high blood pressure (HTN), hyperlipidemia, and Type 2 Diabetes Mellitus[12]. Modifiable lifestyle behaviors, like dietary intake, physical activity, and time spent in sedentary activities have been associated with overweight in adolescents[6].

National recommendations address modifiable nutrition-related health behaviors such as fruit and vegetable intake and leisure-time activities[19]. The 2005 Dietary Guidelines for Americans recommends maintaining a healthy weight, daily physical activity, and

increased fruit and vegetable intake[19]. For children, they also recommend limiting the amount of time spent being sedentary, and to increase physical activity[19]. In 2000, the Centers for Disease Control and Prevention (CDC) recommended that adolescents should participate in moderate or vigorous physical activity for at least twenty minutes at least three times per week, and that physical activity be included as a daily or near-daily practice[21]. Fruit and vegetable intake is recommended to be at least five servings per day, and is marketed nationally as the "5-A-Day for Better Health" program[23]. Television viewing for children is recommended by the American Academy of Pediatrics to be no more than one or two hours per day[22].

Studies have shown that physical activity, television viewing, and fruit and vegetable intake are related to body mass index in children[60-62]. Patrick et al reported that adolescents with lower levels of vigorous physical activity were more likely to be overweight[60]. In a study assessing the effect of television viewing on BMI, Kaur et al reported that increased hours of television viewing was positively associated with an increased BMI[62]. Boynton-Jarrett et al reported that increased hours watching television was inversely associated with fruit and vegetable intake[61].

In the following study, we identified four areas of nutrition-related health behaviors to examine: fruit and vegetable intake, physical activity, television viewing, and no risky dieting behaviors. We seek to determine the prevalence of these nutrition-related health behaviors in youth, to describe the demographics of students who are compliant with these recommendations, and examine the association of these behaviors with overweight / at-risk overweight among adolescents, grades 9-12, publicly educated in the state of Michigan.

Information regarding the percent of children and adolescent's meeting national health recommendations and guidelines is needed to determine their compliance, and assist policymakers, school officials, and health educators in their attempts to address the health of the nation's children. This study seeks to contribute to the current knowledge regarding the associations of multiple nutrition-related health behaviors to overweight / at-risk overweight among adolescents.

4.1.3 Methods

Description of Sample

Subjects for this study were participants in the 2001 Youth Risk Behavior Survey in the state of Michigan. The Michigan YRBS sample from 2001 was gathered by the Michigan Department of Education, as part of a nation-wide survey organized and overseen by the Centers for Disease Control and Prevention (CDC). The study design is a three-stage cluster sample, by area of the state, individual high schools, and then individual classes from each school. The YRBS is then weighted to be representative of all publicly educated high-school students in the state of Michigan based on a response rate of at least 60%. The Michigan YRBS response rate for 2001 was 73%, therefore sample weights were added to each individual observation to allow the sample to be representative of publicly educated adolescents, grades 9-12, in the state.

The original data file contained observations from 3,630 participants from 43 Michigan schools. Participants who reported having been pregnant were excluded from analysis (n=131). Subjects who reported their grade as "ungraded or other grade" were also excluded from analysis. A total of 608 students excluded from further analysis due to missing exposures or outcomes of interest. Adolescents who were missing information

on any of the variables were compared to those who completed all questions of interest. Among those missing variables, significantly more ninth graders were missing variables than completed the survey (39.8% compared to 27.9%, respectively), and significantly more black students were missing variables than completed the survey (24.8% compared to 11.4%, respectively). Our sample included only students who completed all questions of interest (n=2,891).

Body Mass Index (BMI-for-age)

To assess the outcome of overweight or obesity among our sample, self-reported height and weight were used to obtain each individual's body mass index [BMI: weight in kg / (height in m)^2]. The CDC's Growth Charts were used to assess BMI-for-age based on percentile height and weight cut-offs[75]. The 2000 CDC Growth Charts are gender-specific and age-specific. They were developed from national data sets (NHANES I-III), and are recommended to be used as a screening tool to identify overweight / at-risk overweight children and adolescents[75]. The CDC defines overweight and at-risk of overweight based on BMI-for-age as: BMI $\geq 95^{th}$ percentile as overweight, and BMI $\geq 85^{th}$ percentile - 95^{th} percentile as at-risk of overweight. Normal weight is defined as a BMI $\geq 5^{th}$-85^{th} percentile. Underweight is defined as BMI-for-age $<5^{th}$ percentile and children in this group were considered separately, as this may be indicative of disordered eating or other health problems.

Physical Activity

Physical activity was categorized based on questions assessing both vigorous and moderate activity levels. A thorough literature review has shown that several studies used different cut-off points for the determination of 'active'[82,85-87]. Our a priori

designations were based on previous research using similar cut-off points and guidelines set by the International Consensus conference on Physical activity[21]. For vigorous exercise, the question was asked "on how many of the past 7 days did you exercise.....for at least 20 minutes that made you sweat and breathe hard...."; for moderate exercise, it was "on how many of the past 7 days did you participate in physical exercise for at least 30 minutes that did not make you sweat or breathe hard....". Answers were coded for each question as "0-7 days/week". We then created a dichotomous variable that was defined as meeting criteria with either three days per week or more vigorous, five days per week or more moderate, or a combination of five days per week vigorous and moderate exercise.

Television Viewing

Television viewing was included in our study as a health-related behavior of interest due to the well-documented relationship between sedentary behaviors including television viewing, exercise, and BMI[22,25,30,87]. Television viewing was assessed using the following question: "on an average school day, how many hours do you watch TV?" Answers were coded as 0-5 hours per day. Television viewing was considered acceptable for less than or equal to two hours per day based on the guidelines set in 2001 by the American Academy of Pediatrics[22].

Fruit and Vegetable Intake

Dietary intake of fruits and vegetables was based on five questions regarding the intake of 100% fruit juice, fruit, carrots, green salad, and other vegetables. In the Michigan data set, the question regarding potato intake was not used in the variable created because it did not address fried potato products separately. The following

questions were asked: "During the past 7 days, how many times did you eat/drink.... '100% fruit juice', 'fruit', 'green salad', 'carrots', and 'other vegetables'?". Responses were coded as none, times per week, or times per day. In order to assess fruit and vegetable intake, all responses were converted to times per week. A response of '4 or more times per day' was coded as 28 times per week. Based on National Five-per-day recommendations, any combination of answers where the student had an intake of at least five servings of any fruit or vegetable met the recommendation of five fruits and vegetables per day[23].

Risky Dieting Behaviors

Risky dieting behaviors were included in our study to identify students with potential eating disorders in order to distinguish them from the population defined as 'healthy'. The following questions were asked: "During the past 30 days, did you: 'exercise', 'eat less food', 'go without eating for 24 hours (fasting)', 'diet pills, powders, or liquids', and 'vomit or take laxatives' to lose weight or keep from gaining weight?" Answers were coded for all five questions as: "yes or no". The students who answered 'no' to all five questions regarding dieting were considered to have no risky dieting behaviors. For questions regarding exercise or eating less, a response of 'yes' was also considered as having no risky dieting behaviors. For the questions regarding fasting, diet pills/powders, and vomiting/laxative use, a response of 'yes' to any one of these questions was considered a risky dieting behavior.

Covariates:

We examined our nutrition-related variables by covariates of interest. These included gender, grade in school, race, and sports team participation. Grade in school was used as

a demographic variable, and was assessed from the question: "In what grade are you?" Responses were "9th", "10th", "11th", "12th", or "ungraded or other grade". Responses for 9-12th grades were included in the final analysis. Race was determined by the question: "How do you describe yourself?" Responses included "1) American Indian / Alaska Native, 2) Asian, 3) Black or African American, 4) Hispanic or Latino, 5) Native Hawaiian / other Pacific Islander, 6) White, 7) Multiple - Hispanic, and 8) Multiple – Non-Hispanic". For data analysis, we combined groups to white (response #6), Black or African American (response #3), Hispanic (responses #4 & #7), and other (responses #1, #2, #5, & #8). Sports team participation was defined by the question: "During the past 12 months, on how many sports teams did you play?" Answers were coded from "none" to "three or more" teams. We defined a sports team participant as a student who had participated on one or more teams in the last twelve months.

Statistical Analysis

Prevalence and 95% confidence intervals were determined for each nutrition-related health behavior by grade, gender, race, and sports team participation. The same analyses were then done for the number of students who had at least one, at least two, at least three, and all four healthy behaviors. BMI-for-age was determined for all participants. Then, the relationship between students who exhibited all four healthy behaviors and who were also maintaining a healthy body weight was examined. The relationship between number of nutrition-related healthy behaviors and BMI-for-age was also examined. Results were stratified by gender due to differences between BMI-for-age for males and females.

SAS statistical software packages 8.1 and 9.1 were used for all data analysis. To account for the sample design, stratum and weights were used in the SAS analysis, and then the design effect (deff) was applied to all 95% confidence intervals for the MI YRBS, 2001 *(deff=2.2)*. Analyses run were proc frequencies, to determine prevalence of health behaviors among each demographic variable, and by BMI-for-age.

4.1.4 Results

Among study participants, 51.4% were male and 48.6% were female (see Table 1). There were slightly more participants in the ninth grade (27.9%) than in the twelfth grade (22.2%). Study participants were 83.7% white, 11.4% black, 1.1% Hispanic, and 3.7% defined in the 'other' category. A high proportion of students participated on sports teams (61.4%).

Fruit and Vegetable Intake

As seen in Table 2, 19.2% of subjects were meeting the recommendation for fruit and vegetable intake (defined as ≥5 servings per day). There were no significant differences by gender, grade, or race. A significant difference was observed between students who participated in school sports compared to non-participants (22.7%, 95% Confidence Interval (CI): 20.6-24.7 compared to 13.7%, 95%CI: 11.5-15.9, respectively).

Adequate Physical Activity

Significant differences were seen across most demographic groups for adequate physical activity (defined as ≥3 times per week vigorous, ≥5 times per week moderate, or ≥5 week vigorous and moderate). Males had higher prevalence rates than females (78.3% and 67.1%, respectively). There was a decreasing trend in activity levels after the 9th grade. White students had a statistically significant higher prevalence of adequate

physical activity than black students (75.0% and 59.4%, respectively). Students who participated in school sports had a prevalence of 84.0% (95% CI: 82.2-85.8), while students who did not participate in school sports had a significantly lower prevalence, at 55.1% (95% CI: 51.9-58.2).

No Risky Dieting Practices

Gender differences were noted for risky dieting behaviors. Males were more likely to have no risky dieting practices than females (87.9%, 95% CI: 86.0-89.7 and 74.7%, 95% CI: 72.3-77.1, respectively). Among individual dieting practices, females had a higher prevalence of fasting (16.7%), diet pill/powder use (10.2%), and vomiting/laxative use (8.5%) than did males (8.0%, 5.4%, and 3.5%, respectively; data not shown).

Television Viewing

Nearly 70% of our sample reported watching television for two hours or less per day. Significant differences were noted among white and black students, where 74.2% (CI: 72.3-76.1) of white students met the guideline for healthy television viewing, compared to 36.7% (95% CI: 31.4-42.0) of black students. Students who participated in school sports also had a higher rate of compliance to television viewing guidelines than did non-participants (73.0% and 63.6%, respectively).

Compliance with Multiple Nutrition-Related Health Behaviors

Only 50.1% of the total sample were participating in at least three healthy behaviors, and only 9.4% (n=276) were found to be compliant with all four nutrition-related health behaviors (see Table 3). Among subjects who participated in at least one nutrition-related health behavior, there were no significant differences in prevalence by gender, grade, race, or school sports participation. For students who participated in at least two

nutrition-related health behaviors, males had a higher prevalence than females (87.9%, 95% CI: 86.1-89.7 and 81.2%, 95% CI: 79.1-83.3, respectively). There were also differences by race, where the prevalence of black subjects was significantly lower than white subjects (68.3%, 95% CI: 62.9-73.8 and 87.1%, 95% CI: 85.6-88.5, respectively). Differences were also seen among students who participated in sports compared to those who did not, where sports participants had a prevalence of 90.3% for at least two nutrition-related health behaviors, while non-participants had a prevalence of 75.6%. Among those subjects with at least three nutrition-related health behaviors, males had a significantly higher prevalence than females (55.6% and 44.3%, respectively), white subjects had a significantly higher prevalence than black subjects (51.8% and 23.0%, respectively) and sports participants had a significantly higher prevalence rate than non-participants (60.7% and 33.3%, respectively). For students participating in all four health behaviors, significant differences were noted by race, again where white subjects had a higher prevalence rate for all four behaviors (10.2%, 95% CI 8.9-10.2) than did black subjects (3.9%, 95% CI 1.6-6.2), and among students who participated in school sports (13.2%, 95%CI 11.4-14.8) compared to those who did not participate (3.4%, 95% CI 2.3-4.6).

BMI-for-age Distribution and Demographic Characteristics

Among our sample, BMI-for-age distribution did not follow a normal distribution curve. 1.7% of students were considered underweight (BMI-for-age <5th percentile). Of the remaining subjects, 72.7% were maintaining a normal weight, while 14.7% were considered at-risk of overweight, and 10.9% were overweight (see Table 4). Females reported a higher prevalence of normal weight than males (78.7% and 67.0%,

respectively), and had a lower prevalence than males for both at-risk for overweight (11.9% and 17.4 %, respectively) and overweight (7.6 % and 14.0% respectively). Differences by grade and by sports participation were both noted. White subjects had a higher prevalence of normal weight than did black subjects (74.2%, 95% CI: 72.3-76.1 and 62.7%, 95% CI: 56.9-68.4, respectively). Conversely, blacks also had a higher prevalence of at-risk of overweight (20.4%) and overweight (15.6%), compared to white students (13.9% at-risk for and 10.1% overweight).

Nutrition-Related Health Behaviors and BMI-for-age

We then examined prevalence of each NRHB and BMI-for-age (see Table 5a & 5b). Among each individual NRHB, there was a significant difference noted among white and black students. Black students were significantly more likely than white students to be in the overweight / at-risk of overweight category for fruit and vegetable intake, physical activity, television viewing, and no risky dieting practices. Due to small sample size, for further analysis, categories of nutrition-related health behaviors (NRHB) were condensed to zero to one NRHB, and three to four NRHB. We then compared subjects with 0-1 NRHB and 3-4 NRHB by BMI-for-age (see Table 6). For students with 2 NRHB, white students were significantly more likely to be maintaining a healthy body weight than were black students (26.4%, 95% CI: 23.0-29.7 compared to 42.9%, 95% CI: 33.7-52.1, respectively; see Table 6b). Among subjects exhibiting 0-1 NRHB, no differences were noted by gender, grade, race or school sports participation among either BMI-for-age category. Of subjects exhibiting 0-1 NRHB, 67.4% were maintaining a healthy weight, and 30.1% were overweight/ at-risk of overweight. Among subjects with 3-4 NRHB, significant differences were noted between males and females in both BMI-for-age

categories. Females with 3-4 NRHB were more likely to be a normal weight than males with 3-4 NRHB (84.8%, 95% CI: 81.9-87.8 and 70.2%, 95% CI: 66.7-73.6%, respectively). Females with 3-4 NRHB were therefore also less likely to be overweight / at-risk of overweight than males with 3-4 NRHB (13.1%, 95% CI: 10.3-15.9 and 28.6%, 95% CI: 25.2-32.0, respectively). Girls participating in 3-4 NRHB were more likely to be maintaining a healthy weight than girls with 0-1 NRHB (84.8%, 95% CI: 81.9-87.8 and 72.8%, 95% CI: 67.2-78.5, respectively). A similar trend, though not statistically significant, was noted among boys.

Given the differences BMI-for-age by gender, the covariates of grade, race and sports team participation were then examined separately among males and females (data not shown). Among males, there were no significant differences between students participating in 0-1 NRHB when compared to those with 3-4 NRHB, nor were there any noted differences by BMI-for-age, grade, race or school sports participation. However, due to small sample size, confidence intervals were very large.

4.1.5 Discussion

Our results show that a high percentage of adolescents in the state of Michigan are not in compliance with national recommendations regarding nutrition-related health behaviors. Among individual nutrition-related health behaviors, 72.8% of subjects were compliant with physical activity guidelines, 69.4% were compliant with television viewing recommendations, and only 19.2% reported an adequate intake of fruits and vegetables, including 100% fruit juice. Students who participated on sports teams were significantly more likely to be compliant with each recommendation. Only 9.4% of subjects were compliant with all four nutrition-related health behaviors (NRHB), of

which 79% were additionally maintaining a healthy body weight. A total of 7.7% of the population was both compliant with all four NRHB and maintaining a healthy body weight. Among females, there was an association between the number of NRHB and BMI-for-age. Female students who participated in 3-4 NRHB were more likely to be maintaining a normal weight than those with only 0-1 NRHB (84.8% compared to 72.8%, respectively). A similar trend that did not meet statistical significance was also noted for boys.

When examining individual nutrition-related health behaviors, significant differences were noted in behaviors related to physical activity among demographic characteristics. Males had a significantly higher prevalence rate for physical activity than did females (78.3% compared to 67.1%, respectively), which has been similarly noted in other research[28,93]. In 1998, using data from NHANES III, Andersen et al reported a gender difference in vigorous physical activity[28]. Among their sample, 86% of boys, aged 14-16, reported participating in vigorous physical activity $\geq$3 times per week, compared to only 65% of girls of the same age[28].

Racial differences in television viewing were also noted. The prevalence of white students who watched $\leq$2 hours per day was 74.2%, compared to a rate of 36.7% for black students. This trend has been noted in other research[25,93]. Using the national 1999 YRBS, Lowry et al reported that 57.2% of subjects watched television for $\leq$2 hours per day; the prevalence of white students watching $\leq$2 hours of television per day was significantly higher than the prevalence among black students (65.8% compared to 26.3%, respectively)[25].

Differences were also noted in nutrition-related health behaviors related to dietary intake by demographic characteristics. Among our study population, sports participants had a significantly higher prevalence of eating ≥5 fruits and vegetables per day than did non-participants (22.7% compared to 13.7%, respectively). A similar finding was reported by Baumert et al, who reported that 47% of adolescent athletes, defined as participants of organized sports outside of gym class in grades 9-12, ate at least one serving of fruits and vegetables daily, compared to 40% of non-athletes ($p<0.0005$)[94]. There was a significant difference noted in dieting practices by gender in our sample. The prevalence of males with no risky dieting practices was significantly higher than the prevalence among females (87.9% compared to 74.7%, respectively). In a study examining weight control behaviors among adolescents who were trying to control / lose weight, researches reported a similar trend for gender[69].

When examining the prevalence of compliance to multiple health behaviors, one study similar in theory to ours was identified, though the study is examining some different health behaviors. In 2004, using a sample derived from a health plan in the Midwest, Pronk et al examined four behaviors, physical activity, no tobacco use, diet quality and body weight among adolescents aged 13-17[95]. Of that study population, 78.9% had a BMI-for-age ≤85th percentile[95], similar to our findings of 72.7% with a BMI-for-age ≤85th percentile. A total of 31.2% of adolescents in the Pronk study were compliant with all of their defined healthy behaviors (adequate physical activity, no smoking, a high quality diet, and a BMI ≤85th percentile)[95], in contrast to our study, where only 9.4% of subjects were compliant with all four NRHB (adequate physical activity, television viewing ≤2 hours per day, adequate fruit and vegetable intake, and no risky dieting

behaviors). In addition, a total of 7.7% of the population was both compliant with all four NRHB and maintaining a healthy body weight.

Research looking at patterns of healthy lifestyle behaviors has been published among adult subjects. In a study using data from the BRFSS, Reeves and Rafferty identified only 3% of the population nationally was compliant with all four of their defined health behaviors [fruit and vegetable intake (≥5 per day), physical activity (≥30 minutes ≥5 times per week), no tobacco use, and BMI (18.5-25)][37]. Reeves and Rafferty also reported findings for the state of Michigan, with only 3% of the population participating in the same health behaviors[96]. Berrigan et al reported similar results when examining five health behaviors [fruit and vegetable intake (≥5 per day), physical activity (≥3 times per week vigorous or ≥5 times per week moderate), no tobacco use, moderate alcohol consumption (≤ 2 drinks per day for males or ≤1 drink per day for females), and dietary fat intake (<30% of total calories)] using data from NHANES III[88]. In their study, 5% of the population was compliant with their defined health behaviors[88].

Strengths and Limitations

A significant limitation of our study was the fact that the YRBS is self-reported data. In a study examining self-reporting for physical activity, it was noted that there are significant reporting differences when using different reporting tools[89]. One study identified also looked at the questions regarding fruit and vegetable intake on the BRFSS (similar to those on the YRBS), and found that the self-reported intake reported was similar to intake assessed using multiple diet recalls or diet records[91]. There has been considerable research looking at self-report versus measured height and weight, and most studies have found that there was underreporting of both when using self-reported

numbers[79,80,97-99]. Some research has suggested that this trend is more prevalent in females and among subjects that are overweight[80,98,99]. In our study, prevalence of females that were overweight / at-risk of overweight was considerably lower than the rates seen in the male subjects. These results may have been affected by the above trends concerning self-report, whereby the differences between genders may be a remnant of a reporting issue.

Another significant limitation of this study was the unavailability of information regarding socioeconomic status (SES). The YRBS does not ask questions regarding household income, level of parental education, neighborhood information, or access to food. Therefore, we were unable to examine the associations of nutrition-related health behaviors and BMI-for-age with gender, grade, or race within the framework of SES, all of which have been reported elsewhere[13,93,100-102].

A potential limitation to this study includes the significant differences among subjects who completed the survey when compared to students with missing variables. These differences were significant for both grade and race, and approaching significance for gender. Our sample is representative only of students publicly educated in the state of Michigan, so results cannot be generalized to all adolescents in the state, as there may be significant difference among risk behaviors when comparing students educated in different settings[103]. Also, the survey is a cross-sectional design, which does not allow temporality to be determined.

The strengths of this study include its ability to address adherence to national health recommendations among a representative sample of publicly educated adolescents, and to compare the prevalence of overweight / at-risk of overweight among subjects who are

adhering to the defined NRHB. Adherence to national health recommendations for individual behaviors identified were similar to research discussed elsewhere. Of significant importance is the relatively low number of students who are participating in these health behaviors and maintaining a healthy body weight. This is reflective of the growing concern of childhood and adolescent overweight and obesity, and the long-term health effects associated with both lifestyle choices and overweight and obesity in adulthood.

Our results suggest that public health interventions should be focused on determining the barriers to compliance to national health recommendations to help increase the prevalence of nutrition-related healthy behaviors among adolescents in the state of Michigan. Students at-risk should be identified, and specific strategies implemented to help these students make positive nutrition-related healthy lifestyle choices. Another issue of importance to clinicians is the prevalence rate of overweight and at-risk of overweight among Michigan adolescents, as this could have a significant impact on their health and well-being across the lifespan.

Table 1: Population Demographics of Sample Analyzed. Michigan YRBS, 2001, weighted data.

	Adolescents Included in Analysis (n=2,891)		
Independent Variables	n	%	95% CI[a]
Sex:			
Male	1436	51.4	49.4-53.3
Female	1455	48.6	46.7-50.6
Grade:			
9	703	27.9	26.2-29.8
10	855	26.3	24.8-27.9
11	775	23.5	22.0-25.1
12	558	22.2	20.5-23.9
Race:			
White	2191	83.7	82.5-85.0
Black	323	11.4	10.3-12.6
Hispanic	89	1.1	0.9-1.4
Other	288	3.7	3.2-4.1
School Sports:			
Participant	1774	61.4	59.5-63.3
Non-participant	1117	38.6	36.7-40.5

Column percents add to 100% with missing variables removed

[a]95% CI = Confidence Intervals

Table 2: Prevalence of Nutrition – Related Health Behaviors by Demographic Characteristics among Adolescents grades 9-12. Michigan YRBS, 2001, weighted data.

Category	Fruit / vegetable intake (≥5 servings / day) [a]			Adequate Physical Activity [c]			No Risky Dieting Practices [d]			Television viewing (≤2hrs/day) [e]		
	n	%	95% CI [b]	n	%	95% CI	n	%	95% CI	n	%	95% CI
Total	562	19.2	17.6-20.7	2082	72.8	71.1-74.5	2346	81.5	79.9-83.0	1988	69.4	67.6-71.1
Gender :												
Male	286	19.7	17.5-22.0	1109	78.3	76.0-80.5	1262	87.9	86.0-89.7	963	67.9	65.3-70.5
Female	276	18.6	16.5-20.7	973	67.1	64.5-69.6	1084	74.7	72.3-77.1	1025	70.9	68.5-73.4
Grade:												
9	136	19.4	16.3-22.5	546	78.7	75.5-81.9	568	81.4	78.4-84.4	450	63.6	60.0-67.3
10	164	18.6	15.9-21.4	611	71.6	68.4-74.7	678	80.2	77.4-83.0	546	65.1	61.8-68.4
11	153	18.9	16.1-21.8	540	70.2	66.8-73.6	641	82.2	79.3-85.0	565	73.5	70.2-76.8
12	109	19.9	16.3-23.5	385	69.7	65.7-73.7	459	82.3	78.9-85.8	427	77.3	73.6-80.9
Race:												
White	422	19.6	17.9-21.3	1632	75.0	73.1-76.8	1791	81.8	80.2-83.5	1631	74.2	72.3-76.1
Black	52	15.0	10.8-19.2	195	59.4	53.6-65.2	258	79.7	75.1-84.3	116	36.7	31.4-42.0
Hispanic	14	15.6	7.6-23.5	59	62.8	52.5-73.0	71	80.9	72.1-89.8	52	57.8	47.2-68.4
Other	74	23.8	18.8-28.8	196	68.6	62.9-74.3	226	78.5	73.5-83.6	189	65.3	59.5-71.1
School Sports:												
Participant	403	22.7	20.6-24.7	1485	84.0	82.2-85.8	1481	83.7	81.8-85.5	1274	73.0	70.8-75.2
Non participant	159	13.7	11.5-15.9	597	55.1	51.9-58.2	865	78.0	75.4-80.5	714	63.6	60.6-66.6

[a] Dietary intake of fruits and vegetables will be based on five questions regarding the intake of 100% fruit juice, fruits, carrots, green salad, and other vegetables. Five servings per day or more was considered adequate.

[b] CI=Confidence Intervals

[c] Physical activity cut-offs will be determined based on a combination of questions. National guidelines recommend daily physical activity, with vigorous or moderate activity at least three times per week for twenty minutes. Our a priori designations are based on those established by Berrigan et al: (3x/wk vigorous or a combo of 5/wk moderate) = adherent.

[d] Risky dieting behaviors: Fasting, diet pill use, or vomiting/laxative use.

[e] Television viewing will be considered acceptable for less than or equal to 2 hours per day.

Table 3: Prevalence of at least one, at least two, at least three, or all four Nutrition – Related Health Behaviors by Demographic Characteristics among Adolescents grades 9-12. Michigan YRBS, 2001, weighted data.

Category	At least one healthy behavior [a]			At least two healthy behaviors			At least three healthy behaviors			All four healthy behaviors		
	n	%	95% CI [b]	n	%	95% CI	n	%	95% CI	n	%	95% CI
Total	2849	98.9	98.3-99.1	2432	84.7	83.3-86.0	1421	50.1	48.2-52.0	276	9.4	8.3-10.5
Gender :												
Male	1424	99.4	99.0-99.8	1255	87.9	86.1-89.7	780	55.6	52.8-58.3	161	10.9	9.1-12.6
Female	1425	97.9	97.1-98.7	1177	81.2	79.1-83.3	641	44.3	41.6-47.0	115	7.9	6.4-9.3
Grade:												
9	689	98.4	97.6-99.3	592	84.1	81.2-87.0	355	51.8	47.9-55.6	64	8.7	6.6-10.9
10	840	98.1	97.2-99.1	690	81.3	78.6-84.0	390	46.7	43.2-50.1	79	9.4	7.3-11.5
11	764	98.7	97.8-99.6	665	86.2	83.6-88.7	391	50.2	46.4-53.9	79	9.7	7.6-11.9
12	556	99.6	99.1-100.0	485	87.8	85.0-90.6	285	51.9	47.5-56.3	54	9.9	7.2-12.6
Race:												
White	2171	99.1	98.8-99.5	1904	87.1	85.6-88.5	1173	54.1	52.0-56.3	228	10.2	8.9-11.5
Black	309	95.5	93.2-97.9	222	68.3	62.9-73.8	77	23.0	18.1-27.9	13	3.9	1.6-6.2
Hispanic	87	98.4	96.0-100.0	71	78.2	69.1-87.3	35	37.3	27.5-47.1	3	3.1	0.0-6.2
Other	282	97.8	96.0-99.6	235	82.1	77.3-86.8	136	46.0	39.8-52.2	32	10.4	6.8-14.0
School Sports:												
Participant	1759	99.1	98.7-99.6	1595	90.3	88.9-91.8	1054	60.7	58.3-63.1	235	13.2	11.5-14.8
Non-participant	1090	97.9	97.1-98.8	837	75.6	73.0-78.3	367	33.3	30.3-36.2	41	3.4	2.3-4.6

[a] Healthy behaviors: Fruit and vegetable intake ≥5 servings per day; physical activity either ≥3 times per week vigorous, ≥5 times per week moderate, or ≥5 times per week vigorous + moderate; television viewing ≤2 hours per day; and no risky dieting behaviors (fasting/laxative use/diet pills/vomiting).

[b] CI = 95% Confidence Intervals

Table 4: BMI-for-age percentiles by Demographic Characteristics among Adolescents grades 9-12.
Michigan YRBS, 2001, weighted data.

	<5th percentile			5th to 85th percentile [b]			>85th to <95th percentile			≥95th percentile		
Category:	n	%	95% CI [a]	n	%	95%CI	n	%	95% CI	n	%	95% CI
Total	52	1.7	1.2-2.2	2105	72.7	70.9-74.4	418	14.7	13.3-16.1	316	10.9	9.7-12.1
Gender												
Male	27	1.6	0.9-2.3	956	67.0	64.4-69.9	249	17.4	15.2-19.5	204	14.0	12.1-16.0
Female	25	1.8	1.1-2.5	1149	78.7	76.5-80.9	169	11.9	10.1-13.7	112	7.6	6.2-9.1
Grade												
9	12	1.7	0.7-2.6	499	70.0	66.4-73.6	112	16.9	13.9-19.9	80	11.4	9.0-13.9
10	12	1.4	0.6-2.2	588	68.2	64.9-71.5	147	17.9	15.1-20.7	108	12.5	10.2-14.9
11	16	1.9	1.0-2.9	590	76.7	73.5-79.8	99	11.9	9.5-14.3	70	9.4	7.3-11.6
12	12	1.8	0.7-3.0	428	77.2	73.5-80.9	60	11.1	8.3-13.9	58	9.9	7.3-12.5
Race												
White	42	1.8	1.2-2.3	1626	74.2	72.3-76.1	301	13.9	12.4-15.5	222	10.1	8.8-11.4
Black	4	1.3	0.0-2.6	205	62.7	56.9-68.4	64	20.4	15.6-25.2	50	15.6	11.5-19.7
Hispanic	3	3.4	0.0-7.5	52	57.4	46.3-68.6	17	17.5	9.2-25.9	17	21.5	12.2-30.9
Other	3	1.0	0.0-2.2	222	74.8	69.3-80.4	36	13.2	8.9-17.5	27	11.0	6.9-15.0
School Sports												
Participant	36	2.0	1.3-2.7	1329	74.8	72.6-77.0	242	14.0	12.2-15.7	167	9.2	7.8-10.7
Non-participant	16	1.2	0.6-1.9	776	69.3	66.4-72.2	176	15.8	13.5-18.2	149	13.6	11.4-15.7

[a] CI: 95% Confidence Intervals

[b] Body mass index (BMI) was based on self-reported height and weight (kg/m2)[72], and percentile cut-offs will be assessed using the CDC's Growth Charts. Percentile overweight is defined as BMI-for-age ≥95th percentile, and at-risk for overweight is defined as BMI-for-age >85th to <95th percentile.

Table 5a: Individual Nutrition-Related Health Behaviors (Fruit and Vegetable Intake & Physical Activity) and BMI-for-age by Demographic Characteristics among Adolescents grades 9-12. Michigan YRBS, 2001, weighted data.

Category	**Fruit and Vegetable Intake** (≥5 servings / day)						**Physical Activity** (≥3 times per week vigorous, ≥5 times per week moderate, or ≥5 times per week vigorous + moderate)					
	Normal Weight			At-risk or Overweight			Normal Weight			At-risk or Overweight		
	n	%	95% CI[a]	n	%	95% CI	n	%	95% CI	n	%	95% CI
Total	420	73.2	69.2-77.2	128	24.4	20.5-28.3	1533	73.6	71.5-75.6	525	25.3	23.3-27.3
Gender :												
Male	199	67.0	61.1-73.0	82	31.5	25.6-37.4	758	68.7	65.8-71.6	339	30.4	27.5-33.3
Female	221	80.1	75.2-85.1	46	16.4	11.8-21.0	775	79.6	76.9-82.3	186	19.1	16.5-21.7
Grade:												
9	74	67.6	58.5-76.7	33	29.1	19.8-38.3	393	70.7	66.6-74.7	145	27.9	23.9-32.0
10	119	70.7	63.3-78.2	44	28.6	21.2-36.0	427	69.4	65.6-73.2	181	30.0	26.2-33.9
11	124	79.7	72.7-86.7	25	17.4	10.8-24.0	416	78.3	74.6-81.9	117	20.8	17.2-24.3
12	83	75.5	66.1-84.9	22	22.0	12.8-31.1	297	77.8	73.4-82.2	82	20.8	16.5-25.1
Race:												
White	319	74.5	70.1-78.9	91	22.9	18.6-27.1	1226	75.1	72.9-77.2	387	23.9	21.7-26.0
Black	31	59.2	44.2-74.2	21	40.8	25.8-55.8	120	61.0	53.3-68.7	72	37.6	30.0-45.2
Hispanic	8	54.5	51.9-57.1	5	38.7	36.1-41.3	36	61.4	47.5-75.2	22	37.1	23.6-50.6
Other	62	80.5	72.4-88.5	11	17.7	10.4-25.0	151	73.8	66.8-80.8	44	25.7	18.8-32.7
School Sports:												
Participant	311	75.8	71.2-80.4	82	21.7	17.2-26.1	1130	76.0	73.7-78.3	335	22.7	20.4-25.0
Non participant	109	66.3	58.0-74.7	46	31.5	23.3-39.7	403	67.7	63.7-71.7	190	31.8	27.8-35.8

[a] CI: 95% Confidence Intervals

Table 5b: Individual Nutrition-Related Health Behaviors (No Risky Dieting Practices & Television Viewing) and BMI-for-age by Demographic Characteristics among Adolescents grades 9-12. Michigan YRBS, 2001, weighted data.

Category	No Risky Dieting Practices (no fasting/laxative use/diet pills/vomiting)						Television Viewing (≤2 hours per day)					
	Normal Weight			At-risk or Overweight			Normal Weight			At-risk or Overweight		
	n	%	95% CI[a]	n	%	95% CI	n	%	95% CI	n	%	95% CI
Total	1741	74.1	72.2-76.0	560	24.2	22.3-26.0	1498	74.9	72.9-77.0	451	23.1	21.2-25.1
Gender :												
Male	869	69.4	66.7-72.1	369	28.9	26.3-31.6	648	67.0	63.8-70.2	298	31.3	28.2-34.5
Female	872	79.8	77.3-82.4	191	18.2	15.7-20.6	850	82.9	80.5-85.3	153	14.8	12.6-17.1
Grade:												
9	411	71.8	67.8-75.8	148	26.7	22.8-30.6	335	72.9	68.5-77.3	106	25.1	20.9-29.4
10	469	68.1	64.4-71.8	198	30.4	26.7-34.0	393	71.0	67.0-75.1	146	27.7	23.7-31.6
11	503	79.1	75.8-82.4	124	18.8	15.6-22.0	432	76.8	73.1-80.4	119	20.8	17.3-24.3
12	358	78.5	74.5-82.5	90	19.5	15.6-23.3	338	79.1	75.0-83.2	80	18.9	14.9-22.9
Race:												
White	1348	75.3	73.2-77.4	406	22.8	20.8-24.8	1239	75.7	73.5-77.8	357	22.3	20.0-24.4
Black	171	65.5	59.0-71.9	85	33.8	27.4-40.3	74	64.2	55.2-73.2	41	34.6	25.6-43.6
Hispanic	44	60.7	48.0-73.5	24	35.0	22.8-47.2	33	62.9	48.4-77.5	17	33.5	19.5-47.6
Other	178	76.2	69.9-82.5	45	22.5	16.3-28.7	152	77.5	71.0-84.1	36	21.8	15.4-28.3
School Sports:												
Participant	1126	75.8	73.5-78.2	325	22.2	19.9-24.5	981	76.4	73.9-78.9	264	21.3	18.9-23.7
Non participant	615	71.1	67.8-74.3	235	27.4	24.2-30.7	517	72.2	68.7-75.7	187	26.5	23.1-30.0

[a] CI: 95% Confidence Intervals

Table 6: Nutrition-Related Health Behaviors and BMI-for-age by Demographic Characteristics among Adolescents grades 9-12. Michigan YRBS, 2001, weighted data.

Category	0-1 Nutrition-Related Health Behaviors[a]						3-4 Nutrition-Related Health Behaviors[a]					
	Normal Weight			At-risk or Overweight			Normal Weight			At-risk or Overweight		
	n	%	95% CI[b]	n	%	95% CI	n	%	95% CI	n	%	95% CI
Total	309	67.4	61.0-73.8	138	30.1	23.9-36.3	1094	76.5	73.2-79.8	304	21.9	18.7-25.1
Gender :												
Male	104	59.4	48.8-70.0	70	37.2	26.8-47.6	551	70.2	65.4-75.0	219	28.6	23.9-33.3
Female	205	72.8	65.0-80.6	68	25.3	17.7-32.9	543	84.8	80.7-88.9	85	13.1	9.2-17.0
Grade:												
9	74	67.6	54.7-80.5	33	29.1	16.6-41.6	265	74.1	67.3-80.9	83	24.0	17.4-30.6
10	110	67.0	56.4-77.6	49	29.6	19.3-39.9	292	73.4	66.9-79.9	95	25.8	19.4-32.2
11	76	68.4	55.5-81.3	32	29.5	16.9-42.1	314	80.7	74.9-86.5	70	17.6	12.0-23.2
12	49	66.5	50.4-82.6	24	33.5	17.4-49.6	223	78.4	71.3-85.5	56	19.7	12.9-26.6
Race:												
White	195	68.2	60.2-76.2	84	29.2	21.4-37.0	907	76.9	73.3-80.5	246	21.5	18.0-25.0
Black	69	66.3	52.6-80.0	30	31.5	18.1-44.9	54	71.2	56.2-86.2	23	28.8	13.8-43.8
Hispanic	8	39.6	6.1-73.1	9	53.9	19.7-88.1	23	65.0	41.6-88.4	10	29.5	7.0-51.9
Other	37	69.9	51.6-88.2	15	28.7	10.6-46.8	110	77.1	66.6-87.6	25	22.0	11.7-32.3
School Sports:												
Participant	120	67.6	57.4-77.8	52	28.6	18.8-38.4	827	77.8	74.1-81.5	209	20.4	16.8-24.0
Non participant	189	67.3	59.1-75.5	86	31.1	23.1-39.1	267	72.6	65.8-79.4	95	26.3	19.6-33.0

[a] Health Behaviors: Fruit and vegetable intake, physical activity, television viewing, and no risky dieting behaviors

[b] CI= 95% Confidence Intervals

Raw percents among normal weight and at-risk or overweight add to less than 100% within 0-1 and 3-4 Nutrition-Related Health Behaviors because underweight students are not shown

Table 6b: Addendum to Table 6: showing only those students with two Nutrition-Related Health Behaviors and BMI-for-age by Demographic Characteristics among Adolescents grades 9-12. Michigan YRBS, 2001, weighted data.

	Two Health Behaviors[a]					
	Normal Weight			At-risk or Overweight		
Category	n	%	95% CI[b]	n	%	95% CI
Total	702	69.6	66.5-72.6	292	29.0	26.0-32.0
Gender :						
Male	301	64.4	59.8-69.0	164	34.0	29.4-38.6
Female	401	74.4	70.4-78.3	128	24.3	20.4-28.1
Grade:						
9	160	64.6	58.0-71.3	76	34.9	28.3-41.6
10	186	61.8	55.9-67.7	111	37.2	31.3-43.0
11	200	74.3	68.9-79.8	67	23.5	18.2-28.8
12	156	79.0	73.3-84.8	38	18.5	13.1-24.0
Race:						
White	524	72.1	68.7-75.5	193	26.4	23.0-29.7
Black	82	55.9	46.7-65.1	61	42.9	33.7-52.1
Hispanic	21	60.0	43.7-76.4	15	40.0	23.6-56.3
Other	75	74.4	64.8-83.9	23	24.8	15.3-34.3
School Sports:						
Participant	382	71.0	66.8-75.2	148	27.2	23.1-31.3
Non participant	320	68.0	63.5-72.5	144	30.9	26.5-35.4

[a] Health Behaviors: Fruit and vegetable intake, physical activity, television viewing, and no risky dieting behaviors

[b] CI= 95% Confidence Intervals

CHAPTER 5: CONCLUSIONS

5.1 Summary of Findings

My results show that the prevalence of adolescents in the state of Michigan that comply with national recommendations regarding individual healthy lifestyle behaviors is varied, and among combined multiple health behaviors is very low. Among individual nutrition-related health behaviors, 72.8% of subjects were compliant with physical activity guidelines, 69.4% were compliant with television viewing recommendations, but only 19.2% had an adequate intake of fruits and vegetables. Sports team participants were significantly more likely to be compliant with these three recommendations. In addition, males had a higher prevalence of no risky dieting behaviors than did female participants (87.9% compared to 74.7%, respectively). Among this study population, 10.9% were overweight, and 14.7% were at-risk of overweight. Of the sample, 9.4% were compliant with all four nutrition-related health behaviors (NRHB). A total of 7.7% of the population was both compliant with all four NRHB and maintaining a healthy body weight. Among females, there was an association between the number of NRHB and BMI-for-age. Female students who participated in 3-4 NRHB were more likely to be maintaining a normal weight than those with only 0-1 NRHB (84.8% compared to 72.8%, respectively). This difference was also seen for the total sample ((76.5% compared to 67.4%, respectively), but was not noted among male subjects.

5.2 Comparison of Findings to Prior Literature

When examining individual nutrition-related health behaviors, significant differences were noted in level of physical activity by gender. Males had a significantly higher prevalence rate for physical activity than did females (78.3% compared to 67.1%,

respectively), which has been noted in other research[28,93]. In 1998, using data from NHANES III, Andersen et al reported a gender difference in vigorous physical activity, with 86% of boys aged 14-16 participating ≥3 times per week, compared to only 65% of girls of the same age. Significant differences among white and black students were also observed. Among white students, 75.0% were reporting adequate physical activity, while only 59.4% of black students reported the same. This has been reported in other studies[104], however that may be affected by school environment[105]. Another trend noted in our study was the decreased prevalence of physical activity with increased grade, which was approaching statistical significance when comparing 9th and 12th graders. The prevalence rate of adequate physical activity among 9th graders was 78.7% (95% CI: 74.2-83.2), while among 12th graders it was 69.7% (95% CI: 64.0-75.4). Other studies have found a similar inverse relationship: as grade in school increases, physical activity levels decrease[104,106].

Racial differences were noted for television viewing in this study. The prevalence of white students who watched ≤2 hours per day was 74.2%, compared to a rate of 36.7% for black students. This trend has been noted in other research[25,93]. Using the national 1999 YRBS, Lowry et al reported that 57.2% of the sample watched television for ≤2 hours per day, with the prevalence among white students considerably lower than among black students (65.8% compared to 26.3%, respectively)[25]. The YRBS only asks about television; it does not address other media like computer use and video games as seen in other studies[93,107].

Differences were also noted in fruit and vegetable intake in this study. Sports participants had a significantly higher prevalence of eating ≥5 fruits and vegetables per

day than did non-participants (22.7% compared to 13.7%, respectively). A similar finding was reported by Baumert et al, who reported that 47% of adolescent athletes, defined as participants of organized sports outside of gym class in grades 9-12, ate at least one serving of fruits and vegetables daily, compared to 40% of non-athletes ($p<0.0005$)[94].

There was a significant difference noted in no risky dieting practices by gender in this sample. The prevalence of males with no risky dieting practices was significantly higher than the prevalence among females (87.9% compared to 74.7%, respectively). In a study examining weight control behaviors among adolescents who were trying to control / lose weight, researches reported a similar trend for gender[69].

Overweight among children and adolescents has increased over the past several decades[3-5]. My study population followed this trend: 10.9% were overweight, and 25.6% were either overweight or at-risk of overweight. Overweight among males in this study was 14.0% and among females was 7.6%. Nationally, reported prevalence rates in 2003-2004 of overweight males, aged 12-19, were at 18.3% and females of the same age were at 16.4%[3].

When examining the prevalence of participation in multiple nutrition-related health behaviors (NRHB), significant differences were noted by demographic characteristics. By gender, differences were noted among males and females when examining prevalence of adhering to multiple NRHB: males were more likely than females to be participating in at least 2 NRHB (87.9% compared to 81.2%, respectively) and more likely to be participating in at least 3 NRHB (55.6% compared to 44.3%, respectively). This trend was also seen among sports participants, who were more likely to be participating in at

least 2, at least 3, and all 4 NRHB than were non-sports participants. No other studies looking at the same four defined NRHB were identified for the purposes of comparison.

One study looking at multiple health behaviors in adolescents was identified, but for the purposes of comparison, the health behaviors are not all the same. In 2004, using subjects extracted from a health plan in the Midwest, Pronk et al examined four healthy behaviors among adolescents, aged 13-17 years: physical activity (defined as moderate activity ≥30 minutes ≥5 days per week or vigorous activity ≥20 minutes ≥3 times per week), no tobacco use, diet quality (using Recommended Food Score), and healthy body weight (BMI-for-age ≤85th percentile)[95]. Of Pronk's study population, 78.9% were maintaining a healthy weight[95], similar to my findings of 72.7%. A total of 31.2% of adolescents in the Pronk study were compliant with all of their defined healthy behaviors (adequate physical activity, no smoking, high diet quality, and healthy body weight)[95], in contrast to my study, where only 9.4% of subjects were compliant with all four NRHB (fruit and vegetable intake ≥5 per day, adequate physical activity, television viewing ≤2 hours per day and no risky dieting behaviors). In addition, only 7.7% of my total study population was both participating in all four NRHB and maintaining a healthy body weight (BMI-for-age ≥5th – 85th percentile).

Research looking at patterns of healthy lifestyle behaviors has been published among adult subjects. In a study using data from the BRFSS, Reeves and Rafferty identified only 3% of the population nationally was compliant with all four of their defined health behaviors [fruit and vegetable intake (≥5 per day), physical activity (30 minutes at least 5 times per week), no tobacco use, and BMI of 18.5-25][37]. Reeves and Rafferty also reported findings for the state of Michigan, with only 3% participating in the same health

behaviors[96]. Berrigan et al reported similar results when examining five health behaviors using data from NHANES III[88]. In their study, 5% of the population was compliant with their defined health behaviors [fruit and vegetable intake (≥5 per day), physical activity (≥3 times per week vigorous or ≥5 times per week moderate), no tobacco use, moderate alcohol consumption (≤1 drink per day for females or ≤2 drinks per day for males), and dietary fat intake (≤30% of total calories)].

5.3 Strengths and Limitations

A significant limitation of this study was the fact that the YRBS is self-reported data. In a study examining self-reporting for physical activity, it was noted that there are significant reporting differences when using different reporting tools[89]. One study identified also looked at the questions regarding fruit and vegetable intake on the BRFSS (similar to those on the YRBS), and found that the self-reported intake reported was similar to intake assessed using multiple diet recalls or diet records[91]. There has been considerable research looking at self-report versus measured height and weight; most studies have found that there was underreporting of both when using self-reported numbers[79,80,97-99]. Some research has suggested that this trend is more prevalent in females and among subjects that are overweight[80,98,99]. In my study, prevalence of females that were overweight / at-risk of overweight was considerably lower than the rates seen in the male subjects. These results have likely been affected by the above trends concerning self-report, especially among females.

Another significant limitation of my study was the unavailability of information regarding socioeconomic status (SES). The YRBS does not ask questions regarding household income, level of parental education, neighborhood information, or access to

food. Therefore, I was unable to examine the associations of nutrition-related health behaviors and BMI-for-age with gender, grade, or race within the framework of SES, all of which have been reported elsewhere[13,93,100-102].

A potential limitation to this study includes the significant differences in subjects who completed the survey when compared to students with missing variables. These differences were significant for both grade and race, and approaching significance for gender. Also important to note: this sample is representative only of students publicly educated in the state of Michigan, so results cannot be generalized to all adolescents in the state, as there may be significant differences among risk behaviors when comparing students educated in different settings, like private or home schools[103]. Also important to note is that the very nature of a cross-sectional study does not allow temporality to be determined.

The strengths of this study include its ability to address adherence to national health recommendations among a representative sample of publicly educated adolescents, and to compare the prevalence of overweight / at-risk of overweight among subjects who are adhering to the defined NRHB. From a public health standpoint, this information can be used to help assess current education needs, decide on appropriate strategies to target adolescents, and help identify other risk factors that are affecting the health of the population. Another strength with the YRBS is that it is collected in public schools, rather than at home, and this method of data collection has been shown to produce a higher and more accurate prevalence of risky behaviors[108].

5.4 Suggestions for Future Research

This study suggests many avenues for further research into the relationship between current health recommendations and compliance to them, and their relationship to BMI-for-age in adolescents. Further research should take into account the above limitations, like SES, family environment, and include computer use and video games in addition to television viewing. Also interesting would be further examination of the relationship of sports team participation to nutrition-related health behaviors.

From a clinical standpoint, further research needs to examine not only the relationship between nutrition-related health behaviors and overweight among children and adolescents, but must also focus on tools for use in an office setting. Clinicians would benefit from tools developed to help them identify at-risk youth, and to have guidelines for intervention to ensure standardization of care.

From a public health standpoint, further research should examine not only the relationship of these behaviors and overweight, but also the effectiveness of current health guidelines, as there are many students who are not currently compliant with many recommended health behaviors. Both state-wide governmental offices and school officials would benefit from better educational tools for children and adolescents to help increase awareness and compliance with these healthy behaviors.

From an economic standpoint, the burden of overweight and obesity among children is already measurable in healthcare dollars. In 1997-1999, an estimated $127 million dollars was spent on hospital admissions due to overweight / obesity among children[109]. As the rates of overweight / obesity among children and adolescents rise, so will the risk of long-term health issues, health care costs, and lost days of productivity at work, which will together place a large economic burden on the United States in years to come.

Research that can address these nutrition-related health behaviors, their association with overweight among adolescents, and can identify effective education tools to increase compliance will go a long way to lessening these burdens.

APPENDIX

Table 1: Defining Risky Dieting Behaviors: Fasting, diet pills, and/or vomiting to lose weight; compared to students who are either not dieting, or are eating less and/or exercising to lose weight: Michigan YRBS, 2001, weighted data

Dieting Behaviors:	Total Population			Females			Males		
	n	%	95% CI[e]	n	%	95% CI	n	%	95% CI
Risky dieting: Fasting[a]	364	12.2	11.0-13.5	249	16.7	14.7-18.7	115	8.0	6.5-9.6
Diet pills[b]	226	7.7	6.9-8.8	148	10.2	8.6-11.9	78	5.4	4.1-6.6
Vomiting[c]	173	5.9	5.0-6.8	122	8.5	7.0-10.1	51	3.5	2.4-4.5
No risky dieting: Not dieting[d]	2346	81.5	79.9-83.0	1084	74.7	72.3-77.1	1262	87.9	86.0-89.7

[a] Fasting = students who are fasting (go without eating for 24 hours or more) to lose weight

[b] Diet pills = students who are using diet pills, powders, liquids (without doctor's advice) to lose weight

[c] Vomiting = students who are vomiting or taking laxatives to lose weight

[d] Not dieting = students who are either not dieting, or are eating less and/or exercising to lose weight

[e] 95% CI - Confidence Intervals

Table 2a: Students with zero or one Nutrition Related Health Behaviors and BMI-for-age by Demographic Characteristics among Adolescents grades 9-12. Michigan YRBS, 2001, weighted data

Category	Zero Health Behaviors [a]						One Health Behavior					
	Normal Weight			At-risk or Overweight			Normal Weight			At-risk or Overweight		
	n	%	95% CI [b]	n	%	95% CI	n	%	95% CI	n	%	95% CI
Total	25	62.8	48.4-77.1	17	37.2	22.9-51.6	284	67.8	63.1-72.6	121	29.4	24.8-34.1
Gender :												
Male	6	49.7	17.0-82.4	6	50.3	17.6-83.0	98	59.9	52.1-67.6	64	36.6	28.8-44.4
Female	19	66.6	51.5-81.8	11	33.4	18.2-48.5	186	73.6	67.6-79.6	57	24.2	18.5-30.0
Grade:												
9	7	60.0	16.9-100	7	40.0	0.0-83.1	67	68.4	58.7-78.1	26	27.9	18.0-37.7
10	9	63.7	36.1-91.4	6	36.3	8.6-63.9	101	67.4	59.2-75.6	43	28.8	20.9-36.8
11	8	67.2	66.0-68.4	3	32.8	31.6-34.0	68	68.5	58.9-78.0	29	29.1	19.8-38.4
12	1	54.9	-	1	45.1	-	48	66.8	56.3-77.3	23	33.2	22.7-43.7
Race:												
White	13	65.2	50.1-80.2	7	34.8	19.8-49.9	182	68.4	62.8-74.1	77	28.8	23.3-34.3
Black	9	64.4	32.4-96.4	5	35.6	3.6-67.6	60	66.6	55.0-78.1	25	30.8	19.7-42.0
Hispanic	1	71.4	-	1	28.6	-	7	37.1	10.4-63.8	8	55.9	26.3-85.4
Other	2	29.0	-	4	71.0	-	35	75.5	64.5-86.5	11	22.8	12.4-33.2
School Sports:												
Participant	10	75.5	50.0-100	5	24.5	0.0-50.0	110	66.8	58.9-74.7	47	29.0	21.3-36.7
Non participant	15	54.4	37.6-71.2	12	45.6	28.8-62.4	174	68.5	62.5-74.5	74	29.7	23.7-35.8

[a] Healthy behaviors: Fruit and vegetable intake ≥5 servings per day; physical activity either ≥3 times per week vigorous, ≥5 times per week moderate, or ≥5 times per week vigorous + moderate; television viewing ≤2 hours per day; and no risky dieting behaviors (fasting/laxative use/diet pills/vomiting).

[b] 95% CI – Confidence Intervals

Table 2b: Students with two, three, or all four Nutrition- Related Health Behaviors and BMI-for-age by Demographic Characteristics among Adolescents grades 9-12. Michigan YRBS, 2001, weighted data

	Two Health Behaviors [a]						**Three Health Behaviors**						**Four Health Behaviors**					
	Normal Weight			At-risk or Overweight			Normal Weight			At-risk or Overweight			Normal Weight			At-risk or Overweight		
Category	n	%	95% CI [b]	n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI
Total	702	69.6	66.5-72.6	292	29.0	26.0-32.0	872	75.9	73.2-78.6	257	22.7	20.1-25.3	222	78.9	73.5-84.2	47	18.6	13.4-23.8
Gender :																		
Male	301	64.4	59.8-69.0	164	34.0	29.4-38.6	430	69.3	65.4-73.3	180	29.3	25.4-33.1	121	73.5	65.8-81.2	39	25.9	18.2-33.6
Female	401	74.4	70.4-78.3	128	24.3	20.4-28.1	442	84.4	81.2-87.7	77	14.2	11.0-17.3	101	86.7	80.6-92.8	8	8.0	3.5-12.4
Grade:																		
9	160	64.6	58.0-71.3	76	34.9	28.3-41.6	214	73.1	67.7-78.6	74	25.7	20.3-31.1	51	78.8	67.6-90.0	9	15.4	5.2-25.6
10	186	61.8	55.9-67.7	111	37.2	31.3-43.0	233	73.7	68.5-78.9	76	25.6	20.5-30.7	59	72.2	61.4-83.0	19	26.5	15.9-37.0
11	200	74.3	68.9-79.8	67	23.5	18.2-28.8	249	80.4	75.8-85.1	58	18.1	13.5-22.6	65	81.5	72.8-90.3	12	15.7	7.8-23.5
12	156	79.0	73.3-84.8	38	18.5	13.1-24.0	176	77.2	71.5-83.0	49	20.4	14.9-26.0	47	83.7	71.7-95.7	7	16.3	4.3-28.3
Race:																		
White	524	72.1	68.7-75.5	193	26.4	23.0-29.7	726	76.4	73.6-79.2	206	22.2	19.4-24.9	181	78.8	73.1-84.6	40	18.4	12.9-23.9
Black	82	55.9	46.7-65.1	61	42.9	33.7-52.1	44	70.1	57.4-82.9	20	29.9	17.1-42.6	10	76.4	54.9-97.8	3	23.6	2.2-45.1
Hispanic	21	60.0	43.7-76.4	15	40.0	23.6-56.3	20	61.9	42.1-81.7	10	32.2	12.5-51.9	3	100	100	-	-	-
Other	75	74.4	64.8-83.9	23	24.8	15.3-34.3	82	76.0	67.1-85.0	21	22.7	14.0-31.5	28	80.7	72.8-88.6	4	19.3	11.4-27.2
School Sports:																		
Participant	382	71.0	66.8-75.2	148	27.2	23.1-31.3	634	77.1	74.0-80.2	173	21.4	18.4-24.4	193	80.5	74.8-86.1	36	17.0	11.5-22.4
Non participant	320	68.0	63.5-72.5	144	30.9	26.5-35.4	238	73.0	67.8-78.2	84	26.0	20.9-31.2	29	69.0	55.1-82.9	11	28.5	15.6-41.4

[a] Healthy behaviors: Fruit and vegetable intake ≥5 servings per day; physical activity either ≥3 times per week vigorous, ≥5 times per week moderate, or ≥5 times per week vigorous + moderate; television viewing ≤2 hours per day; and no risky dieting behaviors (fasting/laxative use/diet pills/vomiting).

[b] 95% CI – Confidence Intervals

Table 3: Nutrition-Related Health Behaviors and BMI-for-age by Demographic Characteristics among Adolescent Males grades 9-12. Michigan YRBS, 2001, weighted data

Category	Zero to One Nutrition-Related Health Behaviors [a]						Three to Four Nutrition-Related Health Behaviors					
	Normal Weight			At-risk or Overweight			Normal Weight			At-risk or Overweight		
	n	%	95% CI [b]	n	%	95% CI	n	%	95% CI	n	%	95% CI
Total: Males	104	59.4	51.8-67.0	70	37.2	29.7-44.7	551	70.2	66.7-73.6	219	28.6	25.2-32.0
Grade:												
9	27	62.5	50.1-74.8	17	35.3	23.2-47.4	113	69.8	62.5-77.1	51	28.9	21.7-36.1
10	31	50.2	36.2-64.2	27	42.8	29.5-56.1	152	66.1	59.7-72.5	69	33.4	27.1-39.8
11	28	59.8	47.1-72.5	16	37.3	24.8-50.0	166	75.1	69.0-81.2	54	24.2	18.2-30.3
12	18	68.9	50.1-87.7	10	31.1	12.3-49.9	120	70.1	62.4-77.7	45	27.4	19.9-34.9
Race:												
White	69	62.5	53.3-71.6	39	34.4	25.3-43.4	464	70.2	66.6-73.9	185	28.5	24.9-32.2
Black	22	55.1	37.8-72.4	15	41.6	25.0-58.3	28	71.0	57.0-85.0	14	29.0	15.0-43.0
Hispanic	0	-	-	6	85.7	0-100.0	8	54.4	29.2-79.7	5	32.0	16.9-47.1
Other	13	56.6	39.0-74.2	10	40.5	21.8-59.2	51	69.1	56.7-81.5	15	29.1	17.1-41.0
School Sports:												
Participant	40	58.9	46.9-70.8	29	37.5	25.7-49.3	418	70.7	66.7-74.7	159	27.9	23.9-31.8
Non participant	64	59.7	50.1-69.4	41	37.1	27.5-46.7	133	68.4	61.3-75.6	60	30.8	23.7-38.0

[a] Healthy behaviors: Fruit and vegetable intake ≥5 servings per day; physical activity either ≥3 times per week vigorous, ≥5 times per week moderate, or ≥5 times per week vigorous + moderate; television viewing ≤2 hours per day; and no risky dieting behaviors (fasting/laxative use/diet pills/vomiting).

[b] 95% CI – Confidence Intervals

Table 4: Nutrition-Related Health Behaviors and BMI-for-age by Demographic Characteristics among Adolescent Females grades 9-12. Michigan YRBS, 2001, weighted data

	Zero to One Nutrition-Related Health Behaviors [a]						Three to Four Nutrition-Related Health Behaviors					
Category	Normal Weight			At-risk or Overweight			Normal Weight			At-risk or Overweight		
	n	%	95% CI [b]	n	%	95% CI	n	%	95% CI	n	%	95% CI
Total: Females	205	72.8	67.2-78.5	68	25.3	19.8-30.7	543	84.8	81.9-87.8	85	13.1	10.3-15.9
Grade:												
9	47	72.1	59.6-84.6	16	23.6	11.1-36.1	152	79.3	73.0-85.7	32	18.0	12.0-24.0
10	79	77.4	68.5-86.4	22	21.4	12.6-30.2	140	83.8	77.8-89.8	26	14.8	9.1-20.6
11	48	73.2	62.0-84.4	16	25.0	14.4-35.6	148	87.8	82.7-92.8	16	9.2	4.6-13.8
12	31	64.9	53.3-76.5	14	35.1	23.5-46.7	103	90.4	84.8-95.9	11	8.7	3.0-14.5
Race:												
White	126	72.1	65.5-78.7	45	25.7	19.3-32.1	443	85.7	82.6-88.8	61	12.0	9.1-14.9
Black	47	73.3	60.2-86.4	15	25.1	12.5-37.7	26	71.4	53.6-89.2	9	28.6	10.8-46.4
Hispanic	8	72.7	35.9-100.0	3	27.3	0.0-64.1	15	72.2	44.2-100.0	5	27.8	0.0-55.8
Other	24	83.4	71.3-95.5	5	16.6	4.5-28.7	59	85.4	76.9-93.8	10	14.6	6.2-23.1
School Sports:												
Participant	80	74.1	65.0-83.1	23	21.9	13.7-30.2	409	87.4	84.3-90.6	50	10.3	7.4-13.2
Non participant	125	72.1	64.9-79.3	45	27.2	20.1-34.4	134	77.7	71.2-84.1	35	20.7	14.3-27.1

[a] Healthy behaviors: Fruit and vegetable intake ≥5 servings per day; physical activity either ≥3 times per week vigorous, ≥5 times per week moderate, or ≥5 times per week vigorous + moderate; television viewing ≤2 hours per day; and no risky dieting behaviors (fasting/laxative use/diet pills/vomiting).

[b] 95% CI – Confidence Intervals

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