

NORTH CAROLINA LEA CASE STUDY

EXPLORING THE RELATIONSHIP BETWEEN HEALTHFUL LIVING AND GRADUATION RATES

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POLICY QUESTION: Is there a relationship between health and dropout rates that could create future policies addressing high school completion?

PROBLEM STATEMENT

Lowering the dropout rate in North Carolina schools is a major goal of the North Carolina Department of Public Instruction and the North Carolina General Assembly. The 2008-09 graduation rate shows that 69.9% of North Carolina students are completing high school within a 4 year period.ⁱ As such, the State Board of Education's initiative to target and support the persistence of students deemed at-risk for attrition seems necessary. However, determining the specific individual and community-level factors associated with high school dropout is complex and illusive.ⁱⁱ

One of the many complexities associated with student dropout is health, more specifically obesity. As research would suggest, unhealthy students are less likely to be fully engaged in the academic process.ⁱⁱⁱ Obesity is one such core health problem facing North Carolina high school students as well, with the state being ranked 14th in the nation for childhood obesity.^{iv}

Obesity has also been shown to affect student's academic functioning, particularly during the adolescent years.^v Because students who are overweight tend to lose more school days,^{vi} their ability to be academically successful is hindered by absences. Further, students who are obese may also have a greater likelihood of dropping out of school because of the social and physical demands that they face, such as cardiovascular and renal disease as well as bullying and subsequent social withdrawal.

BACKGROUND

Leaving high school before successful graduation is a common problem in the United States. The North Carolina State Board policy defines a dropout as "any student who leaves school for any reason before graduation or completion of a program of studies without transferring to another elementary or secondary school."^{vii} Based on the *2007-2008 Dropout Report* issued by the state of North Carolina some reasons students dropout are attendance, enrollment in community colleges, academic problems, pregnancy, and disciplinary problems among others.^{viii}

When students are disengaged from school they are more likely to have academic problems, lower levels of attendance, and ultimately leave high school before completion. Finn (1989) summarizes participation in high school as having two major components. First, students must be socially engaged at school which means feeling connected to the school environment and people in it. Second, students must fully appreciate the academic focus of school. Students who value their academic work will participate by completing class requirements and obtaining assistance with work as needed. These components may lead to better academic performance and school completion.^{ix}





There may also be certain health related issues that cause a student to become disengaged in school. Since the obesity epidemic affects approximately one-third of North Carolina's children, it is important to consider the repercussions of being overweight on participation in school.

Obesity is defined as an excessive amount of body fat in relation to lean body mass.^{iv} It is most commonly measured by BMI, which takes weight and height into account in a mathematical formula. The classification for obesity is different between adults and children and teenagers. According to the Center for Disease Control and Prevention, the BMI calculation takes into account age and sex in the percentiles provided for children and teens. Given the age and sex of a child, BMIs at or above the 95th percentile constitutes obese. A healthy weight ranges from the 5th percentile to less than the 85th percentile.^x

Carrying additional body fat can contribute to a decline in physical and mental health.^{xi, xii} Physical and mental health concerns may affect a student's connection to the school environment and participation in academic courses at school. This further leads to disengagement from school and potentially dropping out.

METHODOLOGY & RESULTS

The analysis in this study was conducted using the North Carolina Window of Information on Student Education (NC WISE) and North Carolina Alliance for Athletics, Health, Physical Education, Recreation and Dance (NCAAHPERD). Student-level data was matched based on unique statewide identifiers (UID) to provide a sample of 289 North Carolina 8th graders for the 2008-09 school year.

Two statistical models were used to assess the relationship between BMI and absenteeism as well as BMI and academic performance. The findings indicated that there was no statistical relationship between a student's BMI and absences. However, there was a significant inverse relationship between a student's BMI and academic performance on Algebra I End-of-Course exam.

CRITERIA

The following criteria were used to evaluate the policy options:

- 1. Minimize Costs:** Policy options should be implemented and maintained at a minimal cost.
- 2. Maximize Equity:** Policy options should consider the distribution of benefits and burdens to all stakeholders.

3. Maximize Political Acceptability, Responsiveness:

Alternatives should ensure political viability, match community values, and meet the needs of the State Board of Education, the Governor’s office, the General Assembly, the Local Education Agency, individual teachers, administrators, students and parents, and the community.

4. Maximize Administrative Ease: Policy options should assure that schools have the commitment, capacity, and support to execute and continue the alternative.

ALTERNATIVES

Based on the statistical findings and criteria rankings the following alternatives were proposed:

ALTERNATIVE 1: INCORPORATE A WELLNESS CENTER IN ALL NORTH CAROLINA MIDDLE SCHOOLS.

A wellness center is an on-site facility that provides the resources necessary for physical activity and health education. The center would use school and community resources to create a safe and fun place for children to develop healthful living skills that they can carry with them to high school and into adulthood. The center would also provide parents and other community members with the tools they need to support and help their families and other youths make better choices regarding their health. The center will reinforce the healthy living content being taught within school such as nutrition and exercise, helping adolescents develop personal responsibility for their health. Increased physical activity and health education from the center can lead students in becoming more academically and socially engaged in school.

The wellness center would be able to provide the resources and structure needed for middle school students to increase their physical activity. The optimal location for a school wellness center is either the gymnasium or another designated athletic area. There will be workshops offered for adults on the various strands of the curriculum that students are learning in school. Adults would then be able to model healthy lifestyles to their children.

A certified physical education teacher or health instructor will need to be at the wellness center during all sessions. The physical activity courses will be staffed by college students needing service or internship hours in physical education, sports and fitness, or related fields. Also, community members who have a physical

activity talent will be invited to volunteer to teach a course.

An incentive program would be organized so that students are encouraged to attend and participate in the wellness center. After reaching a designated level of involvement, students could be given prizes from various local businesses that encourage healthy lifestyles such as coupons for a healthy meal or a voucher for the skating rink. A bus will also be provided for students and parents who do not live within walking distance of the school to enable participation.

ALTERNATIVE 2: INTEGRATE THE HEALTHFUL LIVING STANDARD COURSE OF STUDY INTO THE REQUIRED NORTH CAROLINA COMPUTER/TECHNOLOGY SKILLS TEST.

The proposed alternative would incorporate the major elements set forth in the 2004 North Carolina Computer/Technology Skills and the 2006 Healthful Living Standard Course of Study. The alternative would then combine the current computer skills test with a mandated healthful living End-of-Grade exam for North Carolina eighth grade students.

The integrated testing would benefit students by increasing academic achievement in the healthful living and computer skills. Considering current computer skills test are above average, fully integrating healthful living standards may further enhance academic achievement while reducing dropouts due to health related behaviors, reduce absenteeism by students and allow for a “healthier, more active citizens, better equipped to handle personal and social environmental, safety, and medical care decisions.”^{xiii}





ALTERNATIVE 3: REVISIT THE RECOMMENDATIONS OUTLINED BY THE REPORT TO THE JOINT LEGISLATIVE EDUCATION OVERSIGHT COMMITTEE'S TASK FORCE ON PREVENTING CHILDHOOD OBESITY

The third alternative is to revisit a special report commissioned by the State Board of Education titled the "*Report from the North Carolina Task Force on Preventing Childhood Obesity*". The goal of revisiting the 22 recommendations provided by the task force is to find relevant information that may help to focus in on North Carolina's childhood obesity and dropout prevention.

Utilizing the information gained from the current paper's investigation, and to highlight each suggestion's importance to academic outcomes, this field of 22 recommendations was narrowed down to the following:

1. The N.C. General Assembly should direct and fund each Local Education Agency to establish one full-time Healthful Living Coordinator in the Central Office whose responsibility is to design, support, implement, manage, and evaluate a district wide Coordinated School Health Program which will address childhood obesity prevention and other health related issues.^{xiv}
2. The N.C. General Assembly should direct the N.C. State Board of Education to establish statewide nutrition standards for foods and beverages available in school-operated vending machines, school stores, snack bars, fundraisers, and all other food sale operations on the school campus during the instructional day.^{xv}
3. The N.C. Division of Public Health should offer technical assistance to state agency workplaces (e.g., N.C. State Health Plan, schools) for healthy workplace initiatives for promoting positive behavior change for physical activity and good nutrition among adults to improve role modeling for children. The N.C. Department of Public Instruction should assist with these efforts in schools.
4. The N.C. State Board of Education should encourage local Boards of Education to work collaboratively with local policy makers to develop a memorandum of understanding to promote joint use of all county facilities. This reciprocal agreement will focus on promoting physical activity between schools and the community during and after school hours while addressing liability issues.



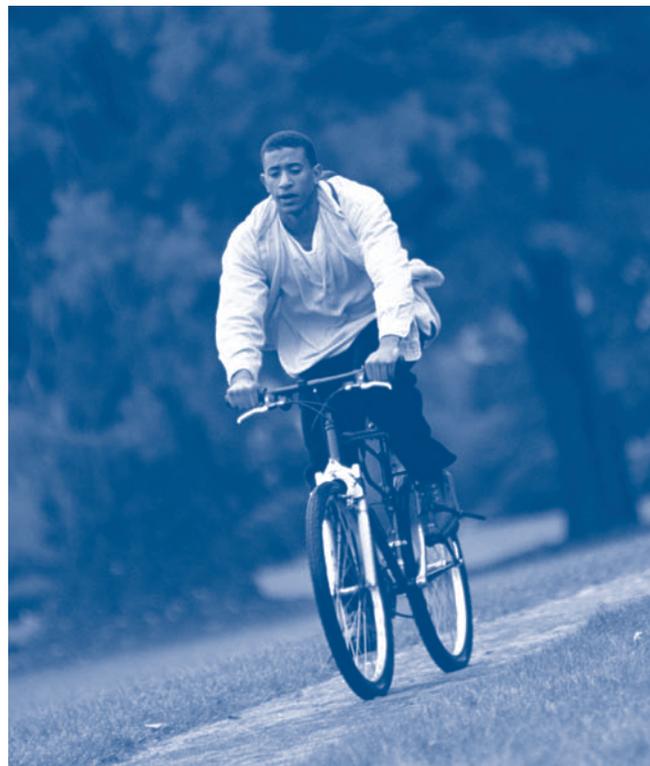
ANALYSIS

OUTCOMES MATRIX

The matrix below assesses the suggested alternatives based on the previously established criteria. Alternatives are ranked on a 1 to 5 scale with 1 meaning the alternative does not meet the specific criterion, 2 denotes the alternative meets a small portion of the specific criterion, 3 signifies the alternative somewhat meets the specific criterion, 4 represents the alternative mostly meets the specific criterion, and 5 indicates that the alternative completely meets the specific criterion. The total score indicates the ability of the alternative to address the policy problem.

POLITICAL ACCEPTABILITY AND RESPONSIVENESS

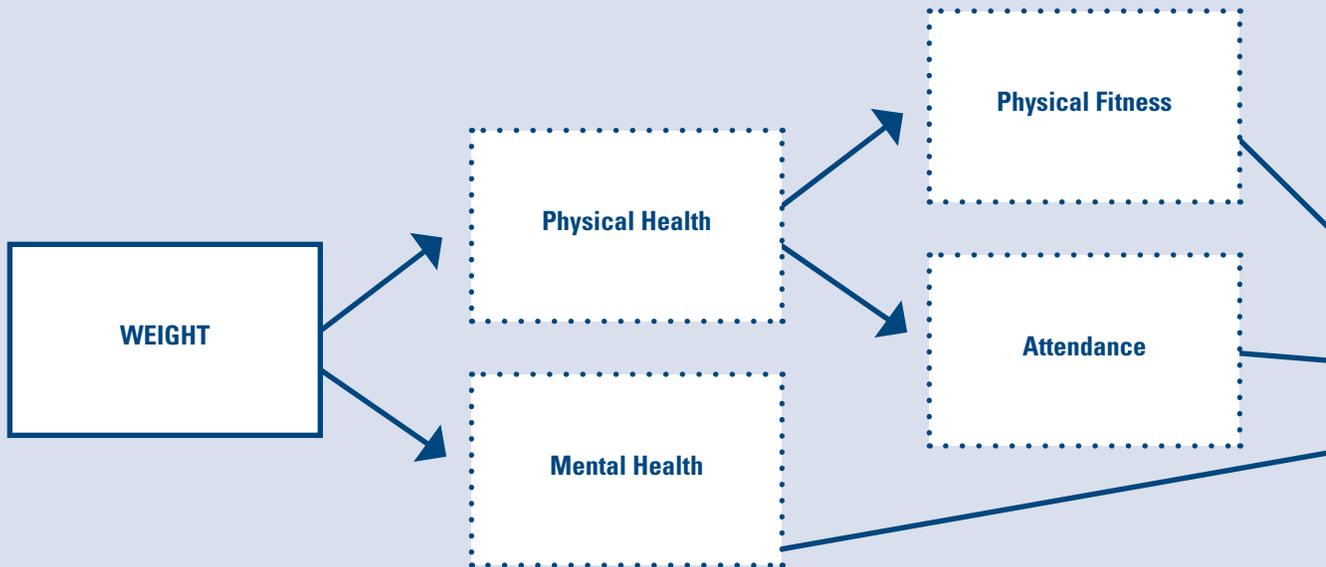
There are many stakeholders with different goals and responsibilities to consider when evaluating political feasibility and responsiveness; thus a separate evaluation was conducted for each of the individual stakeholders including the Governor, General Assembly, State Board of Education, LEA, school administrators, teachers, the community, and students and parents. Each group received a score based on their individual objectives. After rating each group, the scores were averaged in order to obtain a composite score for the political feasibility and responsiveness of each alternative.



OUTCOMES MATRIX

Alternatives	CRITERIA				Total
	Minimize Costs	Maximize Equity	Maximize Administrative Ease	Maximize Political Acceptability & Responsiveness	
Incorporate a wellness center in all North Carolina middle schools	4	4	2	4	14
Integrate Healthy Living Course of Study with the NC Tests of Computer Skills	4	4	2	3	13
Revisit the recommendations outlined by the Report to the Joint Legislative Education Oversight Committee's Task Force on Preventing Childhood Obesity	3	3	3	4	13

FIGURE 1. MODEL OF OBESITY'S IMPACT ON HIGH SCHOOL COMPLETION



RECOMMENDATION

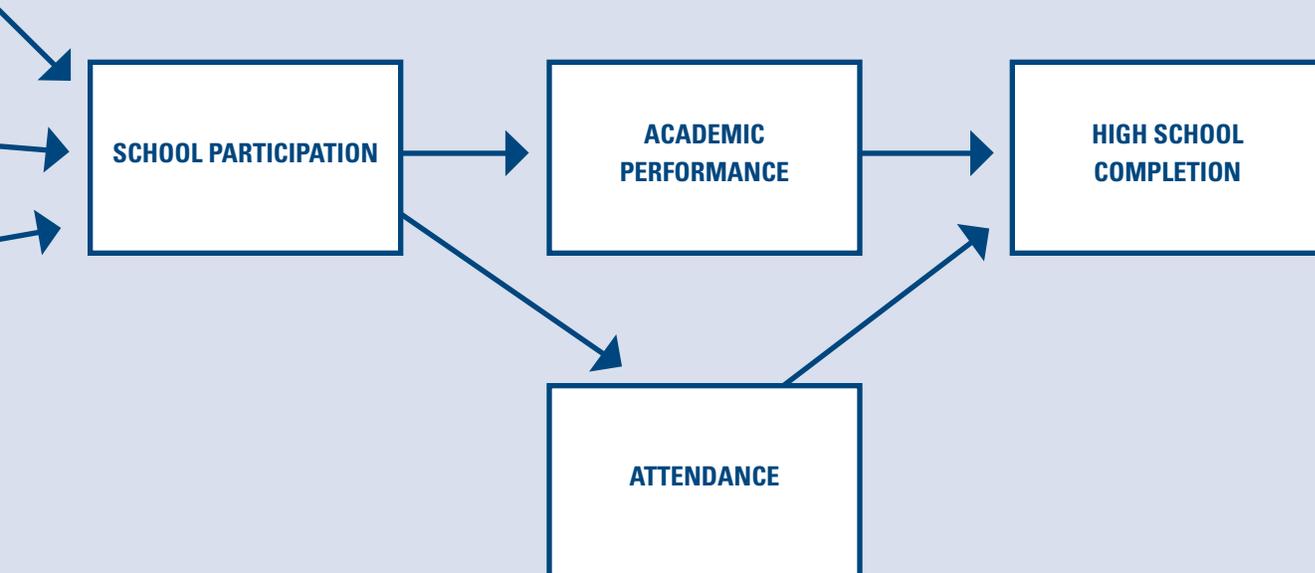
Based on the outcomes matrix, implementing school wellness centers is the best policy option. The programs and courses addressing physical activity and health education provide the most cost-effective opportunity for students to reduce their BMI as well as become more engaged in the school community.

By attending the physical fitness classes, students can work towards meeting the Center for Disease Control and Prevention's recommendation for sixty minutes of activity daily.^{xvi} Students will also see important health education objectives regarding nutrition, safety, and healthy lifestyles modeled and reinforced through the wellness classes offered to parents.

Wellness centers can also support social and academic engagement for student. When students are engaged in school, they are more likely to finish high school, taking

the classes needed to move on to the workforce or higher education.^{xvii} Participation at the wellness center can help students become more socially engaged. Students at the center will have the opportunity to build relationship with adults as well as their peers, which is critical to high school completion.^{xviii} Physical activity also helps the students' participation in school. Physical activity relieves anxiety, which is especially important for adolescents due to the high stress of transitioning from being a child to a teenager.^{xix} Physical activity has also been shown to improve cognitive functioning, which can also help students' academic performance.^{xx} Participation in programs at wellness centers can potentially help students and their communities work towards reducing obesity and high school dropout.

Additional information regarding this study can be found at <http://www.ncpublicschools.org/intern-research/reports>.



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- xiii HEALTHFUL LIVING K-12 Standard Course of Study and Grade Level Competencies (2006). Retrieved from <http://www.ncpublicschools.org/docs/curriculum/healthfulliving/scos/2006healthfullivingscos.pdf>
- xiv House Bill 1128 was filed on April 6, 2009. This Bill addresses funding a Healthful Living Coordinator for North Carolina schools; however it has currently been referred to the Committee of Appropriations for further consideration.
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The Financial and Business Services Area is in its third year of the Research Intern Program. The Program is designed to help build a quality research program within DPI to supplement and supply data for discussions related to procedural, process, and policy changes. This year's program included students from the University of North Carolina at Chapel Hill Doctorate Program in Public Policy and Education, and well as a Doctoral Candidate from North Carolina State University studying Psychology. The intern program is managed by Allison Anderson (919) 807-3731 | intern_research@dpi.state.nc.us

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Exploring the Relationship Between Healthful Living and Graduation Rates Study

APPENDIX I – LITERATURE REVIEW

Introduction

Graduation rates affect all members of a community. For every \$10,000 a high school graduate makes, a high school dropout makes only \$1,000 (Gouskova and Stafford, 2005). This has implications for families, the community and all levels of government. Looking towards the goal of societal and individual improvement, it is critical to look at what factors may influence a student's decision to leave high school before completion. Participation levels in school influence various factors within a high school career, which is evidenced in the myriad of reasons cited for dropping out. These reasons may include high rates of being held back, high absenteeism, misbehavior, poor academic performance, and switching schools (Rumberger, 1995). Their successful participation can be contributed to two levels of involvement. First, students commit academically, meaning they work towards learning new information and meeting course requirements. Second, students commit socially. This entails students feeling connected to their peers, teachers, and the overall school environment and community (Finn, 1989).

Another aspect that impacts a student's school participation is health. Since the obesity epidemic affects approximately one-third of North Carolina's children, it is important to determine the effect that it has on children and their performance in school. As early adolescents, ages 12-14, students experience significant emotional and physical changes. Handling these additional pressures can cause some students to become emotionally disengaged with school, miss days and potentially drop out of school. These stresses are further compounded if a student faces physical or chronic illness as a result of increased weight.

This literature review serves as a background for the study that will examine the relationship between BMI and academic achievement in Algebra I as well as BMI and absenteeism. The review of literature has three sections: physical and mental health challenges due to obesity, the effects of academic achievement and health and associations between attendance and weight.

Physical Conditions Related to Weight

There are many physical conditions associated with an increased body mass index (BMI) such as sleep apnea, gastrointestinal disorders, musculoskeletal problems, metabolic syndrome, asthma and type II diabetes. Two of the most prevalent conditions related to weight are type II diabetes and asthma. Type II diabetes has been previously considered an adult illness, but due to higher obesity levels in children, diabetes occurrences are increasing for this group as well (Hannon, Rao, and Arslanian, 2005). There is a lack of clarity on how obesity and asthma are related, but higher rates of asthma are associated with higher BMIs (Dalton, 2004; Daniels, 2006). In a study done on asthmatic symptoms, school-girls were more likely to develop wheezing if they were obese by the age of eleven (Castro-Rodriguez et. al, 2001). These disorders associated with obesity can reduce the general functioning of students and have implications for students' achievement and attendance. Physical concerns due to obesity can cause absences from a class or from school. Students learn more when they are in class receiving instruction. Absences can result in students learning less content which can negatively impact their academic performance (Monk and Ibrahim, 1984)

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Weight, Physical Fitness, and the Effects on Academic Achievement

Obesity is a physical health concern that has been linked to lower levels of physical fitness. In a study of elementary and middle school students there was a link between weight and physical fitness, measured by the following fitness tests: endurance run, abdominal strength, flexibility, upper body strength, and agility. The students who had BMIs above the 80th percentile passed fewer fitness tests than their lower-weight peers (Kim, Must, and Fitzmaurice, 2005). Students who are obese are less likely to be physically fit which has implications for achievement and cognition. Research has found that there is a link between physical fitness and cognition in preadolescent children and more fit children had better attention, working memory, and response speed by measuring neuroelectric activity. All of these factors work together to influence student academic performance (Hillman, Castelli, and Buck 2005). Physical activity benefits elementary and middle school students' academic performance more than high school students. There is a widespread belief among teachers that elementary students learn best through movement and active engagement, coinciding with the results. For early adolescents, middle school is a particularly stressful time, and it is believed that physical activity helps reduce stress, thereby improving students' academic performance (Sibley and Etnier, 2003). After analyzing Fitnessgram physical fitness data, which measures BMI and several makers of physical fitness such as a sit-and-reach test, and math and reading achievement test data for fourth, sixth, seventh, and eight grade students, it was determined that increased physical fitness positively increased test performance in math and reading (Chomitz et. al, 2009). Since physical fitness is a marker of obesity, this shows that students who likely have lower BMIs are achieving more in math and reading.

Many studies connect physical fitness and achievement; however there have been few that specifically address BMI or weight and achievement (Taras and Potts-Datema, 2005). Only a few of these projects studied the connection between adolescent achievement and BMI. In a study of 6th and 7th graders, Shore et al. found that overweight students' GPAs were about 11 percent lower than their non-overweight peers (2008). Similarly, Li conducted a study of the relationship between obesity and Intelligence Quotient (IQ) in 6-13 year olds demonstrating that the IQ scores of only the severely obese children were significantly lower than their peers of a normal weight (1995). Despite using two different measures, obesity seems to negatively impact achievement.

Mental Health Conditions Related to Weight

Researchers suggest that like physical conditions, mental health related factors are extremely important health issues for overweight students (Daniels, 2008; Strauss and Pollack, 2003; Gornmaker et al. 1993). For these students, mental health issues are compounded by excessive social and psychological factors such as body dissatisfaction and weight-based teasing and bullying.

The transitory period of adolescence is different for girls and boys; therefore, special attention must be given to them distinctly as it relates to weight. As cited in Barker and Galambos, "body dissatisfaction is defined as the affective component of the

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multidimensional construct of body image, that is, how individuals feel about their bodies (2003, p. 141).” How an individual perceives his/her body is especially important for adolescents given their ever changing physical features and emotions. Negative perceptions of image are detrimental to achievement due to social isolation and stigmatization of weight. Further, Barker and Galambos (2003) examined specific predictors of increased body dissatisfaction among adolescents in Canada. The risk factors examined were physical risk, contextual risk i.e. teasing about appearance and resource factors such as parent’s acceptance. They found that weight and being teased about appearance were the significant risk factors for body dissatisfaction among girls. For both boys and girls, a common risk factor for being dissatisfied with their bodies was teasing by their peers. This weight-based teasing has been shown to lead to other psychological problems and social withdrawals which can affect students’ willingness to learn (Eisenberg, Neumark-Sztainer and Story, 2003; Neumark-Sztainer, Eisenberg and Hannan, 2006; Hayden-Wade et al., 2005; Quinlan, Hoy, and Costanzo, 2009; Storch et al. 2007 and Strauss and Pollack, 2003).

Weight-Based Teasing and Bullying

As experienced by most children, teasing cuts across racial and ethnic groups, cultural lines and socioeconomic statuses and can display itself in many different forms: playful or harmful and overt or covert (Eisenberg, Neumark-Sztainer and Perry, 2003). As a form of peer victimization, teasing is psychologically harmful to an individual (Hayden-Wade et al., 2005). Victims of bullying and teasing typically report that they dislike school, lose appetite and carry a protective weapon. These consequences can affect classroom performance and academic achievement. Additionally, 15 percent of all school absenteeism is directly related to fears of being bullied at school (DeHaan, 2009). The importance of body image that Western culture places on individuals adds further pressure on adolescents who are presently experiencing weight fluctuations due to hormonal and pubertal changes. Whether ill-intended or not, weight-based teasing among adolescents can affect the emotional well-being of students. As shown in a study of 7th-12th grade students, Eiensberg, Neumark-Sztainer and Story (2003) found that being teased by peers and family members, as opposed to teasing from one group, resulted in a higher risk of experiencing emotional problems such as body dissatisfaction, low self-esteem, high depressive symptoms and thinking about and attempting. Constant weight-based teasing not only affects adolescents’ emotional health, but academic success as well. Being teased increases social isolation, which may lead to maladjusted outcomes such as dropping out of school (Parker and Asher, 1987; Strauss and Pollack, 2003).

Academic Engagement, Mental Health and Weight

Few studies directly link academic performance to mental health issues caused by weight. Poor eating habits and a sedentary lifestyle has been shown to limit attention and retention of information (Daniels, 2008). Researchers have focused on scholastic achievement and attendance among overweight and non-overweight students to reiterate the need to attend to weight issues among adolescents. A study compared students at-risk and not at-risk of being obese in terms of their socio-demographics, academic achievement and school environment to determine if overweight youths have lower

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academic achievement (Crosnoe and Muller, 2004). The authors' findings suggest that schools with a higher proportion of students dating have strong negative relationships between risk of obesity and achievement. As hypothesized, schools where dating is a social norm, overweight students body image is a "social liability". They also found a similar relationship among students with a smaller body size. Contrary to their hypothesis, overweight students performed better at schools with higher levels of athletic participation because they were more reactive to the school environment. Exploring the social experiences of overweight adolescents has given many researchers the ability to focus on the social, psychological and mental health aspects of students who are obese. Examining the association of obesity and academic achievement by gender, Falkner et al. (2001) found that weight status of both girls and boys affected their perceptions of academic achievement and attainment. Compared to average weight girls, obese girls perceived themselves as below average students, were held back a grade and were not expected to complete college. For obese boys, the authors found that similarly they perceived themselves as below average students and were more likely to quit school. The emotional and physical withdrawal associated with being overweight has shown to substantially increase the likelihood of poor attendance and later dropping out of school (Finn, 1989).

Associations between Attendance and Weight

Research has not been extensively conducted linking attendance, weight, physical and mental health. However, a recent study of fourth through sixth grade students found that overweight children were absent significantly more than normal-weight children even after controlling for socio-demographics and economic factors (Geier, 2007). Another current study of sixth and seventh grade students found that non-overweight students had 25 percent fewer absences and 39 percent fewer days tardy to school (Shore et al., 2008). In addition to complications experienced by overweight students, mental problems such as teasing, social marginalization and low self-esteem may increase absenteeism. These negative factors impact students' academic achievement.

In order to fully understand weight and attendance literature on chronic illness and attendance was reviewed. Studies have shown that students who are obese are more likely to be chronically ill, which leads to missing school and the consequences that are associated with absenteeism (Geier, 2007). In a study of asthmatic children at a Los Angeles elementary school, the students with asthma missed more days (Bonilla et al., 2005). For students with diabetes, extended absences are uncommon; however, brief absences during the school day are needed in order to manage their condition. All absences from the classroom, cause students to miss important academic content (Thies, 1999).

Conclusion

This study adds to the literature in four important ways. First, there is little information on the connection between BMI and adolescent achievement, specifically eighth graders. Second, schools can use knowledge of the relationship between BMI and absenteeism to make modifications for student learning. Overall, this study seeks to understand the

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connection between body weight and school participation which can influence a student's decision to dropout of high school.

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APPENDIX II – METHODOLOGY & RESULTS

Participants

The data for the current investigation were gathered from two different sources: The North Carolina Window of Information on Student Education (NC WISE) and the North Carolina Alliance for Athletics, Health, Physical Education, Recreation and Dance (NCAAHPERD). NC WISE acts as an electronic, internet-based student and school information accounting storehouse, based on the Electronic Student Information System (eSIS). The NCAAHPERD is an alliance of six unique athletically focused research and education entities. The primary goal of NCAAHPERD is the propagation and dissemination of quality research, advocacy, and health-related professional development. As such, the Body Mass Index data were collected and provided by NCAAHPERD.

The participants were North Carolina 2008-09 eighth grade students from seven LEAs and fifteen different middle schools that were geographically dispersed across the state. Of the 1,712 students-level data available, 301 students were able to be matched based on unique statewide identifiers. After considering missing responses, the sample consisted of 289 North Carolina 8th graders.

Design

Two separate linear multiple regression models were used in this study. The first model addressed the relationship between student achievement and obesity. The second model analyzed the relationship between absenteeism and weight. Student achievement was measured by Algebra I End-of-Course test scores. Absenteeism was measured as the number of school days missed. Both of the dependent variables were continuous and normally distributed. The key explanatory variable, obesity, was measured using body mass index as a proxy. Other explanatory variables used in this study include sex (1=male), race (Asian, Hispanic, Black, Multiracial, or White) and economically disadvantaged students which served as the proxy for socioeconomic status. Dummy variables were created for each of these variables with the referent group as the modal category.

Results

The data were analyzed using Statistical Analysis Software (SAS). Two multiple linear regressions were utilized, such that absence and End-of-Course Algebra I scores were analyzed in separate models. The aim of these linear analyses was two fold: a) to determine the predictive power of the independent variables on absences and End-of-Course Algebra I scores and b) to uncover any potential significant relationships between the dependent and independent variables. In order to determine the final model that will be used in this study, several preliminary tests were conducted to determine functional form specification, heteroskedasticity and multicollinearity.

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All variables, including the dependent variable, were tested against each other for multicollinearity through pairwise examination of the correlation of variables in the data set and by calculating the variance inflation factors (VIF). The pairwise correlation coefficients were all less than the suggested threshold of 0.8. The VIF for each variable was also less than the standard threshold of greater than 10. The results from these operations suggested that the multicollinearity was not prevalent within either model.

White Tests were performed to determine if the variance of the error term was correlated with the variables in the regression model. Because residuals are always slightly heteroskedastic in OLS models, studentized residuals were used to determine the predictions. The overall F-statistic, t-statistics and R^2 were examined to determine if heteroskedasticity was present in the model. Lagrange multiplier (LM) statistics were also computed. The results of these tests confirmed that the model of student achievement and obesity did not suffer from heteroskedasticity. However, the model of student absenteeism and obesity did show signs of heteroskedasticity; therefore, robust standard errors were used.

The data was relatively normally distributed, and there were no immediate threats to the statistical assumptions. As there were no a priori predictions regarding the order of importance of the independent variables, all variables were analyzed simultaneously. Descriptive data for the factors previously described in this study are summarized in Table 2. Respondents had an average test score of 163.71 ($SD= 7.32$). The majority of the students in this sample were white, female and were not considered disadvantaged (means = 84%, 56%, and 76% respectively).

There was an overall significance for the absence model, ($F(281) = 3.32, p = .002, R^2 = .07$). Free and Reduced Lunch was a significant predictor of absences ($\beta = 2.25$), suggesting that students who receive free and reduced lunches are more likely to miss school. Compared to White students, Asian ($\beta = -3.41$), Hispanic ($\beta = -3.34$), and Black ($\beta = -3.68$) students were statistically significantly less likely to miss class. The model for End-of-Course Algebra I test scores was also significant, ($F(281) = 5.60, p = .000, R^2 = .13$). In agreement with the hypothesis, students with a higher BMI scored lower on the Algebra I End-of-Course test ($\beta = -0.22$). Compared to students without Free and Reduced Lunch status, students with Free and Reduced Lunch scored more poorly on Algebra I End-of-Course tests ($\beta = -3.02$). Black students scored more poorly on Algebra I End-of-Course tests than did White students ($\beta = -7.54$).

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APPENDIX III – Regression Analysis

VARIABLES	MODEL (1) ABSENCE	MODEL (2) TEST SCORE
BMI	0.00986 (0.0500)	-0.223** (0.0905)
ABSENCE		-0.0219 (0.0894)
SES	2.252** (0.957)	-3.021*** (1.118)
SEX	-0.167 (0.566)	0.571 (0.836)
ASIAN	-3.416*** (1.225)	1.995 (2.893)
HISPANIC	-3.324** (1.446)	-0.231 (1.889)
BLACK	-3.689*** (0.937)	-7.545*** (1.845)
MULTIRACIAL	-2.081 (1.635)	2.832 (2.507)
CONSTANT	5.344*** (1.195)	169.3*** (2.133)
Observations	289	289
R-squared	0.070	0.138

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors were used in Model 1

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APPENDIX IV – Descriptive Statistics

Means of Dependent and Independent Variable

VARIABLES	MEAN (SD)	OBSERVATIONS
ALGEBRA I	163.71 (7.32)	300
ABSENCE	5.39 (4.69)	295
BMI	21.69 (4.62)	300
SES (1=economically disadvantaged)	0.24	294
SEX (1= male)	0.44	300
ASIAN	0.02	300
HISPANIC	0.06	300
BLACK	0.05	300
MULTIRACIAL	0.03	300
WHITE	0.84	300

Exploring the Relationship between Healthful Living and Graduation Rates Next Steps

1. Using updated data re-assess the statistical analysis found in the Healthful Living Project.
 - 8th grade Algebra I
 - High school End-of-Course tests
 - Elementary and middle school End-of-Grade tests
2. Conduct a full cost-effectiveness analysis of a model wellness center.
3. Analyze a current wellness center to assess the feasibility of implementation at all North Carolina middle schools.
4. Conduct a comparative analysis of border state practices concerning obesity.
5. Examine child nutrition programs that could be added to wellness center.
6. Further explore aspects of mental health and obesity.
7. Suggest new alternatives that address mental health issues for obese students.
8. Further explore all aspects of the conceptual model and look for additional literature to strengthen the relationship between obesity and dropout.
9. Create a wellness center model that can be piloted at a middle school.
10. Address socio- or economic demographic groups that are particularly affected by the obesity epidemic.
11. Further examine the alternatives provided in the Healthful Living study.