THE RELATIONSHIPS OF BODY WEIGHT CATEGORY ON SCHOOL-RELATED FACTORS

Suzanne A. Marsan

Bachelor of Science, Central Connecticut State University, 1987

Masters of Science, Western Connecticut State University, 2000

Certificate of Advanced Study in Administration, Sacred Heart University, 2002

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Suzanne A. Marsan, Ed.D.

Western Connectiut State University

Abstract

This study examined the relationships between Weight Category (healthy-weight and overweight/obese) of middle school students and school-related factors such as academic achievement, number of school absences, student engagement, student self-beliefs, and student interpersonal support. A sample of convenience of teachers (n = 20) and students (n = 227) was taken from a middle school in Connecticut. The teacher participants completed the RAPS-TM for each student in the study which measured teacher perception of student engagement in language arts and mathematics learning activities. The student participants completed the RAPS-SM which measured student perceptions of engagement, self-beliefs, and interpersonal support. In addition, the CMT Reading, CMT Writing, and CMT Mathematics scores and the number of school absences were recorded for each student participant.

These data were analyzed through causal comparative and correlational designs to determine if there were relationships between Weight Category and school-related factors. The results of the MANOVA indicated overweight/obese middle school students scored significantly lower on the CMT Reading test ($F = 6.780$, $p = .010$, *partial* $\eta^2 = .031$) and CMT Writing test ($F = 4.262$, $p = .040$, *partial* $\eta^2 = .020$) than healthy-weight middle school students. Overweight/obese students had significantly more absences ($F = 11.085$, $p = .001$,

partial η^2 = .049) and were significantly less engaged in Mathematics learning activities (F = 8.362, p = .004, *partial* η^2 = .038) than their healthy-weight peers. The results of the multiple linear regression indicated that Language Arts Engagement, Domain Engagement, and Weight Category were significant predictors of CMT Reading scores ($F(3,208) = 24.254$, $p < .001$); Language Arts Engagement and Square Root of the Absences were significant predictors of CMT Writing scores ($F(2,209) = 32.343$ and $p < .001$); and Mathematics Engagement and Domain Engagement scores were significant predictors of CMT Mathematics scores ($F(2,208) = 35.029$, $p < .001$).

APPROVAL PAGE

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THE RELATIONSHIPS OF BODY WEIGHT CATEGORY ON SCHOOL-RELATED FACTORS

Presented by

Suzanne A. Marsan, EdD

Deborah Hardy, EdD Primary Advisor	Signature	7/8/14 Date
Marcia Delcourt, PhD Secondary Advisor Committee Member	Signature	7/8/14 Date
Nancy Heilbronner, PhD Secondary Advisor Committee Member	Signature	7/8/14 Date
Kevin Smith, PhD Secondary Advisor Committee Member	Signature	7/8/14 Date

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CHAPTER 1: INTRODUCTION TO THE STUDY

The Center for Disease Control and Prevention (CDC) reports that over the past 30 years obesity levels have more than doubled in children aged 6-11 years and tripled in adolescents aged 12-19 years (CDC, 2013a). As of 2010, one third of U.S. children and adolescents were classified as overweight or obese (CDC, 2013a). The CDC (2013b) defines overweight and obesity through the use of Body Mass Index (BMI) where BMI is calculated by weight (lb) / [height (in)]^2 × 703. Using age- and sex-specific BMI growth charts, children and adolescents whose BMI is above the 85th percentile but at or below the 95th percentile are classified as overweight and children and adolescents whose BMI is above the 95th percentile are classified as obese (CDC, 2013b).

A series of studies using data collected from the National Health and Nutrition Examination Surveys (NHANES) has tracked the overweight and obesity levels of children and adolescents in the United States (Hedley et al., 2004; Ogden & Carroll, 2010; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010; Ogden et al., 2006; Ogden, Carroll & Flegal, 2008; and Ogden, Carroll, Kit, & Flegal, 2012). In the latest study using NHANES data, Ogden, Carroll, Kit, and Flegal (2012) calculated the overweight and obesity rates of U.S. children and adolescents. The researchers concluded that in the United States 32.6% of children and 33.6% of adolescents were either overweight or obese (Ogden et al., 2012).

The CDC cite some health issues related to childhood obesity as high blood pressure, high cholesterol, type II diabetes, sleep apnea, asthma, joint problems, gallstones, and gastro-esophageal reflux (CDC, 2013c). Furthermore, the CDC (2013c) reports that children who are overweight or obese are at greater risk for psychological and social problems such as low self-esteem than their non-overweight peers. Overweight and obese children and adolescents are often the victims of bullying and weight-based criticism (Fox & Farrow, 2008; Griffiths, Wolke, Page, & Horwood, 2005; Jansen, Craig, Boyce, & Pickett, 2004) and victimization (Janicke et al., 2007; Storch et al., 2007). In addition, BMI has been negatively associated with quality of life (Janicke et al., 2007; Swallen, Reither, Haas, & Meier, 2005) and measures of self-esteem (Eisenberg, Neumark-Sztainer, & Story, 2003; Perrin, Boone-Heinonen, File, Coyne-Beasley, & Gordon-Larsen, 2010). Research indicates that children and adolescents who are overweight and obese face health, social, and emotional concerns. This quantitative study examined the relationships between weight category (healthy-weight and overweight/obese) and school-related factors such as academic achievement, absenteeism, beliefs about self (competency, autonomy, and relatedness), student engagement, and interpersonal support.

Rationale

Research has emerged on the relationships of weight-related data (weight, perception of weight, BMI, weight category, and body mass type) with academic performance (Clark & Slate, 2009; Crosnoe & Muller, 2004; Datar & Sturm, 2006; Judge & Jahns, 2007; Li, Dai, Jackson, & Zhang, 2008; Sabia, 2007; Shore et al., 2008) and absenteeism rates (Datar & Sturm, 2006; Geier et al., 2007; Shore et al, 2008), but little or no research exists investigating the relationships of weight-related data with student engagement, beliefs about self, and interpersonal support (Ramaswamy, Mirochna, & Perlmuter, 2010). Most researchers who investigated weight-related data and academic performance found a negative relationship between the variables (Clark & Slate, 2009; Crosnoe & Muller, 2004; Datar & Sturm, 2006; Judge & Jahns, 2007; Li et al., 2008; Sabia, 2007; Shore et al., 2008). However, some researchers indicated mixed results when relating weight to academic performance (MacCann & Roberts, 2007; Sabia, 2007; Wingfield et al., 2007) or found no relationship between weight and academic performance (Huang et al., 2006; Shore et al, 2008). Several studies indicated there was a positive relationship between weight and the number of days absent from school (Datar & Sturm, 2006; Geier et al., 2007; Shore et al, 2008).

Although research has emerged relating weight to academic performance and attendance, there is little or no research on the associations between weight-related data and other school-related factors such as student engagement, beliefs about self, and interpersonal support. A single study was found associating a weight-related variable to student engagement. Ramaswamy, Mirochna, and Perlmuter (2010) concluded there was a negative association between weight and school effort. No research was found suggesting relationships between weight-related data and beliefs about self (competency, autonomy, and relatedness). However, research linking weight-related data to self-esteem does exist. Eisenberg, Neumark-Sztainer, and Story (2003) and Perrin, Boone-Heinonen, Field, Coyne-Beasley, and Gordon-Larsen (2010) concluded that BMI was negatively associated with measures of self-esteem. Wang and Veugelers (2008) concluded that BMI was negatively associated with self-esteem, whereas school performance was positively linked to self-esteem. Fox and Farrow (2009) found associations between being overweight or obese and bullying and obesity and adjustment problems such as low self-esteem and body dissatisfaction. No research was found linking weight-related data to interpersonal support from teachers or parents. However, a study conducted by Strauss and Pollack (2003) indicated that overweight adolescents were socially marginalized and researchers Swallens, Reither, Haas, and Meier (2005) concluded that overweight adolescents have decreased school and social functioning when compared to their non-overweight peers.

Research was found associating weight-related data to academic performance (Clark & Slate, 2009; Crosnoe & Muller, 2004; Datar & Sturm, 2006; Judge & Jahns, 2007; Li et al., 2008; Sabia, 2007; Shore et al., 2008) and absenteeism rates (Datar & Sturm, 2006; Geier et al., 2007; Shore et al, 2008). Limited or no research was found linking weight to other school-related factors such as student engagement, beliefs about self (competence, autonomy, and relatedness), and interpersonal support. Teachers would benefit from knowing the relationships between excess body weight and these school-related factors. This knowledge may assist teachers in creating programs or procedures which encourage the improvement of interpersonal support, competency, autonomy, and relatedness which may lead to increased student engagement. In turn, the improvement in these constructs may lead to increased learning and academic achievement.

Statement of the Problem

Skinner and Pitzer (2012) believe that individuals will constructively engage in school learning tasks when their basic needs have been met by the social contexts or activities to which they belong. The interpersonal support of parents and teachers affect the beliefs students hold about themselves (competence, autonomy, and relatedness) which in turn affect student engagement, and ultimately student learning and achievement (Skinner & Pitzer, 2012). With the current percentages of overweight and obese children and adolescents in the United States, the issue is there is not enough information on the relationships between increased weight and factors that affect student learning and achievement such as interpersonal support, beliefs about self, and engagement in school.

The purpose of this study was to examine the relationships between weight category (healthy-weight and overweight/obese) and academic achievement, attendance, teacher perception of student engagement, student perception of student engagement, beliefs about self (competency, autonomy, and relatedness), and interpersonal support (teacher and parental). This study was implemented to add to previously conducted research associating weight-related data to academic performance and absenteeism and to examine the effects of increased weight on student engagement, beliefs about self, and interpersonal support.

Potential Benefits of the Research

It is important for educators to know the relationships between being overweight or obese and academic achievement, absenteeism rates, student engagement, beliefs about self, and interpersonal support. Knowing what relationships exist, if any, between increased weight and these school-related factors may help educators provide support to those students who are overweight or obese. For instance, educators may be able to provide interpersonal and psychological support, develop methods to motivate overweight students, and provide programs for achieving and maintaining healthy weight for those students who are overweight or obese. Students who maintain a healthy weight may have higher engagement levels, hold self-beliefs that encourage academic growth, and have healthy and constructive interpersonal relationships with their parents, teachers, and peers. In turn, these healthy school-related factors may lead to increased engagement and academic achievement.

Definition of Terms

The following are definitions related to this research:

1. *Beliefs about self* include student perceptions of competence, autonomous self-regulation, and ability to relate to significant others (RAPS, 1998). Competence refers to student perceptions of effectively interacting within the school environment (RAPS, 1998). Students who are autonomous have the desire to be

in control of their own behavior and to self-regulate their level of engagement in the educational environment (RAPS, 1998). Relatedness refers to the psychological need to be respected by, connected to, and cared for by others (RAPS, 1998).

2. *Body Mass Index* is a number calculated from an individual's height and weight and is used to indicate the level of fat on a person's body. The formula used to calculate individual BMI levels is weight (lb) / [height (in)]^2 × 703 (CDC, 2013b).
3. *Body Mass Type*, according to the CDC (2013b), is a category determined by placing individuals into one of four groups based on their age, gender, and BMI percentile: underweight (BMI percentile ≤ 5th), healthy weight (5th < BMI percentile ≤ 85th), overweight (85th < BMI percentile ≤ 95th), and obese (BMI percentile > 95th).
4. The *Connecticut Mastery Test* is administered to students in grades three through eight in the areas of reading, writing, and mathematics. Science is administered in grades five and eight. Scores range from one to five, where one indicates "below basic," two indicates "basic," three indicates "proficient," four indicates "goal," and five indicates "advanced" (Connecticut State Department of Education, 2012).
5. *Interpersonal support* encompasses the relationships formed by the individual with his or her peers, teachers, and parents (RAPS, 1998). The quality of these relationships is measured by time spent with the individual, interest in the

individual, and the sense that these relationships are accepting and affectionate (RAPS, 1998).

6. *Student engagement* is reflected in the level of involvement students have with daily classroom activities and students' reaction to challenges in an educational setting (RAPS, 1998). Students who do not participate in classroom activities have negative emotional reactions towards engagement associated with feelings of boredom, discouragement, and anger (RAPS, 1998). Those students who participate regularly in classroom activities have positive emotional reactions to educational tasks such as feelings of enthusiasm, optimism, and interest (RAPS, 1998). Student behavioral engagement includes the amount of time spent on work, the level of concentration and effort, the ability to stay on task, the difficulty level of tasks selected, and the likelihood to take action when given the opportunity (RAPS, 1998).

Chapter Summary

Overweight and obesity levels have increased over the past 30 years in U.S. children and adolescents (CDC, 2013a). Research conducted has indicated negative relationships between increased weight with health, social, and emotional constructs. Research has emerged that focused on the relationships between weight-related data and school-related factors. Although results were mixed, the majority of the studies investigating weight and academic performance indicated there was a negative relationship between weight and academic performance. Several studies indicated there was a positive relationship between weight and the number of school absences. A single study was found negatively relating weight to student effort. There was no apparent research associating weight-related data to beliefs about self (competency, autonomy, and relatedness) or to interpersonal support (parental and teacher) and it is this gap that the current research hoped to fill. It is important to know the relationships between being overweight or obese and school-related factors so that educators may be able to create and provide interpersonal and psychological support for those students who are overweight or obese.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

To create a context for this study, the review of the literature is organized into the following sections: the emergence of growth charts, childhood overweight and obesity trends, self-determination theory, motivational dynamics model, health and social-emotional concerns for overweight and obese children, and weight-related data for the concepts academic achievement, absenteeism, student engagement, interpersonal support, and beliefs about self.

The Emergence of Growth Charts

Growth charts have been used by doctors to measure healthy growth in infants, children, and adolescents (Kuczmarski et al., 2002). The emergence of the first growth charts in the 1940's lacked balance in ethnic, socioeconomic, and geographical representations (Kuczmarski et al., 2002). In 1971 the American Academy of Pediatrics and Maternal and Child Health Program of the Bureau of Community Health Services, U.S. Public Health Services, recommended that a new series of growth charts be created based on the National Center for Health Statistics (NCHS) Health Examination Surveys (Kuczmarski et al., 2002). These sentiments were repeated in 1974 by the Food and Nutrition Board of the National Academy of Sciences and in 1975 by a study group sponsored by the National Institute of Child Health and Human Development, National Institutes of Health (Kuczmarski et al., 2002). The results of these recommendations were the creation of the 1977 NCHS growth charts that were used until 2000 (Kuczmarski et al., 2002).

As more data became available on the heights and weights of the nation's children, the 1977 NCHS growth charts were revised in 2000 and these revised growth charts are used today to measure healthy weight for stature of American children (Kuczmarski et al., 2002). Data from five national surveys were used to create the 2000 CDC growth charts: National

Health Examination Survey (NHES) II (1963-1965), NHES III (1966-1970), National Health and Nutrition Examination Surveys (NHANES) I (1971-1974), NHANES II (1976-1980), and NHANES III (1988-1994) (Kuczmarski et al., 2002). The 2000 CDC growth charts were created from nationally representative samples and were constructed for use with specific age groups: infants, birth through 36 months, and children and adolescents 2 through 20 years (Kuczmarski et al., 2002). The charts for children and adolescents include the 3^{rd}, 5^{th}, 10^{th}, 25^{th}, 75^{th}, 85^{th}, 90^{th}, 95^{th}, and 97^{th} percentiles weight-for-stature, stature-for-age, and BMI-for-age growth charts (Kuczmarski et al., 2002).

These percentiles were used to construct four weight categories based on BMI percentiles for children and adolescents (CDC, 2013b). The current terminology used by the CDC (2013b) to describe the weight categories is underweight (BMI $\leq 5^{th}$ percentile), healthy weight (5^{th} < BMI percentile $\leq 85^{th}$), overweight (85^{th} < BMI percentile $\leq 95^{th}$), and obese (BMI percentile > 95^{th}). A change in terminology occurred in 2010 by Ogden, Carroll, Curtin, Lamb, and Flegal to allow for consistency between different organizations. The current terminology was used throughout this research to encourage ease in reading.

The CDC BMI-for-age growth charts have been recommended for use with children, adolescents, and adults to measure weight adjusted for height using the formula weight (kg) / [height (m)]^2 (Kuczmarski et al., 2002). The tracking of BMI curves indicate that BMI increases from birth to eight months old and then decreases from eight months old to six years old (Kuczmarski et al., 2002). At approximately six years old, BMI reaches a relative low point before beginning to increase again, or when adiposity rebound occurs (Kuczmarski et al., 2002). The younger a child is when the minimum BMI is achieved the more likely the level of adiposity will be high in adolescence and early adulthood (Kuczmarski et al., 2002).

Tracking indicates that by the age of eight years most children are in the percentile range they will follow until their growth ends. The CDC BMI-for-age growth charts are recommended for clinical use by doctors and for the purpose of conducting research (Kuczmarski et al., 2002).

Childhood Overweight and Obesity Trends

Hedley, Ogden, and Carroll along with their colleagues, have conducted numerous studies examining the weight trends of children, adolescents, and adults over the past two decades (Hedley et al., 2004; Ogden & Carroll, 2010; Ogden et al., 2010; Ogden, Carroll & Flegal, 2008; Ogden et al., 2012; Ogden et al., 2006). In each of these studies, the data collected through NHANES were used to calculate BMIs based on the measured heights and weights of the participants. The data were used to establish percentages of children and adolescents who were overweight and obese in the United States. These data were systematically compared to data collected from the preceding two-year collection period to determine if there were differences between the two collection periods and were combined with all previous collection periods to determine if significant trends existed.

Hedley et al. (2004) used a sample of 4,018 children from the 2001-2002 NHANES data to determine the prevalence of children aged 2-20 years who were labeled overweight or obese (BMI for age $\geq 85^{th}$ percentile) and obese (BMI $\geq 95^{th}$ percentile). Examining the 2001-2002 data, the researchers concluded there were no significant changes in the prevalence of children who were overweight or obese when compared to the 1999-2000 sample (Hedley et al, 2004). After combining the data from 1999-2002, Hedley et al. (2004) concluded that 31.0% of children aged 6 through 19 years were either overweight or obese and 16% were obese.

The researchers calculated the percentages for children who had a BMI ≥ 85^{th} based on age and gender. For male children Hedley et al. (2004) concluded that 32.5% aged 6-11 years, 31.2% aged 12-19 years, and 31.8% aged 6-19 were either overweight or obese. For female children they concluded that 29.9% aged 6-11 years, 30.5% aged 12-19 years, and 30.3% aged 6-19 were either overweight or obese (Hedley et al., 2004). Percentages for obese male children were 16.9% aged 6-11 years, 16.7% aged 12-19, and 16.8% aged 6-19 years while percentages for obese female children were 14.7% aged 6-11 years, 15.4% aged 12-19, and 15.1% aged 6-19 (Hedley et al., 2004). The researchers used NHANES data from the previous two decades to conclude that overweight and obesity levels in children and adolescents had increased (Hedley et al., 2004).

Ogden et al. (2006) examined data from the NHANES collected over a six-year period, 1999-2004. Logistic regressions over 1999-2000, 2001-2002, and 2003-2004 indicated significant increases in obesity rates of children and adolescents (Ogden et al., 2006). In particular, combined overweight or obesity rates in children aged 6-11 years increased from 29.8% in 1999-2000, to 32.2% in 2001-2002, to 37.2% in 2003-2004 while combined overweight or obesity rates in adolescents aged 12-19 years old increased from 30.0%, to 31.1%, to 34.3% (Ogden et al., 2006). Over the same time period, obese children aged 6-11 years increased from 15.1% to 16.3%, to 18.8% and obese adolescents aged 12-19 years increased from 14.8%, to 16.7%, to 17.4% (Ogden et al., 2006). In general, Ogden et al. (2006) concluded that the prevalence of obesity in the United States remained high and that the prevalence of overweight children and adolescents continued to increase.

A study estimating the three high level BMIs for age (85^{th}, 95^{th}, and 97^{th}) among children and adolescents was conducted by Ogden, Carroll, and Flegal (2008) using data collected from 2003-2004 and 2005-2006 NHANES. The high BMI levels were based on the 2000 CDC BMI-for-age growth charts. Logistic regressions were used to model trends over 1999-2000, 2001-2002, 2003-2004, and 2005-2006 and showed no significant trend over the four time periods (Ogden et al., 2008). Significance was found for each of the three cutoff percentiles where high BMI-for-age was significantly different for age group and racial/ethnic group but not for gender (Ogen et al., 2008). In addition, the data were used to create estimates for population percentages of children and adolescents at or above the three cutoff points. Ogden et al. (2008) estimated 11.3% of children and adolescents were at or above the 97^{th} percentile, 16.3% were at or above the 95^{th} percentile, and 31.9% were at or above the 85^{th} percentile. In general, the increase in the percentage of children with high BMI for age that was previously observed in the NHANES III (1988-1994) and NHANES 2003-2004, was not observed between 2003-2004 and 2005-2006. The researchers concluded data from 2007-2008 would be needed to determine if the trend would continue (Ogden et al., 2008).

Ogden et al., (2010) used data gathered from the NHANES 2007-2008 to provide estimates of high BMI for children and adolescents and to determine trends in high BMI for the same groups from 1999 to 2008. Ogden et al. (2010) estimated the prevalence of BMI greater than or equal to the 97^{th} percentile for all children aged 6-11years was 14.5%, male children was 16.3%, and female children was 12.6%. For adolescents aged 12-19 years the respective statistics were 12.5%, 14.3%, and 10.4%. The estimated percentages of children aged 6-11 years with BMI greater than or equal to the 95^{th} percentile was 19.6% for both sexes, 21.2% for male children, and 18.0% for female children. For adolescents aged 12-19 years the respective statistics were 18.1%, 19.3%, and 16.8% (Ogden et al., 2010). Finally, the percentage estimates for children with BMIs greater than or equal to the 85th percentile were calculated to be 35.5% for both sexes, 35.9% for male children, and 35.2% for female children aged 6-11 years. For adolescents aged 12-19 years the respective statistics were 34.2%, 35.0%, and 33.3% (Ogden et al., 2010).

Ogden et al., (2010) concluded there were no significant differences between the sexes at the three high BMI cutoff points. The researchers did find significant differences between children and adolescent age groups and race/ethnic groups and high BMI. Furthermore, Ogden et al., (2010) did not find any statistical differences in the prevalence of high BMI cutoff points between children aged 6-11 years and adolescents aged 12-18 years. A statistical linear trend was found for 6-19 year old male children and adolescents who were at or above the 97th percentile for BMI (Ogden et al., 2010). In general, the researchers concluded that the prevalence of high BMI for children and adolescents had remained steady for the last decade and that the heaviest of the male children and adolescents had gotten heavier (Ogden et al., 2010).

In a follow-up study, Ogden and Carroll (2010) used the same NHANES 2007-2008 data and compared it to data gathered from 1976-1980 in the NHANES II for children and adolescents in the 95th percentile. The researchers found that obesity significantly increased in all age groups from 5.0% to 10.4% in children aged 2-5, 6.5% to 19.6% in children aged 6-11, and 5.0% to 18.1% in children aged 12-19 years (Ogden & Carroll 2010).

The latest report available in this series of studies continued to update the estimates of obesity percentages and to investigate obesity trends in U.S. children and adolescents. Ogden et al. (2012) estimated that in the time period 2009-2010, 16.9% of children and adolescents aged 2-19 years were obese, 31.8% were either overweight or obese, and 12.3%

were above the 97th percentile for BMI for age. The researchers found that male children and adolescents aged 2-19 years had a significantly higher prevalence of obesity than female children and adolescents of the same age range (Ogden, Carroll, Kit, & Flegal, 2012).

The prevalence of high BMIs by gender and age group were also calculated. Combining prevalence for both sexes in the 6-11 year range, 32.6% were at or above the 85th percentile, 18.0% were at or above the 95th percentile, and 13.0% were at or above the 97th percentile (Ogden et al., 2012). Respective percentages for the 12-19 year range were 33.6%, 18.4% and 13.0%. The prevalence of high BMI for age of male children in the 6-11 year range were 33.1% at or above the 85th percentile, 20.1% at or above the 95th percentile, and 14.6% at or above the 97th percentile. Respective percentages for the male adolescent 12-19 year range were 34.6%, 19.6%, and 14.7% (Ogden et al., 2012). The prevalence of high BMI for age for female children in the 6-11 year range were 32.1% at or above the 85th percentile, 15.7% at or above the 95th percentile, and 11.3% at or above the 97th percentile (Ogden et al., 2012). Respective percentages for the female adolescent 12-19 year range were 32.6%, 17.1%, and 11.2% (Ogden et al., 2012).

While examining the obesity trends over the last 12-year period, Ogden et al. (2012) concluded there was a significant trend in the prevalence of obesity in male children and adolescents aged 2-19 years between 1999-2000 and 2009-2010, however, no trend was detected in female children of the same age range. A significant increase was detected in BMI among male adolescents aged 12-19 years. In general, Ogden et al. (2012) concluded that the rapid increase in the prevalence of obesity in children and adolescents witnessed in the 1980s and 1990s did not continue in this decade and may be leveling off.

A team from the CDC viewed the data over a 30-year period and simplified the findings as reported through the investigations of the NHANES data. The CDC (2013d) reports that childhood obesity has more than doubled in children and tripled in adolescents in the past 30 years. The prevalence of children aged 6-11 years who were obese increased from 7% in 1980 to approximately 18% in 2010 (CDC, 2013d). In addition, the prevalence of obesity in adolescents aged 12-19 years increased from 5% to 18% over the same time period (CDC, 2013d). Finally, the CDC (2013d) reported that more than one third of U.S. children and adolescents were either overweight or obese in 2010.

The purpose of these studies was to track the overweight and obesity rates of infants, children, adolescents, and adults. The data collected from the NHANES surveys were used to determine if there were differences in weight categories between the age groups and between the sexes. The data were also analyzed to determine if there were significant trends over time. The researchers did not examine factors that might be related to or contribute to overweight and obesity rates in U.S. individuals. Table 1 contains data from the NHES and NHANES surveys which show the changes in obesity from 1963 – 1965 through 2009 – 2010.

Table 1

Prevalence of Obesity Among Children and Adolescents Aged 2 – 19 Years: United States, 1963 – 1965 Through 2009 – 2010

Age (years)[a]	NHES 1963 1965 1966 1970[b]	NHANES I 1971 – 1974	NHANES II 1976 – 1980	NHANES III 1976 – 1980	NHANES 1999 – 2000	NHANES 2001 – 2002	NHANES 2003 – 2004	NHANES 2005 – 2006	NHANES 2007 – 2008	NHANES 2009 – 2010
Boys and Girls										
2 - 19	[c]	5.1	5.5	10.0	13.9	15.4	17.1	15.4	16.8	16.9
2 – 5	[c]	4.8	5.0	7.2	10.3	10.6	13.9	10.7	10.1	12.1
6 - 11	4.2	4.0	6.5	11.3	15.1	16.2	18.8	15.1	19.6	18.0
12 - 19	4.6	6.1	5.0	10.5	14.8	16.7	17.4	17.8	18.1	18.4
Boys										
All	[c]	5.2	5.4	10.2	14.0	16.4	18.2	15.9	17.7	18.6
2 – 5	[c]	4.9	4.6	6.2	9.5	10.7	15.1	10.4	9.3	14.4
6 - 11	4.0	4.3	6.7	11.6	15.8	17.5	19.9	16.2	21.2	20.1
12 - 19	4.5	6.0	4.8	11.3	14.8	17.6	18.2	18.2	19.3	19.6
Girls										
All	[c]	5.0	5.7	9.8	13.8	14.3	16.0	14.9	15.9	15.0
2 – 5	[c]	4.8	5.4	8.2	11.2	10.5	12.7	11.0	10.9	9.6
6 - 11	4.5	3.6	6.4	11.0	14.3	14.8	17.6	14.1	18.0	15.7
12 - 19	4.7	6.2	5.3	9.7	14.8	15.7	16.4	17.3	16.8	17.1

Note. Data from 1963 – 1970 were collected from NHES surveys and data from 1971 – 2008 were collected from NHANES surveys. Obesity is defined as BMI greater than or equal to the 95th percentile form the 2000 CDC growth Charts. Adapted from "Prevalence of Obesity among Children and Adolescents: United States, Trends 1963-1965 through 2007-2008," by C. Ogden and M. Carroll, 2010. Copyright 2010 by Centers for Disease Control and Prevention.

[a]Excludes pregnant females starting with 1971-1974. Pregnancy information not available for 1963 - 1965 and 1966 - 1970. [b]Data for 1963-1965 are for children aged 6 – 11 and data for 1966 –1970 are for adolescents aged 12 – 17, not 12 – 19 years. [c]Children aged 2 – 5 were not included in the data collection process of the 1960s.

Regional Obesity Rates for Adults

The CDC (2013d) stored data collected on the obesity rates of adults from 1985 to 2012 on its website. In 2012, Colorado had the lowest adult obesity rate of 20.5% and Louisiana recorded the highest adult obesity rate of 34.7% (CDC, 2013d). Nine states and the District of Columbia had an adult obesity rate of greater than or equal to 20% but less than 25%; 27 states had an adult obesity rate greater than or equal to 25% but less than 30%; and 14 states had an obesity rate greater than or equal to 30% but less than 35% (CDC, 2013d). Connecticut's adult obesity rate has steadily increased from 1985 to 2012. In 1985, 1988, and 1989 (no data were available for 1986 and 1987) the adult obesity rate in Connecticut was less than 10% (CDC, 2013d). The obesity rate rose to greater than or equal to 10% but less than 15% during the time period 1990 to 1999. During the 2000 to 2006 span, the adult obesity rate was greater than or equal to 15% but less than 20%. From 2007 to 2010 the obesity rate increased again to greater than or equal to 20% but less than 25%. Finally, during 2012 the adult obesity rate rose to greater than or equal to 25% but less than 30% (CDC, 2013d).

The CDC's Behavioral Risk Factor Surveillance System (BRFSS) and data from the U.S. Census Bureau's Population Estimates Program were used to estimate the prevalence of diabetes and selected risk factors for diabetes by county (CDC, 2013d). The BRFSS is a monthly, state based telephone survey of the adult population (CDC, 2013d). Obesity was one of the risk factors tracked through BRFSS. BMI was calculated from the respondents self-reports of their heights and weights and individuals were considered obese if their BMI was 30 or greater (CDC, 2013d). Data from consecutive years were used to improve the estimates of year-specific, county-level estimates of diagnosed diabetes and selected risk factors. For example, the years 2003, 2004, and 2005 were used to estimate the 2004 rates (CDC, 2013d). The data collected for Fairfield County indicated the adult obesity rates during the years 2004 to 2010 were 17.6%, 18.5%, 20.4%, 21.1%, 20.3%, 20.2%, and 21.9%, respectively (CDC, 2013d). The obesity rates of children and adolescents by state were not provided.

Self-Determination Theory

Self-determination theory explains human motivation and personality in social environments and specifically differentiates motivation in terms of autonomy and controllability (Deci & Ryan, 2008). The underpinnings of self-determination theory assume that humans are innately active, intrinsically motivated, and geared to develop naturally through integration with their environment and human interaction (Deci & Ryan, 2008). These qualities are inherent in all individuals, develop over time, play an integral role in learning, and are affected by social environments (Deci & Ryan, 2008). Basic psychological needs must be met in order for these inherent qualities to grow within the individual. These basic psychological needs are competence, autonomy, and relatedness (Deci & Ryan, 2008).

Whether or not these fundamental needs (competence, autonomy, and relatedness) are met, help to determine the classification of the environment as supportive or antagonistic (Deci & Ryan, 2002). Social environments that satisfy these basic needs are predicted to support healthy functioning and those that do not are predicted to be antagonistic to healthy functioning (Deci & Ryan, 2002). Therefore, the concept of satisfying basic needs is critical to predicting the conditions that promote or hinder optimal personality development (Deci & Ryan, 2002). When given the opportunity, individuals will seek out situations that support the development of competence, autonomy, and relatedness (Deci & Ryan, 2002).

Competence refers to feeling effective with social interactions while being able to exercise and express one's true capacities (Deci & Ryan, 2002). The need for competence encourages individuals to seek out challenges that are right for their capabilities, persist in mastering those challenges, and enhance their capabilities through action (Deci & Ryan, 2002). Competence is an individual sense of confidence (Deci & Ryan, 2002).

Relatedness refers to feeling connected to other individuals, to care for them, and to be cared for by them (Deci & Ryan, 2002). Individuals who possess these connections have a sense of belongingness to others and to the community. A sense of relatedness includes the need to be connected to and accepted by others in a secure and safe community (Deci & Ryan, 2002).

Autonomy refers to the individual's perception that they are in control of their own behavior (Deci & Ryan, 2002). Autonomous individuals act from interest and integrated values. When individuals experience their behaviors as a reflection of their true self, whether those actions are influenced by outside sources or not, they are more likely to initiate and value the task at hand (Deci & Ryan, 2002). While self-determination theory can be applied to multiple settings, Skinner and Pitzer's dynamics of motivational development is applied specifically to the educational environment.

Dynamics of Motivational Development

Skinner and Pitzer's (2012) dynamics of motivational development is grounded in self-determination theory and is structured around student engagement and disaffection with learning activities. In particular, this model is appropriate for a classroom setting where students' engagement with academic tasks is of importance (Skinner & Pitzer, 2012). Engagement, in this context, refers to the constructive, enthusiastic, emotionally positive, and cognitively focused participation with learning activities (Skinner & Pitzer, 2012). Engagement with academic tasks is important because (a) it is a necessary condition for students to learn, (b) it shapes the social and psychological experiences of school, and (c) it is critical to students' academic performance (Skinner & Pitzer, 2012).

There are three dimensions to engagement: behavioral, emotional, and cognitive (Skinner & Pitzer, 2012). The behavioral component of engagement includes effort, intensity, persistence, determination, and perseverance in the face of obstacles and difficulties (Skinner & Pitzer, 2012). Emotional engagement includes enthusiasm, enjoyment, fun, and satisfaction (Skinner & Pitzer, 2012). Finally, cognitive engagement refers to attention, concentration, focus, "heads-on" participation, and a willingness to go beyond what is required (Skinner & Pitzer, 2012). Skinner and Pitzer's (2012) dynamics of motivational model also includes the opposite of engagement or disaffection.

Disaffection refers to the ways in which students withdraw from learning activities including physical withdrawal of effort, lack of exertion, passivity, and exhaustion (Skinner & Pitzer, 2012). Students may also withdrawal mentally through lack of concentration, apathy, inattention or lack of motivation (Skinner & Pitzer, 2012). The emotional reactions of disaffection are important because the behavior elicited differs depending on whether removal from the learning activity is due to boredom, anxiety, shame, sadness, or frustration (Skinner & Pitzer, 2012).

Skinner and Pitzer (2012) believe that humans come with basic needs and when these needs are met by social contexts or activities, individuals will constructively engage with them. These fundamental psychological needs are relatedness, competence, and autonomy (Skinner & Pitzer, 2012). Similar to the work of Deci and Ryan (2002), relatedness refers to the need for individuals to be connected to other people or to have a sense of belonging. Competence refers to the need of individuals to have effective interactions with the social and physical environments (Skinner & Pitzer, 2012). Autonomy refers to the need for individuals to express and experience their authentic self as part of the social and physical environments (Skinner & Pitzer, 2012). School experiences can encourage or undermine student engagement. When students feel related to school, believe they are competent, and have autonomy in the classroom they are more likely to be engaged (Skinner & Pitzer, 2012). The beliefs students hold about themselves are built by their experiences in the classroom forming self-system processes (Skinner & Pitzer, 2012).

Students enter the classroom with the need for relatedness, competence, and autonomy and act on the motivations provided by these needs (Skinner & Pitzer, 2012). Skinner and Pitzer's (2012) Dynamic Model of Motivational Development emphasizes the importance of the supportive interactions of teachers, peers, and parents to engagement and learning. Teachers provide pedagogical caring which supports relatedness, optimal structure to facilitate competence, and autonomy support to promote self-determination motivation (Skinner & Pitzer, 2012). Positive peer interactions can improve academic development and influence motivation and behavior. Parents have the ability to shape classroom engagement, intrinsic motivation, preference for challenge, commitment to school, and an enthusiasm and enjoyment of school work (Skinner & Pitzer, 2012). The type of learning activities undertaken in the classroom also affects engagement (Skinner & Pitzer, 2012). Active participation, engagement, and effort are encouraged by tasks that students find intrinsically motivating, interesting and fun such as hands-on, heads-on, project-based, and relevant

(Skinner & Pitzer, 2012). Skinner and Pitzer's (2012) Dynamic Model of Motivational Development is depicted graphically in *Figure 1*.

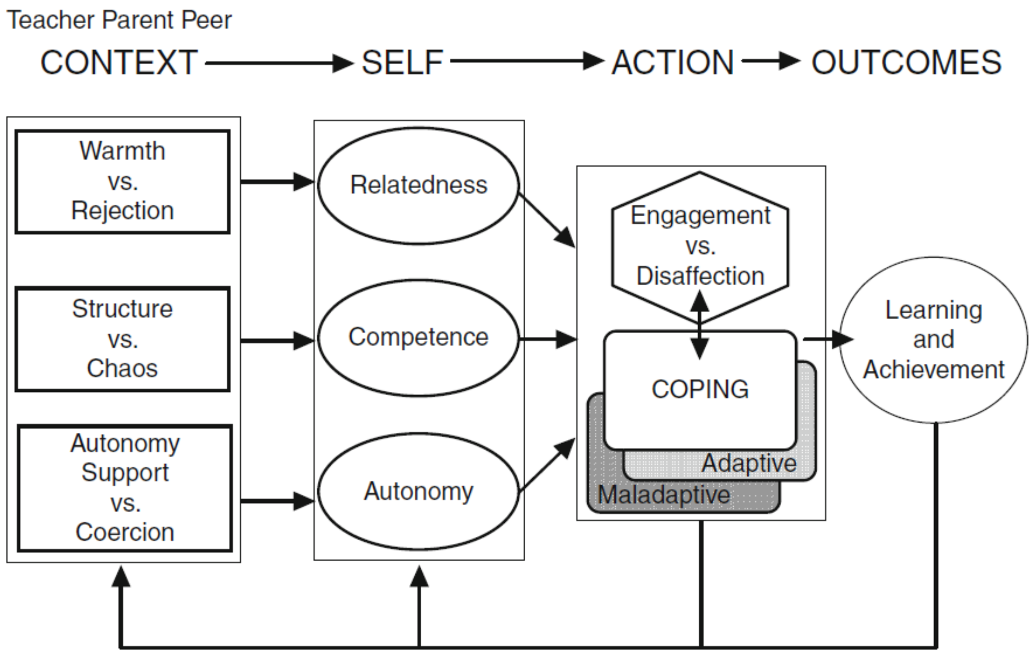

Figure 1. The Dynamic Model of Motivational Development is organized around student engagement and disaffection with educational activities. Adapted from "Developmental Dynamics of Student Engagement, Coping, and Everyday Resilience," by E. A. Skinner and J. R. Pitzer, 2012, *Handbook of Research on Student Engagement*, p. 29. Copyright 2012 by Springer Science+Business Media, LLC.

In this model, interpersonal relationships provide opportunities for students to meet their psychological needs (Skinner & Pitzer, 2012). Teachers, parents, and peers provide, on a continuum, warmth or rejection, structure or chaos, and autonomy support or coercion (Skinner & Pitzer, 2012). Based on the quality of these relationships, students form self-system processes organized around self-beliefs of relatedness, competence, and autonomy (Skinner & Pitzer, 2012). In turn, these self-system processes create a motivational basis for patterns of engagement or disaffection with learning activities. Student engagement or disaffection with classroom activities ultimately influences learning and achievement (Skinner & Pitzer, 2012). The model of motivational development is reciprocal in nature where engagement and disaffection contribute to student learning and achievement which, in turn, cycles back to influence interpersonal relationships with teachers, parents, and peers (Skinner & Pitzer, 2012).

Health and Social-Emotional Concerns for Overweight and Obese Children

Over the past 30 years, there have been significant increases in the prevalence of children and adolescents who are overweight or obese. There are short- and long-term health factors related to being overweight or obese that may affect the 33% of the children and adolescents who fit into these weight categories. The CDC (2013c) reports that in the short term, obese children and adolescents (BMI > 95^{th} percentile) were more likely to have risk factors for cardiovascular disease, such as high cholesterol or high blood pressure, than their non-obese peers. In a sample of obese children and adolescents aged 5-17 years, 70% of the sample had at least one factor for cardiovascular disease (CDC, 2013c). Furthermore, obese children are more likely to have pre-diabetes, bone and joint problems, sleep apnea, and social and psychological problems such as stigmatization and poor self-esteem (CDC, 2013c). In the long-term, children and adolescents who are obese are more likely to be obese as adults and, therefore, are more likely to be at risk for obese adult health factors such as heart disease, type two diabetes, stroke, osteoarthritis, and several types of cancer (CDC, 2013c).

Overweight and obese children and adolescents are often the victims of bullying and weight-based criticism (Fox & Farrow, 2008; Griffiths et al., 2005; Jansen et al., 2004) and victimization (Janicke et al., 2007; Storch et al., 2007). Quality of life in overweight and obese children has been negatively associated with BMI (Janick et al., 2007; Swallen et al., 2005). Furthermore, measures of self-esteem have been negatively associated with BMI, as

BMI levels increase self-esteem scores decrease (Eisenberg et al., 2003; Perrin et al, 2010). Research indicates that children and adolescents who are overweight and obese face health and social-emotional concerns. In addition, children who are overweight or obese may have academic concerns.

Weight-Related Data and Academic Achievement

Research has been conducted examining the relationship of weight-related data (BMI, BMI percentile, adiposity, weight, weight perception, and weight category) with academic achievement such as GPA, self-reported grades, and standardized tests (Baxter, Royer, Hardin, Guinn, & Devlin, 2010; Clark & Slate, 2009; Crosnoe & Muller, 2004; Datar & Sturm, 2006; Huang et al., 2006; Judge & Jahns, 2007; Li et al., 2008; MacCann & Roberts, 2012; Sabia, 2007; Shore et al., 2007; Wingfield, Graziano, McNamara, & Janicke, 2011). While investigating academic achievement, the researchers simultaneously examined the relationships between weight-related data and other variables such as disciplinary actions, fitness scores, attendance, and grade repetition. Outcomes with a focus associating weight-related data with academic achievement are highlighted in this section but other outcomes are also included in the conclusions for each study.

Longitudinal Studies

Crosnoe and Muller (2004) conducted a causal comparative study to explore the effects of students who were overweight or obese related to their academic performance. The individuals (n = 90,000) in this longitudinal study included 7th- through 12th-grade students from 132 middle and high schools from 80 different communities in the United States who completed an in-school survey for the National Longitudinal Study of Adolescent Health (Add Health). A stratified sample of American high schools was constructed based on region, urbanicity, school type, racial composition, and size. The selected high schools were matched to a feeder school, usually a middle school, in such a way that the feeder school selected was proportional to the student make-up of the high school (Crosnoe & Muller, 2004).

From the students who participated in the survey, 20,475 students were selected from the feeder schools to participate in a 90-minute Wave 1 in-home interview in 1995. During the Wave 1 in-home interviews students self-reported their height and weight and these measures were used to calculate individual BMIs using the formula weight (lb) / height^2 (in^2) × 703 (Crosnoe & Muller, 2004). In turn, the BMIs were used to identify those individuals who were overweight (BMI > 85th percentile) as specified by the 2000 CDC growth charts for age and gender (Crosnoe & Muller, 2004). Of the individuals who participated in the Wave 1 in-home interviews, 14,736 participated in the Wave II in-home interviews in 1996. The students self-reported their grades from four subject areas, mathematics, science, English, and social studies, and these grades were averaged and converted to a 4-point grade point average for each year (Crosnoe & Muller, 2004). These grades were slightly inflated when compared to official transcripts, but the self-reported grades and the actual grades were highly correlated (Crosnoe & Muller, 2004).

Crosnoe and Muller (2004) compared the academic achievement of students considered not overweight (BMI $\leq$ 85th percentile) to students who were classified as overweight (BMI > 85th percentile). The researchers found that during both Wave 1 (p < .001) and Wave 2 (p < .001), students who were overweight reported significantly lower grades than students who were classified as not overweight. Crosnoe and Muller (2004) also wanted to determine if being overweight was related to students' academic performance across time. Using Wave II data, Crosnoe and Muller (2004) controlled for socio-demographic characteristics and Wave I achievement. The findings were significant after controlling for socio-demographic characteristics but not after accounting for academic achievement in Wave I (Crosnoe & Muller, 2004). These findings partially supported Crosnoe and Muller's (2004) theory; being overweight was a significant predictor of academic achievement at any one time period but was not a significant predictor of academic achievement across a one-year time period.

Crosnoe and Muller (2004) used multi-level mixed models to determine how students who were overweight functioned in relationship to the normative structure of the school environment. The first model added three school-level controls (SES, minority representation, and school level) and four school level factors (rate of athletic participation, mean student romantic activity, mean student peer involvement, and mean BMI) and no factor significantly predicted change in academic achievement between Wave I and Wave II (Crosnoe & Muller, 2004). In the second model cross-level interactions (overweight and school-level factors) were used to examine across-school variation in the association between being overweight and students' academic achievement (Crosnoe & Muller, 2004). The researchers determined that two cross-level interactions were significant: rate of athletic participation ($p < .05$) and mean level of romantic activity ($p < .05$).

In general, Crosnoe and Muller (2004) concluded there was partial support for their theory that students who were overweight would perform at a lower academic level than individuals who were not overweight. However, despite the theorists' expectations that the gap in achievement levels between the two groups would widen, this did not occur (Crosnoe & Muller, 2004). This finding suggests that the academic achievement of students of varying weights is relatively fixed before they enter middle or high school (Crosnoe & Muller, 2004). In addition, Crosnoe and Muller (2004) concluded that the differences that existed over time between students who were overweight versus those who were not, depended on the normative structure of the school. When dating was a normative structure of the school, students who were overweight performed at a lower academic level than students who were not overweight (Crosnoe & Muller, 2004). When overweight students were enrolled in schools with higher body mass index averages, these students performed better academically than overweight students enrolled in schools with lower body mass index averages (Crosnoe & Muller, 2004).

A second longitudinal study examining the associations between being obese (BMI $\geq$ 95^{th} percentile) and school outcomes was conducted by Datar and Sturm (2006). These researchers explored the relationships between being obese and test scores, behavior problems, social skills, approaches to learning, school attendance, and grade repetition over a 4-year period. The baseline data were taken from the Early Childhood Longitudinal Study-Kindergarten Class (ECLS-K) a national representation of approximately 1,000 kindergarten programs in the U.S. in 1998 - 1999 (Datar & Sturm, 2006). The ECLS-K study was designed to collect data from students as they progressed from kindergarten through fifth grade. Datar and Sturm (2006) used a sample of 7,000 students from the ECLS-K whose heights, weights, and school outcomes were collected in both kindergarten and third grade.

The ECLS-K study measured students' weights and heights twice and a composite measure for each was given (Datar & Sturm, 2006). These composite measures were used to create a composite BMI using the formula weight (km) / height^2 (m^2). Based on the composite BMI, students were placed into one of two categories non-obese or obese using the CDC's age and gender specific percentile charts (Datar & Sturm, 2006). Students with BMIs greater than or equal to the 95th percentile for their weight and gender were labeled obese (Datar & Sturm, 2006). Composite BMIs were calculated for kindergarten students during Wave I, and third-grade students during Wave 2 of the data collection process (Datar & Sturm, 2006).

To collect data on academic achievement, the ECLS-K researchers administered a two-stage assessment (Datar & Sturm, 2006). During the first stage students took a 12 to 20-question test. Based on the results of this test, students took a second test that was appropriate in level of difficulty (Datar & Sturm, 2006). Because all students did not take the same test, an item response theory (IRT) score was calculated for each student. IRT scores estimate the total number of questions students would have answered correctly if they had taken the entire 92-question test (Datar & Sturm, 2006).

Data were gathered from kindergarten teachers and third-grade teachers through teacher-reported behavioral problem scores on the same cohort of students (Datar & Sturm, 2006). These scores were calculated for each student from the externalizing and internalizing scales of the teacher-report social rating scale (Datar & Sturm, 2006). The social rating scale was administered to teachers and the data were part of the ECLS-K (Datar & Sturm, 2006). Data on teacher-reported social skills and approaches to learning were also collected through the use of the social rating scale. Datar and Sturm (2006) indicated these three scales measured positive behaviors of children such as approaches to learning (six items), self-control (four items), and interpersonal skills (five items).

The researchers for the ECLS-K study collected information on other school-related factors. School attendance was measured by the number of excused and unexcused absences for each academic year for the kindergarten and third-grade students. Grade repetition was recorded if a student was retained at any year from kindergarten to third grade (Datar & Sturm, 2006). Other explanatory variables that were collected through the ECLK-S were used for control variables. These included gender, race-ethnicity, family income, mother's education, number of hours of television watched, and parent-reported physical activity (Datar & Sturm, 2006).

Once the data were extracted from the ECLK-S study, individual student weight classifications were created (Datar & Sturm, 2006). Datar and Sturm (2006) placed students into one of three groups based on the change of their weight status from kindergarten to third grade: never-obese, became-obese, and always-obese. Datar and Sturm (2006) concluded that obesity increased from 9% in kindergarten to 17% at the end of the third grade. Baseline scores in both reading and math of children who were never-obese were significantly higher ($p < .01$) than students who became-obese or were always-obese (Datar & Sturm, 2006).

When examining other school outcomes, Datar and Sturm (2006) concluded that teacher-reported scores for externalizing behaviors were significantly higher ($p < .01$) in the always-obese group than for the other two groups. However, there were no statistical differences of externalizing behaviors across the three groups at the end of the four years (Datar & Sturm, 2006). Furthermore, the researchers found that the always-obese group had significantly higher ($p < .01$) scores for internalizing behavior problems than the never-obese group; the always-obese group had significantly more ($p < .05$) absences in kindergarten and third grade than the never-obese and became-obese groups; and the became-obese group had significantly higher ($p < .05$) grade repetition rates than the never-obese and always-obese groups (Datar & Sturm, 2006).

Datar and Sturm (2006) concluded there were gender differences between change of weight status and school outcomes. Girls who became obese scored significantly lower on the reading ($p < .001$) and math tests ($p < .05$), teacher ratings of self-control ($p < .05$), interpersonal skills ($p < .05$), and approaches to learning ($p < .05$) than girls who were never obese. In addition, the girls who became obese scored significantly higher ($p < .05$) on externalizing behavior problems than girls who were never obese (Datar & Sturm, 2006). The only significant difference ($p < .001$) the researchers found between girls who were always obese and girls who were never obese was with scores on internalizing behavior problems where girls who were always obese scored higher. There were no significant associations between change of weight status and school attendance and grade repetition in girls (Datar & Sturm, 2006).

For male students, there were no significant differences between change in weight status in all but one adverse school-related outcome (Datar & Sturm, 2006). Boys who became obese had significantly more ($p < .05$) absences when compared to boys who were never obese (Datar & Sturm, 2006). In addition, boys who became obese or who were always obese had significantly lower ($p < .05$) teacher-reported externalizing behavior scores when compared to boys who were never obese (Datar & Sturm, 2006).

In general, Datar and Sturm (2006) concluded changing weight categories from non-obese in kindergarten to obese in third grade had negative effects on academic achievement, social, and behavioral problems for girls. These relationships did not exist for boys who became obese and in one instance, externalizing behavior, had fewer teacher-reported behavior problems than boys who were never obese (Datar & Sturm, 2006). Additionally, becoming obese was associated with greater absences in boys but not with girls (Datar & Sturm, 2006).

A third longitudinal study examining weight-related data and academic performance was conducted by Sabia (2007) who analyzed data gathered from Add Health. Similarly, Sabia (2007) collected data through two phases: Wave 1 data were collected during the 1994-1995 school year and Wave 2 data were collected during the 1995-1996 school year. The nationally representative sample contained students in grade 7 through grade 12, their parents, and administrators (Sabia, 2007). Data from 5,139 students during Wave 1 were used to run ordinary least squares, instrumental variable models, and fixed effects models. Data from 4,218 students who completed both Wave 1 and Wave 2 requirements were used for individual fixed effects models (Sabia, 2007). The data collected during an in-school survey contained information on over 30 variables including, but not limited to, GPA, perception of weight, exercise, college aspirations, education level of mother, romantic relationships, alcohol consumption, and parental monitoring of friends and curfews (Sabia, 2007).

Ordinary least squares equations were calculated to predict academic achievement from individual, family, and community level characteristics and body weight (Sabia, 2007). Two-stage least squares regression models were constructed to jointly estimate academic performance from the ordinary least squares and a body-weight equation (Sabia, 2007). In this model two exclusions were the parent’s report of the biological mother or father classified as obese. The data controlled for in the two-stage least squares were: (a) parent moved to neighborhood for quality of schools, (b) parent a member of parent teacher association, (c) parent prioritizes scholastic achievement, (d) mother has graduated from college, (e) parent discusses school work with child, (f) degree to which parent monitors curfew and friends, (g) innate academic intelligence using Add Health Picture and Vocabulary Test (Sabia, 2007). The fixed effects model used weights and grades of individual students over two consecutive years to determine the effect of body weight on academic achievement as measured by a combined mathematics and English/language arts GPA (Sabia, 2007).

The results of the ordinary least squares model yielded significant ($p < .01$) negative relationships between weight and BMI and GPA for white female students (Sabia, 2007). Sabia (2007) concluded overweight white females have a 0.182 lower GPA than healthy weight females. However there would need to be a weight difference of 150 pounds for there to be a one-half letter grade difference. An ordinary least squares model also generated a significant ($p < .01$) negative association between the perception of being overweight and GPA for white females. White females who perceive themselves as being overweight have a 0.153 lower GPA than those white females who do not perceive themselves as being overweight (Sabia, 2007). For nonwhite females there was a significant ($p < .05$) negative association between BMI and academic achievement. Overweight nonwhite females have an average GPA 0.273 points lower than their nonwhite healthy weight females. There was no significant correlation between perception of being overweight and academic achievement for nonwhite females (Sabia, 2007). For nonwhite males, there was a significant ($p < .01$) negative relationship between body weight and GPA, however, the relationship was weak in two of the four models (Sabia, 2007). There was no significant relationship found between weight and GPA for white males. In general, Sabia (2007) concluded there was a negative relationship between body weight and academic performance among white females. This relationship was not consistently found for white males or for nonwhite females after controlling for individual, family, and community level characteristics (Sabia, 2007).

Causal Comparative Studies with Two Weight Categories

Other researchers who compared weight-related data to academic performance were non-longitudinal in design. Huang, Goran, and Spruijt-Metz, (2006) created a study to examine the associations of BMI and body fat percentage with self-reported academic performance and GPA. The researchers used a sample of convenience of seven middle schools from three school districts in greater Los Angeles. The final sample contained 666 students of whom 73% were female. The original research was designed to investigate physical activity levels in female middle school students which accounted for the large percentage of female participants (Huang et al., 2006). The sample was obtained by targeting all girl physical education classes or physical education classes that contained mostly females. The males in the mostly female physical education classes were also recruited to participate in the study. The sample contained 68.0% Latino, 18.8% Asian/Pacific Islander, 8% white, and 5.2% were other (Huang et al., 2006).

Data were collected through the use of a self-administered survey that took 45 to 60 minutes to complete (Hung et al., 2006). Students self-reported their grades on a 4-point scale (0, mostly F's to 4, mostly A's) and actual GPA's were collected from the previous year using the same scale. The participants' heights and weights were measured by trained staff members and BMI percentiles were determined in accordance with the CDC age-and-gender-specific growth charts. Students were placed into one of two groups based on their BMI, overweight (BMI $\geq 85^{th}$ percentile) and healthy-weight ($5^{th} \leq$ BMI $< 85^{th}$ percentile). Percentage of body fat was determined through the use of a foot-to-foot bioelectric impedance scale (Huang et al., 2006). A modified version of the Previous Day Physical Activity Recall was used to collect data on the intensity level in metabolic equivalents (METs). Huang et al. (2006) labeled the intensity levels as light physical activity (METs < 3), moderate-to-vigorous activity ($3 \leq$ METs < 6), and vigorous activity (METs ≥ 6).

The researchers (Huang et al., 2006) calculated descriptive statistics for the overweight and healthy-weight groups. Multivariate models were created to determine the effects of overweight, BMI, or body fat percentage on either GPA or self-reported grades. After adjusting for gender, ethnicity, and age physical activity for Huang et al. (2006) concluded there was no significant difference between healthy-weight students and overweight students on GPA. Huang et al. (2006) also concluded that none of the weight-related data (weight category, BMI, and percentage body fat) significantly explained the variance in measured GPA. However, the researchers did find a significant difference (p = .01) between healthy-weight students and overweight students on self-reported GPA after adjusting for demographic and physical activity level covariates (Huang et al., 2006). Other outcomes reported by Huang et al. (2006) included the following: male participants had significantly lower ($p < .01$) measured and self-reported grades than female participants; white and Asian students had significantly ($p < .05$) higher measured and self-reported grades than Latinos; measured and self-reported grades significantly decreased ($p < .01$) with age; and measured and self-reported grades significantly decreased ($p < .05$) with increased METS (Huang et al., 2006).

Another causal comparative study exploring the relationships of two weight categories (obese and non-obese) along with gender on academic performance and social and behavioral problems was conducted by Judge and Jahns (2007). The data were collected through the Early Childhood Longitudinal Study-Kindergarten Class 1998-1999. A sample of 3rd-grade children (*n* = 13,680) who had validated BMIs and their teachers were participants in the study. The data on the students were collected by trained field representatives through one-on-one child assessments. Teacher information was collected from a set of self-administered questionnaires about their students' behavior and social skills (Judge & Jahns, 2007).

The participants' heights and weights were measured twice and the mean of the measurements was recorded. The heights and weights were used to calculate individual BMIs (kg / m^2) in accordance with the formula as stated by the CDC (Judge & Jahns, 2007). Using the CDC 2000 growth curves, children whose BMI score placed them in the 95th percentile or above were labeled obese and the remaining students were classified as non-obese (Judge & Jahns, 2007). Students' reading and math skills were measured through Item Response Theory (IRT) scale scores from subject specific assessments. The participants took each subject area test in two stages. The first stage was a 12- to 20-item baseline test administered to all students. The results of this test placed each student into one of three versions (low- medium- or high-difficulty) of the second round of tests (Judge & Jahns, 2007). The results of these tests were calculated for all students in all waves permitting comparison of performance over time (Judge & Jahns, 2007).

Teachers self-administered the Social Rating Scale (SRS) which measured how often their students exhibited certain social and behavioral skills. The social and behavioral skills included the following: approach to learning, self-control, interpersonal skills, externalizing problem behaviors, and internalizing problem behaviors (Judge & Jahns, 2007). For each social and behavioral skill, the teacher indicated the frequency of occurrence from 1 (never) to 4 (often). The mean was calculated for each of the five social and behavioral skills (Judge & Jahns, 2007).

Judge and Jahns (2007) calculated the means of the IRT reading and mathematics scores and the five levels of the SRS for obese female participants, non-obese female participants, obese male participants, and non-obese male participants. The researchers conducted a series of *t*-tests to determine if there were any significant differences between obese and non-obese students for IRT scores and SRS scores (Judge & Jahns, 2007). The scores were then adjusted for socioeconomic status (SES), mother's educational level, and race/ethnicity. A series of one-way analysis of covariance (ANCOVA) procedures controlling for SES, mother's educational level, and race/ethnicity were conducted to determine differences on academic achievement scores between obese and non-obese students (Judge & Jahns, 2007).

Judge and Jahns (2007) concluded that obese 3rd-grade males and females scored significantly lower on the IRT reading ($p < .05$) and mathematics ($p < .01$) assessments than their peers who were classified as non-obese. These findings were not replicated after adjusting for SES, maternal education, and ethic differences. While investigating gender differences, Judge and Jahns (2007) concluded obese female students had significantly lower approaches to learning ($p < .01$), self-control ($p < .001$), and interpersonal skill ($p < .05$) scores than female students who were not obese. Furthermore, obese female students had significantly higher externalizing ($p < .05$) and internalizing ($p < .05$) problem behavior scores than female students who were not obese. Judge and Jahns (2007) found there were no significant differences between obese non-obese male students on the five SRS factors.

In general, Judge and Jahns (2007) concluded that being obese in female children had an effect on social and behavioral outcomes. The researchers also concluded that the reading and math test scores were more strongly associated with SES, mother's education, and race/ethnicity than weight category (Judge & Jahns, 2007).

In another causal comparative study comparing two weight categories, Baxter, Royer, Hardin, Guinn, and Devlin (2010) investigated the relationships between weight categories and absenteeism, academic achievement, and socioeconomic status (SES). The researchers recruited 4^{th}-grade students from 28 elementary schools in a single school district from Columbia, South Carolina, to participate in the study. The data were collected over a 3-year period during the school years 2004-2005, 2005-2006, and 2006-2007, where 17, 17, and 8 elementary schools participated, respectively. The sample consisted of 920 students (Baxter et al., 2010).

With the exception of BMI, the measures were collected by Baxter et al. (2010) through existing school records. The number of absences individual students had for the 2005-2006 and 2006-2007 were recorded. The Palmetto Achievement Challenge was used as a measure of academic achievement. The Palmetto Achievement Challenge is a set of standardized tests (English language arts, mathematics, science, and social studies) given in May to third through eighth grade students. The numeric value given for each performance level for the four tests were "below basic" = 1, "basic" = 2, and "proficient/advance" = 3 (proficient and advanced students were collapsed because few students were classified as advanced). The four subject scores were combined to give a composite score ranging from 4 to 12 (Baxter et al., 2010). SES was determined by student eligibility for free or reduced-price school lunch. The free or reduced levels were collapsed because few students were eligible for reduced lunch. Students who were eligible for free or reduced-price lunch were classified as “low-SES” and those who were not eligible for free or reduced lunch were classified as “high-SES” (Baxter et al., 2010).

The researchers measured the heights and weights of the participants in order to calculate their BMI (kg / m^2) and BMI percentile (Baxter et al., 2010). Students were placed into one of five categories based on their BMI percentile, underweight (BMI < 5th percentile), healthy weight (5th ≤ BMI < 85th percentile), overweight (85th ≤ BMI < 95th percentile), obese (95th ≤ BMI < 99th percentile), and severely obese (BMI ≥ 99th percentile). These categories were then collapsed by Baxter et al. (2010) into two categories underweight and healthy-weight (BMI < 85th percentile) and overweight, obese, and severely obese (BMI ≥ 85th percentile).

The researchers used logistic binomial models to investigate the associations of absenteeism with BMI, academic achievement, SES, and school year (Baxter et al., 2010). Baxter et al. (2010) concluded that absenteeism was not significantly related to the expanded BMI percentile categories ($p > .118$) or to the collapsed BMI percentile categories ($p = .4334$). Furthermore, they found no significant relationships between absenteeism and SES ($p = .352$) or between absenteeism and school year ($p = .195$). Baxter et al. (2010) concluded that absenteeism was negatively associated with Palmetto Achievement Challenge scores ($p < .0001$).

Causal Comparative Studies with Three Weight Categories

Shore et al. (2007) compared several school-related outcomes of three weight categories: non-overweight (BMI < 85^{th} percentile), overweight (85^{th} percentile ≤ BMI < 95^{th} percentile) and obese (BMI ≥ 95^{th} percentile). In particular, Shore et al. (2007) wanted to determine if there were significant differences in GPAs, Degree of Reading Power (DRP) scores, attendance, disciplinary actions, and physical fitness scores of non-overweight, overweight, and obese sixth and seventh grade students. The sample consisted of 566, 6^{th}- and 7^{th}-grade students from a large public middle school in Philadelphia, Pennsylvania. To gather the data, Shore et al. (2007) examined school records and recorded DRP national percentile scores, GPAs, number of days absent, number of days tardy, number of detentions, and number of days suspended for the school year for each participating student. The physical education teachers recorded the height and weight of all students and the researchers used these measures to calculate BMI percentiles in accordance with the 2000 CDC weight by age and gender tables (Shore et al., 2007). A fitness test was administered by the physical education teachers and the results on curl-ups, shuttle run, endurance 1-mile walk/run, pull-ups, and the sit and reach were recorded for each participant. The purpose of the fitness test was to determine eligibility for the Presidential Physical Fitness Award and the National Physical Fitness Award. The participation of 7^{th}-grade students on interscholastic teams was also recorded (Shore et al., 2007).

Using one-way ANOVA analysis procedures while controlling for gender, socioeconomic status, and ethnicity, Shore et al. (2007) concluded non-overweight students had significantly higher ($p < .05$) GPAs (11% higher), fewer detentions (50% less), lower absences (25% less), and less days tardy to school (39% less) when compared to their obese peers. DRP scores were lower in the obese group when compared to the non-overweight group; however, the difference was not significant. There was no significant difference in the number of suspensions between the obese and non-overweight groups (Shore et al., 2007). Non-overweight individuals scored significantly higher ($p < .0001$) on the fitness test than their overweight and obese peers. Finally, Shore et al. (2007) concluded a significantly higher ($p < .001$) percentage (75%) of non-overweight students participated in at least one sport when compared to overweight (61%) and obese (33%) individuals. The general findings for Shore et al. (2007) included non-overweight students receive higher grades, have fewer days absent, and less school discipline issues than their obese peers. These results suggest that body mass may be an important indicator of academic achievement, attendance, behavior, and physical fitness.

Another study investigating the differences of three weight categories on academic performance was conducted by Wingfield, Graziano, McNamara, and Janicke (2011). In particular, the researchers investigated the relationship between BMI, physical fitness, and academic performance. The researchers wanted to examine the relative contributions of BMI and physical fitness as correlates of academic performance. The researchers used a sample of 4^{th}- ($n = 132$) and 5^{th}-grade ($n = 66$) students from a k-12 school located in North Central Florida to investigate their hypotheses (Wingfield et al., 2011).

A member of the physical education department measured each participant's height to the nearest ¼ inch and weight to the nearest 0.5 pound (Wingfield et al., 2011). These measures were used to calculate BMI and to place participating students into one of four categories based on their BMI z-score and the CDC's growth charts: underweight (BMI < 5^{th} percentile), healthy-weight (5^{th} percentile ≤ BMI < 85^{th} percentile), overweight (85^{th} percentile ≤ BMI < 95^{th} percentile), and obese (BMI ≥ 95^{th} percentile). The three participants with BMI percentile < 5^{th} percentile were excluded from the study (Wingfield et al., 2011). The physical fitness scores were collected by the physical education teachers using the six components of the President's Challenge: curl-ups, shuttle run, one mile run/walk, pull-ups, flexed arm hang, and V-sit reach. Scoring was completed following the procedures of The President's Challenge Program Manual. Academic performance was measured using the Florida Comprehensive Assessment Tests which measures reading mathematics, science, and writing ability where the range of raw scores was 86 to 3,008 (Wingfield et al., 2011).

The researchers used ANOVAs and correlational and regression analyses to analyze the data (Wingfield et al., 2011). Academic reading and math scores were combined into a single academic performance variable because of their high correlation (r = -.69, p < .001). A single fitness variable, where higher scores represented greater fitness, was created from five of the six standardized fitness scores. Flexibility was omitted because of its low loading when compared to the other fitness variables (Wingfield et al., 2011).

An ANOVA was conducted to determine whether physical fitness levels differed by weight category when gender and grade were controlled (Wingfield et al., 2011). There was a significant (p < .001) main effect for fitness where children classified as obese had significantly lower fitness levels when compared to individuals classified as overweight (p < .01) and healthy-weight (p < .001). Participants classified as overweight had significantly lower (p < .001) fitness scores than participants classified as healthy-weight (Wingfield et al., 2011). Correlational analyses were conducted to determine if BMI and fitness level were associated with academic performance where separate analyses were conducted for grade level and gender. A significant (p < .05) positive relationship was found between fitness and academic performance in 5^{th}-grade female participants. A regression analysis was conducted to determine if BMI and fitness were uniquely associated with academic performance. BMI and fitness significantly predicted academic performance (p < .01). However, only BMI marginally predicted ($p < .08$) academic performance in 5th-grade female participants over fitness level (Wingfield et al., 2011).

In general, Wingfield et al. (2011) concluded that 5th-grade girls with higher BMIs performed worse academically than 5th-grade girls with lower BMIs. Fitness level no longer significantly predicted academic performance when BMI was in the model. The researchers concluded that female students may be impacted more by being overweight than male students (Wingfield et al., 2011).

Another causal comparative using three weight categories was conducted by Li, Dai, Jackson, and Zhang (2008). In particular Li et al. (2008) examined the associations between academic performance, cognitive functions, and increased BMI. A sample of 3,903 children and adolescents aged 8 – 16 years who participated in the medical and cognitive examinations during the NHANES III were initially considered as part of the study. After excluding underweight children, children who were in neonatal care for more than two weeks, and children who had severe learning disabilities or health concerns, 2,519 remained for the primary analyses (Li et al., 2008).

To measure cognitive functioning and academic performance Li et al. (2008) used the results of the block-design and digit-span subtests of the Wechsler Intelligence Scale for Children and the reading and arithmetic sections of the Wide Range Achievement Test. The results of each of the tests were turned into z-scores using the representative mean and standard deviation for each test (Li et al., 2008). Weight was measured to the nearest 0.05 kg and height was measured to the nearest 0.1 cm. BMI was calculated in kilogram per meter squared and converted to a sex- and gender-specific BMI percentile derived from 2000 CDC charts. Based on their BMI percentile, individuals were placed into one of three groups, obese (BMI ≥ 95^{th} percentile), overweight (85^{th} percentile ≤ BMI < 95^{th} percentile), and normal-weight (BMI < 85^{th} percentile). Blood pressure was measured three times after the individual was at rest for at least five minutes and the average of the second and third reading were used as the final reading for each individual (Li et al., 2008). Total cholesterol levels, serum cholesterol measures, heart rate, and iron deficiency status were recorded. In addition, general health was reported by the parent or guardian as excellent, very good, good, fair, or poor and turned into a dichotomous variable, fair/poor or excellent/very good/good. (Li et al., 2008).

Linear regression models were used by Li et al. (2008) as a primary adjustment tool to estimate the adjusted mean z-score on cognitive outcomes for each stratum of BMI. Pairwise comparisons were performed to determine if there were statistical differences between the normal-weight group and the overweight and obese groups. Mediation analyses were conducted to assess the confounding effects of various factors on the association between BMI and academic performance and cognitive functioning (Li et al., 2008).

After adjusting for age and gender, the association between BMI and all academic performance and cognitive functioning tests were significant ($p < .05$); as BMI values increased, test *z*-scores decreased (Li et al., 2008). However, the association of academic performance with BMI decreased when adjustments were made for parental and familial SES. The block-design, digit-span tests and global functioning tests remained statistically significant ($p < .05$) after adjustments were made for all potential confounding or mediating variables. In general, the researchers used a nationally representative sample to conclude that there was an association between BMI percentile category and cognitive impairment in visuospatial organization and general mental ability in school-aged children (Li et al., 2008).

Causal Comparative Studies with Four Weight Categories

Clark and Slate (2009) conducted a causal comparative study to examine the relationships between four weight categories and academic achievement. The researchers used a sample of 9,471 of first through fifth grade elementary students from a Southwestern urban school district during the 2006-2007 academic year. The heights and weights of the students were collected during routine health screenings. These data were used to calculate individual BMIs, which were used to place the students into one of four categories: underweight (BMI < 5^{th} percentile), healthy-weight (5^{th} percentile $\leq$ BMI < 85^{th} percentile), overweight (85^{th} percentile $\leq$ BMI < 95^{th} percentile), and obese (BMI $\geq$ 95^{th} percentile) as designated by the CDC (Clark & Slate, 2009). Student indicators and academic performance data were gathered from school records. Class averages in mathematics, reading, science, social studies, and conduct were extracted from the district's main data base. Student scores on the Texas Assessment of Knowledge and Skills (TAKS) test for reading, math, writing, and science were also recorded (Clark & Slate, 2009).

Clark and Slate (2009) used chi-square procedures to examine the relationships between (a) weight category and gender, (b) weight category and student ethnicity, (c) gender and obesity by ethnic group, (d) weight category and grade level, and (e) weight category and conduct grades. In addition, nonparametric procedures were used to determine the relationships between weight category and teacher grades and weight category and TAKS scores (Clark & Slate, 2009).

Clark and Slate (2009) found that male participants (21.4%) were significantly more likely ($p < .001$) to be obese than female participants (17.8%), male participants (17.8%) were significantly more likely ($p < .001$) to be overweight than female participants (16.0%), and male participants (58%) were less likely to be in the healthy-weight category than female participants (63.7%). The researcher found that obesity percentages for ethnic groups were statistically significant ($p < .001$). Of the students in the study 27.5% of Hispanics, 21.3% of African Americans, 16.5% of Asian-Pacific Islanders, and 14.1% Whites were labeled obese.

Clark and Slate (2009) also examined the teacher grades, conduct grades, and TAKS scores of the elementary students as they related to student weight category. In every subject, reading ($p < .0001$), math ($p < .0001$), language arts ($p < .0001$), science ($p < .0001$), and social studies, ($p < .0001$) the average grade for obese students was significantly lower than for non-obese students. Furthermore, in every subject area, the average grade for obese students was significantly lower ($p < .0001$) than their peers in overweight, healthy-weight, and underweight categories (Clark & Slate, 2009). Clark and Slate (2009) found a significant difference ($p < .001$) between obesity and conduct grades. A trend developed where students who were overweight or obese received lower conduct grades than their healthy-weight and underweight peers. Finally, students who were obese had significantly lower TAKS scores in reading ($p < .0001$), math ($p < .0001$), writing ($p < .003$), and science ($p < .01$) than students in the remaining three weight categories (Clark & Slate, 2009).

In general, Clake & Slate (2009) concluded that teachers' grades and standardized scores were significantly lower for obese students than for non-obese students. As student weight category increased, academic performance decreased in both the standardized and non-standardized measures (Clarke & Slate, 2009).

Another causal comparative study using four weight categories was conducted by MacCann and Roberts (2012) to determine if there were differences in the test scores and school grades of underweight, healthy-weight, overweight, and obese middle school students and college/university students. Only the procedures and conclusions for the middle school portion of the study will be included here. The middle school sample consisted of 383, 8^{th}-grade students and their parents from five U.S. cities, Atlanta, Chicago, Denver, Fort Lee (N.J.), and Los Angeles. The parent sample contained 376 individuals of whom 83.3% were the mother and 12.5% were the father. The data were collected over two time periods, 14 months apart (MacCann & Roberts, 2012). During the first time period, vocabulary test scores and information relating to SES were gathered. During the second time period the information needed to calculate the mathematics test scores, BMIs, conscientiousness scores, and life satisfaction scores were collected (MacCann & Roberts, 2012).

The vocabulary test consisted of 18 items taken from the Vocabulary Levels Test and scores were recorded as percentage correct. Similarly, the mathematics test consisted of 19 items taken from the National Assessment of Educational Progress mathematics test and scores were recorded as the percentage of correct answers given (MacCann & Roberts, 2012). Students and parents reported the height, weight, and report card grades of the participating students. The mean of the student report and parent report of the participant's height and weight were recorded and the BMI (weight in kg / height in m^2) was calculated using these means. The participating students were placed into one of four categories (underweight, healthy-weight, overweight, or obese) based on BMI percentile values from the World Health Organization Reference 2007 male and female growth charts (MacCann & Roberts, 2012).

Students and parents reported the students' letter grades from the previous semester in English, mathematics, science, and social studies (MacCann & Roberts, 2012). Grades were converted to a 13-point scale from 0 (failure) to 13 (A+). These eight scores were combined to create an overall grade which was then standardized to have a mean of zero and a standard deviation of 1.00 (MacCann & Roberts, 2012). Additional measures included a students' conscientiousness score and a students' life satisfaction score. Eighteen items from the Industriousness and Perfectionism component of the Comprehensive Conscientiousness Scale were used to create a student conscientiousness score. Both the parents and the students rated the students on these items using a five-point scale. The mean score of the parent ratings and student ratings was used as an overall conscientiousness score. Seven items were taken from the students' life satisfaction scale and were rated on a 6-point scale by both the parents and the students. The mean score of the parent ratings and student ratings was used as a measure of student life satisfaction (MacCann & Roberts, 2012).

Correlational analyses were conducted to determine if significant relationships existed between weight category and mathematics scores, vocabulary scores, and student grades (MacCann & Roberts, 2012). The researchers concluded there was no significant correlation between BMI and vocabulary test scores before or after accounting for the covariates collected through the SES survey. There was a small, significant ($p < .05$) negative association between BMI and mathematics scores, however, after adding the covariates, this significance no longer existed. There were significant negative correlations between BMI values and student grades before ($p < .01$) and after ($p < .01$) incorporating the covariates into the analyses (MacCann & Roberts, 2012).

MacCann and Roberts (2012) concluded that in general, intelligence test scores for obese students did not differ from healthy-weight students after introducing the covariates related to SES. However, both overweight and obese students received lower grades than their non-overweight peers. No results were given relating BMI to conscientiousness scores or life satisfactions scores (MacCann & Roberts, 2012).

Weight-Related Data and Absenteeism

The previous section reviewed three empirical studies that explored the relationship of weight-related data and absenteeism along with academic performance. Baxter et al. (2011) found no significant associations between BMI or BMI percentile categories and absenteeism. Shore et al. (2008) concluded that non-overweight students had significantly fewer absences and days tardy to school than their overweight peers. Datar and Sturm (2006) determined that individuals who were always overweight had significantly more absences than individuals who were never overweight or who became overweight. An additional study was found where the researchers' sole purpose was to investigate the relationship between weight-related data and absenteeism.

Geier et al. (2007) conducted a study to examine the relationship between relative weight and school attendance. The data were collected from 9 of 10 inner city schools in Philadelphia. A sample (n = 1,126) of fourth-, fifth-, and sixth- grade students were used from schools where the rate of students qualifying for free or reduced lunch was at least 50%. One inner city school did not meet this requirement and was not used in the study. Attendance records were missing or not available for 57 students who were excluded from the sample. The exclusionary factors resulted in a sample of 1,069 students (Geier et al., 2007).

Trained research assistants recorded the weights and heights of the participants (Geier et al., 2007). The weights were measured to the nearest 0.1 kg on a digital scale during the second semester of the school year. Heights were measured to the nearest 0.1 cm through the use of a wall-mounted stadiometer. These measures were used to calculate BMI and to place the participants into relative weight categories as described by the Institute of Medicine: underweight (BMI < 5^{th} percentile), healthy-weight (5^{th} percentile ≤ BMI ≤ 84.9^{th} percentile), overweight (85^{th} percentile ≤ BMI ≤ 94.9^{th} percentile), and obese (BMI ≥ 95^{th} percentile) (Geier et al., 2007). Student attendance was recorded each morning by the homeroom teachers. If a student arrived before the third period their absence was changed from absent to late for the purposes of this study (Geier et al., 2007).

Geier et al. (2007) used one-way ANOVAs to determine if there were significant differences between the number of days absent across relative weight categories and if there were significant differences between the number of days absent and racial/ethnic categories. When significant differences were identified, follow-up analyses were conducted to determine the categories responsible for the significant differences (Geier, et al., 2007). Linear regression procedures were used to examine the contributing factors of BMI, age, race/ethnicity and gender to the number of student absences. This procedure was repeated using BMI *z*-scores (Geier, et al., 2007).

The researchers concluded that Whites were absent the greatest mean number of days, followed by Blacks, Hispanics, Other, and Asians (Geier et al., 2007). The only significant finding across race/ethnic groups was that Asians were absent significantly less ($p < .0001$) than all other groups. Geier et al. (2007) stated absentee rates increased with an increase in weight category. Underweight students were absent 7.5 ± 10.6 days, healthy-weight students were absent 10.1 ± 10.5 days, overweight students were absent 10.9 ± 9.5 days, and obese students were absent 12.2 ± 11.7 days. Obese students were absent significantly more often ($p < .05$) than their healthy-weight peers, after controlling for school (Geier, et al., 2007). The categories were then collapsed by placing underweight and healthy-weight in one group and overweight and obese in another group. The heavier students were absent 11.7 ± 10.9 days which was significantly more ($p < .05$) than their non-overweight peers who were absent 10.0 ± 10.5 days, after controlling for school (Geier et al., 2007).

Results from the linear regression suggested that weight category, race/ethnicity, gender, age, and school location explained 11% of the variation in the number of days absent (Geier, et al., 2007). The researchers found no main effect for gender and the number of days absent. The researchers did not find significant interactions between weight category and gender nor weight category and race/ethnicity. Geier et al. (2007) concluded that overweight students were significantly more ($p < .05$) likely to be absent than healthy-weight students after controlling for age, race/ethnicity, and school. An increase of age by one year was significantly associated ($p < .001$) with an increase in the number of days absent. In general Geier et al. (2007) suggested the findings indicated that overweight children are at a greater risk than their non-overweight peers for school absenteeism. The researchers did not conclude that the increase in absences significantly impacted school performance (Geier et al., 2007).

Weight-Related Data and Engagement

A single study was found associating weight-related data to student engagement. Ramaswamy et al. (2010) used a sample of convenience of 45, 3^{rd}-, 4^{th}-, and 5^{th}-grade students from a single elementary school in Waukegan, Illinois to investigate the relationship between BMI and classroom effort. The participants were also members of an after school program encouraging physical fitness and eating nutritionally. The data were collected during the 2005-2007 school years (Ramaswamy, Mirochna, & Perlmuter, 2010).

The participants self-reported their age and ethnicity. Individual heights were measured using a stadiometer and individual weights and body fat percentages were measured using a Tanita Body Composition Analyzer (Ramaswamy et al., 2010). The participants' BMIs were calculated from the measured heights and weights (Ramaswamy et al., 2010). Student grades and effort grades were collected through quarterly report cards. Five effort grades were given for each participant in the following content areas: English, reading, mathematics, social studies, and science. The effort scale ranged from 1 through 4 where "academic warning" = 1, "does not meet expectations, below grade level standards" = 2, "meets expectations, at grade level standards" = 3, and "exceeds effort expectations above grade (year) level standards" = 4. The mean of the effort grades and class grades were calculated for the five courses and a single effort grade and class grade were determined for each participant (Ramaswamy et al., 2010).

The researchers used a stepwise multiple regression with the composite effort score as the response variable (Ramaswamy et al., 2010). The effects of BMI were examined after controlling for gender, ethnicity and age, which were entered as the first three steps, followed by grade score and BMI. Gender, ethnicity, and age were not significant predictors of effort. As grade score increased the effort value score significantly increased ($p < .01$). Ramaswamy et al. (2010) concluded BMI was negatively associated with effort value ($p < .05$). The model showed similar results when BMI was exchanged for body fat percentage in the final stage of the multiple linear regression (Ramaswamy et al, 2010). In general, Ramaswamy et al. (2010) concluded that increasing BMI or body fat is negatively associated with student effort as rated by teachers.

Weight-Related Data and Interpersonal Support

No research was found examining the relationships of weight-related data with the interpersonal support of peers, teachers, or parents. Limited studies suggest that building meaningful relationships may be more challenging for those children and adolescents who are overweight or obese. Strauss and Pollack (2003) conducted a study exploring the social marginalization and social connections of obese adolescents. The Add Health Study, a federally funded study designed to measure the health of adolescents, was used to mine data on social networking (Strauss & Pollack, 2003). The 123 participating schools were systematically selected from the Add Health data base. The sample consisted of 7^{th}- to 12^{th}-grade students who completed the in-school questionnaire administered by Add Health (n = 90,118) and those students who did not complete the questionnaire but were on the school rosters (n = 20,762). All of the students from the combined group were eligible for random selection for an in-home interview (Strauss & Pollack, 2003). During the in-home interviews, self-reported weights and heights were recorded and used to calculate BMI in accordance with the formula stated by the CDC. Individuals with BMI > 95^{th} percentile for age and sex were classified as obese (Strauss & Pollack, 2003).

Strauss and Pollack (2003) used the Add Health collection of data on social networking to determine students who were labeled the most popular in each of the participating school. During the Add Health study, each participant stated his or her five best male friends and five best female friends. The number of best friend nominations and the total number of friends of friends were calculated and the group of adolescents receiving the most nominations for friend and best friend were labeled the most popular (Strauss & Pollack, 2003). The Bonacich measure was used to calculate the centrality of the participants in their social network. Low centrality scores were associated with those individuals who reported fewer friends than those in his or her network (Strauss & Pollack, 2003). An in-degree social network was created based on the number of friendships reported by the participants' peers rather than self-reported friendships. The in-degree social network was used as a centrality measure because previous research indicated this methodology was more accurate than an out-degree social network. In-degree social networks were used to expose observed differences in social connections and reciprocity among unpopular, average, and popular adolescents (Strauss & Pollack, 2003). Friendship networks were generated using PAJEK and SAS IML software. Chi-square analyses were used to determine differences in proportions in friendship networks and multivariate analyses were used to determine differences in the continuous variables (Strauss & Pollack, 2003).

Strauss and Pollack (2003) concluded obese individuals had significantly fewer ($p < .001$) friendship nominations than non-obese individuals. Obese children were significantly more likely ($p < .001$) to report having zero to three friends than their non-obese peers. Healthy-weight individuals were more likely ($p < .001$) to have six or more friendship nominations than their obese peers. Furthermore, obese individuals were significantly less likely ($p < .001$) to receive five or more friendship nominations. Obese male participants were significantly less likely ($p < .002$) to receive two or more best-friend nominations and obese female participants were significantly less likely ($p < .001$) to receive two or more best-friend nominations (Strauss & Pollack, 2003).

Overall, Strauss and Pollack (2003) concluded that obese adolescents were more isolated, were less likely to be selected as friends, and had fewer friends in their extended network than their non-obese peers. Individuals who nominated an obese peer as a friend were less popular than adolescents who did not nominate an obese peer. Individuals who were nominated as a best friend by an obese individual were less likely to reciprocate the friendship. In general, obese individuals are less likely to play an important role between well-connected individuals than their non-obese peers (Strauss & Pollack, 2003).

Weight-Related Data and Beliefs About Self

For the purposes of this study, beliefs about self refers to competence, autonomy, and relatedness. No empirical studies were found associating weight-related data to these constructs; however, studies were found that associated competence, autonomy, and relatedness to engagement and academic performance. These studies support the theory that competence, autonomy, and relatedness are integral components to engagement and academic performance. Empirical research studies outside a 10-year window were included in this section as they support the theoretical framework for this study.

Furrer and Skinner (2003) conducted a study with four major objectives: (a) to examine the relationship between a sense of relatedness with engagement and academic performance; (b) to examine the relationships between relatedness and parents, teachers, and students; (c) to examine gender and age differences with relatedness to parents, teachers, students; and (d) to examine the differential, cumulative, compensatory effects of relatedness to parents, teachers, and students. The sample was collected from a longitudinal study which included 251, 3rd- through 6th-grade students from a suburban-rural school district (Furrer & Skinner, 2003).

Students completed self-report questionnaires during three 45-minute sessions (Furrer & Skinner, 2003). The student questionnaires were designed to measure relatedness, perceived control, and student perception of engagement or disaffection. Relatedness was measured through a 20-item self-report instrument designed to examine the associations to five social partners: mother, father, teacher, classmates, and friends. Perceived control was measured through a subscale of the Student Perceptions of Control Questionnaire (SPOCQ) (Furrer & Skinner, 2003). Children self-reported their engagement or disaffection levels in the classroom through a survey created for this purpose (Furrer & Skinner, 2003). In addition, teachers completed a questionnaire designed to measure student behavioral and emotional engagement in the classroom. Finally, academic performance was measured by converting letter grades to number grades ranging from 1 (F or U-) to 12 (A or V). The mean of student mathematics, reading, language, and/or spelling scores was calculated and the mean grade represented academic performance in the classroom (Furrer & Skinner, 2003).

To determine if there was a relationship between children's general sense of relatedness and overall engagement, Furrer and Skinner (2003) ran two mediator models, one for self-reported engagement and the other for teacher-reported engagement. Both teacher-reported ($p < .01$) and student-reported ($p < .01$) engagement significantly mediated the relationship between relatedness and academic performance. Two regressions were analyzed using perceived control and relatedness as the predictors of teacher-reports and child-reports of engagement. The researchers concluded that both perceived control ($p < .01$) and relatedness ($p < .01$) were significant predictors of teacher-reports. Perceived control ($p < .01$) and relatedness ($p < .01$) were also, significant predictors of child-reports of engagement (Furrer & Skinner, 2003).

To examine the relationships between relatedness and social partners, Furrer and Skinner (2003) conducted regressions to determine if relatedness to parents, teachers, and peers significantly predicted behavioral and emotional engagement. In all but relatedness to peers, feelings of relatedness toward individual social partners significantly predicted ($p <$

.05) behavioral and emotional engagement as reported by both teachers and students. Furrer and Skinner (2003) concluded that student relatedness to all social partners were significant ($p < .01$) and were moderately high. Furthermore, student relatedness to parents was the highest, followed by student relatedness to teachers, and student relatedness to peers (Furrer & Skinner, 2003).

Hierarchical regression models were analyzed to examine grade and gender differences on the effects of relatedness (Furrer & Skinner, 2003). The researchers compared the mean levels of relatedness for parents, teachers, and peers and behavioral and emotional levels of engagement as functions of age and gender. The researchers concluded that female students felt significantly more related ($p < .001$) to their teachers than did male students but there were no significant differences in relatedness between male and female students to their parents or peers. Relatedness to all social partners significantly increased ($p < .05$) from 3rd- to 5th-grade. Student's sense of relatedness to teachers significantly lowered ($p < .05$) in 6th-grade (Furrer & Skinner, 2003).

Furrer and Skinner (2003) used MANOVAs to examine whether, within a single person, low levels of relatedness to the three social partners were associated with low engagement levels. Significant multivariate effects were found for teacher-reports ($p < .01$) and child-reports ($p < .01$) of engagement. In general, Furrer and Skinner (2003) concluded engagement significantly decreased as cumulative risk increased where cumulative risk was the relatedness to parents, teachers, and peers.

Autonomy is another construct under investigation in the current research. Patrick, Skinner, and Connell (1993) conducted a study to examine the contributions of perceived control and autonomy on student behavioral and emotional engagement in the classroom.

The sample consisted of 264 children in 3rd-, 4th-, and 5th-grade from two elementary schools in a suburban and rural district in New York State. Data on perceived control, autonomy, and engagement in the classroom were collected over three, 45-minute periods (Patrick, Skinner & Connell, 1993).

Perceived control was measured through the use of the Student Perceptions of Control Questionnaire and produced scores on individual's strategy and capacity beliefs in five areas: effort, ability, powerful others, luck, and unknown causes (Patrick et al., 1993). These scores were combined to create a maximum control score. The Self-Regulatory Style Questionnaire was used to measure student's perceived autonomy levels and resulted in four autonomy scores: external, introjected, identified, and intrinsic self-regulation, and one summary score named the relative autonomy index. Individual motivational behavior in the classroom was measured through a self-report instrument that assessed effort, persistence, attention, and participation during the initiation and culmination of learning tasks (Patrick et al, 1993).

Patrick et al., (1993) assessed individual emotional behavior through a self-report questionnaire which was designed to measure five negative emotions (bored, worried, sad, bad, and angry) and three positive emotions (interested, relaxed, and happy). After exploratory factor analysis, the behavioral and emotional engagement scores were reduced to: motivated behavior; positive emotion; and bored, distressed, and angry emotions. In addition, a total emotion score was created by averaging the positive and negative emotion scores (Patrick et al., 1993).

Two regression analyses were conducted to determine the unique effects of perceived control and autonomy on emotion and behavior (Patrick et al., 1993). In both cases, the maximum control score, relative autonomy index, and their interaction were used as the independent variables and emotion and behavior were used as the dependent variable in two separate analyses. The overall equations for emotion ($p < .0001$) and behavior ($p < .0001$) were significant. Perceived control, after covarying on autonomy, contributed significantly to behavior ($p < .001$) and emotion ($p < .001$). Also, autonomy uniquely contributed to behavior ($p < .001$) and emotion ($p < .001$). There were no significant interactions in either model (Patrick et al., 1993).

Further analyses included conducting regression procedures to discern any unique relationships between the five component subscales of student perception (effort, ability, powerful others, luck, and unknown) and behavior and emotion (Patrick et al., 1993). Effort ($p < .001$) and powerful others ($p < .001$) accounted for unique variance in behavioral engagement in the classroom. Furthermore, effort ($p < .001$), powerful others ($p < .02$), luck ($p < .005$), and unknown ($p < .005$) contributed uniquely to emotional engagement in the classroom (Patrick et al., 1993). The same techniques were used to determine if the four components of autonomy (external, introjected, identified, and intrinsic self-regulation) contributed significantly to behavior and emotion in the classroom. Patrick et al. (1993) concluded that external ($p < .001$), identified ($p < .001$), and intrinsic self-regulation ($p < .05$) contributed significantly to behavioral engagement in the classroom. Furthermore, external ($p < .02$), introjected ($p < .001$), identified ($p < .001$), and intrinsic self-regulation ($p < .005$) contributed significantly to emotional engagement in the classroom (Patrick et al., 1993). In general, Patrick et al. (1993) concluded that there were two distinct sources of motivation, perceived control and autonomy, which affect student's behavior and emotion during academic activities.

A study exploring the characteristics of children who seek extra-help was conducted by Marchand and Skinner (2007). The researchers used the self-system model of motivational development as the underlying theory for their study. According to this model, engagement and disaffection are the motivational states that respectively, encourage and discourage learning and academic success (Marchand & Skinner, 2007). Data for this study were taken from the third year of a 4-year longitudinal study that included 765, 3rd- through 6th-grade students and their teachers. Self-report questionnaires were administered to the students by trained interviewers in three 45-minute sessions during October and May of the same school year. During the same time period, the teachers who felt they knew each child the best, filled out a survey on the level of involvement, structure, and autonomy support they provided for each student (Marchand & Skinner, 2007). The student survey included questions designed to gather data on help-seeking and concealment, relatedness to teachers, perceived control and competence, autonomy orientation, and engagement versus disengagement. The teacher survey was designed to gather data on teacher warmth versus neglect, teacher structure versus chaos, and teacher autonomy support versus coercion (Marchand & Skinner, 2007).

The first goal of the study was to investigate the relationships between individuals who, during an academic challenge, seek help (help-seeking) with engagement and those who do not seek help (concealment) with engagement in learning activities (Marchand & Skinner, 2007). Correlations between ways of coping (help-seeking or concealment) and engagement (behavioral, emotional, and total) were calculated. Marchand and Skinner (2007) concluded that help-seeking and total engagement were strongly, positively correlated ($r = .48$, $p < .01$) and concealment and total engagement were strongly, negatively correlated

($r = -.62$, $p < .01$). Regression procedures were used to determine if help-seeking and concealment made unique contributions to engagement during the fall and the spring measurement points. Overall models were significant ($p < .001$) and all individual coefficients were significant ($p < .001$) for both measuring points. In particular, help-seeking ($\beta = .27$) and concealment ($\beta = -.48$) were significant predictors of behavior in the fall; help-seeking ($\beta = .39$) and concealment ($\beta = -.38$) were significant predictors of behavior in the spring; help-seeking ($\beta = .30$) and concealment ($\beta = -.47$) were significant predictors of emotion in the fall; and help-seeking ($\beta = .36$) and concealment ($\beta = -.45$) were significant predictors of emotion in the spring (Marchand & Skinner, 2007).

The second goal of the study was to examine the effects of self-system processes (competence, autonomy, and relatedness) on help-seeking and concealment (Marchand & Skinner, 2007). Correlations were calculated to determine the strength and type of relationship that existed. Marchand and Skinner (2007) concluded that all three self-system processes were moderately, positively related to help-seeking ($r = .38$, $p < .01$) and moderately, negatively related to concealment ($r = -.43$, $p < .01$). To determine if individual self-system processes were unique predictors of coping, Marchand and Skinner (2007) conducted two sets of concurrent regression procedures using help-seeking and concealment as dependent variables. The researchers concluded that all regression procedures were significant ($p < .001$). In addition, all three self-system processes were significant at predicting coping during the two time periods. For the fall time period competence ($\beta = .22$, $p < .001$), autonomy ($\beta = .11$, $p < .01$), and relatedness ($\beta = .28$, $p < .001$) significantly predicted help-seeking. Similarly, during the spring, competence ($\beta = .22$, $p < .001$), autonomy ($\beta = .15$, $p < .001$), and relatedness ($\beta = .36$, $p < .001$) significantly predicted help-seeking. For the fall time period competence (β = -.37, $p < .001$), autonomy (β = -.33, $p < .001$), and relatedness (β = -.11, $p < .001$) significantly predicted concealment. Similarly, during the spring competence (β = -.35, $p < .001$), autonomy (β = -.23, $p < .001$), and relatedness (β = -.17, $p < .001$) significantly predicted concealment (Marchand & Skinner, 2007).

The third goal of the study was to investigate the how teacher support affected children's coping in the classroom. Marchand and Skinner (2007) calculated the correlations between the three aspects of teacher-reported support (involvement, structure, and autonomy support) and student coping (help-seeking and concealment). All correlations were significant (p < .01), although low, and in the expected direction (Marchand & Skinner, 2007).

In general, Marchand and Skinner (2007) concluded that help-seeking and concealment were closely linked to student engagement and disaffection with classroom activities, at different time periods during the study. Those individuals who demonstrated higher levels of seeking help in the fall became more engaged as the year progressed and those individuals who demonstrated higher levels of concealment in the fall became more disaffected as the year progressed. In particular, concealment was a strong predictor of behavioral and emotional engagement over time. Self-system processes were related to behavioral and emotional engagement where competency, autonomy, and relatedness were positively related to help-seeking and negatively related to concealment. Finally, teacher support was linked to help-seeking and concealment where teacher support had a stronger feed-forward effect on help-seeking and a stronger feed-back effect on concealment (Marchand & Skinner, 2007).

Chapter Summary

The emergence of growth charts and childhood obesity trends were reviewed in this section. Nationally representative samples were used to create growth charts for age- and gender-specific groups. The first sets of growth charts were revised as more data became available culminating with the creation of the 2000 CDC growth charts. The CDC growth charts have been recommended for clinical use by doctors and for the purpose of conducting research (Kuczmarski et al., 2002). Longitudinal studies focusing on the national health and nutrition of people living in the United States indicate the overweight and obesity levels have been on the rise over the last 30 years. From 1980 to 2010 obesity levels have increased from 7% to 18% in 6-11 year olds and 5% to 18% in 12-19 year olds (CDC, 2013a). In 2010, it was reported that more than one third of U.S. children and adolescents were either overweight or obese (CDC, 2013a).

The constructs developed in self-determination theory are the underpinnings of Skinner and Pitzer's (2012) motivational dynamics model. Self-determination theory holds that individuals are by nature active, intrinsically motivated, and develop through interactions with their environment and other individuals (Deci & Ryan, 2008). When the three basic human needs (competence, autonomy, and relatedness) are met, individuals are able to act on their true nature and move towards their potential (Deci & Ryan, 2008). Skinner and Pitzer's (2012) motivational dynamics model brings self-determination theory into the classroom. Teachers, parents, and peers have the ability to create an environment that supports competence, autonomy, and relatedness, where students become engaged positively affecting learning and academic achievement (Skinner & Pitzer, 2012). Interpersonal support, beliefs about self (competence, autonomy, and relatedness), and engagement as they are related to weight category are under investigation in this study.

In this review of the literature, weight Category (healthy-weight or overweight/obese) were related to several constructs: academic achievement (CMT reading, writing, and mathematics scores), absenteeism, teacher perception of student engagement, student perception of student engagement, beliefs about self (competence, autonomy, and relatedness), and interpersonal support (parent and teacher). Research is emerging on weight-related data, academic performance, and absenteeism rates but there is little or no research reported on engagement, beliefs about self, or interpersonal support. Most researchers have found a negative relationship between weight and academic performance or achievement (Clark & Slate, 2009; Crosnoe & Muller, 2004; Datar & Sturm, 2006; Judge & Jahns, 2007; Li et al., 2008; Sabia, 2007; Shore et al., 2008). However, Huang et al. (2006) found no relationship between increased weight and academic performance or achievement, and mixed results were found by Wingfield et al. (2009), Sabia (2007); and MacCann and Roberts (2012).

Research investigating the relationship between weight and attendance indicated that there was a positive relationship between weight and the number of days absent from school (Datar & Sturm, 2006; Geier et al., 2007; and Shore et al, 2008). A single study was found linking a weight-related variable to engagement. Ramaswamy et al. (2010) concluded there was a negative association between weight and school effort. No studies were found associating a weight-related variable to beliefs about self or interpersonal support. This study was implemented to add to previously conducted research and to fill the gap of the effects of increased weight on school-related factors.

CHAPTER THREE: METHODOLOGY

The purpose of this study was to examine the relationships between students of various body mass types (healthy-weight and overweight/obese) and academic achievement, attendance, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support. This study was implemented to add to previously conducted research and to examine the relationships of increased weight on school-related factors. This chapter provides details of the methodology used to examine this topic and includes the following sections: (a) research questions, (b) hypotheses, (c) description of the setting and subjects, (d) instrumentation, (e) description of the research design, (f) description of the analyses, (g) threats to internal validity, (h) threats to external validity, (i) data collection procedures and timeline, and (j) ethics statement.

Research Questions

This research addressed the following questions:

1. Is there a significant difference between weight categories with respect to academic achievement, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
2. Is there a significant difference between male and female middle school children with respect to academic achievement, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
3. To what extent and in what manner can the variation in CMT Reading scores be explained by weight category, school absences, teacher perception of student

engagement, student perception of student engagement, beliefs about self, and interpersonal support?

4. To what extent and in what manner can the variation in CMT Writing scores be by weight category school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
5. To what extent and in what manner can the variation in CMT Mathematics scores be explained by weight category, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?

Hypotheses

The researcher formed the following hypotheses:

1. There is a significant difference between weight categories with respect to academic achievement, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support.
2. There is a significant difference between male participants and female participants with respect to academic achievement, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support.
3. Weight category, school absences, teacher perception of student engagement, student perception of engagement, beliefs about self, and interpersonal support will significantly explain the variation in CMT Reading scores.

4. Weight category, school absences, teacher perception of student engagement, student perception of engagement, beliefs about self, and interpersonal support will significantly explain the variation in CMT Writing scores.
5. Weight category, school absences, teacher perception of student engagement, student perception of engagement, beliefs about self, and interpersonal support will significantly explain the variation in CMT Mathematics scores.

Descriptions of the Setting and the Subjects

A sample of convenience was taken from a middle school of a suburban town in Connecticut. The demographic profile taken during the 2010 Census indicated the town's population was 18,584 with 16.5% of the population greater than or equal to 5 years of age but less than 18 years of age (United States Census Bureau, 2013). The ethnic make-up of the community was 78.4% Whites, 10.4% Latinos, 5.8% Asians, 2.6% Blacks or African Americans, and 2.3% two or more races (United States Census Bureau, 2013). The home ownership rate during 2007 – 2011 was 62.7%, the median price of owner-occupied housing was $304,000, and the median income was $72,236 (United States Census Bureau, 2013).

The participants were 6^{th}-, 7^{th}-, and 8^{th}-grade students and their corresponding language arts and mathematics teachers. The language arts and mathematics teachers were recruited to participate in the study because the CMT Reading, Writing, and Mathematics scores were used as measures of academic achievement and their perception of student engagement for their discipline was an integral part of the study. All language arts teachers (N = 14) and mathematics teachers (N = 6) consented to be a part of the study. The racial/ethnic makeup of the teachers was 100% White/Caucasian. Table 2 displays the grade level and gender of the teacher participants.

Table 2

Grade Level and Gender of the Teacher Sample

Gender	6^{th}-Grade	7^{th}-Grade	8^{th}-Grade	Total
Mathematics				
Male	0	0	0	0
Female	2	2	2	6
Language Arts				
Male	1	1	1	3
Female	4	3	4	11
Total	7	6	7	20

The student population contained 706 students and was comprised of 76.1% White/Caucasian, 12.7% Hispanic/Latino, 7.2% Asian, 2.4% multi-racial, and 1.6% Black/African American; however, only those students who were enrolled in general education mathematics and language arts classes (n = 680) were targeted to participate in the study. Table 3 displays the counts and percentages of the targeted student population by gender and grade level.

Table 3

Grade Level and Gender of the Targeted Student Population by Count and Percentage

Gender	6^{th}-Grade	7^{th}-Grade	8^{th}-Grade	Total
Count				
Males	132	118	112	362
Females	106	101	111	318
Total	238	219	223	680
Percentage				
Males	19.41%	17.35%	16.47%	53.23%
Females	15.59%	14.86%	16.32%	46.77%
Total	35.00%	32.21%	32.79%	100.00%

Note. n = 680.

After receiving parental consent and student assent, an initial student sample of 229 resulted from this population. The heights, weights, and RAPS-SM were measured for 227 of the student participants. Two students did not complete the RAPS-SM and were omitted from the study. The student sample was comprised of 74.0% White/Caucasian, 7.0% Hispanic/Latino, 7.0% Asian, 6.6% multi-racial, 2.2% Black/African American, and 3.1% other. Table 4 displays the counts and percentages of the student sample by gender and grade level.

Table 4

Grade Level and Gender of the Student Sample by Count and Percentage

Gender	6th-Grade	7th-Grade	8th-Grade	Total
Count				
Males	37	55	9	101
Females	41	57	28	126
Total	78	112	37	227
Percentage				
Males	16.30%	23.79%	3.96%	44.05%
Females	18.06%	25.55%	12.33%	55.95%
Total	34.36%	49.34%	16.30%	100.00%

Note. n = 227.

Instrumentation

The RAPS is an instrument designed to measure three main constructs: Student Engagement, Beliefs About Self, and Experiences of Interpersonal Support from teachers and parents. There are two types of RAPS instruments used to assess these constructs. The first is the RAPS-S, a student self-report student version measuring Engagement (Ongoing Engagement and Reaction to Challenge), Beliefs About Self (Perceived Competence, Perceived Autonomy, and Perceived Relatedness), and Experiences of Interpersonal Support (Parent Support and Teacher Support). The second is the RAPS-T a teacher-report instrument designed to measure teacher perception of student engagement. There are two versions of the RAPS one for the use with children in elementary school, RAPS-SE and RAPS-TE, and the second for use with children in middle school, RAPS-SM and RAPS-TM (RAPS, 1998). The RAPS-SM and RAPS-TM were used for this study because the participants were middle school students. For permission to use the RAPS surveys see Appendix B.

RAPS-SM

The RAPS-SM is an 84-item self-report instrument which measures the psychological and interpersonal processes which affect students' adjustment to school and performance (RAPS, 1998). The psychological and interpersonal processes are measured in three domains: Engagement, Beliefs About Self, and Interpersonal Support with seven separate subdomains: Ongoing Engagement, Reaction to Challenge, Perceived Competence, Perceived Autonomy, Perceived Relatedness, Parent Support, and Teacher Support (RAPS, 1998). The student responds to each statement by indicating very true, sort of true, not very true, or not at all true (RAPS, 1998).

The Engagement construct includes two subdomains: Ongoing Engagement and Reaction to Challenge (RAPS, 1998). There are five statements involving Ongoing Engagement. Sample items include: "I work very hard on my schoolwork." and "I often come to class unprepared." The six statements involving Reaction to Challenge sectioned into projection and coping themes. Examples include: "When something bad happens to me in school, I say the teacher didn't cover the things on the test" and "When something bad happens to me in school, I try to figure out what I did wrong so that it won't happen again" (RAPS, 1998).

The domain Beliefs About Self includes 16 items and three subdomains: Perceived Competence, Perceived Autonomy, and Perceived Relatedness (RAPS, 1998). The subdomain Perceived Competence contains two items on perceptions of control in a school setting and six items relating to strategies necessary to achieve desirable outcomes or avoid undesirable outcomes. Four strategies are presented to measure this subscale: unknown, powerful others, effort, and luck (RAPS, 1998). The final eight items in this subdomain measure the student's belief of his or her ability to enact strategies. Sample items include: "I don't know how to keep myself from getting bad grades" and "The best way for me to get good grades is to get my teacher to like me" (RAPS, 1998).

The subdomain Perceived Autonomy contains nine items involving three types of self-regulation: introjected self-regulation, identified self-regulation, and intrinsic self-regulation (RAPS, 1998). There are three statements associated with each type of self-regulation. Sample statements include: "I do my homework because I'll feel bad about myself if I don't do it" and "I work on classwork because I think it is important" (RAPS, 1998). The relatedness subdomain contains 17 items that measure emotional security with self, satisfaction with self, parental emotional security, teacher emotional security, and peer emotional security. Sample statements include: "I wish I were someone else" and "When I'm with my teacher, I feel good" (RAPS, 1998).

The Experiences of Interpersonal Support domain includes 31 items within two subdomains: Parental Support and Teacher Support. Each subdomain measures the extent to which the student believes that critical adults are involved with them, provide support for their autonomy, and provide structure for them (RAPS, 1998). Sample items include: "My parents don't make it clear what they expect of me in school" and "My teacher thinks what I say is important" (RAPS, 1998).

Directions for RAPS-SM. The directions for the RAPS-SM state that the instrument should be given to groups of children during one 50-minute time period, should not be administered by the students' teacher, and the administrator should read aloud the instructions and each question to the participants as the participants circle their responses (RAPS, 1998).

Validity of RAPS-SM. The RAPS-SM was designed to measure the supports and opportunities available to students in the middle school setting (RAPS, 1998). The motivational model used to create the RAPS-SM dictated how the validity of the instrument was developed. This motivational model indicates that student experiences of support directly affect the beliefs students have about themselves which directly affects their engagement in school (RAPS, 1998). Engagement, in this model, has a direct influence on academic performance and adjustment to school (RAPS, 1998).

The theoretical ordering of the constructs in this motivational model determined the criterion measures used to assess the validity of the domains and subdomains of the RAPS-SM instrument (RAPS, 1998). Optimal and High Risk indicators of student performance and commitment were used to determine the validity of the three main constructs of the RAPS: Student Engagement, Beliefs About Self, and Experiences of Interpersonal Support from teachers and parents. Optimal indicators of student performance and commitment for the middle school students included attendance rate of at least 93% and one or both of the following: a standardized reading achievement test percentile rank score of at least the 70^{th} percentile rank or standardized math achievement test percentile rank score of at least 65 (RAPS, 1998). High Risk performance and commitment indicators for middle school students included an attendance rate below 79%, a standardized reading achievement test percentile rank score below 25, or both criteria (RAPS, 1998). Students whose indicators were not Optimal or High Risk were considered Other.

The validity of the three domains of the RAPS-SM (Engagement, Beliefs About Self, and Interpersonal Support) was assessed by examining the extent to which each measure was associated with the criterion variable with which it was expected to be associated (RAPS, 1998). The continuous Engagement composite scores and performance and commitment indicators were associated with dichotomous criterion indices (High Risk versus Other, Optimal versus Other, and High Risk versus Optimal) using point-biserial correlations (RAPS, 1998). The range of correlations and phi coefficients was .10 – .50 and the relationships were all significant at $p < .0001$ (RAPS, 1998). The same method was used to determine the validity of the Engagement and Interpersonal Support domains (RAPS, 1998).

The Beliefs About Self composite scores and the performance and commitment indicators were associated with the criterion indices (High Risk versus Other, Optimal versus Other, and High Risk versus Optimal) for the RAPS-SM (RAPS, 1998). The strengths of the associations between the RAPS-SM composite scores and the criterion indices were assessed using point-biseral correlations. The strengths of the associations between the RAPS-SM indices and the criterion indices were assessed using phi coefficients (RAPS, 1998). The range of the correlations and phi coefficients was .10 – .50 and all relationships were significant at $p < .0001$ except for Beliefs About Self and High Risk versus Optimal and Beliefs About Self Indicators and High Risk versus Optimal which had a range of correlations and phi coefficients greater than or equal to .51 and were significant at $p < .0001$ (RAPS, 1998).

The Interpersonal Support composite scores and the performance and commitment indicators were associated with the criterion indices (High Risk versus Other, Optimal versus Other, and High Risk versus Optimal). Three associations had a range of correlations and phi coefficients of .10 – .50 and were significant at $p < .0001$ (RAPS, 1998). These associations were Interpersonal Support composite and Optimal versus Other, Indicators and High Risk versus Other, and Indicators and Optimal versus Other. The remaining three associations had a correlation and phi coefficient greater than or equal to .51 and were significant at $p < .0001$ (RAPS, 1998). These associations were Interpersonal composite and High Risk versus Other, Interpersonal composite and High Risk versus Optimal, and Indicators and High Risk versus Optimal (RAPS, 1998).

Reliability of RAPS-SM. To measure the internal consistency of the RAPS-SM, a cronbach alpha value was calculated for the three domains (Engagement, Beliefs About Self, and Experiences of Interpersonal Support) and the sixteen subdomains (RAPS, 1998). The reliability of the RAPS-SM domains Engagement, Beliefs About Self, and Experiences of Interpersonal Support have alpha reliabilities of .77, .87, and .88, respectively. The 16 measured subdomains had alpha levels as follows: Ongoing Engagement (.68), Reaction to Challenge (.69), Promote Competence (.57), Undermine Competence (.76), Maximize Competence (.79), Introjected Self-Regulation (.76), Identified Self-Regulation (.72), Intrinsic Self-Regulation (.78), Emotional Security with Self (.67), Satisfaction with Self (.71), Parental Emotional Security (.74), Teacher Emotional Security (.72), Peer Emotional Security (.73), Relatedness (.82), Parental Support (.86), and Teacher Support (.82) (RAPS, 1998).

RAPS-TM

The RAPS-TM is a three-item teacher-report instrument that measures teacher perception of student engagement in school (RAPS, 1998). The teacher responds to each statement identifying the degree to which individual students seem tuned in to class, come to class unprepared, and does more than is required. The teacher responds very true, sort of true, not very true, or not at all true for each statement (RAPS, 1998).

Directions for RAPS-TM. The directions state that all participating teachers should be given enough questionnaires as they have students, the questionnaires should be distributed at the same time, and should be returned by a fixed deadline (RAPS, 1998).

Validity and reliability of RAPS-TM. The validity of the composite Student Engagement measure and of the Optimal and High Risk indicators was assessed by examining the strength of the associations of these measures with middle school performance and commitment indicators (RAPS, 1998). The middle school performance and commitment indicators for High Risk were an attendance rate below 79%, standardized reading achievement test percentile rank score below 25, or both attendance rate and standardized reading achievement test results (RAPS, 1998). The Optimal performance and commitment indicators for middle school were attendance rate greater than or equal to 93% and one or both of the following: standardized reading achievement test percentile rank score of at least 70 or standardized math achievement test percentile rank score of at least 65 (RAPS, 1998).

The strengths of the associations between the RAPS-TM Engagement composite score and the criterion indices were assessed using point-biseral correlations and the strengths of the associations between the RAPS-TM Engagement indices and the criterion indices were assessed using phi-coefficients (RAPS, 1998). Four of the six correlations and phi-coefficients were in the range .10 – .50 and the remaining two correlations and phi-coefficients were greater than or equal to .51. All correlations and phi coefficients were significant at $p < .0001$ (RAPS, 1998). The reliability of the RAPS-TM student engagement composite had an average inter-item correlation of .69 and an alpha reliability of .87 (RAPS, 1998).

Connecticut Mastery Test (CMT)

The CMT has measured academic growth in Connecticut students in grades 3 – 8 since 1985 and the fourth generation of the CMT, the version used in this study, was introduced in March of 2006 (Hendrawan & Wibowo, 2012). All Connecticut public school children are required to take the CMT except for a small group of children with limited English proficiency (Hendrawan & Wibowo, 2012). The content of the CMT reflects the standards of Connecticut's Curriculum Frameworks and was selected to represent the most important skills from the areas of mathematics, reading, writing, and science for students at each of the grades tested (Hendrawan & Wibowo, 2012). The science portion of the CMT was not reviewed in this section as it was only administered to students in grade 8 and was not used in this study.

The mathematics portion of the CMT consists of a single test that is administered in three sessions for grades 5 through 8 (Hendrawan & Wibowo, 2012). The test questions are comprised of multiple-choice items, grid-in items, and open-ended items which are scored on a 0 – 1, 0 – 2, or 0 – 3 scale, respectively (Hendrawan & Wibowo, 2012). The reading test contains two subsets: Degrees of Reading Power and Reading Comprehension (Hendrawan & Wibowo, 2012). The Degree of Reading Power is administered over a single session and is made up of multiple-choice questions scored on a 0 – 1 scale. The Reading Comprehension portion is given over two sessions and is comprised of multiple-choice items and open-ended items scored on a 0 – 1 scale and a 0 – 2 scale, respectively (Hendrawan & Wibowo, 2012). Finally, the writing test consists of two subsets: Editing and Revising and

Direct Assessment of Writing (Hendrawan & Wibowo, 2012). The Editing & Revising is one session long and contains only multiple-choice items scored on a 0 – 1 scale (Hendrawan & Wibowo, 2012). The Direct Assessment of Writing provides students with a single prompt and the response is scored on a 2 – 12 scale (Hendrawan & Wibowo, 2012).

Validity of CMT. Several studies were conducted to ensure the CMT measured its intended applications (Hendrawan & Wibowo, 2012). In 1984 a survey was sent to more than 8,000 educators in the state of Connecticut to determine (a) the importance of the proposed mathematics, reading, and writing objectives and (b) whether the objectives were taught prior to the fall administration of the CMT (Hendrawan & Wibowo, 2012). In 2000, another survey was created and distributed to validate the test objectives in a similar manner as the 1984 survey. In addition, a two-step validation procedure was created and used to help determine content validity (Hendrawan & Wibowo, 2012). In the first step content experts examined all objectives and test items by evaluating the relationship between each item and its related objective. During the second step content experts evaluated how well each item and objective measured the purported content domain (Hendrawan & Wibowo, 2012). With the implementation of the fourth generation of the CMT, a comprehensive survey of the language arts and mathematics items was undertaken to determine the match between item content and the respective content strands. In addition, categorical concurrence between the test items and the broader content standards were determined (Hendrawan & Wibowo, 2012).

Several established tests were correlated to the CMT to further establish validity of the instrument. In 1993, the seventh edition of the Metropolitan Achievement Test was correlated with the CMT (Hendrawan & Wibowo, 2012). In 2000, the eighth edition of the Metropolitan Achievement Test was correlated with the first administration of the third generation of the CMT (Hendrawan & Wibowo, 2012). Data from the four sections of the Metropolitan Achievement Test (Total Language, Reading Comprehension, Math Concepts, and Math Procedures) were used to calculate the correlations between the CMT tests and MAT sections (Hendrawan & Wibowo, 2012). Concurrent validity was established through these correlations, however, the exact correlations were not stated (Hendrawan & Wibowo, 2012).

The Direct Assessment of Writing portion of the CMT is a single, extended-response measure which is vastly different from the rest of the CMT (Hendrawan & Wibowo, 2012). Therefore, the validity of this portion of the CMT assessment was conducted using a different strategy than the other sections of the test. To establish evidence of construct and concurrent validity, correlations between the Direct Assessment of Writing test and other Language Arts tests such as the Degreees of Reading Power, Reading Comprehension, and Editing and Revising were calculated (Hendrawan & Wibowo, 2012). The authors concluded the CMT tests had construct and concurrent validity but did not state the specific correlations.

Reliability of CMT. Reliability is a measure of the consistence of test performance over time (Hendrawan & Wibowo, 2012). A single administration of the test was used to determine reliability by correlating the selected half-length tests (Hendrawan & Wibowo, 2012). Cronbach's alpha levels were used to measure internal consistency (Hendrawan & Wibowo, 2012). Only the results for the 2011 CMT Writing portion of the test were stated. The Cronbach's alpha levels for 6^{th}-grade, 7^{th}-grade, and 8^{th}-grade Writing scores were .87, .89, and .90, respectively (Hendrawan & Wibowo, 2012).

Researcher-Designed Demographic Survey

Demographic data were collected using a survey designed by the researcher (Appendix B). Each participant was instructed to self-report their gender, grade-level, and ethnicity. The average completion time for this survey was less than two minutes. The results of this survey were used to determine ethnic percentages of the sample and to verify student grade level and gender.

Description of the Research Design

The data collected for this research study were quantitative in nature and were analyzed through inferential statistics. The heights and weights of the participating students were measured directly by the researcher or the school nurse and converted to BMIs. CMT Reading, CMT Writing, and CMT Mathematics scores and the number of absences from school were retrieved from the participating school's data base. Survey research was used to collect data measuring teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support. Gall, Gall, & Borg (2003) indicate that survey research is an effective process for collecting data pertaining to opinions, attitudes, and perceptions of individuals.

For the purposes of this study, the measures of teacher perception of student engagement were the obtained from the results of the RAPS-TM administered to the language arts (Language Arts Engagement) and the mathematics (Mathematics Engagement) teachers. The RAPS-TM was completed twice for each student participant, once by the language arts teacher and a second time by the mathematics teacher. Language Arts Engagement was used as a measure of teacher perception of student engagement when CMT Reading or CMT Writing score was the criterion variable. Similarly, Mathematics

Engagement was used as a measure of teacher perception of student engagement when CMT Mathematics score was the criterion variable. The scores from the three domains of the RAPS-SM administered to the participating middle school students were used as measures of student perception of student engagement (Domain Engagement), self-beliefs (Domain Beliefs About Self) and perception of interpersonal support (Domain Interpersonal Support).

A causal-comparative research design was used for research questions one and two. This design supports the comparison of two or more groups to determine if there are statistical differences on one or more variables (Gall, Gall, & Borg, 2003). The groups being compared for research question one were healthy-weight and overweight/obese and for research question two were male middle school students and female middle school students. The variables under investigation for the varying groups for research questions one and two were academic achievement (CMT Reading, CMT Writing, and CMT Mathematics scores), school absences (Absences), teacher perception of student engagement (Language Arts Engagement and Mathematics Engagement), student perception of student engagement (Domain Engagement), self-beliefs (Domain Beliefs About Self), and interpersonal support (Domain Interpersonal Support).

Correlational research designs were used for research questions three, four, and five. Gall, Gall, and Borg (2003) state that correlational research is used to explore possible causal patterns among variables. In particular, correlational research allows the researcher to analyze a large number of variables in a single study (Gall et al., 2003). Research questions three and four used the same six predictor variables: Weight Category, Absences, Language Arts Engagement, and Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support. The criterion variable for research question three was CMT Reading score and the criterion variable for research question four was CMT Writing score. Research question five used Weight Category, Absences, Mathematics Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support as the predictor variables and CMT Mathematics score as the criterion variable.

Description and Justification of the Analyses

To analyze the data collected for research questions one and two, one-way multiple analysis of variances (MANOVA) were conducted. A MANOVA is used to analyze data when there is one or more independent variables and at least two dependent variables (Meyers, Gamst, & Guarino, 2006). For research question one there was one independent variable, Weight Category, with two levels (healthy-weight and overweight/obese) and eight dependent variables (CMT Reading score, CMT Writing score, CMT Mathematics score, Absences, Language Arts Engagement, Mathematics Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support). Similarly, research question two had one independent variable, Gender, with two levels (male middle school students and female middle school students) and the same nine dependent variables mentioned used in research question one. The MANOVA was evaluated with an *F*-statistic with a traditional alpha value of .05 (Meyers et al., 2006).

Research questions three, four, and five were analyzed through stepwise multiple linear regression procedures. Meyers, Gamst, and Guarino (2006) state that in multiple regression research, the researcher predicts one variable (the criterion variable) from a combination of other related variables (the predictor variables). The predictor variables for research questions three and four were Weight Category, Absences, Language Arts Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal

Support. The predictor variables for research questions five were Weight Category, Absences, Mathematics Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support. The criterion variables for research questions three, four, and five were CMT Reading score, CMT Writing score, and CMT Mathematics score, respectively. A coefficient of multiple determination, R^2, was used with an alpha level of .05 to determine the strength and direction of association of the criterion variable with the multiple predictor variables (Meyers et al., 2006).

Although the researcher used the same data in multiple research questions and analyses, a Bonferroni adjustment was not applied and significance was reached when $p < .05$ for each research question. Nakagawa (2004) states that Bonferroni adjustments reduce the power of the test, increase Type II errors, and contribute to publication bias. Instead, Nakagawa (2004) suggests reporting observed effect size and exact *p*-values which allows the reader to determine the importance and the statistical significance of the results.

Data Collection Procedures and Timeline

A complete portrayal of the timeline with the data collection procedures are presented in this section. The timeline presents the steps taken to perform the study in the order they were undertaken along with a comprehensive account of the data collection procedures for all measured items: heights, weights, RAPS-SM, RAPS-TM, CMT scores, and the number of student absences.

Receiving Permission and Consent

Permission from the Institutional Review Board of Western Connecticut State University was requested and received before the implementation of this study. Written permission to conduct the study was obtained from the superintendent of schools and the principal of the middle school before contacting potential teacher participants. The researcher met with the 6^{th}-, 7^{th}-, and 8^{th}-grade language arts and mathematics teachers during their grade level and content specific Professional Learning Community meetings, a total of nine meetings, to explain the purpose of the study, gather support for the study, and obtain teacher consent. Of the 20 eligible teachers present during these meetings, 18 gave written permission to be a part of the study at this time. The mathematics teachers were given the parental consent forms three days prior to the distribution date along with written directions on how to distribute them, where to return them, and how to contact the researcher should they have questions. The 6^{th}-, 7^{th}-, and 8^{th}-grade mathematics teachers distributed the parent consent forms to all general education students. Of the eligible 680 general education students, 119 returned signed parent consent forms by the deadline. Because the parental consent rate was low (17.50%), the researcher visited all 6^{th}-, 7^{th}-, and 8^{th}-grade mathematics classes to explain the purpose of the study, encourage additional student participation, and redistribute the parent consent forms to potential student participants. The 6^{th}-, 7^{th}-, and 8^{th}-grade mathematics teachers collected the signed forms and returned them to a secretary in the main office by the given deadline. An additional 110 signed parent consent forms were obtained for a total of 229 student participants or 33.68% of the eligible students. In addition, the remaining two teachers provided written consent for a total of 20 teacher participants, the entire language arts and mathematics teacher population. See Appendix C for letters of consent and assent.

Height and Weight Data Collection

To collect the heights and weights of the participating students, the researcher attended all 6^{th}-, 7^{th}-, and 8^{th}-grade physical education classes over a two-day period. There were 30 total physical education classes, with 15 meeting each day. During each class period, all students with written parental consent were asked to report to the office of one of the physical education teachers. The researcher explained to the participants their written assent was needed to continue in the study. All students with parental consent gave their written assent to be a part of the study. Of the 229 students with parental consent, 206 were present on these two days, gave written assent to be a part of the study, and had their heights and weights measured.

Heights and weights were measured and recorded in a back room of the office allowing privacy for the student participants. All measurements were taken with students dressed in their gym uniforms, comprised of a short-sleeved shirt and shorts, and without footwear. The heights were taken on a Health O Meter Professional scale, model number 402KL, and were measured to the nearest quarter inch. Weights were measured on a Tanita digital scale, model number BF-679W, and were measured to the nearest two-tenths of a pound. The researcher returned a third day to obtain student assent and record the heights and weights of as many of the 23 students who were absent the day their physical education class met. The written assents and the heights and weights of 11 additional students were obtained at this time for a total 217 students. Over the next three school days, the nurse collected the signed assent forms and measured and recorded the heights of the remaining 12 students who had parental consent, for a total of 229 students.

RAPS-SM Data Collection

The RAPS-SM was administered on the same day the researcher returned to record the missing heights and weights of students with parent consent. The students reported by grade level (6^{th}-, 7^{th}-, or 8^{th}-grade) to one of three designated areas in the school cafeteria. Once in their designated areas, one of three assistants gave each participating student a hard copy of the RAPS-SM with their individual identification number written on the front cover. The students were asked to take a seat in the cafeteria and wait for further instruction. After all students had their assigned test, the researcher administered the RAPS-SM in accordance with the directions stated in the manual. The directions were read aloud followed by each of the statements of the RAPS-SM. The students circled their response to each question after it was read aloud. The three assistants circulated through the cafeteria to keep students on task and to define any terms they did not know. A total of 203 of the 229 participating students with parent consent took the RAPS-SM at this time. Over the next three school days the assistant principal of the school administered the RAPS-SM to 24 of the remaining 26 students using the protocols as stated in the RAPS manual. Two students were unable to take the RAPS-SM and were omitted from the study.

RAPS-TM Data Collection

The RAPS-TM was given to the 14 language arts and 6 mathematics teachers following the directions as stated in the manual. The participating teachers were given a copy of the RAPS-TM for each of their students who gave parental consent and student assent to be a part of the study. The directions on how to complete the forms were stated on the first page of each series of questionnaires. The directions were clear and stated the teacher should circle one of four responses (very true, sort of true, not very true, or not at all true) for each of the three statements for each student (RAPS, 1998). The student names appeared on each form and the teachers circled their responses to each of the three questions on the survey. The teachers were given time during a Professional Learning Community meeting to complete the surveys. All teachers completed and returned the forms by the given deadline.

CMT Scores Data Collection

The Connecticut State Department of Education released the results of the CMT reading, writing, and mathematics scores to individual schools in August. The assistant principal examined the academic records of the participants and recorded the individual CMT reading, writing, and mathematics scale scores for the 2012-2013 school year. Table 5 displays the average CMT scale cores for reading, writing, and mathematics for the state, the school, and the sample by grade level.

Table 5

Average Scale CMT Scores by Grade Level and Grouping

Grouping	CMT Reading	CMT Writing	CMT Mathematics
6th-Grade			
Connecticut	260.1	258.1	263.8
School	271.2	276.5	276.4
Sample	280.3	287.4	286.0
7th-Grade			
Connecticut	255.5	248.9	264.5
School	259.8	260.6	271.5
Sample	270.3	270.3	282.8
8th-Grade			
Connecticut	264.1	254.4	261.9
School	278.5	271.1	279.3
Sample	301.2	303.9	301.9

Absences Data Collection

The assistant principal recorded the number of absences accrued during the school year where the length of the school year was from the last week of August to the second week of June. An absence was indicated when a student was on campus for less than four hours of the school day.

Ethics Statement

This research project was approved by the Institutional Review Board of Western Connecticut State University. Permission to participate in this research was sought and received from the school district's superintendent, the middle school principal, participating teachers, and the parents of participating students. Assent was obtained from all participating students. To assure confidentiality, each participating student and teacher were given a coded identification number. The name of the school district and the participants were omitted when reporting the findings of the study.

CHAPTER FOUR: ANALYSIS OF THE DATA
AND AN EXPLANATION OF THE FINDINGS

The purpose of this study was to examine the relationships between overweight/obese students and healthy-weight students on school-related factors. Five research questions were addressed:

1. Is there a significant difference between Weight Categories (healthy-weight and overweight/obese) of middle school students with respect to academic achievement, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
2. Is there a significant difference between Gender (male middle school students and female middle school students) with respect to academic achievement, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
3. To what extent and in what manner can the variation in CMT Reading scores be explained by weight category, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
4. To what extent and in what manner can the variation in CMT Writing scores be explained by weight category, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
5. To what extent and in what manner can the variation in Mathematics CMT scores be explained by weight category, school absences, teacher perception of student

engagement, student perception of student engagement, beliefs about self, and interpersonal support?

Chapter Four presents the results of this research project in the following sections: (a) description of the data, (b) data screening process, (c) calculations of BMI and body weight categories, (d) data preparation and analysis for research questions one through five.

Description of the Data

The data analyzed in this study were collected through the use of two versions of the Research Assessment Package for Schools, the teacher version (RAPS-TM) and the student version (RAPS-SM) designed for use in middle schools. The RAPS-TM was administered to two groups of teachers, the language arts (N = 14) and mathematics teachers (N = 6). For each participating student, the teachers completed a three-question survey designed to measure teacher perception of student engagement in their content area. Each student in the study had a teacher perception of student engagement score for both language arts (Language Arts Engagement) and mathematics (Mathematics Engagement). The RAPS-SM was administered to the participating students (n = 227) measuring three domains and seven subdomains. The scores for the three domains (Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support) were used during the data analysis. The number of student absences for the 2012-2013 school year were recorded for each participating student. In addition, the Connecticut Mastery Test (CMT) scores in Reading, Writing, and Mathematics were used in the data analysis. Finally, each student's BMI was calculated and a body weight category (underweight, healthy-weight, overweight, or obese) was assigned based on the age, gender, and BMI of the student.

Data Screening Process

Student identification numbers and the corresponding results of the RAPS-SM were entered into a spreadsheet. There were 17 student participants who circled multiple responses for at least one question on the RAPS-SM. An average of their responses for a single statement was entered into the spreadsheet for each statement with multiple responses (Tabachnick & Fidell, 2007). The identification numbers of the individuals who circled multiple responses for at least one statement were: 205, 227, 233, 235, 237, 238, 239, 248, 260, 264, 267, 283, 285, 293, 415, 436, and 438. Once the student responses to the RAPS-SM were entered into the spreadsheet, a verification process was used to check that the data entered were complete and accurate.

Meyers et al. (2006) advise inspecting the data to verify they fall within the acceptable range of possible responses. The results of the RAPS-SM were reviewed and all values had scores from 1 to 4, the possible scores of the instrument. Meyers et al. (2006) suggest a confirmation procedure be utilized to assure data were entered correctly. The researcher examined 25 hard copies of the RAPS-SM and compared the results to the data entered electronically to confirm the data were entered accurately. There were no errors found with the data entry.

The researcher scanned the data and recorded the identification numbers of the individuals with missing data and confirmed through the corresponding hard copy of the RAPS-SM that the data were missing. There were 29 pieces of data missing from 21 participating students. Tabachnik and Fidell (2007) state a conservative method to replace missing values is with the mean value of the variable. The mean of each domain (Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support) was calculated and the missing values for the 21 students were replaced with the mean of the corresponding domain. The identification numbers of these individuals were 106, 118, 128, 136, 145, 164, 167, 175, 176, 207, 263, 264, 212, 235, 253, 266, 285, 302, 421, 423, and 438.

The scores of the RAPS-TM were entered into the spreadsheet and inspected under the same criteria as the scores from the RAPS-SM. All data fell in the appropriate range, there were no multiple responses, and no data were missing. The researcher concluded that the data collected from the RAPS were cleaned and continued preparing the data for analysis.

Calculations of BMI and Body Weight Categories

Individual BMIs were calculated in EXCEL (Microsoft, 2010) from the recorded heights and weights using the following formula weight (lb) / [height (in)]^2 × 703 (CDC, 2013). These values were used to place students into one of four weight categories based on the BMI growth charts for age and gender (Appendix C): underweight (BMI percentile ≤ 5th), healthy-weight (5th < BMI percentile ≤ 85th), overweight (85th < BMI percentile ≤ 95th), and obese (BMI percentile > 95th). The CDC Data Table of BMI-for-Age Charts provide the BMI cutoff points for the 3rd, 5th, 10th, 25th, 50th, 75th, 85th, 90th, 95th, and 97th percentiles of children and adolescents by age and gender (Kuczmarski, 2002). Ages in the CDC Data Table of BMI-for-Age Charts begin at 24-24.99 months and include every consecutive month ending with 239-239.99 months (Kuczmarski, 2002). An example of these cutoff points is given in Table 6.

Table 6

Excerpt from the CDC Data Table of BMI-for-Age Charts

Months Old	5th Percentile BMI Value	85th Percentile BMI Value	95th Percentile BMI Value
Females			
144 – 144.99	14.83	21.74	25.26
145 – 145.99	14.87	21.81	25.35
146 – 146.99	14.91	21.88	25.43
Males			
144 – 144.99	14.98	21.02	24.23
145 – 145.99	15.01	21.09	24.31
146 – 146.99	15.05	21.16	24.39

Adapted from "Data Table of BMI-for-Age Charts 2-20 Years." Copyright 2002 by Centers for Disease Control and Prevention. 2000 CDC Growth Charts for the United States: Methods and Development.

The BMIs for the participating students were calculated using the age in months at the time that the heights and weights were recorded. The Data Table of BMI-for-Age Charts was used in conjunction with the participants' gender and BMI to find the weight category (underweight, healthy-weight, overweight, or obese) to which each individual belonged. Table 7 presents the number of students in each weight category by gender and grade level.

Table 7

Weight Category by Gender and Grade Level

Gender	Underweight	Healthy-Weight	Overweight	Obese	Total
Males					
6th-Grade	1	25	7	4	37
7th-Grade	0	39	8	7	54
8th-Grade	1	5	2	1	9
Females					
6th-Grade	3	31	5	2	41
7th-Grade	0	42	9	7	58
8th-Grade	2	17	8	1	28
Total	7	159	39	22	227

The original intent of this research was to compare the four groups (underweight, healthy-weight, overweight, and obese) on school-related factors through research question one. Tabachnick and Fidell (2007) state it is important to have more cases in each cell than there are dependent variables to avoid the cell becoming singular. When cell numbers do not meet the criteria the assumption of homogeneity of the variance-covariance matrices is violated and the power of the test is not significant (Tabachnick & Fidell, 2007). Additionally, even if the cell has one or two more cases than dependent variables, the assumption is likely to be rejected (Tabachnick & Fidell, 2007).

For the purposes of this research, the underweight category was omitted and the overweight and obese categories were collapsed to create the group overweight/obese. There were seven individuals who were classified as underweight. The number of individuals in this cell did not meet the threshold of the nine dependent variables needed to avoid the cell becoming singular. The researcher chose to eliminate these individuals from the analysis of research question one instead of collapsing them into the healthy-weight group because the two groups may have had different attributes. Furthermore, the researcher collapsed the overweight and obese groups to create the group overweight/obese in an attempt to avoid violating the assumption of homogeneity of variances. Table 8 displays the number of participants in the resulting two groups.

Table 8

Weight Category by Gender for Collapsed Groups

Gender	Healthy-Weight	Overweight/Obese	Total
Males	69	29	98
Females	90	32	122
All Students	159	61	220

Note. n = 220.

Data Preparation for Research Question One

After the data were cleaned and the participants were placed into one of two weight categories, the data were copied and pasted into a spreadsheet using Statistical Package for the Social Sciences (SPSS) software (IBM Corp., 2012). SPSS (IBM Corp., 2012) was used to find and eliminate univariate and multivariate outliers, verify assumptions, calculate descriptive statistics, and conduct analyses of the research question.

Research Question One

1. Is there a significant difference between Weight Category (healthy-weight and overweight/obese) of middle school students with respect to academic achievement, school absences, teacher perception of student engagement, student perception of student engagement beliefs about self, and interpersonal support?

Outliers for Research Question One

Meyers et al. (2006) state cases with extreme values need to be addressed before proceeding with any statistical analysis. Univariate outliers exist when extreme values on a single variable are present while multivariate outliers are present when extreme values exist on a combination of variables (Meyers et al., 2006). Tabachnick and Fidell (2007) state that when performing a MANOVA on grouped data the univariate outliers should be sought within each group.

Univariate outliers. To investigate research question one, the data were grouped by weight category (healthy-weight and overweight/obese). Tabachnick and Fidell (2007) recommend that boxplots be used to identify potential outliers as they display extreme values that fall far from the median (Tabachnick & Fidell, 2007). SPSS software (IBM Corp., 2012) was used to construct boxplots for each dependent variable (CMT Reading, CMT Writing, CMT Mathematics, Language Arts Engagement, Mathematics Engagement, Absences, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support) for Weight Category. Initial indications for Weight Category suggested that there were 22 possible outliers for the healthy-weight group and 8 possible outliers for the overweight/obese group over the 9 dependent variables. Tabachnick and Fidell (2007) propose that after potential univariate outliers are located, the researcher must decide whether transformations should be performed to improve the normality of the distributions and to pull univariate outliers closer to the center of the distribution. The researcher completed these tasks in the order that was suggested by Tabachnick and Fidell (2007) confirming that univariate outliers were present and a transformation was needed.

The researcher checked for normality using skewness and kurtosis where skewness refers to the symmetry of the distribution and kurtosis refers to clustering of scores toward the center of the distribution for each variable (Meyers et al., 2006). Departures from normality were considered when skewness or kurtosis measured above +1 or below -1 (Meyers et al., 2006). An examination of Weight Category indicated that skewness (1.326) and kurtosis (1.503) parameters were violated for Absences in the healthy-weight group and skewness (1.039) was violated for Domain Engagement in the overweight/obese group.

Tabachnick and Fidell (2007) suggest transforming the data to produce skewness and kurtosis values that are nearest to zero with the fewest outliers possible. A square root transformation should be tried first if the distribution differs moderately from normal, followed by a logarithmic transformation if the distribution differs substantially, and an inverse transformation if the distribution differs severely from normal (Tabachnick & Fidell, 2007). Furthermore, if the data are negatively skewed, the best strategy is to reflect the variable and perform the transformation on the reflected variable (Tabachnick & Fidell, 2007). Finally, Tabachnick and Fidell (2007) suggest transforming the data before the removal of outliers.

A square root transformation was performed on the variables Absences and Domain Engagement to help improve normality and reduce the effects of outliers. No reflection was necessary before the square root was taken of the variable Absences as it was positively skewed. The transformation resulted in a skewness of 0.07 and a kurtosis of -0.38 for Square

Root of the Absences in the healthy-weight group and a skewness of -0.15 and a kurtosis of -0.54 for the overweight/obese group. Because the variable Domain Engagement was negatively skewed, it was first reflected to make it positively skewed. Tabachnick and Fidell (2007) state to reflect a variable find the largest score in the distribution and add one to it to create a constant that is larger than any score in the distribution, then, subtract each score from that constant to create a new variable. The new variable will have a positive skewness which may be transformed under the above guidelines (Tabachnick & Fidell, 2007). The largest score for Domain Engagement was 4.00 and 1.00 was added to that score to create a new constant of 5.00. Each score was subtracted from 5.00 to create a new variable named Reversals of Domain Engagement. The square root of the variable was taken and the resulting transformation for Square Root of the Reversals of the Domain Engagement yielded a skewness of -0.69 and kurtosis of 0.13 for the healthy-weight group and a skewness of -0.17 and a kurtosis of -0.63 for overweight/obese group. The Square Root of the Absences and the Square Root of the Reversals of Domain Engagement were used in the analysis of the data in research question one. The skewness and kurtosis levels for the healthy-weight group are displayed in Table 9 and the skewness and kurtosis levels for the overweight/obese group in Table 10.

Table 9

Skewness and Kurtosis Levels for Healthy-Weight Group

Variable	Skewness	Kurtosis
CMT Reading[a]	0.00	-0.14
CMT Writing[a]	0.44	0.17
CMT Mathematics[a]	-0.06	0.50
Language Arts Engagement[b]	-0.49	-0.84
Mathematics Engagement[b]	-0.74	-0.43
Square Root of the Absences	0.07	-0.38
Square Root of the Reversals of Domain Engagement[c]	0.67	0.04
Domain Beliefs About Self[c]	-0.69	0.13
Domain Interpersonal Support[c]	-0.43	-0.73

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics represent measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement as measured by the RAPS-TM. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support as measured by the RAPS-SM; and *n* = 156.

Table 10

Skewness and Kurtosis Levels for Overweight/Obese Group

Variable	Skewness	Kurtosis
CMT Reading[a]	-0.43	0.05
CMT Writing[a]	0.82	0.97
CMT Mathematics[a]	-0.36	0.03
Language Arts Engagement[b]	-0.66	-0.49
Mathematics Engagement[b]	-0.70	0.03
Square Root of the Absences	-0.15	-0.54
Square Root of the Reversals of Domain Engagement[c]	0.78	0.13
Domain Beliefs About Self[c]	-0.17	-0.63
Domain Interpersonal Support[c]	-0.24	-0.40

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics represent measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement as measured by the RAPS-TM. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support as measured by the RAPS-SM; and n = 60.

Tabachnick and Fidell (2007) suggest checking for outliers and removing them after the transformation of variables has been completed. An outlier was determined by a score that was more than three standard deviations away from the mean (Tabachnick & Fidell, 2007). Scores that were potential outliers as indicated by the boxplots were converted to z-scores using the formula in Figure 2.

$$z = \frac{\text{(score - mean)}}{\text{standard deviation}}$$

Figure 2. Formula for calculating z-scores (Meyers et al., 2006).

The participants with z-scores greater than 3.00 or less than -3.00 were considered outliers and were omitted from the analysis of research question one (Tabachnick & Fidell, 2007). SPSS (IBM Corp., 2012) was used to calculate the z-scores for each dependent variable for the healthy-weigh and overweight/obese groups. An examination of the healthy-weight group indicated that there were three outliers. Students with identification numbers 127 (z = -3.48), 204 (z = -3.72), and 266 (z = -3.28) were classified as outliers in Mathematics Engagement, CMT Reading, and Domain Beliefs About Self, respectively, and were removed from the data set. No outliers were found in the overweight/obese group using these criteria.

Multivariate outliers. Meyers et al. (2006) suggest using Mahalanobis distance (D^2) as an objective procedure for detecting multivariate outliers where D^2 measures the multivariate “distance” between each case and the multivariate mean of each group. This method requires evaluation through a chi-square distribution with a stringent significance level of .001 (Meyers et al., 2006). The chi-squared criterion was set at χ^2 = 27.877, with 9 degrees of freedom, and significance at .001. SPSS (IBM Corp., 2012) was used to calculate the Mahalanobis distance for each of variable where 27.496 was the largest D^2 value calculated. The researcher concluded there were no multivariate outliers because the criterion was not reached for any of the variables. After the removal of the univariate outliers and confirming there were no multivariate outliers, a sample size of n = 217 was used during the data analysis for research question one.

Multivariate Statistical Assumptions for a MANOVA

Several assumptions were verified before performing the multivariate analysis. In the case of conducting a MANOVA the assumptions include independence, normality, linearity, correlations of the dependent variables, homoscedasticity, and Bartlett's test of spherecity (Meyers et al., 2006).

Independence. The assumption of independence requires that the scores for each participant on any variable are independent from the scores of all the other participants (Green & Salkind, 2008). Research question one compared two distinct groups, healthy-weight and overweight/obese. The classification of the participants based on CDC Data Table of BMI-for-Age Charts places each individual into one of the two groups based on distinct cutoff points, healthy-weight (5^{th} < BMI percentile ≤ 85^{th}) and overweight/obese (BMI > 85^{th}). Each participant may belong to one and only one group.

Normality. The assumption of normality is verified when the continuous variables are normally distributed meaning they are approximately bell-shaped (Meyers et al., 2006). Skewness and kurtosis are measures of normality where skewness is a measure of symmetry of the distribution and kurtosis is a measure of the peakedness of the distribution (Meyers et al., 2006). Departures from normality were considered when skewness or kurtosis measured above +1 or below -1 range in data normality (Meyers et al., 2006). Skewness and kurtosis levels for the dependent variables were all in the acceptable range of -1 to 1 (Meyers et al., 2006).

Linearity. Tabachnick and Fidell (2007) define linearity as a straight line relationship between the variables which may be assessed through the examination of bivariate scatterplots. If the variables are normally distributed and linearly related, the bivariate scatterplots will be oval-shaped (Tabachnick & Fidell, 2007). SPSS (IBM Corp., 2012) was used to create scatterplots to examine all possible pairs of dependent variables. The data produced bivariate scatterplots which were oval-shaped and the researcher concluded the assumption of linearity had been met.

Correlations of the dependent variables. Meyers et al. (2006) state the variables used in the analysis should be related to each other in a linear relationship. The Pearson correlation coefficient (Pearson r) may be used to assess the degree of the linear relationship between two variables (Meyers et al., 2006). Furthermore, Meyers et al. (2006) suggest that two variables with a correlation in the middle .7s or higher should not be used together in multivariate analysis. Table 11 displays the Pearson product moment correlations of the dependent variables. Domain Beliefs About Self was highly correlated with the Square Root of the Reversals of Domain Engagement ($r = .764$, note that the opposite correlation is reported because the variable was reversed throughout the data transformation) and Domain Interpersonal Support ($r = .737$) and was omitted from the analysis of the research question. All remaining correlations were between -.75 and .75 and remained in the analysis of the data.

Table 11

Pearson Product-Moment Correlations for Research Question One

	CMTWrite	CMTMath	LAEngage	MAEngage	Absences	DEngage	DBeliefs	DInter	Weight
CMTRead[a]	.592**	.700**	.437**	.460**	-.153*	.365**	.316**	.163*	-.175**
CMTWrite[a]		.505**	.468**	.502**	-.172*	.278**	.339**	.191**	-.140*
CMTMath[a]			.348**	.483**	-.117	.291**	.284**	.135*	-.106
LAEngage[b]				.510**	-.073	.278**	.312**	.212**	-.012
MAEngage[b]					-.296**	.349**	.301**	.204**	-.194**
Absences						-.155*	-.095	-.034	.222**
DEngage[c]							.764**	.612**	-.080
DBeliefs[c]								.737**	-.075
DInter[c]									-.014

Note. CMTRead is CMT Reading score, CMTWrite is CMT Writing score, CMTMath is CMT Mathematics score, LAEngage is Language Arts Engagement, MAEngage is Mathematics Engagement, DEngage is Domain Engagement, DBeliefs is Domain Beliefs About Self, and DInter is Domain Interpersonal Support. [a]CMT Reading, CMT Writing, and CMT Mathematics scores represent measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support. Absences represents the Square Root of the Absences; Domain Engagement represents the Square Root of the Reversals of Domain Engagement; $n = 216$; $^{*}p < .05$; $^{**}p < .01$; two-tailed analyses were performed. Opposite correlations are reported for the Square Root of the Reversals of Domain Engagement because the variable was reversed.

Homoscedasticity. The assumption of homogeneity of variance is met when the variability of the dependent variables is approximately the same at all levels of the grouped data (Tabachnick & Fidell, 2007). The Box's *M* test for equality of variance-covariance matrices is used when analyzing grouped data with more than one quantitative dependent variable (Meyers et al., 2006). Unequal variability for unequal sample sizes occurs when $p < 0.001$ (Tabachnick & Fidell, 2007). The assumption for homoscedasticity was verified as Box's $M = 57.424$, where $p = .025$.

Bartlett's test of spherecity. Meyers et al. (2006) state there must be sufficient correlation between the dependent variables for multivariate analysis to continue. Bartlett's test of spherecity is significant when $p < 0.001$ indicating there is sufficient correlation between the dependent measures (Meyers et al., 2006). The assumption for sufficient correlation between the dependent variables was verified as the Bartlett's test of spherecity yielded $\chi^2 = 7958.047$ with $p < 0.001$.

Descriptive Statistics Research for Question One

After removal of the outliers a sample 156 participants for the healthy-weight group and a sample of 60 students for the overweight/obese group was used for the data analyses. Table 12 displays the descriptive statistics for the healthy-weight group and Table 13 displays the descriptive statistics for the overweight/obese group.

Table 12

Descriptive Statistics for the Healthy-Weight Group for Research Question One

Variable	Min	Max	*Mean*	*SD*
CMT Reading[a]	189.00	366.00	283.33	33.60
CMT Writing[a]	200.00	400.00	285.83	39.66
CMT Mathematics[a]	189.00	385.00	290.33	34.06
Language Arts Engagement[b]	1.33	4.00	3.14	0.76
Mathematics Engagement[b]	2.00	4.00	3.41	0.56
Absences	0.00	25.00	5.74	5.40
Domain Engagement[c]	2.20	4.00	3.53	0.37
Domain Interpersonal Support[c]	2.28	4.00	3.31	0.42

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement and Domain Interpersonal Support are measures of student perception of engagement and interpersonal support. Statistics for Absences and Domain Engagement are reported in the table although Square Root of the Absences and Square Root of the Reversals of Domain Engagement were used in the data analysis; and n = 156.

Table 13

Descriptive Statistics for the Overweight/Obese Group for Research Question One

Variable	Min	Max	*Mean*	*SD*
CMT Reading[a]	175.00	359.00	269.25	40.22
CMT Writing[a]	191.00	400.00	273.08	43.08
CMT Mathematics[a]	190.00	351.00	282.07	37.30
Language Arts Engagement[b]	1.00	4.00	3.12	0.82
Mathematics Engagement[b]	1.33	4.00	3.14	0.69
Absences	0.00	26.00	9.02	7.19
Domain Engagement[c]	2.23	4.00	3.49	0.42
Domain Interpersonal Support[c]	2.42	4.00	3.29	0.37

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support. Statistics for Absences and Domain Engagement are reported in the table although Square Root of the Absences and Square Root of the Reversals of Domain Engagement were used in the data analysis; and $n = 60$.

Data Analysis for Research Question One

The results of the MANOVA indicated that Wilks' Lambda was significant at the $p < .05$ significance level where $F(8, 207) = 2.661$, $p = .007$, and *partial* $\eta^2 = 0.093$ demonstrating significance of the model. The Levene's test assesses whether the variances are equal across the levels of the independent variable where unequal variability is indicated when $p < .05$ (Meyers et al., 2006). The Levene's test indicated that the variances were equal across the levels of weight category. The results of the Levene's test are reported in Table 14.

Table 14

The Levene's Tests for Research Question One

Variable	*F*	df_1	df_2	Sig.
CMT Reading[a]	2.626	1	214	.107
CMT Writing[a]	.208	1	214	.649
CMT Mathematics[a]	1.289	1	214	.257
Language Arts Engagement[b]	.400	1	214	.528
Mathematics Engagement[b]	3.621	1	214	.058
Square Root of the Absences	.012	1	214	.911
Domain Engagement[c]	.325	1	214	.189
Domain Interpersonal Support[c]	.874	1	214	.351

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement and Domain Interpersonal Support are measures of student perception of engagement and interpersonal support, respectively. Domain Engagement represents the Square Root of the Reversals of Domain Engagement.

The Tests of Between-Subjects Effects indicated there were significant differences between the healthy-weight and overweight/obese groups on CMT Reading (F = 6.780, p = .010, *partial* η^2 = .031), CMT Writing (F = 4.262, p = .040, *partial* η^2 = .020), Mathematics Engagement (F = 8.362, p = .004, *partial* η^2 = .038), and Square Root of Absences (F = 11.085, p = .001, *partial* η^2 = .049). Table 15 provides a complete list of the results for the Tests of Between-Subjects Effects.

Table 15

Tests of Between-Subjects Effects for Weight Category for Research Question One

	SS	*df*	*MS*	*F*	Sig.	*partial* η^2
CMT Reading[a]	8566.602	1	8566.602	6.780	.010*	.031
CMT Writing[a]	7037.293	1	7037.293	4.262	.040*	.020
CMT Mathematics[a]	2956.713	1	2956.713	2.416	.122	.011
LA Engagement[b]	0.017	1	0.017	0.029	.866	.000
MA Engagement[b]	3.013	1	3.013	8.362	.004**	.038
Absences	16.958	1	16.958	11.085	.001**	.049
Domain Engagement[c]	0.032	1	0.032	1.377	.242	.006
Domain Interpersonal[c]	0.007	1	0.007	0.041	.839	.000

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement and Domain Interpersonal Support are measures of student perception of engagement and interpersonal support, respectively. LA Engagement represents Language Arts Engagement; Math Engagement represents Mathematics Engagement; Absences represents Square Root of the Absences; Domain Engagement represents the Square Root of the Reversals of Domain Engagement; Domain Interpersonal represents Domain Interpersonal Support; $^{*}p < .05$; and $^{**}p < .01$.

The results of the MANOVA indicated that overweight/obese middle school children scored significantly lower ($p = .010$, *partial* $\eta^2 = .031$) on CMT Reading scores ($M = 269.25$, $SD = 40.22$) than healthy-weight students ($M = 283.33$, $SD = 33.60$). Overweight/obese middle school students scored significantly lower ($p = .040$, *partial* $\eta^2 = .020$) on CMT Writing scores ($M = 273.08$, $SD = 43.08$) than healthy-weight students ($M = 285.83$, $SD = 39.66$). Overweight/obese middle school students scored significantly lower ($p = .004$, *partial* $\eta^2 = .038$) on Mathematics Engagement scores ($M = 3.14$, $SD = 0.69$)

than healthy-weight students (*M* = 3.41, *SD* = 0.56). Finally, overweight/obese middle school children recorded significantly higher (p = .001, *partial* η^2 = .049) Absences (*M* = 9.02, *SD* = 7.19, *Min.* = 0, *Max.* = 26) than the healthy-weight students (*M* = 5.74, *SD* = 5.40, *Min*. = 0, *Max.* = 25). The Square Root of the Absences were used in the analysis of the data resulting in *M* = 2.70 and *SD* = 1.32 for overweight/obese middle school children and *M* = 2.08 and *SD* = 1.20 for healthy-weight middle school children. There were no significant differences between the healthy-weight and overweight/obese groups on CMT Mathematics, Language Arts Engagement, Square Root of the Reversals of Domain Engagement, or Domain Interpersonal Support.

Data Preparation and Analysis for Research Question Two

The data were prepared by checking for and eliminating univariate and multivariate outliers after grouping the participants by gender. The resulting data set was used to verify the assumptions of a MANOVA, calculate descriptive statistics, and conduct analyses for research question two.

Research Question Two

2. Is there a significant difference between Gender (male middle school students and female middle school students) with respect to academic achievement, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?

Outliers for Research Question Two

The data were examined for univariate and multivariate outliers in the same manner as in research question one.

Univariate outliers. To investigate research question two, the data were grouped by gender. An examination of skewness and kurtosis were undertaken to determine if a transformation should be used before removal of any outliers as suggested by Tabachnick and Fidell (2007). Violations of skewness (1.338) and kurtosis (1.452) were indicated for female participants for the variable Absences. A violation of skewness (1.019) also was indicated for male participants for the variable Absences. No other violations of skewness or kurtosis were found for the participants when grouped by gender as the values were between -1 and 1 (Meyers et al., 2006). A transformation of the square root of the Absences was taken to correct this issue before checking for univariate outliers. The transformation resulted in values of skewness and kurtosis that fell within the acceptable range of -1 to 1. The variable Square Root of Absences had a skewness of 0.111 and kurtosis of -0.121 for the female participants and a skewness of 0.065 and a kurtosis of -0.816 for the male participants.

After the data for the Absences was transformed to the Square Root of the Absences, the researcher examined the data for univariate outliers. Boxplots were created to identify potential univariate outliers for CMT Reading, CMT Writing, CMT Mathematics, Square Root of the Absences, Mathematics Engagement, Language Arts Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support for the male group and the female group. Initial indications for gender suggested that there were 11 possible outliers for the female middle school students and 12 possible outliers for the male middle school students over the 9 dependent variables.

The participants with *z*-scores greater than 3.00 or less than -3.00 for each dependent variable were considered outliers and were omitted from the analysis of research question two (Tabachnick & Fidell, 2007). SPSS (IBM Corp., 2012) was used to calculate the *z*-scores of the nine dependent variables for the male and female groups. An examination of the female group indicated that there were three outliers. Female students with identification numbers 127 (z = -3.59), 266 (z = -3.16), and 406 (z = -3.58) were classified as outliers in Mathematics Engagement, Domain Beliefs About Self, and Domain Engagement, respectively, and were omitted from the data set. Male students with identification numbers 111 (z = 3.63) and 204 (z = -3.20) were classified as outliers for CMT Writing and CMT Reading, respectively, and were deleted from the data set.

Multivariate outliers. The Mahalanobis distance was calculated to check for multivariate outliers as in research question one. The chi-square criterion was set at χ^2 = 27.877, with 9 degrees of freedom, and significance at .001. SPSS (IBM Corp., 2012) was used to calculate the Mahalanobis distance for each of the variables where 24.40 was the largest D^2 value calculated. The researcher concluded there were no multivariate outliers because the criterion was not reached for any of the variables (Meyers et al., 2006).

Multivariate Statistical Assumptions for a MANOVA

After the removal of univariate and confirmation that there were no multivariate outliers, the data set (n = 222) was used to verify the assumptions for a MANOVA.

Independence. Research question two compared two distinct groups, female middle school students and male middle school students. The classification of the participants based on gender placed each individual into one of the two distinct groups. Because no participant belonged to both groups, the assumption of independence was met (Green & Salkind, 2008).

Homoscedasticity. Box's *M* was calculated to determine if the assumption of homogeneity of variance-covariance matrices was met (Tabachnick & Fidell, 2007). The researcher concluded that the variances were not equal as Box's $M = 73.515$ where $p < .001$. To address this issue the researcher created sample sizes that were equal by randomly selecting 98 females from the 124 available to match the number male participants. Tabachnick and Fidell (2007) state that if sample sizes are equal, the test of significance is expected to be robust and the results of the Box's *M* test may be disregarded.

Normality. Skewness and kurtosis levels for the two groups (male participants and female participants) were examined to verify the assumption of normality was met. All skewness and kurtosis levels for the dependent variables were in the acceptable range of -1 to 1 (Meyers et al., 2006). The skewness and kurtosis levels for female participants are shown in Table 16 and for male participants in Table 17. The researcher concluded the assumption of normality was met as all values fell in the acceptable range of -1 to 1 (Meyers et al., 2006).

Table 16

Skewness and Kurtosis Levels for Female Students

Variable	Skewness	Kurtosis
CMT Reading[a]	-0.108	0.137
CMT Writing[a]	0.296	-0.090
CMT Mathematics[a]	-0.131	0.045
Language Arts Engagement[b]	-0.887	-0.265
Mathematics Engagement[b]	-0.738	-0.495
Square Root of Absences	-0.033	-0.020
Domain Engagement[c]	-0.713	-0.179
Domain Beliefs About Self[c]	-0.600	-0.114
Domain Interpersonal Support[c]	-0.301	-0.888

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support, respectively; and n = 98.

Table 17

Skewness and Kurtosis Levels for Male Participants

Variable	Skewness	Kurtosis
CMT Reading[a]	-0.356	0.351
CMT Writing[a]	0.269	-0.317
CMT Mathematics[a]	-0.082	0.686
Language Arts Engagement[b]	-0.273	-0.665
Mathematics Engagement[b]	-0.639	-0.137
Square Root of Absences	0.091	-0.821
Domain Engagement[c]	-0.957	0.711
Domain Beliefs About Self[c]	-0.481	-0.218
Domain Interpersonal Support[c]	-0.536	-0.359

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support, respectively; and n = 98 for male students.

Linearity. Linearity of the dependent variables began with the inspection of the bivariate scatterplots. SPSS (IBM Corp., 2012) was used to create scatterplots of all possible pairs of dependent variables. The data produced bivariate scatterplots which were oval-shaped and the researcher concluded the assumption of linearity was met (Meyers et al., 2006).

Correlations of the dependent variables. Pearson *r* correlations were calculated to bivariate relationships between the dependent variables. All correlations were within the acceptable range of -.75 to .75 and the researcher concluded the data were sufficiently related and could be used together in multivariate analysis (Meyers et al, 2006). Table 18 displays correlations and significance levels of the variables.

Table 18

Pearson Product-Moment Correlations for Research Question Two

	CMTWrite	CMTMath	LAEngage	MAEngage	Absences	DEngage	DBeliefs	DInter	Gender
CMTRead[a]	.586**	.705**	.409**	.444**	-.170*	.341**	.284**	.139	-.180**
CMTWrite[a]		.487**	.420**	.463**	-.219**	.292**	.334**	.202**	-.347**
CMTMath[a]			.322**	.491**	-.173*	.275**	.273**	.116	-.008
LAEngage[b]				.508**	-.065	.297**	.313**	.218**	-.241**
MAEngage[b]					-.307**	.360**	.287**	.192**	-.204**
Absences						.162*	-.074	-.025	-.040
DEngage[c]							.742**	-.562**	-.154*
DBeliefs[c]								.728**	-.060
DInter[c]									.028

Note. CMTRead represents CMT Reading score, CMTWrite represents CMT Writing score, CMTMath represents CMT Mathematics score, LAEngage represents Language Arts Engagement, MAEngage represents Mathematics Engagement, DEngage represents Domain Engagement, DBeliefs represents Domain Beliefs About Self, and DInter represents Domain Interpersonal Support. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support, respectively. Absences represents the Square Root of the Absences; $n = 196$; $^{*}p < .05$; $^{**}p < .01$; and two-tailed analysis were performed.

Bartlett's test of spherecity. The assumption for sufficient correlation between the dependent variables was verified as the Bartlett's test of spherecity yielded $\chi^2 = 8318.064$ with $p < 0.001$ (Meyers et al., 2006).

Descriptive Statistics for Research Question Two

A sample size of 196 was obtained after removal of univariate and confirmation of no multivariate outliers, verification of the assumptions, and randomly selecting 98 female students for the analyses. Table 19 presents the descriptive statistics for female students and Table 20 displays the descriptive statistics for male students.

Table 19

Descriptive Statistics for Female Students for Research Question Two

Variable	Min	Max	*Mean*	*SD*
CMT Reading[a]	181.00	366.00	285.05	33.66
CMT Writing[a]	191.00	400.00	295.14	44.16
CMT Mathematics[a]	190.00	376.00	288.78	36.75
Language Arts Engagement[b]	1.33	4.00	3.30	0.76
Mathematics Engagement[b]	2.00	4.00	3.44	0.55
Absences	0.00	26.00	7.35	6.17
Domain Engagement[c]	2.68	4.00	3.59	0.32
Domain Beliefs About Self[c]	1.90	3.90	3.14	0.43
Domain Interpersonal Support[c]	2.39	4.00	3.31	0.41

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support. The descriptive statistics for Absences are reported in the table but the Square Root of the Absences were used in the data analyses; and $n = 98$.

Table 20

Descriptive Statistics for Male Students for Research Question Two

Variable	Min	Max	*Mean*	*SD*
CMT Reading[a]	175.00	359.00	272.48	35.34
CMT Writing[a]	202.00	350.00	267.16	30.68
CMT Mathematics[a]	190.00	385.00	288.20	33.52
Language Arts Engagement[b]	1.00	4.00	2.93	0.74
Mathematics Engagement[b]	1.33	4.00	3.18	0.66
Absences	0.00	25.00	6.79	6.60
Domain Engagement[c]	2.23	4.00	3.47	0.41
Domain Beliefs About Self[c]	1.95	3.90	3.18	0.42
Domain Interpersonal Support[c]	2.41	4.00	3.34	0.39

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support. The descriptive statistics for Absences are reported in the table but the Square Root of the Absences were used in the data analyses; and $n = 98$.

Data Analysis for Research Question Two

The two groups being compared (female students and male students) were of equal size therefore Box's *M* and Levene's Test of Equality were not considered. Bartlett's Test of Sphericity ($\chi^2 = 8318.064$, $p < .001$) was significant indicating sufficient correlation between the dependent variables (CMT Reading, CMT Writing, CMT Mathematics, Square Root of the Absences, Language Arts Engagement, Mathematics Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal). All bivariate correlations were between -0.75 and 0.75. Conditions of normality, linearity, and homoscedasticity were met and the researcher continued with the data analysis. The results of the MANOVA indicated that Wilks' Lambda was significant at the $p < .05$ significance level where $F(9, 186) = 6.403$, $p < .001$, and *partial* $\eta^2 = 0.237$ demonstrating significance of the model.

The Tests of Between-Subjects Effects indicated there were significant differences between male students and female students on CMT Reading ($F = 6.503$, $p = .012$, *partial* $\eta^2 = .032$), CMT Writing ($F = 26.533$, $p < .001$, *partial* $\eta^2 = .120$), Language Arts Engagement ($F = 12.006$, $p = .001$, *partial* $\eta^2 = .058$), Mathematics Engagement ($F = 8.402$, $p = .004$, *partial* $\eta^2 = .042$) and Domain Engagement ($F = 4.694$, $p = .031$, *partial* $\eta^2 = .024$). Table 21 provides a complete list of the results for the Tests of Between-Subjects Effects.

Table 21

Tests of Between-Subjects Effects for Gender for Research Question Two

	SS	*df*	*MS*	*F*	Sig.	*partial* η^2
CMT Reading[a]	7744.000	1	7744.000	6.503	.012*	.032
CMT Writing[a]	38360.020	1	38360.020	26.533	.000***	.120
CMT Mathematics[a]	16.000	1	16.000	0.013	.910	.000
LA Engagement[b]	6.797	1	6.797	12.006	.001**	.058
Math Engagement[b]	3.104	1	3.104	8.402	.004**	.042
Absences	0.494	1	0.494	0.312	.577	.002
Domain Engagement[c]	0.635	1	0.635	4.694	.031*	.024
Domain Beliefs[c]	0.125	1	0.125	0.695	.406	.004
Domain Interpersonal	0.024	1	0.024	0.149	.700	.001

Note. [a]CMT Reading, CMT Writing, and CMT Mathematics are measures of academic achievement. [b]Language Arts Engagement and Mathematics Engagement are measures of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support, respectively. Absences represents the Square Root of the absences, however, statistics for Absences are reported in the table; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; and $n = 196$.

The results of the MANOVA indicated that female middle school students scored significantly higher ($p = .012$, *partial* $\eta^2 = .032$) on CMT Reading tests ($M = 285.05$, $SD = 33.66$) than male students ($M = 272.48$, $SD = 35.34$) and female students scored significantly higher ($p < .001$, *partial* $\eta^2 = .120$) on CMT Writing tests ($M = 295.14$, $SD = 44.16$) than male students ($M = 267.16$, $SD = 30.68$). In addition, female students had significantly higher ($p < .001$ and *partial* $\eta^2 = .058$) Language Arts Engagement scores ($M = 3.30$, $SD = 0.76$) than male students ($M = 2.93$, $SD = 0.74$) and female students had significantly higher ($p = .004$, *partial* η^2= .042) Mathematics Engagement scores (*M* = 3.44, *SD* = 0.55) than male students (*M* = 3.18, *SD* = 0.66). Finally, female students scored significantly higher (*p* = .031, *partial* η^2= .024) Domain Engagement scores (*M* = 3.59, *SD* = 0.32) than male students (*M* = 3.47, *SD* = 0.41). There were no significant differences between male and female middle school students with respect to the school-related factors CMT Mathematics scores, Square Root of the Absences, Domain Beliefs About Self, or Domain Interpersonal Support.

Data Preparation for Research Question Three

A stepwise regression was used to analyze the effects of the predictor variables (Weight Category, Absences, Language Arts Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support) on CMT Reading scores for research question three. The stepwise regression model starts with an empty equation and enters each independent variable one at a time (Tabachnick & Fidell, 2007). The independent variable remains in the equation if the statistical criteria are met and any independent variable may be removed from the equation if it no longer contributes significantly to the model (Tabachnick & Fidell, 2007).

Research Question Three

3. To what extent and in what manner can the variation in CMT Reading scores be explained by weight category, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?

Outliers for Research Question Three

A stepwise regression is susceptible to univariate and multivariate outliers (Meyers et al, 2006). Univariate and multivariate outliers were deleted from the sample before the assumptions for multivariate analysis were verified and the analysis was undertaken. As with MANOVA, univariate outliers are cases with extreme values for a single variable and multivariate outliers are cases with extreme values on a combination of scores on two or more variables (Tabachnick & Fidell, 20070. Univariate outliers should be addressed first by transforming the data before searching for multivariate outliers because the statistics that verify multivariate outliers are sensitive to detractors from normality (Tabachnick & Fidell, 2007).

Univariate outliers. A check for potential univariate outliers began with the inspection of boxplots for each of the predictor variables. Sixteen possible outliers were located over the six predictor variables Weight Category, Absences, Language Arts Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support. Before removing outliers, the researcher examined skewness and kurtosis levels to determine if transformations should be undertaken to improve the normality of the distributions and to pull univariate outliers closer to the center of the distribution (Tabachnick & Fidell, 2007). The predictor variable Absences had a skewness value of 1.174 while all other skewness and kurtosis values were in an acceptable range, between -1 and 1. (Meyers et al., 2006). The researcher performed a square root transformation on the variable Absences. The resulting transformation yielded a skewness level of .072 and a kurtosis value of -.486. The researcher used the variable Square Root of the Absences in the data analysis as it improved the normality of the univariate data. The square root transformation redistributed five of the potential outliers to cases that were not outliers, which left eleven possible outliers for inspection.

An outlier was determined by a score that was more than three standard deviations away from the mean (Tabachnick & Fidell, 2007). Scores that were potential outliers as indicated by the boxplots for each predictor variable were converted to *z*-scores for further analysis. An examination of the *z*-scores through SPSS (IBM Corp., 2012) indicated there were four outliers for Domain Engagement, participants with identification numbers 245 (z = -3.15), 300 (z = -3.23), 406 (z = -3.32), and 410 (z = -3.10). There was one outlier for the Domain Beliefs About Self belonging to participant 266 (z = -3.27). These five participants were removed from the analysis of research question three. In addition, data from the seven participants who were classified as underweight (116, 135, 160, 176, 409, 418, and 420) were removed to improve linearity of the data set.

Multivariate outliers. Mahalanobis distance (D^2) is an objective method for assessing the presence of multivariate outliers (Meyers et al., 2006). This method measures the "distance" between each case and the multivariate mean which was evaluated through a chi-square distribution at a significance level of .001 (Meyers et al., 2006). The chi-square criterion was set at χ^2 = 22.458, with 6 degrees of freedom, and significance at .001. There were three cases that were determined to be multivariate outliers based on these criteria. Participants with identification numbers 159 (D^2 = 26.64), 273 (D^2 = 23.43), and 234 (D^2 = 23.17) were removed from the data set leaving a sample of 212.

Multivariate Statistical Assumptions for a Multiple Linear Regression

The assumptions for a multiple linear regression include multicollinearity and singularity, normality, linearity, and homoscedasticity (Meyers et al., 2006). The researcher verified that each of these assumptions was met before analyzing the data for research question three.

Multicollinearity and singularity. Multicollinearity occurs when the independent variables are correlated too highly. Singularity occurs when an independent variable is redundant or a combination of two or more of the independent variables measure the same attribute (Tabachnick & Fidell, 2007). When utilizing a stepwise regression and two or more of the predictor variables are highly correlated, those variables are measuring the same characteristic and it would be impossible to determine which variable is more important to the model (Meyers et al, 2006). Meyers et al. (2006) suggest that variables with a correlation higher than r = .75 or lower than r = -.75 should not be used together in multivariate analysis. Pearson r correlations were calculated to assess the linear relationships between the bivariate variables. Table 22 displays correlations and significance levels of the predictor and criterion variables for research question three. The researcher removed the variable Domain Beliefs About Self from the data analysis for research question three as it was highly correlated with Domain Interpersonal Support (r = .783) and Domain Engagement (r = .775).

Table 22

Pearson Product-Moment Correlations for Research Question Three

	Weight Category	Absences	LA Engage[b]	Domain Engage[c]	Domain Beliefs[c]	Domain Inter[c]
CMT Reading[a]	-.124	-.130	.449**	.359**	.317**	.171*
Weight Category		.186*	-.005	-.008	-.026	-.023
Absences			-.057	-.109	-.069	-.045
LA Engage				.368**	.362**	.246**
Domain Engage					.775**	.665**
Domain Beliefs						.783**

Note. [a]CMT Reading is a measure of academic achievement. [b]Language Arts Engagement is a measure of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support. LA Engage represents Language Arts Engagement, Domain Engage represents Domain Engagement, Domain Beliefs represents Domain Beliefs About Self, and Domain Inter represents Domain Interpersonal Support. Absences represents the Square Root of the Absences $n = 212$; $^{*}p < .05$; $^{**}p < .01$; and two-tailed analyses were performed.

An assessment of multicollinearity may be conducted through the inspection of tolerance or the variance inflation factor (VIF) (Meyers et al., 2006). Tolerance is calculated by $1 - R^2$ for each independent variable where each predictor variable plays the role of the criterion variable being predicted by the remaining predictor variables (Meyers et al., 2006). Multicollinearity is indicated for a tolerance value that is less than or equal to .01. An alternative method for finding multicollinearity occurs when the VIF (1 / *tolerance*) for any independent variable is greater than 10 (Meyers et al., 2006). VIF measures the degree of linear association between each chosen independent variable and the remaining independent variables being used in the analysis (Meyers et al., 2006). Table 23 displays the tolerance and VIFs for the predictor variables for research question three. All tolerance levels were greater than .01 and all VIFs were less than 10, therefore, multicollinearity was not indicated and the assumption was met for research question three.

Table 23

Tolerance Values and VIFs for Research Question Three

Predictor Variables	Tolerance	VIF
Weight Category	1.000	1.000
Language Arts Engagement[a]	0.864	1.157
Square Root of Absences	0.954	1.049
Domain Engagement[b]	0.864	1.157
Domain Interpersonal Support[b]	0.557	1.794

Note. [a]Language Arts Engagement is a measure of teacher perception of student engagement. [b]Domain Engagement and Domain Interpersonal Support are measures of student perception of engagement and interpersonal support, respectively; and $n = 212$.

Normality, linearity, and homoscedasticity. Normality, linearity, and homoscedasticity may be verified simultaneously through the examination of a residuals scatterplot between the predicted dependent variable scores and the errors of prediction (Tabachnick & Fidell, 2007). If the assumptions of normality, linearity, and homoscedasticity are met the residuals will be rectangular in shape with a concentration of scores along the midline (Tabachnick & Fidell, 2007). Figure 3 displays the residuals plot using Weight Category, Square Root of the Absences, Language Arts Engagement, Domain Engagement, and Domain Interpersonal Support as the predictor variables and CMT Reading as the criterion variable. The researcher concluded the assumptions of normality, linearity, and homoscedasticity had been met for research question three because the residuals plot was rectangular in shape and there were a concentration of scores along the midline, the horizontal line at the regression standardized residual value of zero.

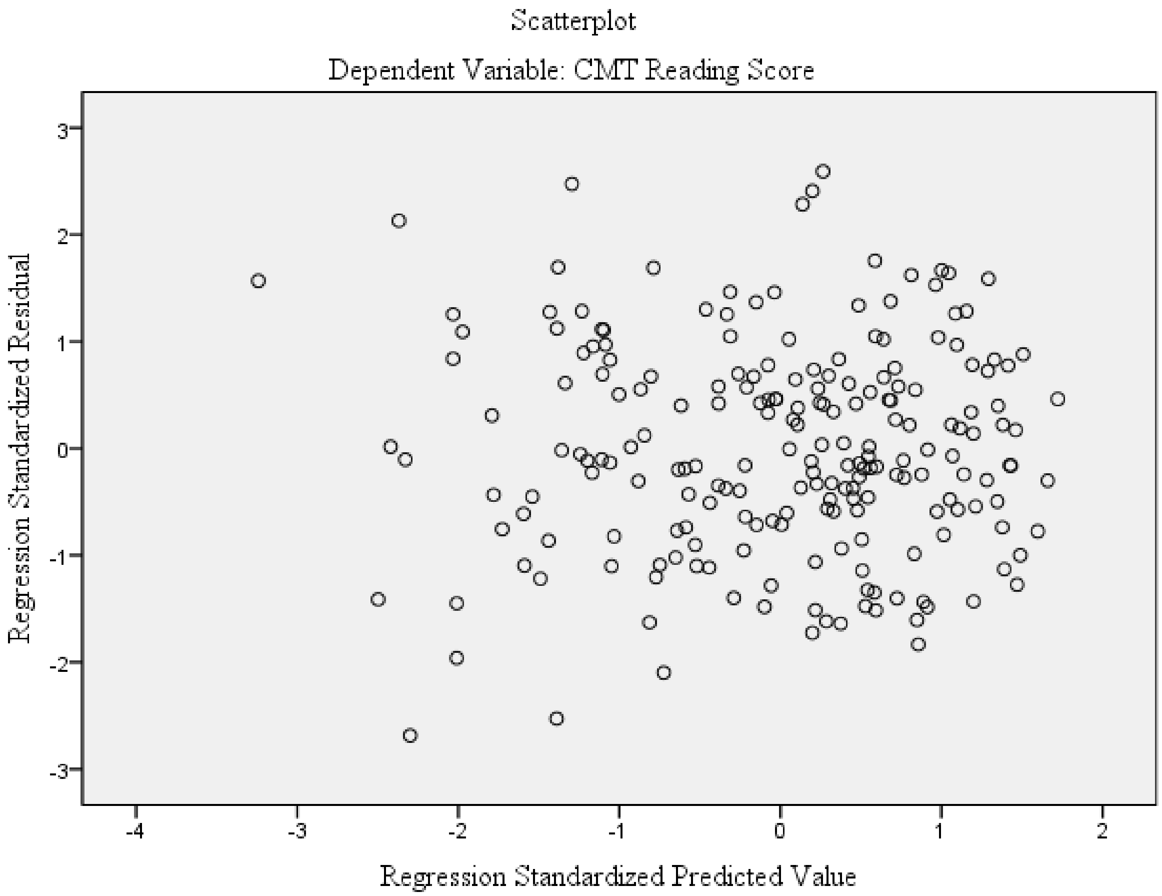

Figure 3. Residuals plot for research question three.

Descriptive Statistics for Research Questions Three

After the data were cleaned and the assumptions for a stepwise regression were verified, the descriptive statistics were calculated for the sample and are displayed in Table 24.

Table 24

Descriptive Statistics of the Sample for Research Question Three

Variable	Min	Max	*Mean*	*SD*
CMT Reading[a]	153.00	366.00	279.94	35.82
Language Arts Engagement[b]	1.00	4.00	3.11	0.78
Absences	0.00	26.00	6.42	5.91
Domain Engagement[c]	2.52	4.00	3.53	0.35
Domain Interpersonal Support[c]	2.28	4.00	3.30	0.41

Note. [a]CMT Reading is a measure of academic achievement. [b]Language Arts Engagement is a measure of teacher perception of student engagement. [c]Domain Engagement and Domain Interpersonal Support are measures of student perception of engagement and interpersonal support, respectively. The descriptive statistics for Absences are displayed in the table although Square Root of the Absences were used in the data analyses; and $n = 212$.

Data Analysis Research for Question Three

In predicting CMT Reading scores, the results of the ANOVA (Table 25) indicated that Language Arts Engagement, Domain Engagement, and Weight Category were significant predictors of CMT Reading scores ($F(3,208) = 24.254$, $p < .001$).

Table 25

ANOVA Results for Predicting CMT Reading Scores for Research Question Three

Model		*SS*	*df*	*MS*	*F*	Sig.
ANOVA[a]						
1	Regression	55509.606	1	55509.606	52.932	.000[b]
	Residual	220227.677	210	1048.703		
	Total	275737.283	211			
2	Regression	67454.133	2	33727.066	33.843	.000[c]
	Residual	208283.150	209	996.570		
	Total	275737.283	211			
3	Regression	71459.166	3	23819.722	24.254	.000[d]
	Residual	204278.117	208	982.106		
	Total	275737.283	211			

Note. [a]Dependent Variable: CMT Reading scores. [b]Predictors: (Constant) and Language Arts Engagement. [c]Predictors: (Constant), Language Arts Engagement, and Domain Engagement. [d]Predictors: (Constant), Language Arts Engagement, Domain Engagement, and Weight Category.

The model summary (Table 26) displays the coefficient of multiple determination which measures the overall strength of the linear relationship between the predictor and criterion variables by reporting the R^2 and the adjusted R^2 values for the model (Meyers et al., 2006). The R^2 depicts the amount of variation of the criterion variable (CMT Reading) that can be explained by the combination of the predictor variables (Language Arts Engagement, Domain Engagement, and Weight Category). For research question three, the R^2 indicates that 25.9% of the variation in CMT Reading scores was explained by Language Arts Engagement, Domain Engagement, and Weight Category. The adjusted R^2, a more conservative estimate of the coefficient of multiple determination, was not used in the analysis because the sample was greater than 60 and there were not numerous independent variables (Tabachnick & Fidell, 2007).

Table 26

Model Summary for Predicting CMT Reading Scores for Research Question Three

Model Summary[d]									
Model	*R*	R^2	Adj. R^2	*SEE*	Change Statistics				
					R^2 Change	*F* Change	df_1	df_2	Sig *F* Change
1	.449[a]	.201	.198	32.384	.201	52.932	1	210	.000
2	.495[b]	.245	.237	31.568	.043	11.986	1	209	.001
3	.509[c]	.259	.248	31.339	.015	4.078	1	208	.045

Note. [a]Predictors: (Constant), Language Arts Engagement. [b]Predictors: (Constant), Language Arts Engagement, Domain Engagement. [c]Predictors: (Constant), Language Arts Engagement, Domain Engagement, Weight Category. [d]Dependent Variable: CMT Reading Score.

An examination of the coefficients output (Table 27) indicates that three of the five independent variables contributed significantly to the model, Language Arts Engagement ($p < .001$), Domain Engagement ($p = .001$), and Weight Category ($p = .045$) . The bivariate correlations (Table 22) indicated Language Arts Engagement was positively related ($r = .449$, $p < .01$) to CMT Reading scores, Domain Engagement was positively related ($r = .359$, $p < .01$) to CMT Reading scores, and Weight Category was negatively related ($r = -.124$, $p > .05$) CMT Reading scores. These associations suggest that as Language Arts Engagement scores increase CMT Reading scores increase, as Domain Engagement scores increase CMT

Reading scores increase, and as Weight Category changes from healthy-weight to overweight/obese CMT Reading scores decrease.

Table 27

Coefficients for Predicting CMT Reading Scores for Research Question Three

Model	Unstandardized Coefficients		Standardized Coefficients	*t*	Significance	Collinearity Statistics	
	B	*SE*	*Beta*			Tolerance	VIF
1 (Constant)	215.230	9.191		23.417	.000		
Language Arts Engagement	20.878	2.870	.449	7.275	.000	1.000	1.000
2 (Constant)	145.041	22.166		6.544	.000		
Language Arts Engagement	17.042	3.009	.366	5.664	.000	.864	1.157
Domain Engagement	23.237	6.712	.224	3.462	.001	.864	1.157
3 (Constant)	157.852	22.900		6.893	.000		
Language Arts Engagement	17.028	2.987	.366	5.701	.000	.864	1.157
Domain Engagement	23.151	6.663	.223	3.474	.001	.864	1.157
Weight Category	-4.929	2.441	-.121	-2.019	.045	1.000	1.000

Note. Dependent Variable is CMT Reading Score.

Finally, Table 28 displays the results of the excluded variables of the stepwise multiple linear regression. Language Arts Engagement was the first predictor variable to be entered into the model. For each subsequent model, the predictor variable with the largest partial correlation was entered into the stepwise multiple linear regression to determine if it added significantly to the model (Tabachnick & Fidell, 2007). Square Root of the Absences and Domain Interpersonal Support did not add significantly to the final model.

Table 28

Excluded Variables at Each Step in the Procedure for Predicting CMT Reading Scores for Research Question Three

Model		*Beta* In	*t*	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Weight Category	-.122[a]	-1.990	.048	-.136	1.000	1.000	1.000
	Square Root of the Absences	-.105[a]	-1.715	.088	-.118	.997	1.003	.997
	Domain Engagement	.224[a]	3.462	.001	.233	.864	1.157	.864
	Domain Interpersonal Support	.065[a]	1.019	.309	.070	.940	1.064	.940
2	Weight Category	-.121[b]	-2.019	.045	-.139	1.000	1.000	.864
	Square Root of the Absences	-.086[b]	-1.431	.154	-.099	.988	1.012	.856
	Domain Interpersonal Support	-.12[cb]	-1.513	.132	-.104	.558	1.793	.513
3	Square Root of the Absences	-.066[c]	-1.082	.281	-.075	.954	1.049	.856
	Domain Interpersonal Support	-.125[c]	-1.572	.118	-.109	.557	1.794	.513

Note. [a]Predictors in the Model: (Constant) and Language Arts Engagement. [b]Predictors in the Model: (Constant), Language Arts Engagement, and Domain Engagement. [c]Predictors in the Model: (Constant), Language Arts Engagement, Domain Engagement, and Weight Category.

Data Preparation for Research Question Four

A stepwise regression was used to analyze the effects of the predictor variables (Weight Category, Absences, Language Arts Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support) on CMT Writing scores for research question four using the same methods as for research question three.

Research Question Four

4. To what extent and in what manner can the variation in CMT Writing scores be explained by weight category, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?

Outliers for Research Question Four

Univariate and multivariate outliers were found using the same techniques as in research question three. Because the predictor variables were the same in research question three and four, the search for univariate and multivariate outliers in research question four yielded the same outcome as in research question three.

Univariate outliers. The predictor variable Absences had a skewness value of 1.174 while all other skewness and kurtosis values were in an acceptable range, between -1 and 1. (Meyers et al., 2006). The researcher performed a square root transformation on the variable Absences. The resulting transformation yielded a skewness of .072 and a kurtosis of -.486. The researcher used the variable Square Root of the Absences in the data analysis as it improved the normality of the univariate data. An examination of the *z*-scores indicated there were four outliers for Domain Engagement, participants with identification numbers 245 (z = -3.15), 300 (z = -3.23), 406 (z = -3.32), and 410 (z = -3.10). There was one outlier for the Domain Beliefs About Self belonging to participant 266 (z = -3.27). These five participants were removed from the analysis of research question three. In addition, data from the seven participants who were classified as underweight (116, 135, 160, 176, 409, 418, and 420) were removed from the data set to improve linearity of the data set.

Multivariate outliers. Mahalanobis distance (D^2) is an objective method for assessing the presence of multivariate outliers (Meyers et al., 2006). This method measures the "distance" between each case and the multivariate mean which is evaluated through a chi-square distribution at a significance level of .001 (Meyers et al., 2006). The chi-square criterion was set at $\chi^2 = 22.458$, with 6 degrees of freedom, and significance at .001. There were three cases that were determined to be multivariate outliers based on these criteria. Participants with identification numbers 159 ($D^2 = 26.64$), 273 ($D^2 = 23.43$), and 234 ($D^2 = 23.17$) were removed from the data set leaving a sample of 212.

Multivariate Statistical Assumptions for a Multiple Linear Regression

The assumptions for a multiple linear regression include multicollinearity and singularity, normality, linearity, and homoscedasticity (Meyers et al., 2006). The researcher verified that each of these assumptions was met before analyzing the data for research question four.

Multicollinearity and singularity. Multicollinearity and singularity were verified using the same techniques as in research question three. Pearson r correlations were calculated to assess the linear relationships between the bivariate variables (Meyers et al., 2006). Table 29 displays correlations and significance levels of the predictor and criterion variables for research question four. The researcher removed the variable Domain Beliefs

About Self from the data analysis for research questions four as it was highly correlated with Domain Interpersonal Support ($r = .792$) and Domain Engagement ($r = .776$).

Table 29

Pearson Product-Moment Correlations for Research Question Four

	Weight Category	Absences	LA Engage[b]	Domain Engage[c]	Domain Beliefs[c]	Domain Inter[c]
CMT Writing[a]	-.083	-.161*	.467**	.288**	.336**	.215
Weight Category		.158*	.010	-.032	-.034	-.062
Absences			-.070	-.122	-.069	-.054
LA Engage				.352**	.355**	.234**
Domain Engage					.776**	.671**
Domain Beliefs						.792**

Note. [a]CMT Writing is a measure of academic achievement. [b]Language Arts Engagement is a measure of teacher perception of student engagement. [c]Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support are measures of student perception of engagement, self-beliefs, and interpersonal support, respectively. LA Engagement represents Language Arts Engagement, Domain Engage represents Domain Engagement, Domain Beliefs represents Domain Beliefs About Self, and Domain Inter represents Domain Interpersonal Support. Absences represents the Square Root of the Absences; $n = 212$; $^{*}p < .05$; $^{**}p < .01$; and two-tailed analyses were performed.

Table 30 displays the tolerance values and VIFs for the predictor variables for research question four. All tolerance levels were greater than .01 and all VIFs were less than 10, therefore, multicollinearity was not indicated and the assumption was met for research question four.

Table 30

Tolerance Values and VIFs for Research Questions Four

Predictor Variables	Tolerance	VIF
Weight Category	0.965	1.036
Language Arts Engagement[a]	0.868	1.152
Square Root of Absences	0.994	1.006
Domain Engagement[b]	0.387	2.584
Domain Interpersonal Support[b]	0.385	2.600

Note. [a]Language Arts Engagement is a measure of teacher perception of student engagement. [b]Domain Engagement and Domain Interpersonal Support are measures of student perception of engagement and interpersonal support, respectively; and n = 212.

Normality, linearity, and homoscedasticity. Normality, linearity, and homoscedasticity were verified simultaneously through the examination of the residuals scatterplot between the predicted dependent variable scores and the errors of prediction (Tabachnick & Fidell, 2007). Figure 4 displays the residuals plot using Weight Category, Square Root of the Absences, Language Arts Engagement, Domain Engagement, and Domain Interpersonal Support as the predictor variables and CMT Writing as the criterion variable. The researcher concluded the assumptions of normality, linearity, and homoscedasticity had been met for research question four because the residuals plot was rectangular in shape and there were a concentration of points along the midline, the horizontal line at the regression standardized residual value of zero.

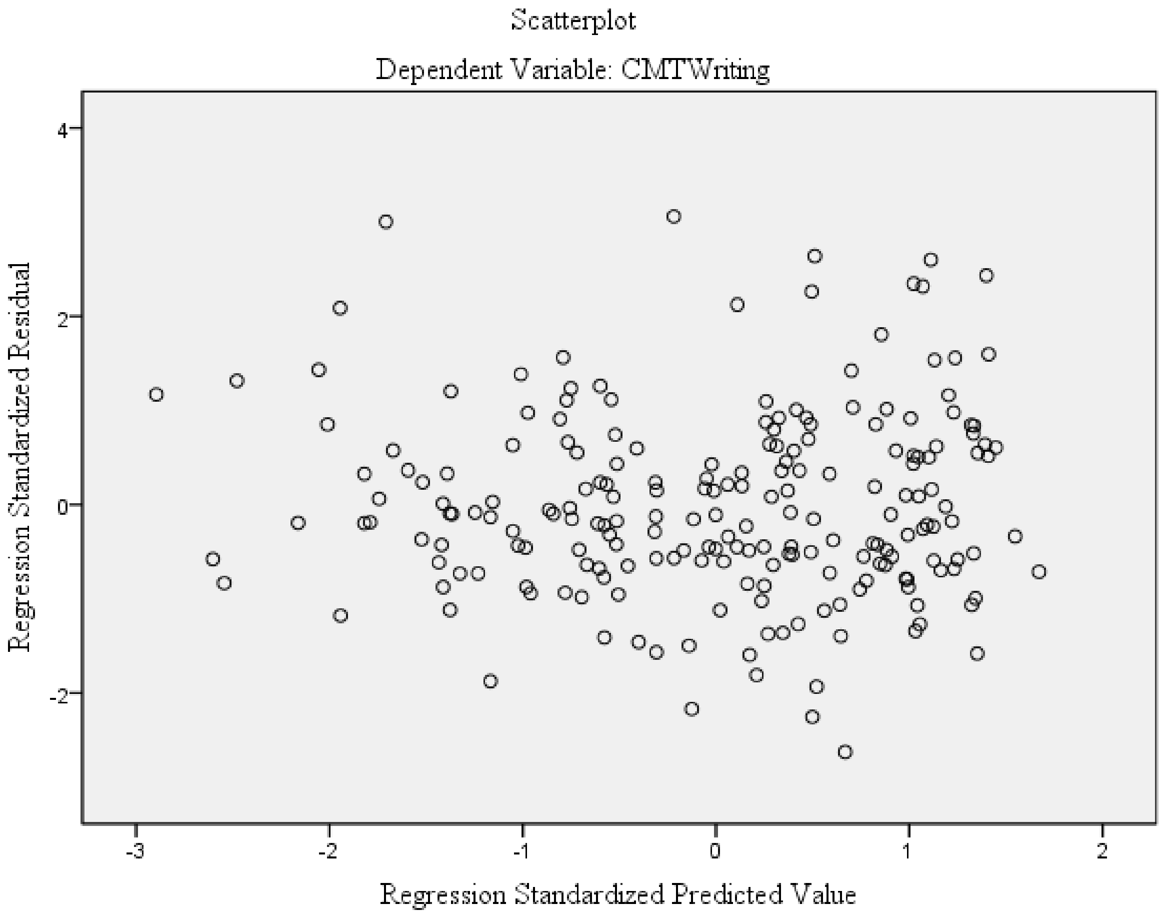

Figure 4. Residuals plot for research question four.

Descriptive Statistics for Research Questions Four

After the univariate and multivariate outliers were removed from the data set and the assumptions for a multiple linear regression were met, the descriptive statistics were calculated for the sample used to investigate research question four and are displayed in Table 31.

Table 31

Descriptive Statistics of the Sample for Research Question Four

Variable	Min	Max	*Mean*	*SD*
CMT Writing[a]	191.00	400.00	282.45	41.13
Language Arts Engagement[b]	1.00	4.00	3.11	0.78
Absences	0.00	26.00	6.42	5.91
Domain Engagement[c]	2.52	4.00	3.53	0.35
Domain Interpersonal Support[c]	2.28	4.00	3.30	0.41

Note. [a]CMT Writing is a measure of academic achievement. [b]Language Arts Engagement is a measure of teacher perception of student engagement. [c]Domain Engagement and Domain Interpersonal Support are measures of student perception of engagement and interpersonal support, respectively. Absences are reported in the table although Square Root of the Absences was used in the data analysis; and $n = 212$.

Data Analysis Research for Question Four

In predicting CMT Writing scores, the results of the ANOVA (Table 32) indicated that Language Arts Engagement and Square Root of the Absences (referred to as Absences) were significant predictors of CMT Writing scores ($F(2,209) = 32.343$, $p < .001$).

Table 32

ANOVA Results for Predicting CMT Writing Scores for Research Question Four

Model		*SS*	*df*	*MS*	*F*	Sig.
				ANOVA[c]		
1	Regression	78542.932	1	78542.932	58.598	.000[a]
	Residual	281475.049	210	1340.357		
	Total	360017.981	211			
2	Regression	85090.441	2	42545.221	32.343	.000[b]
	Residual	274927.540	209	1315.443		
	Total	360017.981	211			

Note. [a]Predictors: (Constant), Language Arts Engagement. [b]Predictors: (Constant) Language Arts Engagement and Square Root of the Absences. [c]Dependent Variable: CMT Writing Scores.

The model summary (Table 33) displays the coefficient of multiple determination which measures the overall strength of the linear relationship between the predictor and criterion variables by providing the R^2 and the adjusted R^2 values for each model (Meyers et al., 2006). The R^2 depicts the amount of variation of the criterion variable (CMT Writing scores) that can be explained by the combination of the predictor variables (Language Arts Engagement and Absences). For research question four the R^2 indicated that 23.6% of the variation in CMT Writing scores was explained by Language Arts Engagement and Absences. The adjusted R^2, a more conservative estimate of the coefficient of multiple determination, was not used in the analysis because the sample was greater than 60 and there were not numerous independent variables (Tabachnick & Fidell, 2007).

Table 33

Model Summary for Predicting CMT Writing Scores for Research Question Four

Model	*R*	R^2	Adj R^2	*SEE*	Change Statistics				
					R^2 Change	*F* Change	df_1	df_2	Sig *F* Change
1	.467[a]	.218	.214	36.611	.218	58.598	1	210	.000
2	.486[b]	.236	.229	36.269	.018	4.977	1	209	.027

Note. [a]Predictors: (Constant), Language Arts Engagement. [b]Predictors: (Constant), Language Arts Engagement and Square Root of the Absences.

An examination of the coefficients output (Table 34) indicates that two of the five independent variables contributed significantly to the model, Language Arts Engagement ($p < .001$) and Absences ($p = .027$) . The bivariate correlations (Table 29) indicate Language Arts Engagement was positively related ($r = .467$, $p < .01$) to CMT Writing scores and Absences was negatively related ($r = -.161$, $p < .05$) to CMT Writing scores. These significant associations suggest that as Language Arts Engagement scores increase CMT Writing scores increase and as the Absences increase CMT Writing scores decrease.

Table 34

Coefficients for Predicting CMT Writing Scores for Research Question Four

Model	Unstandardized Coefficients		Standardized Coefficients	*t*	Significance	Collinearity Statistics	
	B	*SE*	*Beta*			Tolerance	VIF
1 (Constant)	205.830	10.391		19.808	.000		
Language Arts Engagement	24.835	3.244	.467	7.655	.000	1.000	1.000
2 (Constant)	216.976	11.442		18.963	.000		
Language Arts Engagement	24.429	3.219	.459	7.589	.000	.997	1.003
Square Root of the Absences	-4.477	2.007	-.135	-2.231	.027	.997	1.003

Note. Dependent Variable is CMT Writing Scores.

Finally, Table 35 displays the results of the excluded variables of the stepwise regression. Language Arts Engagement was the first predictor variable to be entered into the model. For the next model Absences, the predictor variable with the largest partial correlation, was entered into the stepwise multiple linear regression because it added significantly to the model (Tabachnick & Fidell, 2007). Weight Category, Domain Engagement, and Domain Interpersonal Support did not add significantly to the final model.

Table 35

Excluded Variables at Each Step in the Procedure for Predicting CMT Writing Scores for Research Question Four

Model		*Beta* In	*t*	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Weight Category	-.080[b]	-1.319	.089	-.091	1.000	1.000	1.000
	Square Root of the Absences	-.135[b]	-2.231	.027	-.153	.997	1.003	.977
	Domain Engagement	.134[b]	2.058	.041	.141	.864	1.157	.864
	Domain Interpersonal Support	.107[b]	1.707	.089	.117	.940	1.064	.940
2	Weight Category	-.057[c]	-.931	.353	-.064	1.000	1.036	.962
	Domain Engagement	-.121[c]	1.868	.063	-.128	.988	1.168	.856
	Domain Interpersonal Support	-.103[c]	1.651	.100	-.114	.558	1.065	. 938

Note. [a]Predictors in the Model: (Constant) and Language Arts Engagement. [b]Predictors in the Model: (Constant), Language Arts Engagement and Square Root of the Absences.

Data Preparation for Research Question Five

A stepwise regression was used to analyze research question five. The removal of univariate and multivariate outliers was undertaken and the assumptions for multivariate analysis (multicollinearity and singularity, normality, linearity, and homoscedasticity) were verified before a stepwise linear regression was conducted to analyze the data. The initial predictor variables were Weight Category, Absences, Mathematics Engagement, Domain Engagement, and Domain Interpersonal Support and the criterion variable was CMT Mathematics Scores.

Research Question Five

5. To what extent and in what manner can the variation in Mathematics CMT scores be explained by weight category, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?

Outliers for Research Question Five

Univariate and multivariate outliers were located and removed from the data set using the same method as indicated in research questions three and four.

Univariate outliers. Univariate outliers for the predictor variables Absences, Mathematics Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support were located and removed from the data set as in the previous research questions. The square root of the absences was taken to bring skewness and kurtosis levels into the acceptable range of -1 to 1 (Meyers et al., 2006). All remaining predictor variables had skewness and kurtosis levels within the acceptable range therefore no other transformations were undertaken. SPSS (IBM Corp., 2012) was used to calculate the *z*-

scores of the dependent variables. An examination of the *z*-scores indicated there were eight participants with scores that were outliers as they fell outside the acceptable range of -3 to 3 (Tabachnick & Fidell, 2007). Participants with identification numbers 245 (z = -3.15), 300 (z = -3.23), 406 (z = -3.32), and 410 (z = -3.10) were removed because their scores were outliers for Domain Engagement. There was one score that was an outlier for the Domain Beliefs About Self belonging to participant 266 (z = -3.27) and three outliers for Mathematics Engagement belonging to 127 (z = -3.16), 234 (z = -3.16), and 423 (z = -3.16). In addition, data from the seven participants who were classified as underweight (116, 135, 160, 176, 409, 418, and 420) were removed from the data set to improve linearity of the data set.

Multivariate outliers. Mahalanobis distance (D^2) was used to check for multivariate outliers. The chi-square criterion was set at χ^2= 22.458, with 6 degrees of freedom, and significance at .001. There was one case that was determined to be a multivariate outlier based on these criteria. A participant with identification number 146 (D^2 = 23.82) was removed from the data set. The removal of univariate and multivariate outliers yielded a sample size of 211.

Multivariate Statistical Assumptions for a Multiple Linear Regression

The assumptions for a multiple linear regression include multicollinearity and singularity, normality, linearity, and homoscedasticity. The researcher verified that each of these assumptions was met before analyzing the data for research question five.

Multicollinearity and singularity. Singularity was checked by examining the correlations to assess the strength of the linear relationships between the bivariate variables. Table 36 displays correlations and significance levels of the predictor and criterion variables for research question five. The researcher removed the variable Domain Beliefs About Self from the data analysis as it was highly correlated with Domain Interpersonal Support (*r* =.745) and Domain Engagement (*r* = .783).

Table 36

Pearson Product-Moment Correlations for Research Question Five

	Weight Category	Absences	Math Engage[b]	Domain Engage[c]	Domain Beliefs[c]	Domain Interper[c]
CMT Math[a]	-.070	-.098	.474**	.324**	.303**	.145*
Weight Category		.211**	-.153*	-.003	-.028	.003
Absence			-.278**	-.137*	-.089	-.037
Math Engage				.355**	.312**	.212**
Domain Engage					.783**	.625**
Domain Beliefs						.745**

Note. Math Engage represents Mathematics Engagement; Domain Engage represents Domain Engagement; Domain Beliefs represents Domain Beliefs About Self; and Domain Inter represents Domain Interpersonal Support. [a]CMT Mathematics is a measure of student achievement; [b]Mathematics Engagement is a measure of teacher perception of student engagement; [c]Domain Engagement, Domain beliefs About Self, and Domain Interpersonal support are measures of student perception of engagement, self-beliefs, and interpersonal support, respectively. Absences represents the Square Root of the Absences; $^{*}p < .05$; $^{**}p < .01$; and $n = 211$.

Table 37 displays the tolerance values and VIFs for the predictor variables for research question five. All tolerance levels were greater than .01 and all VIFs were less than 10 therefore multicollinearity was not indicated (Meyers et al., 2006) and the assumption was met for research question five.

Table 37

Tolerance Values and VIFs for Research Questions Five

Predictor Variables	Tolerance	VIF
Weight Category	.977	1.027
Square Root of the Absences	.921	1.086
Mathematics Engagement[a]	.874	1.144
Domain Engagement[b]	.874	1.144
Domain Interpersonal Support[b]	.609	1.642

Note. [a]Mathematics Engagement is a measure of teacher perception of student engagement; [b]Domain Engagement and Domain Interpersonal Support are measures of student perception of engagement and interpersonal support, respectively; and n = 211.

The researcher removed Domain Beliefs About Self from the analysis to address the issue of multicollinearity. All remaining intercorrelations were between -.75 and .75 and the tolerance and VIF levels were within acceptable ranges. The researcher concluded that the assumptions of singularity and multicollinearity were met and proceeded with the data analysis.

Normality, linearity, and homoscedasticity. A residuals plot was used to check the assumptions of normality, linearity, and homoscedasticity simultaneously. Figure 5 displays the residuals plot using Weight Category, Square Root of the Absences, Mathematics Engagement, Domain Engagement, and Domain Interpersonal Support as the predictor variables and CMT Mathematics as the criterion variable. The researcher concluded the assumptions of normality, linearity, and homoscedasticity were met because the residuals plot was rectangular in shape, there are no points outside three standard deviations from the mean, and there were a concentration of scores along the midline, the horizontal line at the regression standardized residual value of zero.

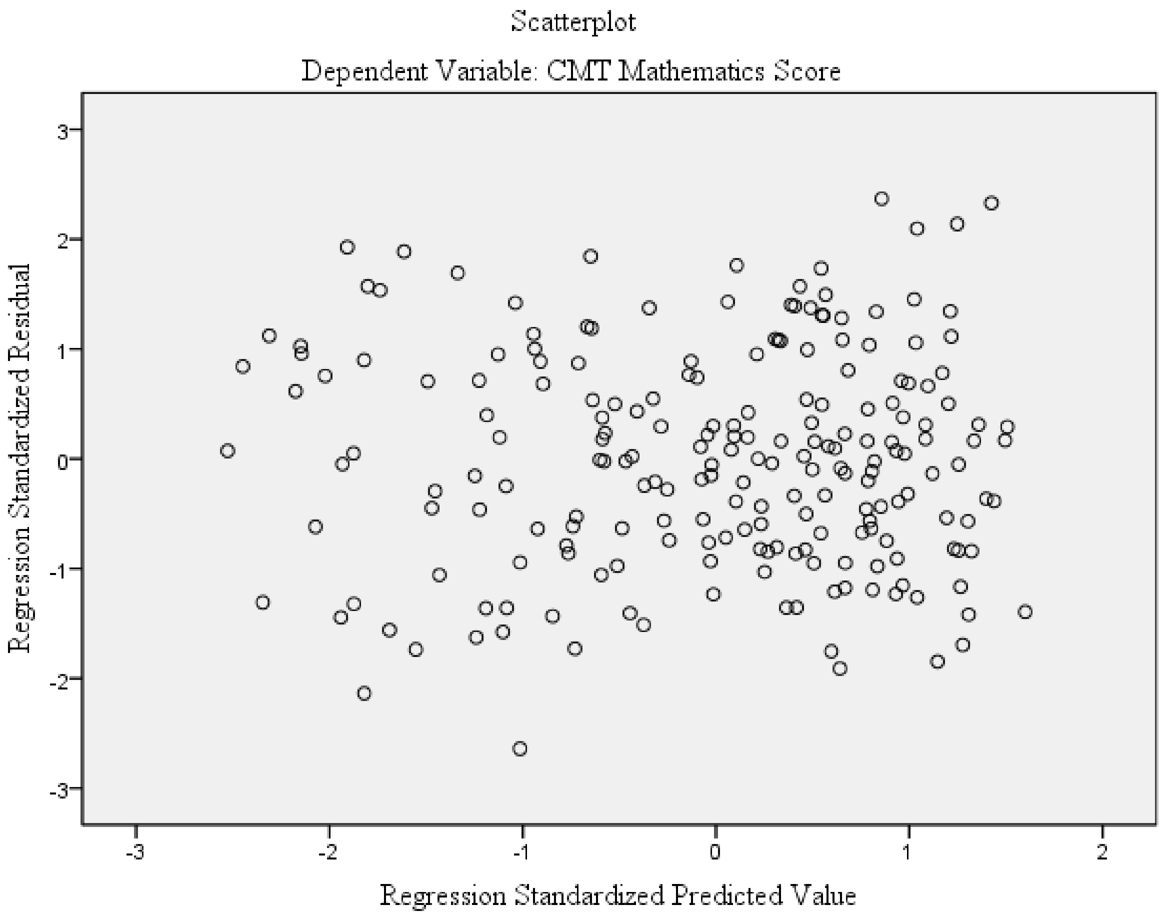

Figure 5. Residuals plot for research question five.

Descriptive Statistics for Research Question Five

After the data were cleaned and the assumptions for a multiple linear regression were verified, the descriptive statistics were calculated for the sample used to investigate research question five which are presented in Table 38.

Table 38

Descriptive Statistics of the Sample for Research Question Five

Variable	Min	Max	*Mean*	*SD*
CMT Mathematics[a]	189.00	385.00	288.09	35.19
Absences	0.00	26.00	6.53	6.05
Mathematics Engagement[b]	1.67	4.00	3.35	0.59
Domain Engagement[c]	2.52	4.00	3.53	0.35
Domain Interpersonal Support[c]	2.28	4.00	3.31	0.41

Note. [a]CMT Mathematics is a measure of student achievement; [b]Mathematics Engagement is a measure of teacher perception of student engagement; [c]Domain Engagement and Domain Interpersonal Support are measures of student perception of engagement and interpersonal support, respectively. Absences are reported in the table although Square Root of the Absences were used in the data analysis; and $n = 211$.

Data Analysis Research for Question Five

In predicting CMT Mathematics scores, the results of the ANOVA (Table 39) indicated that Mathematics Engagement and Domain Engagement were significant predictors of CMT Writing scores $F(2,208) = 35.029$, $p < .001$).

Table 39

ANOVA Results for Predicting CMT Mathematics Scores for Research Question Five

ANOVA[c]						
Model		*SS*	*df*	*MS*	*F*	Sig.
1	Regression	58312.773	1	58312.773	60.435	.000[a]
	Residual	201659.692	209	964.879		
	Total	259972.464	210			
2	Regression	65501.082	2	32750.541	35.029	.000[b]
	Residual	194471.383	208	934.959		
	Total	259972.464	210			

Note. [a]Predictors: (Constant), Mathematics Engagement. [b]Predictors: (Constant) Mathematics Engagement and Domain Engagement. [c]Dependent Variable: CMT Mathematics Scores.

The model summary (Table 40) displays the coefficient of multiple determination which measures the overall strength of the linear relationship between the predictor and criterion variables by providing R^2 and the adjusted R^2 values for the model (Meyers et al., 2006). The R^2 depicts the amount of variation of the criterion variable, CMT Mathematics scores, which can be explained by the combination of the predictor variables Mathematics Engagement and Domain Engagement (Tabchnick & Fidell, 2007). For research question four the R^2 indicated that 25.2% of the variation in CMT Mathematics scores was explained by Mathematics Engagement and Domain Engagement. The adjusted R^2, a more conservative estimate of the coefficient of multiple determination, was not used in the analysis because the sample was greater than 60 and there were not numerous independent variables (Tabachnick & Fidell, 2007).

Table 40

Model Summary for Predicting CMT Mathematics Scores for Research Question Five

Model	*R*	R^2	Adj. R^2	*SEE*	Change Statistics				
					R^2 Change	*F* Change	df_1	df_2	Sig *F* Change
1	.474[a]	.224	.221	31.063	.224	60.435	1	209	.000
2	.502[b]	.252	.245	30.577	.028	7.688	1	208	.006

Note. [a]Predictors: (Constant), Mathematics Engagement. [b]Predictors: (Constant), Mathematics Engagement and Domain Engagement.

An examination of the coefficients table (Table 41) indicates that two of the five independent variables contributed significantly to the model, Mathematics Engagement ($p < .001$) and Domain Engagment ($p < .01$). The bivariate correlations (Table 36) indicates Mathematics Engagement ($r = .474$, $p < .01$) and Domain Engagement ($r = .324$, $p < .01$) were positively related to CMT Mathematics scores. These significant associations suggest that as Mathematics Engagement scores increase CMT Mathematics scores increase and as the Domain Engagement scores increase CMT Mathematics scores increase. Although Domain Beliefs About Self and Domain Interpersonal Support were positively associated with CMT Mathematics scores, they did not contribute significantly to the model.

Table 41

Coefficients for Predicting CMT Mathematics Scores for Research Question Five

Model	Unstandardized Coefficients		Standardized Coefficients	*t*	Significance	Collinearity Statistics	
	B	*SE*	*Beta*			Tolerance	VIF
1 (Constant)	193.711	12.327		15.715	.000		
Mathematics Engagement	28.205	3.628	.474	7.774	.000	1.000	1.000
2 (Constant)	143.472	21.806		6.579	.000		
Mathematics Engagement	24.443	3.820	.410	6.398	.000	.874	1.144
Domain Engagement	17.784	6.414	.178	2.773	.006	.874	1.144

Note. Dependent Variable is CMT Mathematics Scores.

Finally, Table 42 displays the results of the excluded variables of the stepwise regression. Mathematics Engagement was the first predictor variable to be entered into the model. For the next model Domain Engagement, the predictor variable with the largest partial correlation, was entered into the stepwise multiple linear regression because it added significantly to the model (Tabachnick & Fidell, 2007). Weight Category, Absences, and Domain Interpersonal Support did not add significantly to the final model.

Table 42

Excluded Variables at Each Step in the Procedure for Predicting CMT Mathematics Scores for Research Question Five

Model		*Beta* In	*t*	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Weight Category	.003[a]	.042	.966	.003	.977	1.024	.977
	Square Root of the Absences	.037[a]	.583	.560	.040	..923	1.084	.923
	Domain Engagement	.178[a]	2.773	.006	.189	.874	1.144	.874
	Domain Interpersonal Support	.046[a]	.741	.459	.051	.955	1.047	.955
2	Weight Category	-.007[b]	-.110	.913	-.008	.974	1.027	.851
	Square Root Absences	.045[b]	.712	.477	.049	.921	1.086	.820
	Domain Interpersonal Support	-.088[b]	-1.147	.253	-.079	.609	1.642	.557

Note. [a]Predictors in the Model: (Constant) and Mathematics Engagement. [b]Predictors in the Model: (Constant), Mathematics Engagement and Domain Engagement.

Chapter Summary

Two MANOVAs and three stepwise multiple linear regression procedures were conducted to investigate the relationships of Weight Category and school-related factors. The data were obtained from the responses to the RAPS-SM and RAPS-TM, from results of the CMT Reading, Writing, and Mathematics tests, school records, and the measurements of heights and weights taken by the researcher.

Research question one grouped the data based by Weight Category (healthy-weight or overweight/obese) to determine if there were differences in academic achievement (CMT Reading, CMT Writing, and CMT Mathematics scores), absences (Square Root of the Absences), teacher perception of student engagement (Language Arts Engagement and Mathematics Engagement), and student perception of engagement and interpersonal support (Domain Engagement and Domain Interpersonal Support). Results indicated healthy-weight students scored significantly higher on CMT Reading and CMT Writing tests than overweight/obese students. Furthermore, mathematics teachers perceived healthy-weight students as significantly more engaged in mathematics tasks than overweight/obese students. Finally, overweight/obese students accrued significantly more absences than healthy-weight students.

Research question two grouped the data by gender (male or female) to investigate if there were significant differences in academic achievement (CMT Reading, CMT Writing, and CMT Mathematics scores), absences (Square Root of the Absences), teacher perception of student engagement (Language Arts Engagement and Mathematics Engagement), and student perception of engagement, self-beliefs, and interpersonal support (Domain Engagement, Beliefs About Self and Domain Interpersonal Support). The findings indicated that female middle school students scored significantly higher on CMT Reading and CMT Writing tests than male middle school students and that female students were significantly more engaged in learning tasks than male students whether the engagement was perceived by the teacher (Language Arts Engagement and Mathematics Engagement) or the student (Domain Engagement).

The data collected were used to run three multiple linear regression procedures to investigate weight category and school-related factors on CMT scores. Research question three investigated the relationships between Weight Category, Absences, Language Arts Engagement, Domain Engagement, Domain Interpersonal Support on CMT Reading scores. The results indicated that Language Arts Engagement, Domain Engagement, and Weight Category significantly predicted CMT Reading scores where Language Arts Engagement and Domain Engagement were positively related to CMT Reading scores and Weight Category was negatively associated with CMT Reading scores. Research question four investigated the relationships between the same four predictor variables used in research question three on CMT Writing scores. The results of the stepwise multiple linear regression indicated that Language Arts Engagement and Absences significantly predicted CMT Writing scores with a positive association between Language Arts Engagement and CMT Writing scores and a negative relationship between Absences and CMT Writing scores.

The last research question investigated the relationships between Weight Category, Absences, Mathematics Engagement, Domain Engagement, and Domain Interpersonal Support on CMT Mathematics scores. The results indicated that Mathematics Engagement and Domain Engagement significantly predicted CMT Mathematics scores where both measures of engagement were positively associated with CMT Mathematics scores. An overview of the results and the implications of the findings are presented in Chapter Five.

CHAPTER FIVE: SUMMARY AND CONCLUSIONS

Chapter five begins with an overview of the present study including the research questions that were investigated, the methods used to collect the data and the results of the data analyses. The discussion of the findings section elaborates on the results of the previous chapter as they apply to each research question. The discussion of the literature section draws connections between the results of this study to the findings related to the review of the literature. The limitations section addresses the characteristics of the design and methodology of the study which impacted the results of the study. The implications section contains a discussion on how the results of the study impact education. Suggestions for future research are offered in three areas of interest. Finally, a chapter summary completes chapter five.

Overview of the Research

Over the past 30 years overweight and obesity rates have been on the rise in the United States. In the latest study by NHANES, Ogden et al. (2012) concluded that 32.6% of children and 33.6% of adolescents in the United States were either overweight or obese. Health issues, such as high cholesterol and type II diabetes, and social issues, such as poor self-esteem and discrimination, have been related to children and adolescents who are overweight or obese (CDC, 2013). Limited research has been conducted associating weight-related data to school-related factors and academic performance. The researcher conducted this study to explore the relationships between Weight Category (healthy-weight and overweight/obese) on school-related factors such as academic performance, absences, teacher perception of student engagement and student perception of student engagement, beliefs about self, and interpersonal support.

A sample of convenience of sixth, seventh, and eighth grade students was taken from a single middle school in, Connecticut. Letters obtaining parental consent were sent home with the 680 regular education students enrolled in the school. Of the 680 eligible regular education students 229, or 33.68%, had parental permission and gave student assent to participate in the study. The Language Arts and Mathematics teachers were also recruited to participate in the study as they rated their students on engagement levels in their respective discipline. All fourteen Language Arts teachers and six Mathematics teachers consented to be a part of the study for 100% of the eligible teacher population.

The student data collected for this study included heights and weights, the number of school absences, CMT Reading scores, CMT Writing scores, CMT Mathematics scores, and the results of the RAPS-SM. The heights and weights were used to calculate individual BMIs based on the formula as stated by the CDC (2013). The BMIs were used to place the participating students into one of four weight categories based on the CDC Data Table of BMI-for-Age Charts by age and gender (Kuczmarski, 2002). The CMT Reading, Writing, and Mathematics scores were used as measures of student academic achievement. The results of the RAPS-SM were used to calculate the scores on three school-related factors associated with success in the classroom engagement, beliefs about self, and interpersonal support (Skinner & Pitzer, 2012). The data collected from the teachers measured teacher perception of student engagement as measured by the RAPS-TM.

The researcher used these data to address the following research questions:

1. Is there a significant difference between weight categories of middle school students with respect to academic achievement, school absences, teacher

perception of student engagement, and student perception of engagement, beliefs about self, and interpersonal support?

2. Is there a significant difference between gender with respect to academic achievement, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
3. To what extent and in what manner can the variation in CMT Reading scores be explained by weight category, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
4. To what extent and in what manner can the variation in CMT Writing scores be explained by weight category, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?
5. To what extent and in what manner can the variation in Mathematics CMT scores be explained by weight category, school absences, teacher perception of student engagement, student perception of student engagement, beliefs about self, and interpersonal support?

The researcher used a causal-comparative research design to answer research questions one and two. In research question one the groups under investigation were the healthy-weight group and the overweight/obese group. For research question two, the groups under investigation were female middle school students and male middle school students. The statistical analysis for each research question was conducted using SPSS software (IBM Corp., 2012).

A MANOVA was conducted for research one which compared the means of the CMT Reading, CMT Writing, CMT Mathematics, Absences, Language Arts Engagement, Mathematics Engagement, Domain Engagement, and Domain Interpersonal Support of the healthy-weight and overweight/obese groups. Similarly, research question two compared the means of the CMT Reading, CMT Writing, CMT Mathematics, Absences, Language Arts Engagement, Mathematics Engagement, Domain Engagement, Domain Beliefs About Self, and Domain Interpersonal Support of the female and male participants. Each MANOVA was evaluated through the *F*-statistic with an alpha level of .05.

For research questions three, four, and five, a correlational research design was implemented. Stepwise multiple linear regression procedures were conducted to explore the relationships between school-related factors on CMT Reading, CMT Writing, and CMT Mathematics scores. Research questions three and four examined the relationships between Weight Category, Absences, Language Arts Engagement, Domain Engagement, and Domain Interpersonal Support on CMT Reading and CMT Writing Scores, respectively. Research question five examined the relationships between Weight Category, Absences, Mathematics Engagement, Domain Engagement, and Domain Interpersonal Support on CMT Mathematics scores. Each stepwise multiple linear regression model was evaluated through R^2 at the .05 significance level.

Discussion of the Findings

This section summarizes the results of each research question.

Research Question One Results and Conclusions

The results of *the* MANOVA indicated that Wilks' Lambda was significant at the $p < .05$ significance level where $F(8, 207) = 2.661$, $p = .007$, and *partial* $\eta^2 = 0.093$

demonstrating significance of the model. The Tests of Between-Subjects Effects indicated there were significant differences between the healthy-weight and overweight/obese groups on CMT Reading (F = 6.780, p = .010, *partial* η^2 = .031), CMT Writing (F = 4.262, p = .040, *partial* η^2= .020), Mathematics Engagement (F = 8.362, p = .004, *partial* η^2 = .038), and Absences (F = 11.085, p = .001, *partial* η^2 = .049).

The findings partially supported the researcher's hypothesis that there was a significant difference between healthy-weight and overweight/obese middle school children on school-related factors. The results of the MANOVA indicated that overweight/obese middle school children scored significantly lower (p = .010 and *partial* η^2 = .031) on CMT Reading scores (M = 269.27, SD = 40.22) than healthy-weight students (M = 283.33, SD = 33.60). Overweight/obese middle school students scored significantly lower (p = .040, *partial* η^2 = .020) on CMT Writing scores (M = 273.08, SD = 43.08) than healthy-weight students (M = 285.83, SD = 39.66). Overweight/obese middle school students scored significantly lower (p = .004, *partial* η^2 = .038) on Mathematics Engagement scores (M = 3.14, SD = 0.69) than healthy-weight students (M = 3.39, SD = 0.57). Finally, overweight/obese middle school children recorded significantly higher (p = .001, *partial* η^2 = .049) Absences (M = 9.02, SD = 7.19, Min. = 0, Max. = 26) than the healthy-weight students (M = 5.74, SD = 5.40, Min. = 0, Max. = 25). There were no significant differences between the healthy-weight and overweight/obese groups on CMT Mathematics, Language Arts Engagement, Domain Engagement, or Domain Interpersonal Support.

The results indicated that students who were classified as overweight or obese scored significantly lower on the CMT Reading and CMT Writing standardized tests than students who were classified as having a healthy weight. Overweight and obese middle school children accrued significantly more absences than their healthy-weight peers. In addition, students who were overweight or obese were perceived by their mathematics teachers to be significantly less engaged in mathematics activities. It is important to note that although overweight and obese students were less engaged in mathematics tasks, they did not perform significantly lower than healthy-weight students on the CMT Mathematics test.

The overweight/obese students scored lower on Language Arts Engagement, Domain Engagement, Domain Interpersonal Support, and CMT Mathematics than the healthy-weight group, but these differences were not significant. These outcomes suggest Language Arts teachers perceive healthy-weight students and overweight or obese students as being equally engaged in Language Arts activities. Students who are overweight or obese have similar beliefs about themselves as defined by competency, autonomy, and relatedness. Finally, there were no differences between healthy-weight students and overweight/obese students in terms of their perceived interpersonal support from teachers and parents.

Research Question Two Results and Conclusions

The results of the MANOVA indicated that Wilks' Lambda was significant at the $p < .05$ significance level where $F(9, 186) = 6.403$, $p < .001$, and *partial* $\eta^2 = 0.237$ demonstrating significance of the model. The Tests of Between-Subjects Effects indicated there were significant differences between male students and female students on CMT Reading ($F = 6.503$, $p = .012$, *partial* $\eta^2 = .032$), CMT Writing ($F = 26.533$, $p < .001$, *partial* $\eta^2 = .120$), Language Arts Engagement ($F = 12.006$, $p = .001$, *partial* $\eta^2 = .058$), Mathematics Engagement ($F = 8.402$, $p = .004$, *partial* $\eta^2 = .042$) and Domain Engagement ($F = 4.694$, $p = .031$, *partial* $\eta^2 = .024$).

The findings partially supported the researcher's hypothesis that there were significant differences between male and female middle school students on school-related factors. The results of the MANOVA indicated that female middle school students scored significantly higher (p = .012, *partial* η^2= .032) on CMT Reading scores (M = 285.05, SD = 33.66) than male students (M = 272.48, SD = 35.34). Female students scored significantly higher (p < .001, *partial* η^2= .120) on CMT Writing scores (M = 295.14, SD = 44.16) than male students (M = 267.16, SD = 30.68). Female students scored significantly higher (p < .001 and *partial* η^2= .058) on Language Arts Engagement scores (M = 3.30, SD = 0.76) than male students (M = 2.93, SD = 0.74). Female students scored significantly higher (p = .004, *partial* η^2 = .042) on Mathematics Engagement scores (M = 3.44, SD = 0.55) than male students (M = 3.18, SD = 0.66). Finally, female students scored significantly higher (p = .031, *partial* η^2 = .024) on Domain Engagement scores (M = 3.59, SD = 0.32) than male students (M = 3.47, SD = 0.41). There were no significant differences between male and female middle school students with respect to CMT Mathematics scores, Absences, Domain Beliefs About Self, or Domain Interpersonal Support.

The results suggest that female middle school students performed higher on the CMT Reading and CMT Writing tests than male middle school students. Language Arts teachers and Mathematics teachers perceived female students as more engaged than male students on Language Arts and Mathematics tasks. Female students' perception of academic engagement was higher than male students' perception of academic engagement. Although female students were significantly more engaged on mathematical tasks, as reported by their teachers and by themselves, there were no significant differences in the CMT Mathematics scores of female middle school students and male middle school students. The findings indicated that female students and male students accumulated the same amount of absences throughout the school year, that they had similar beliefs about themselves (competency, autonomy, and relatedness), and they perceived themselves similarly in regards to the amount of support they received from their parents and teachers (interpersonal support).

Research Question Three Results and Conclusions

The ANOVA output indicated the model was significant at predicting CMT Reading scores ($F(3,208) = 24.254$, $p < .001$) from Language Arts Engagement, Domain Engagement, and Weight Category. The R^2 indicated that 25.9% of the variation in CMT Reading scores was explained by Language Arts Engagement, Domain Engagement, and Weight Category. These findings suggest that the more teachers perceive a student as being engaged, the more students perceive themselves as being engaged, and the more likely students were to be at a healthy weight, the higher their CMT Reading scores. Teacher perception of student engagement in Language Arts activities ($p < .001$), student perception of engagement in academic activities ($p = .001$), and student weight category ($p = .045$) were significant predictors of academic performance on the CMT Reading test.

Research Question Four Results and Conclusions

The ANOVA output indicated there was a significant relationship, $F(2,209) = 32.343$ and $p < .001$ between the weighted linear composite of the independent variables Language Arts Engagement and Absences as specified by the model and the dependent variable CMT Writing scores. The R^2 indicated that 23.6% of the variation in CMT Writing scores was explained by Language Arts Engagement and Absences.

These findings suggest that the more teachers perceive students as being engaged in Language Arts and the lower the student absence rate, the higher the their score on the CMT

Writing test. Both teacher perception of student engagement in Language Arts activities ($p < .001$) and the number of school absences ($p = .027$) were significant predictors of academic performance on the CMT Writing test.

Research question Five Results and Conclusions

The results of the regression analysis of the ANOVA indicated the model was significant at predicting CMT Mathematics scores $F(2,208) = 35.029$, $p < .001$) from Mathematics Engagement and Domain Engagement scores. The R^2 indicated that 25.2% of the variation in CMT Mathematics scores was explained by Mathematics Engagement and Domain Engagement.

These findings suggest that the more teachers perceive a student as being engaged in Mathematics activities and the more students perceive themselves as being engaged in academic activities, the higher their score on the CMT Mathematics test. Both teacher perception of student engagement ($p < .001$) in Mathematics and student perception of engagement in academic activities ($p = .006$) were significant predictors of academic performance on the CMT Mathematics test.

Findings Related to the Literature

This study utilized Skinner and Pitzer's (2012) Dynamics of Motivational Development as the theoretical framework. In this model, the interpersonal relationships of students with teachers, parents, and peers help to structure self-beliefs of relatedness, competence, and autonomy in students (Skinner & Pitzer, 2012). In turn, these self-beliefs create a motivational basis for patterns of engagement or disaffection with learning activities (Skinner & Spitzer, 2012). Student engagement with learning activities ultimately influences learning and academic achievement (Skinner & Spitzer, 2012).

The researcher investigated the interpersonal relationships of students with teachers and parents (Domain Interpersonal Support), self-beliefs (Domain Beliefs About Self) and engagement (Domain Engagement, Language Arts Engagement, Mathematics Engagement and Absences) with academic performance (CMT Reading, CMT Writing, and CMT Mathematics scores) when body mass type (healthy-weight or overweight/obese) was a factor. The discussion of the literature draws connections between the results of this study to the theory and previously conducted research investigating weight-related data to academic achievement, absences, engagement, self-beliefs, and interpersonal support.

Findings Related to the Theory

The results of the current research partially supported Skinner and Pitzer's theory of Dynamics of Motivational Development. In this model, the quality of the relationships students have with parents and teachers (Domain Interpersonal Support) was directly affected the beliefs students have about themselves (competence, autonomy, and relatedness) as measured by Domain Beliefs About Self (Skinner & Pitzer, 2012). Although causation was not established in the current research, significant and positive relationships were established between the two variables. Domain Interpersonal Support was positively, significantly related to Domain Beliefs About Self in research question one (r = .737, $p < .05$), research question two (r = .728, $p < .05$), research question three (r = .783, $p < .05$), research question four (r = .792, $p < .05$), and research question five (r = .745, $p < .05$).

The next step in Skinner and Pitzer's model of Dynamics of Motivational Development indicates that self-beliefs (Domain Beliefs About Self) directly affects student engagement in the classroom. Causation was not established in the current research, however, significant and positive relationships were found between the variables when engagement was measured by teacher perception of student engagement (Language Arts Engagement or Mathematics Engagement) or student perception of student engagement (Domain Engagement). For research question one, Domain Beliefs About Self was significantly and positively related to Language Arts Engagement ($r = .312$, $p < .05$), Mathematics Engagement ($r = .301$, $p < .05$), and Domain Engagement ($r = .764$, $p < .05$). Similarly, in research question two Domain Beliefs About Self was significantly and positively related to Language Arts Engagement ($r = .313$, $p < .05$), Mathematics Engagement ($r = .287$, $p < .05$), and Domain Engagement ($r = .742$, $p < .05$). A continuation of the pattern was confirmed in research question three through five. Domain Beliefs About Self was significantly related to Language Arts Engagement in research question three ($r = .362$, $p < .05$) and research question four ($r = .355$, $p < .05$) and Mathematics Engagement in research question five ($r = .312$, $p < .05$). Finally, Domain Beliefs About Self was significantly and positively related to Domain Engagement in research question three ($r = .775$, $p < .05$), research question four ($r = .776$, $p < .05$), and research question five ($r = .783$, $p < .05$).

Skinner and Pitzer (2012) theorized that engagement in academic tasks directly affects learning and achievement. The findings of this study suggest there were significant, positive relationships between engagement levels, as perceived by teachers and students, and academic achievement as measured by the CMT Reading, Writing, and Mathematics tests. An examination of the correlations in research question one indicated that there were significant, positive relationships between CMT Reading scores and Language Arts Engagement ($r = .437$, $p < .05$) and Domain Engagement ($r = .365$, $p < .05$), significant relationships between CMT Writing scores and Language Arts Engagement ($r = .468$, p <

.05) and Domain Engagement (r = .278, p < .05), and significant associations between CMT Mathematics scores and Mathematics Engagement (r = .483, p < .05) and Domain Engagement (r = .291, p < .05). Similar associations were found in research question two where CMT Reading scores were significantly related to Language Arts Engagement (r = .409, p < .05) and Domain Engagement (r = .341, p < .05), CMT Writing scores were significantly associated to Language Arts Engagement (r = .420, p < .05) and Domain Engagement (r = .292, p < .05), and CMT Mathematics scores were significantly linked to Mathematics Engagement (r = .491, p < .05) and Domain Engagement (r = .275, p < .05).

The significant and positive associations found between engagement levels as perceived by students and teachers and academic achievement were also witnessed in research questions three through five. In addition, the results of research questions three through five indicated that teacher perception of student engagement was the primary predictor of CMT Reading (R^2 = .201), Writing (R^2 = .218), and Mathematics (R^2 = .224) scores. The secondary predictors were student perception of student engagement when predicting CMT Reading (R^2 = .043) and CMT Mathematics (R^2 = .018).

The results of the current research established the links portrayed in Skinner and Pitzer's (2012) model of Dynamics of Motivational Development without proving causation. Interpersonal relationships (Domain Interpersonal Support) was positively related to the self-beliefs (Beliefs About Self) students have about themselves which include competence, autonomy, and relatedness. In turn, student self-beliefs were positively associated with student engagement, where student engagement was measured by both the teacher and the student. Finally, teacher perception of student engagement and student perception of engagement were positively linked to academic achievement as measured by the CMT

Reading, Writing, and Mathematics tests. These associations support Skinner and Pitzer's theory of Dynamics of Motivational Development.

Research Question One

Previous research associating weight-related data to academic achievement was conducted by Li et al. (2008). Li et al. (2008) concluded that there were significant negative associations between BMI values with academic performance and cognitive functioning tests. The current research study indicated there were significant differences between CMT Reading and CMT Writing scores of healthy-weight and overweight/obese middle school students. However, no significant difference was found between the CMT Mathematics scores of healthy-weight and overweight/obese students.

Geier et al. (2012) conducted a study which positively related weight category to number of school absences accrued. The researchers concluded that the number of absences increased with a change in weight category over time from healthy-weight to overweight/obese. The current research indicated that overweight/obese students were absent significantly more days ($p = .001$) than healthy-weight students. Absences were significantly, negatively related to CMT Reading ($p = .010$) and CMT Writing scores ($p = .040$) and negatively related to CMT Mathematics scores ($p > .05$). However, the researcher did not conclude that absences impacted academic performance.

Weight-related data were associated with engagement through a study conducted by Ramaswamy et al. (2010). In the Ramaswamy et al. (2010) study, the researchers concluded that BMI was negatively associated with effort. The current research partially supported the findings of Ramaswamy et al. (2010). The results of the analysis indicated that teachers perceived overweight/obese students as significantly less engaged in Mathematics tasks

(p = .004) than their healthy-weight peers. However, teachers did not perceive overweight/obese students as less engaged in Language Arts tasks than their healthy-weight students. Similarly, overweight/obese and healthy-weight students did not perceive themselves as being engaged differently while performing academic tasks. It is important to note that although overweight/obese students were perceived as less engaged in Mathematics tasks, they did not perform significantly lower on the CMT Mathematics tests than their healthy-weight peers. However, overweight/obese students who were perceived as being less engaged in Language Arts tasks by their teachers, did perform significantly lower on the CMT Reading (p = .010) and CMT Writing tests (p = .040) than their healthy-weight peers.

No studies were found examining the relationships of weight-related data and the affective constructs of Beliefs About Self (competency, autonomy, relatedness) and Interpersonal Support (teacher support and parental support). The researcher of the current study did not find significant differences between healthy-weight students and overweight/obese students on Beliefs About Self and Interpersonal Support.

Research Question Two

Previous research relating gender to literature/arts reading performance was conducted by Conrad-Curry (2011). The researcher concluded that female students scored higher on literature/arts performance tests than male students. In addition, Deary, Strand, Smith, and Fernandes (2007) determined that female students scored significantly higher on all Cognitive Ability Tests, including language arts and mathematics tests, with the exception of physics. Duckworth and Seligman (2006), however, suggested that although female students of all grade levels earned higher grades than male students in all major subjects, they do not outperform male students on achievement tests. The researchers surmised the difference in grades was related to female students having more self-discipline than male students which was relevant to report card grades. Furthermore, other research indicated there were no significant differences between male students and female students on mathematics achievement tests (Cheema & Galluzzo, 2013; Hyde, Lindberg, Linn, Ellis, & Williams, 2008). The current research supported the findings of Conrad-Curry (2011) and partially supported the findings of Deary et al. (2007) as female middle school students scored significantly higher on the CMT Reading (p = .012) and CMT Writing tests (p < .001) than male middle school students while there was no significant difference between female students and male students on CMT Mathematics tests.

Marks (2000) conducted research on gender differences of engagement levels of elementary, middle, and high-school students. The researcher concluded that across all three grade levels, female students were more engaged in educational activities than male students. The current research supported these findings. Teacher perception of student engagement and student perception of student engagement were significantly higher in female middle school students than in male middle school children. Language Arts teachers (p < .001) and Mathematics teachers (p = .004) perceived female students as being significantly more engaged on Language Arts and Mathematics tasks than male students. Female students' perception of academic engagement was higher (p = .031) than male students' perception of academic engagement.

No research was found on gender differences of the school-related factors beliefs about self (competency, autonomy, and relatedness) or on interpersonal support. The researcher did not find any significant differences between male and female middle school students on these factors.

Research Question Three, Four, and Five

Previous research indicated that classroom engagement was a predictor of academic achievement and standardized test scores (Ladd & Dinella, 2009). The current research indicated that teacher perception of student engagement (*p*s < .01) and student perception of student engagement (*p*s < .01) were significant predictors of CMT Reading and CMT Mathematics scores. In addition, teacher perception of student engagement was a significant predictor ($p < .01$) of CMT Writing scores. Student engagement in academic tasks, whether the engagement was perceived by the teacher or the student, was a predictor of academic achievement on the CMT standardized tests.

Morrissey, Hutchison, and Winsler (2013) conducted a study exploring the relationship between absenteeism and academic performance. The researchers concluded that the number of school absences was negatively related to academic achievement. The current research partially supports this finding. The number of absences was a significant predictor ($p < .05$) of the CMT Writing scores; as the numbers of absences increased the CMT Writing scores decreased. However, the same relationship between the number of days absent and academic achievement did not exist for CMT Reading scores or CMT Mathematics scores.

Research was previously conducted relating weight category to academic performance. Judge and Jahns (2007) concluded that overweight students performed lower on reading and mathematics assessments than their non-overweight peers. The current study partially supports their findings. Weight Category was a significant predictor ($p = .035$) of CMT Reading scores. As the Weight Category changed from healthy-weight to overweight/obese, middle school students' CMT Reading scores decreased. A similar relationship was not indicated between weight-category and CMT Writing or CMT Mathematics scores.

Links were found between research question one and research questions three, four, and five. A MANOVA was conducted for the data analysis of research question one while stepwise multiple linear regression procedures were conducted for the data analysis of research questions three, four, and five. The results of research question one indicated there were significant differences in the CMT Reading (p = .010) and CMT Writing scores (p = .040) of healthy-weight and overweight/obese middle school children. The results of research question three and four indicated that weight category was a significant predictor of CMT Reading scores (p = .035) but not of CMT Writing scores, respectively. It is possible that weight category is a predictor of CMT Writing scores but another variable related to weight category supersedes it. For instance, there was a significant difference in the number of Absences (p = .001) between the healthy-weight and overweight/obese groups. Furthermore, Absences was a significant predictor (p = .027) of CMT Writing scores. These findings suggest there was a relationship between weight category and CMT Writing scores, however, this relationship was not significant enough to enter the prediction equation after accounting for engagement in language arts activities and school absences.

Teacher perception of student engagement (Language Arts Engagement and Mathematics Engagement) and student perception of student engagement (Domain Engagement) were analyzed when weight category was a factor. Research question one indicated there were differences in the Mathematics Engagement and Domain Engagement scores between healthy-weight and overweight/obese middle school students, where overweight/obese students recorded lower scores on both variables. Teacher perception of student engagement in language arts activities (Language Arts Engagement) was a predictor of CMT Reading and CMT Writing scores while teacher perception of student engagement with mathematics tasks (Mathematics Engagement) was a predictor of CMT Mathematics scores. In addition, student perception of engagement in learning tasks (Domain Engagement) was a predictor of CMT Reading and CMT Mathematics scores. Because there was a relationship between Weight Category and Mathematics Engagement, and Mathematics Engagement was a significant predictor of CMT Mathematics scores, there was a link between Weight Category and CMT Mathematics scores even though weight category was not a significant predictor of CMT Mathematics scores.

No significant relationships were found between Domain Beliefs About Self (competency, autonomy, and relatedness) or Interpersonal Support (parent or teacher) and weight category or academic achievement.

Differences between Current Research and Previously Conducted Research

Prior research focused on the relationships between weight-related constructs and academic achievement (Clark & Slate, 2009; Crosnoe & Muller, 2004; Datar & Sturm, 2006; Judge & Jahns, 2007; Li et al., 2008; Sabia, 2007; Shore et al., 2008) and absenteeism rates (Datar & Sturm, 2006; Geier et al., 2007; Shore et al, 2008). A single study was found associating weight-related data with student engagement (Ramaswamy et al., 2010). The current study differs from other studies because it included an examination of the relationships between Weight Category and the school-related factors important to learning and academic achievement. Skinner and Pitzer (2012) stated positive interactions with significant others (parents, teachers, peers) build strong self-beliefs (competence, autonomy, and relatedness) in students, which enhances student engagement, and ultimately leads to an increase in learning and academic achievement.

One of the purposes of this study was to examine the relationships between overweight/obese students and healthy-weight students with measurements of interactions with significant others (Domain Interpersonal Support), self-beliefs (Domain Beliefs About Self) and engagement (Language Arts Engagement, Mathematics Engagement, and Domain Engagement). The results indicated the only significant difference between the two groups occurred with Mathematics Engagement (p = .004), or teacher perception of student engagement with mathematics activities. An examination of the correlations from research question one suggested that there were negative relationships between Weight Category and Language Arts Engagement (r = -.012, $p \geq .05$), Mathematics Engagement (r = -.194, $p <$ .05), Domain Engagement (r = -.080, $p \geq .05$), Domain Beliefs About Self (r = -.075, $p \geq$ .05), and Domain Interpersonal Support (r = -.014, $p \geq .05$). However, the relationship between Weight Category and Mathematics Engagement was the only significant relationship.

Implications for Educators

This study provided support for previous research studies that resulted in negative associations between weight-related data and academic performance (Clark & Slate, 2009; Crosnoe & Muller, 2004; Datar & Sturm, 2006; Judge & Jahns, 2007; Li et al. 2008; Sabia, 2007; Shore et al., 2007), positive associations between weight-related data and school absences (Datar & Sturm, 2006; Geier et al., 2007; Shore et al, 2008), and a negative association between weight-related data and student engagement (Ramaswamy, Mirochna, & Perlmuter, 2010). Although the current research indicated there were differences in academic achievement of healthy-weight and overweight/obese students, student engagement explained a greater variability in academic achievement scores than Weight Category. In addition, student engagement (both teacher perceived and student perceived) was a more consistent predictor of academic achievement than Weight Category. This section reviews each research question and discusses the implications of the findings to the field of education.

Research Question One

The significant findings from the analysis of research question one indicated that overweight/obese students perform lower on CMT Reading ($p = .010$) and CMT Writing tests ($p = .040$) than healthy-weight students. Because overweight/obese students recorded significantly lower teacher perception of engagement scores ($p = .004$) than their healthy-weight peers, and teacher perception of engagement scores were significantly, negatively associated ($p < .001$) with CMT Mathematics scores, a link was found between an increase in weight category and a decrease in CMT Mathematics scores. In addition, the analysis of the data indicated that overweight/obese students have significantly more school absences ($p = .001$) than their healthy-peers.

As of 2010, 32.6% of children and 33.6% of U.S. adolescents were classified as either overweight or obese using age- and sex-specific BMI growth charts (Ogden et al., 2012). Because negative associations were found between weight-related data and academic achievement, potentially one third of U.S. children and adolescents are performing below their healthy-weight peers on measures of academic achievement. The implications of these findings for educators and school personnel include incorporating procedures and programs that encourage the development of maintaining a healthy weight, improve school attendance, and support overweight and obese students in the classroom.

For instance, Hollar, Messiah, Lopez-Mitnik, Hollar, Almon, and Agaston (2010) implemented an intervention program, Healthier Options for Public Schoolchildren (HOPS), to children aged 6 to 13 to determine its effects on academic achievement as measured by the Florida Comprehensive Achievement Test (FCAT) for Reading and Mathematics. HOPS included a dietary intervention for school breakfasts and lunches, a curricula component about healthy lifestyle and weight management program, and a physical activity component. There were no significant differences between the baseline comparisons of the control group to the intervention group on the academic achievement tests. However, Hollar et al. (2010) indicated there were significant differences on the FCAT Mathematics scores in both years of the intervention from the baseline scores and the FCAT Reading scores trended higher but were not significant.

The CDC (2014) states that schools have a responsibility to help prevent children and adolescents from becoming overweight or obese, promote physical activity, and encourage healthy eating strategies through its policies, practices, and environments. The CDC (2014) developed the Summary of School Health Guidelines to Promote Healthy Eating and Physical Activity in collaboration with specialists from universities and national organizations. These recommendations were based on research, theory, and best practices in healthy eating and physical activity and were designed to be used in the school setting. These parameters could be used to create programs that provide students with the opportunities to learn about and practice maintaining a healthy weight and lifestyle. Examples of these guidelines include “Use a coordinated approach to develop, implement, and evaluate healthy eating and physical activity policies and practices" and "Partner with families and community members in the development and implementation of healthy eating and physical activity policies, practices, and programs" (CDC, 2014). To see the complete list of guidelines, see Appendix E.

Schools could encourage students with high absent rates to attend school by creating and implementing programs that are designed to increase attendance. Sheldon (2007) compared the attendance rates of Ohio elementary schools that developed school-wide programs of school, family, and community partnerships designed to decrease school absences with the attendance rates of elementary schools that did not develop programs. Findings indicated that schools with an implemented program improved attendance rates by an average of .5%, where schools without a program rates declined slightly (Sheldon, 2007). Furthermore, the greatest factor for improving attendance rates was parental involvement (Sheldon, 2007). The programs designed to increase student attendance varied from school to school, however, significant results were found. Schools and districts could implement their own programs designed to increase attendance by following some or all of the guidelines created by Smink and Reimer.

Smink and Reimer (2005) created Fifteen Effective Strategies to improve attendance and prevent truancy for students in grades K through 12. These strategies are grouped into four general categories: school and community perspective, early interventions, basic core strategies, and making the most of instruction (Smink & Reimer, 2005). Smink and Reimer (2005) suggest that schools do not exist in isolation and should have the support of the community. Therefore, programs that are designed to improve attendance rates should contain strategies that include a systemic renewal of the program, school-community collaboration, and safe learning environments. These three components are baseline strategies for the other components (Smink & Reimer, 2005).

Early intervention is vital to improving attendance rates. Smink and Reimer (2005) theorize that attitudes and behaviors can be changed before they become entrenched in students. These attitudes and behaviors can be changed through family engagement, early childhood education, and early literacy development (Smink & Reimer, 2005). Smink and Reimer's (2005) basic core strategies target middle and high school students and are proposed to improve attendance. These interventions include: mentoring/tutoring, service-learning, alternative schooling, and after-school opportunities (Smink & Reimer, 2005). Finally, Smink and Reimer (2005) suggest that what happens in the classroom is vital to keeping students in school. Therefore strategies that address different learning styles, improve teacher knowledge and skills, and encourage the use of technology are important to encouraging students to attend school. The following school-based initiatives are effective for keeping at-risk students in school: professional development, active learning, educational technology, individualized instruction, and career and technical education (Smink and Reimer, 2005).

Research Question Two

The analysis of research question two indicated that female middle school students scored significantly higher on CMT Reading (p = .012) and CMT Writing tests ($p < .001$) than male middle school students. In addition, student perception of student engagement (Domain Engagement, p = .031) and teacher perception of student engagement (Mathematics Engagement, p = .004 and Language Arts Engagement, p = .001) of female middle school students were significantly higher than the engagement levels of male middle school students. Regardless of whether the teacher or the student was rating student engagement, female middle school students scored higher than male middle school students on engagement levels.

Engagement has been positively associated with academic achievement (Phan, 2014; Reeve, 2013). The results of this study indicated that female middle school students are consistently more engaged in learning activities than male middle school students. The positive association between engagement and academic achievement was supported through the current study as female students were more engaged in learning tasks and scored higher on academic achievement tests than male students. Because engagement is positively related to academic achievement (Phan, 2014; Reeve, 2013), one possible implication of these findings suggest that educators and school personnel may develop learning strategies and activities that engage male students in learning activities in an attempt to bridge the engagement gap between male and female middle school students.

Younger, Warrington, and McLellan (2005) propose there are four groups of intervention strategies that are crucial to affecting boys' learning: pedagogical, individual, organizational, and socio-cultural. Pedagogical strategies include approaches that are focused in the classroom, incorporate collaborative and competitive activities, and encourage accelerated learning and preferred learning styles (Younger, Warrington, & McLellan, 2005). Individual strategies designed to improve students' confidence and self-assurance as learners such as mentoring and targetsetting may increase student engagement (Younger et al., 2005). Organizational strategies emphasize the need for whole school approaches which, as the norm, celebrates academic achievement in many areas (Younger et al., 2005). Whole school approaches include developing leadership, implementing single-sex groupings, creating support clubs, and developing high profile praise and reward systems (Younger et al., 2005). Finally, social-cultural strategies include changing the perception of a peer group or community from one where learning is not valued to one where learning and achieving is valued amongst boys (Younger et al, 2005). These strategies may be used to improve both boys' and girls' learning in the classroom setting.

Research Question Three, Four, and Five

The significant findings from research questions three, four, and five indicated that the main predictor of academic achievement was student engagement. Language Arts Engagement (change in R^2 = .201) and Domain Engagement (change in R^2 = .043) were the main predictors of CMT Reading scores; Language Arts Engagement (change in R^2 = .218) was the main predictor of CMT Writing scores; and Mathematics Engagement (change in R^2 = .224) and Domain Engagement (change in R^2 = .028) were the only predictors of CMT Mathematics scores. Although Weight Category was a significant predictor (p = .045) of CMT Reading scores and the number of school absences was a significant predictor (p = .027) of CMT Writing scores, the amount of variability explained by weight category (change in R^2 = .015) and Absences (change in R^2 = .018) in the corresponding models was less than the amount of variability explained by the teacher perception of student engagement and student perception of student engagement. These findings suggest that student engagement was more important to predicting achievement scores than Weight Category or Absences.

Phan (2014) and Reeve (2013) concluded in separate studies that engagement in learning activities was positively associated with academic achievement. This study supports their conclusions. The implications of these findings suggest one possible method to increase student achievement is to increase student engagement and vice versa. Teachers and school personnel may develop learning activities that are of personal interest to the students to encourage student engagement (Huang, Liang, Su, & Chen, 2012).

Schraw, Flowerday, and Lehman (2001) suggest student interest increases learning where there are two types of interest, situational and personal. Situational interest is spontaneous and activated by the environment where as personal interest is less spontaneous and is activated internally (Scrhaw, Flowerday, & Lehman, 2001). Situational interest is important to catching students' attention and often precedes personal interest. Therefore, Schraw et al. (2001) suggest teachers should focus on situational interest because it is changeable and partially under the control of teachers. Teachers can increase situational interest by offering meaningful choices to students, selecting texts that are well organized, and helping students acquire appropriate background information needed for the educational task (Schraw et al., 2001). In particular, Schraw et al. (2001) suggest six strategies for improving situational interest with classroom activities.

The first, offer meaningful choices to students, satisfies the students' need for autonomy by providing them with a greater sense of self-determination (Schraw et al., 2001). Teachers should offer their students a wide variety of choices to all students on a regular basis. Struggling, less knowledgeable, or less self-regulated students should be helped to make choices and teachers should provide feedback to the students about the effectiveness of their choices (Schraw et al., 2001).

Texts that are coherent and informationally complete are strongly related to student interest and to learning (Schraw et al., 2001). Well-organized texts, those that are coherent and complete, should be used as often as possible in the classroom. As texts become less coherent or as students become less knowledgeable about the contents of the material, the teacher should make greater efforts to provide background information about the text. In turn, this background information will improve coherence and lead to greater understanding and learning (Schraw et al., 2001).

The third strategy to increase situational interest, as recommended by Schraw et al. (2001), is to select texts that are vivid. Written materials that contain rich imagery, provocative information, and engaging themes have a positive impact on student interest and learning provided the information is connected to the academic task (Schraw et al., 2001). On the other hand, writings that contain irrelevant or highly seductive information may interfere with learning by distracting students from important segments of the text (Schraw et al., 2001).

Another strategy to increase student situational interest is to use texts and materials that students know about prior knowledge is positively related to interest and learning (Schraw et al., 2001). Teachers may use materials with which students have some familiarity. This familiarity encourages students to create thematic inferences within the written work as well as between the piece and prior knowledge (Schraw et al., 2001). Teachers also may choose to assign pre-reading background information to help students familiarize themselves with what they are about to learn through teacher direction or small group instruction (Schraw et al., 2001).

Encouraging students to become active learners is another strategy that may be employed to increase student engagement. Students who are actively engaged in learning activities make more meaningful connections than students who are not (Schraw et al., 2001). Teachers may encourage students to make predictions and to summarize findings as methods of engaging students in active learning (Schraw et al., 2001). Another method is to have students synopsiz what they already know, what they want to know, and what they have learned (Schraw et al, 2001).

The last strategy suggested for increasing student situational interest is for teachers to provide relevant cues for students (Schraw et al., 2001). When students understand what is relevant beforehand, the interest in the educational task increases as does learning (Schraw et al., 2001). Schraw et al. (2001) suggest several tactics for highlighting information specifically for reading which include: (a) encourage students to set personal goals before reading, (b) help students comprehend what is most important to the reading assignment, (c) suggest that students focus on causal claims, and (d) require that the students explain the written work to other students.

Limitations of the Study

This section provides a discussion of the characteristics of the design or methodology of the research project that affected the application or the interpretation of the study. The present study used survey methods that were incorporated into a causal comparative design and a correlational design, therefore, issues of internal validity and external validity related to these research designs are discussed below.

Internal Validity

Internal validity refers to the extent to which extraneous variables have been controlled for by the researcher (Gall et al., 2003). A causal comparative design was used for research questions one and two and a correlational design for research questions three, four, and five. Fraenkel and Wallen (2009) state the threats to internal validity of a causal comparative and correlational designs using survey research methods include subject characteristics, location, instrumentation, testing, and mortality. These threats to internal validity are reviewed below.

Subject Characteristics. In causal comparative research the inability to randomly assign subjects to groups creates the possibility that the groups differ by some characteristic other than the independent variable under investigation (Fraenkel & Wallen, 2009). In correlational research whenever two or more characteristics of groups or individuals are correlated, the possibility exists that the correlation is due to an extraneous variable common to the groups or individuals that was not under investigation in the study (Fraenkel & Wallen, 2009).

Middle school children, with consent from their parents, volunteered to participate in this study. Students were not randomly selected from the population nor were they randomly assigned to be a member of a specific group (healthy-weight or overweight/obese and male middle school students or female middle school students). The absence of randomization allowed the sample and the gender-specific and weight-related groups to differ from the school population and from each other on some unknown characteristic.

For instance, the mean CMT Reading, Writing, and Mathematics scores for the sample were all higher than the scores for the school population and the Connecticut population (see Table 3). The sample was comprised of 27.7% overweight/obese children and adolescents which is lower than the 33.3% estimated by the CDC (2013d). It is feasible that the majority of the students of the sample were high achieving students, across weight categories, who were engaged in school-related and academic activities. If more overweight/obese students were included in the sample, CMT scores may have been closer to the school population averages and more significant relationships may have been discovered between weight category and school-related factors. In other words, it is conceivable that overweight/obese students scored lower on academic achievement tests, were less engaged in classroom activities, received less interpersonal support, and had different self-beliefs than their healthy-weight peers. Because the overweight/obese students were underrepresented in the sample, all of the relationships between Weight Category and school-related factors may not have been revealed.

The percentage of 6^{th}-, 7^{th}-, and 8^{th}-graders who participated in the study were 34.36%, 49.34%, and 16.30% (see Table 2), respectively which did not produce a similar distribution of approximately 33% across grade levels. It is possible that the 7^{th}-grade teachers encouraged their students to be a part of the study more than 6^{th}-grade and 8^{th}-grade teachers. Students who were in 7^{th}-grade may have perceived their teachers as being more involved with the research and educational tasks in general and supposed this involvement as interpersonal support which influenced other school-related factors. In addition, there may be some characteristics of 7^{th}-grade students that are different from 6^{th}- and 8^{th}-grade students such as engagement levels and overweight/obese status.

There were limitations with using Weight Category as an independent variable in the design of the study. The underweight category was dropped from the analysis of research question one because there were too few participants to conduct a MANOVA. Furthermore, the underweight group was eliminated from research questions three, four, and five because including them created a curvilinear relationship when homoscedasticity was checked by the researcher. The remaining students in the sample were not necessarily representative of the school population.

The researcher tried to minimize the threat to subject characteristics by gathering a larger sample that might better reflect the school population. The collection of the first round of parent consent forms indicated that 16.17% of the student population volunteered and had parental consent to be a part of the study. In an attempt to gather a more representative sample, the researcher visited all mathematics classes, explained the importance of the study, redistributed parental consent forms, and extended the deadline for admittance into the study. As a result, the sample size grew to 33.68%. This sample could have better reflected the student body population if more students and their parents had agreed to participate. The researcher considered there to be a moderate threat to subject characteristics.

Location. A location threat occurs when testing conditions differ for groups of participants (Fraenkel & Wallen, 2009). In the current study, the RAPS-SM was administered to the student participants in two separate locations within the school building. The first administration occurred in the school cafeteria with 203 students completing the RAPS-SM. Subsequent administrations occurred in small groups in a meeting room attached to the main office for the remaining 24 students. The RAPS-TM was administered to the participating teachers during one of their Professional Learning Community meetings. The CMT Reading, Writing, and Mathematics tests were administered to general education students by their homeroom teachers and to special education students and English language learners in small group settings by the special education teachers.

Students may test differently under testing conditions that are not the same. For instance, the students who were administered the RAPS-SM in the cafeteria may not have been able to focus as well as and may have received less adult support than students in the small group setting which may have influenced their responses. In an effort to limit the threat to location, the directions to each instrument used were followed. In the case of the RAPS-SM the directions and each question were read aloud as the students circled their responses. The researcher read the questions aloud to the participants in the cafeteria while three assistants circulated to keep students on task and to answer questions. Subsequent administrations in the small group settings were conducted by an assistant who followed the directions of the instrument.

The RAPS-TM was distributed to the language arts and mathematics teachers along with written directions. The written directions contained the manual's directions to the taking the survey and the researcher's contact information should the teacher participants have questions on completing the RAPS-TM. No teachers contacted the researcher. The CMT Reading, Writing, and Mathematics tests were administered in similar locations to the general education students and in small group settings to the special education and English language learners in accordance with the directions of the CMTs. The researcher considered the threat to location to be low.

Instrumentation. An instrumentation threat occurs when directions materials designed to collect data are not followed or when the measuring devices are not used for their intended purpose (Fraenkel & Wallen, 2009). Multiple people administered the RAPS-SM and CMT subject tests. To limit the threat to instrumentation, the RAPS-SM and CMTs that were used to collect student data were administered in accordance with the corresponding directions. The researcher and the school nurse measured the heights and weights of the student participants using the same Health O Meter Professional scale to measure the heights and the same Tanita digital scale to measure the weights. These tools were used as accurately as possible when measuring student height to the nearest quarter inch and student weight to the nearest one fifth of a pound. The researcher considered instrumentation to be a low threat to the study.

Mortality. Mortality occurs when participants are lost during the course of the study because they drop out or because they are absent during the administration of one or more of the tests (Gall et al., 2003). The original sample contained 229 student participants and complete data sets were collected on 227 student participants. Mortality was a low threat to the study.

External Validity

Gall et al. (2003) state external validity refers to the extent to which the findings of a study can be applied to different individuals in a new setting. Two types of external validity are population validity and ecological validity (Gall et al., 2003).

Population validity. The degree to which the results of a study can be generalized from the sample to a larger population is known as population validity (Gall et al., 2003). Obtaining a representative sample of the population of interest is important when establishing population validity (Fraenkel & Wallen, 2009). It would not be advised to generalize the results of this study to a larger population such as Connecticut as the characteristics of the students in the sample do not represent all students in Connecticut. The means of the CMT subject tests illustrate this concern as the means of CMT Reading, Writing, and Mathematics tests were higher in the sample than in the state of Connecticut (see Table 3) establishing a difference between the sample and the larger population. While these results should not be generalized to any other middle school in Connecticut, it is possible to that an educator or researcher could relate these findings to another situation where students and teachers have similar characteristics as the investigated school's population. These characteristics include, but are not limited to, school size, socio-economic status, percentage of children and adolescents who are classified as either overweight or obese, similar CMT testing scores, and similar social opportunities.

Ecological validity. Ecological validity refers to the extent to which the results of a study can be extended to other subjects and settings (Fraenkel & Wallen, 2009). The nature of the environmental settings and the characteristics of the participants of the study must be made clear to potential researchers who may choose to replicate the study (Fraenkel & Wallen, 2009). The researcher of this study was transparent in describing the details of the data collection process, methodology used, and analysis procedures were complete and stated in detail so that other researchers may reproduce the study in a different setting. The instruments used to collect the data (RAPS-TM and RAPS-SM) and the result of the CMTs were easily accessible once parental permission was obtained. The researcher concluded the findings would have high ecological validity and would have a low threat to the study.

Suggestions for Future Research

The prevalence of children aged 6-11 years who were classified as obese in the United States has increased from 7% in 1980 to approximately 18% in 2010 (CDC, 2013). Over the same time period obesity rates in adolescents aged 12-19 years increased from 5% to 18% (CDC, 2013). As of 2010, the CDC (2013) reported that approximately one third of U.S. children and adolescents were overweight or obese. As overweight and obesity rates continue to rise in children and adolescents, it is important for researchers to continue to investigate the relationships of being overweight or obese on academic achievement and school-related factors. Several research ideas have stemmed from the results of this study including a longitudinal study, a simplified research design that isolates affective measures, and the effects of programs designed to increase student engagement and maintain a healthy weight.

Longitudinal Study

The current research captured the relationships of being overweight or obese on academic achievement and school-related factors during a moment in time. Researchers could follow students for a longer period of time and record their BMIs, academic achievement scores in relationship to the norms, and other school-related factors such as engagement and absence rates. The data could be analyzed to determine if changes occur in academic achievement scores and school-related factors as weight category changes from healthy-weight, to overweight, to obese or in the opposite direction. In addition, the effects of remaining in either the overweight or obese category for an extended period of time could be investigated.

Research Study Design

One of the objectives of the current research was to investigate the relationships of being overweight or obese on constructs such engagement, competency, autonomy, and relatedness simultaneously with academic achievement. The current research partially supported the hypothesis that weight category was related to academic achievement but, other than engagement, no significant relationships were found between weight category and the stated school-related factors. However, negative relationships have been found between increased excess weight and measures of self-esteem (Eisenberg et al., 2003; Perrin et al., 2010).

It is possible that no relationships were found between Weight Category and school-related factors because the design of the research project contained an investigation of academic achievement. A possible future research study could simplify the design of the study to isolate school-related factors (engagement, competency, autonomy, and relatedness) that are associated with academic achievement (Skinner & Pitzer, 2012) using a causal modeling approach, without studying academic achievement directly. This would allow the researcher to determine if there are relationships between BMI or Weight Category and school-related factors associated with academic achievement.

The Effects of the Implementations of Programs on Academic Achievement

The results of this study indicated that female middle school children scored higher on CMT Reading and CMT Writing tests and were more engaged in academic tasks than male middle school children. A future study could examine the effects of implementing a program that was created to increase the engagement levels of male students on engagement levels and academic achievement. Similarly, future studies could explore the effects of programs that encourage maintaining a healthy weight on academic achievement.

Chapter Summary

Chapter five included an overview of the research, discussion of the findings, connection of the findings to the related literature, a description of the limitations, and implications for education, and suggestions for future research. As of 2010, approximately one-third of U. S. children and adolescents were classified as either overweight or obese. The purpose of this study was to explore the relationships of weight category on academic achievement and school-related factors. It is important for educators and school personnel to know these relationships so that they may provide support and develop programs that encourage maintaining a healthy weight. This study indicated that increased excess weight was negatively related to academic achievement and student engagement and was positively related to school absences.

The results of this study support the findings of MacCann and Roberts (2007), Sabia (2007), and Wingfield et al. (2007) who had mixed results when associating weight-related data to academic achievement. The findings of this study indicated that healthy-weight middle school students scored higher on CMT Reading and CMT Writing tests than their overweight/obese peers. However, there were no differences in the CMT Mathematics scores of healthy-weight and overweight/obese middle school children. The results of this study indicated that overweight/obese students accrued more absences than their healthy-weight peers supporting the findings of Datar and Sturm (2006), Geier et al., (2007), and Shore et al. (2007). The researcher concluded that teachers perceived overweight/obese middle school children as less engaged in Mathematics tasks than healthy-weight middle school children. However, there were no differences in the teacher perception of student engagement in Language Arts activities or of student perception of engagement in educational activities. These findings partially supported Ramaswamy et al. (2010) who concluded there was a negative association between weight and school effort. Finally, the researcher concluded student engagement levels, as perceived by either the teacher or the student, are more important at predicting academic achievement than Weight Category. These findings support Phan (2014) and Reeve (2013) who concluded student engagement was positively associated with academic achievement.

The greatest limitation of this research was the characteristics of the subjects. A sample of convenience was used for this study that was causal comparative and correlational in design. The underweight category was removed from the data analysis that included weight category because there were not enough students in that category to run the statistical analysis or the inclusion of the underweight group made the data curvilinear. In addition, the overweight and obese groups were collapsed to improve the analysis of the data. The nature of the sample and the design of the study make it difficult to apply the findings of this study to a different or larger population.

Future research based on the findings of this study include developing a longitudinal study to determine the long term effects of being overweight or obese, designing a study that isolates the school-related factors that have been associated with academic achievement when weight category is a factor, and creating a research project that investigates the effects of implementing engagement or maintaining healthy weight programs on academic engagement and achievement. As the overweight and obesity rates continue to climb in the United States, more research is needed to determine the relationships between increased excess weight and school-related constructs as well as programs and supports that may help overweight and obese children in the classroom.

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Appendix A: Permission to Use RAPS Surveys

Adena Klem [akirre@aol.com]

To: Suzanne Marsan

Monday, October 22, 2012 3:32 PM

Dear Suzanne,

I apologize for the prior email which was addressed incorrectly. The rest of the information holds true. The Institute for Research and Reform in Education received your request for information on our RAPS surveys. You are welcome to use our surveys in your research as long as you indicate in your publications that the surveys are copyrighted to IRRE. You can download the RAPS manual -- which includes copies of our surveys, administration directions, as well as validity and reliability information -- directly from the publications section of our website: http://www.irre.org/publications/research-assessment-package-schools-raps-manual .

If you have any further questions after looking over the manual, I'd be happy to talk with you. Feel free to call me at 215-242-1082.

Best

Adena

Appendix B. Student Demographic Survey

Identification Number:______________________________

Student Demographic Survey

The purpose of this survey is to gather data for a research project on student attitudes toward school. **This survey is voluntary** and will take approximately 5 minutes to complete.

Directions Section 1: Circle the correct response.

Gender: Male Female

Grade: 6 7 8

Ethnicity:

1. American Indian or Alaska Native
2. Asian
3. Black or African American
4. Native Hawaiian or Other Pacific Islander
5. White
6. Hispanic or Latino or Spanish Origin
7. Not Hispanic or Latino or Spanish Origin

Appendix C: Letters of Consent and Assent

Western Connecticut State University
Department of Education and Educational Psychology
181 White Street
Danbury, CT 06810

Superintendent of Schools
Address of Office
[Date XX/XX/XX]

Dear __________,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a research study. The study I have created examines the relationships between students of varying body mass types and engagement, beliefs about self, interpersonal support, and academic achievement of middle school students.

To collect the data related to these constructs, a survey named The Research Assessment Package for Schools (RAPS) will be administered to all participating students and teachers. The RAPS-SM is an 84-item, self-report instrument designed for middle school students that will take approximately 50 minutes to complete. The RAPS-SM measures student perception of engagement, beliefs about self, and interpersonal support. The language arts and mathematics teachers of the participating students will complete the RAPS-TM, a three-question survey designed to measure teacher perception of student engagement. The RAPS-TM will take approximately 50 minutes to complete for every 100 students.

In a private location, the school nurse will measure and record the heights and weights of the participating students and the results will be used to calculate body mass indices. The school registrar will record the number of absences for the 2012-2013 school year and the CMT reading, writing, and mathematics scores for each student. The data will be added to the demographic information for each participant and will be analyzed to see if there are relationships between students of varying body mass types and engagement, beliefs about self, interpersonal support, and academic achievement.

The participating teachers and students will be given identification numbers which will be used in place of their names on the survey results and all data collected. This will be done to protect the confidentiality of the participants. Should any student or teacher have concerns about the content or the procedures of this study, they may contact __________, coordinator of (your school's) guidance department, for support. The results of this study will be used for the sole purpose of fulfilling the dissertation requirement in the doctoral program at Western Connecticut State University. Participation in this study is completely voluntary and participants may exit the study at any time.

This research project has been reviewed and approved by the WCSU Institutional Review Board. If you have questions concerning the rights of the subjects involved in research studies please email the WCSU Assurances Administrator at irb@wcsu.edu and mention Protocol Number [to be filled in after approved]. This study is valid until [fill in 1 year date from approved date].

Thank you for your consideration of this research project. If you would like (your school) to participate in this study, please sign and return the enclosed consent form in the addressed envelope provided.

Sincerely,

Suzanne Marsan
Western Connecticut State University Doctoral Candidate
Marsan006@connect.wcsu.edu

Superintendent Consent Form

By signing below you are giving consent for the study described on the previous pages to be conducted at (your school), Protocol Number (XX). It is understood consent will be needed from the principal and parent or guardian as well as assent from the student before the study begins.

****

_______________________________________ ___________________

Signature of Superintendent Date

(Printed Name of Superintendent)

Western Connecticut State University
Department of Education and Educational Psychology
181 White Street
Danbury, CT 06810

Address of School
[Date XX/XX/XX]

Dear ___________,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a research study. The study I have created examines the relationships between students of varying body mass types and engagement, beliefs about self, interpersonal support, and academic achievement of middle school students.

To collect the data related to these constructs, a survey named The Research Assessment Package for Schools (RAPS) will be administered to all participating students and teachers. The RAPS-SM is an 84-item, self-report instrument designed for middle school students that will take approximately 50 minutes to complete. The RAPS-SM measures student perception of engagement, beliefs about self, and interpersonal support. The language arts and mathematics teachers of the participating students will complete the RAPS-TM, a three-question survey designed to measure teacher perception of student engagement. The RAPS-TM will take approximately 50 minutes to complete for every 100 students.

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The participating teachers and students will be given identification numbers which will be used in place of their names on the survey results and all data collected. This will be done to protect the confidentiality of the participants. Should any student or teacher have concerns about the content or the procedures of this study, they may contact__________, coordinator of (your school's) guidance department, for support. The results of this study will be used for the sole purpose of fulfilling the dissertation requirement in the doctoral program at Western Connecticut State University. Participation in this study is completely voluntary and participants may exit the study at any time.

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Thank you for your consideration of this research project. If you would like (your school) to participate in this study, please sign and return the enclosed consent form in the addressed envelope provided.

Sincerely,

Suzanne Marsan
Western Connecticut State University Doctoral Candidate
Marsan006@connect.wcsu.edu

Principal Consent Form

By signing below you are giving consent for the study described on the previous pages to be conducted at (your school), Protocol Number (XX). It is understood consent will be needed from the parent or guardian as well as assent from the student before the study begins.

****

______________________________________ __________________

Signature of Principal Date

(Printed Name of the Principal)

Western Connecticut State University
Department of Education and Educational Psychology
181 White Street
Danbury, CT 06810

Dear Teacher,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a research project. The study I have designed examines the relationships of engagement, beliefs about self, interpersonal support, and academic achievement of middle school students.

The Research Assessment Package for Schools (RAPS) will be used to collect data from students and their language arts and mathematics teachers. The RAPS-SM will be administered to participating students to measure student perception of engagement, beliefs about self, and interpersonal support. Student demographic information including gender, grade-level, race/ethnicity, and body mass index will also be collected. The language arts and mathematics teachers will complete the RAPS-TM for each student. This is a three-question survey designed to measure teacher perception of student engagement. Release time for participating teachers has been arranged to complete the surveys. The school registrar will record the number of absences and CMT reading, writing, and mathematics scores for each student. The data will be analyzed to see if there are relationships between the demographic information and student engagement, beliefs about self, interpersonal support, and CMT scores.

Teachers will be given identification numbers to be used in place of their names on the survey results. This will be done to protect the confidentiality of the teacher. Any teacher who has a concern about the content of this study may contact __________, coordinator of (your school's) guidance department, for support. The results of this study will be used for the sole purpose of fulfilling the dissertation requirement in the doctoral program at Western Connecticut State University. Participation in this study is completely voluntary and teachers may exit the study at any time. Teachers who complete the RAPS-TM will be placed in a raffle to win one of four $15Starbucks gift cards.

This research project has been reviewed and approved by the WCSU Institutional Review Board. If you have questions concerning the rights of the subjects involved in research studies please email the WCSU Assurances Administrator at irb@wcsu.edu and mention Protocol Number [to be filled in after approved]. This study is valid until [fill in 1 year date from approved date].

Thank you for your consideration in the participation of this research study. If you choose to participate, please sign the enclosed consent form and return it to the front office by [enter date].

Sincerely,

Suzanne Marsan
Western Connecticut State University Doctoral Candidate
Marsan006@connect.wcsu.edu

Teacher Consent Form

By signing below you are consenting to participate in the research study described on the previous page, Protocol Number (XX). Participation in this study is completely voluntary and teachers may exit the study at any time.

****

Name of Participating Teacher____

Signature of Teacher____

Date____

Western Connecticut State University
Department of Education and Educational Psychology
181 White Street
Danbury, CT 06810

Dear Parent or Guardian,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a research study. The study I have designed examines the relationships of engagement, beliefs about self, interpersonal support, and academic achievement of middle school students.

The Research Assessment Package for Schools will be administered to all participating students to collect data on student engagement, beliefs about self, and interpersonal support. A short survey designed to collect student demographic information will also be given. Privately, the school nurse will record the heights and weights of the participating students and body mass indices will be calculated and added to the demographic information. The school registrar will record the number of absences for the school year and the CMT reading, writing, and mathematics scores for each student. The data will be analyzed to see if there are relationships between the demographic information, student engagement, beliefs about self, interpersonal support, and CMT scores.

Students will be given identification numbers to be used in place of their names on the survey results and additional data collected. This will be done to protect the confidentiality of the students. Should any student have concerns about the content or the procedures of this study, he or she may contact __________, coordinator of (your son's or daughter's) guidance department, for support. The results of this study will be used for the sole purpose of fulfilling the dissertation requirement in the doctoral program at Western Connecticut State University. Participation in this study is completely voluntary and students may exit the study at any time. Students who complete the study will be entered into a raffle to win one of six $10 iTunes gift cards.

This research project has been reviewed and approved by the WCSU Institutional Review Board. If you have questions concerning the rights of the subjects involved in research studies please email the WCSU Assurances Administrator at irb@wcsu.edu and mention Protocol Number [to be filled in after approved]. This study is valid until [fill in 1 year date from approved date].

Thank you for considering the participation of your son or daughter in this research study. If you choose to have your son or daughter participate, please sign the enclosed consent form and return it to your mathematics teacher by [enter date].

Sincerely,

Suzanne Marsan
Western Connecticut State University Doctoral Candidate
Marsan006@connect.wcsu.edu

Parental Consent Form

By signing below you are acknowledging that you are at least 18 years old and are giving consent for your son or daughter to participate in the research described on the previous page, Protocol Number (XX). Participation in this study is completely voluntary and students may exit the study at any time.

****

Name of Participating Student____

Name of Parent/Guardian____

Signature of Parent/Guardian____

Date____

WESTERN CONNECTICUT STATE UNIVERSITY

Western Connecticut State University
Department of Education and Educational Psychology
181 White Street
Danbury, CT 06810

Dear Student,

I am currently a doctoral student at Western Connecticut State University. As part of my student work I am required to design and carry out a research project in a local school. The study I designed examines the thoughts that middle school students have about being in school, the beliefs they have about themselves, and the support they receive from the adults in their lives. I would like to include you in my research project.

If you are willing to participate, you will be asked to complete a survey named The Research Assessment Package for Schools. To gather more information, the school nurse will measure and record your height and weight in a private location and your body mass index will be calculated. The number of absences you have for the year and your CMT scores will also be recorded to become part of the data. All of the students who decide to participate will be given an identification number so that their responses are kept private. I will use all of this information to see if there are relationships between what middle school students think about school and how they do academically. Participation is completely voluntary and should you change your mind you may leave the study at any time. If you have concerns about self-image you may seek the help of **___________**, (your school's) guidance counselor. All students who complete the study will be entered into a raffle to win one of six $10 iTunes gift cards.

This research project has been reviewed and approved by the WCSU Institutional Review Board. If you have questions concerning the rights of the subjects involved in research studies please email the WCSU Assurances Administrator at irb@wcsu.edu and mention Protocol Number [to be filled in after approved]. This study is valid until [fill in 1 year date from approved date].

If you would like to participate in this research study, please sign the enclosed assent form and return it to your mathematics teacher by [date to be determined].

Thank you for your consideration.

Sincerely,

Suzanne Marsan
Western Connecticut State University Doctoral Candidate
Marsan006@connect.wcsu.edu

Student Assent Form

By signing below you are agreeing to participate in the research described on the previous page, Protocol Number (XX). Participation is completely voluntary and students may leave the study at any time.

****

Name of Student____

Signature of Student____

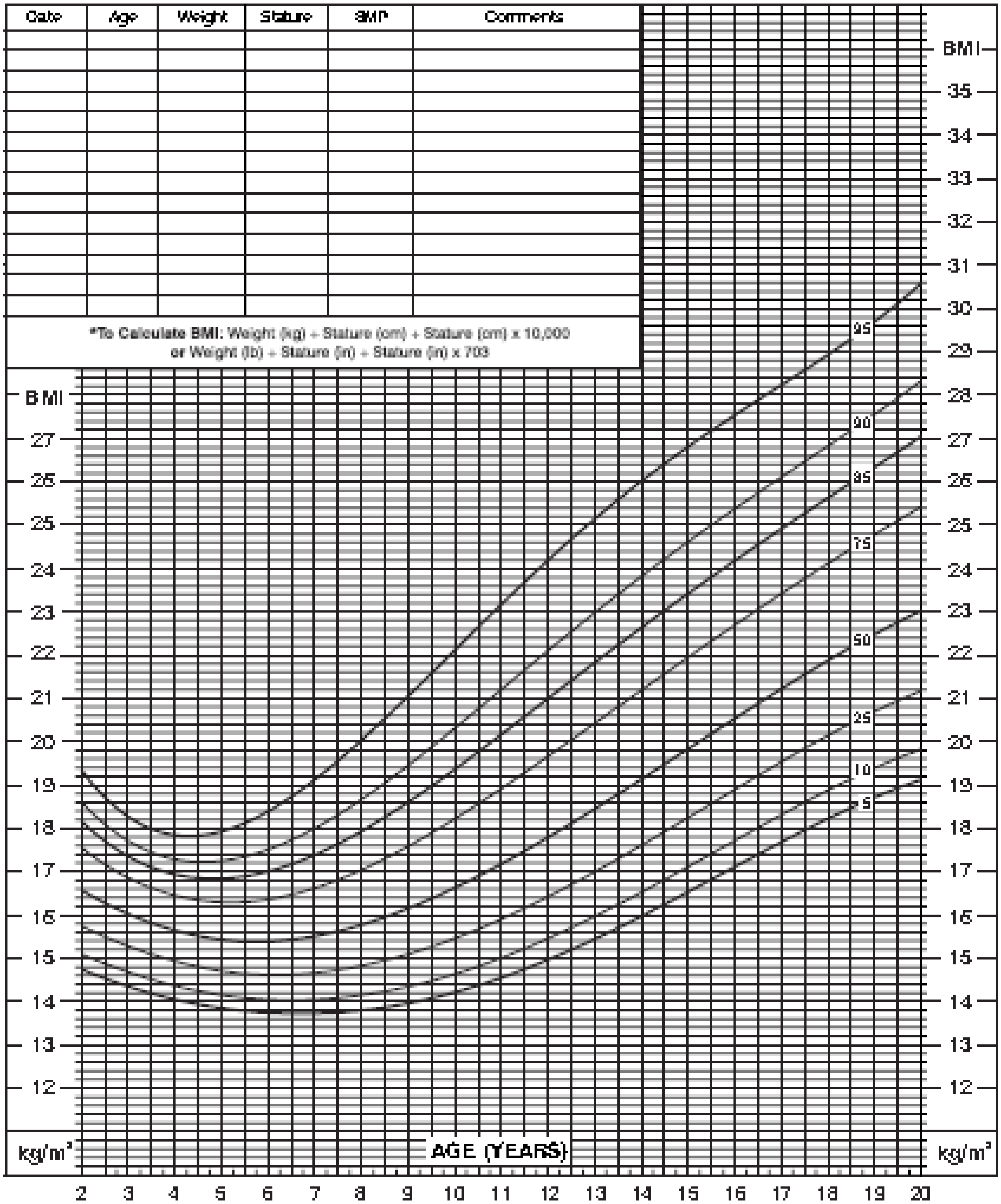
Date____

Appendix D: Growth Charts

2 to 20 years: Boys
Body mass index-for-age percentiles

NAME ____________________

RECORD # ______________



Published May 30, 2000 (modified 10/16/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

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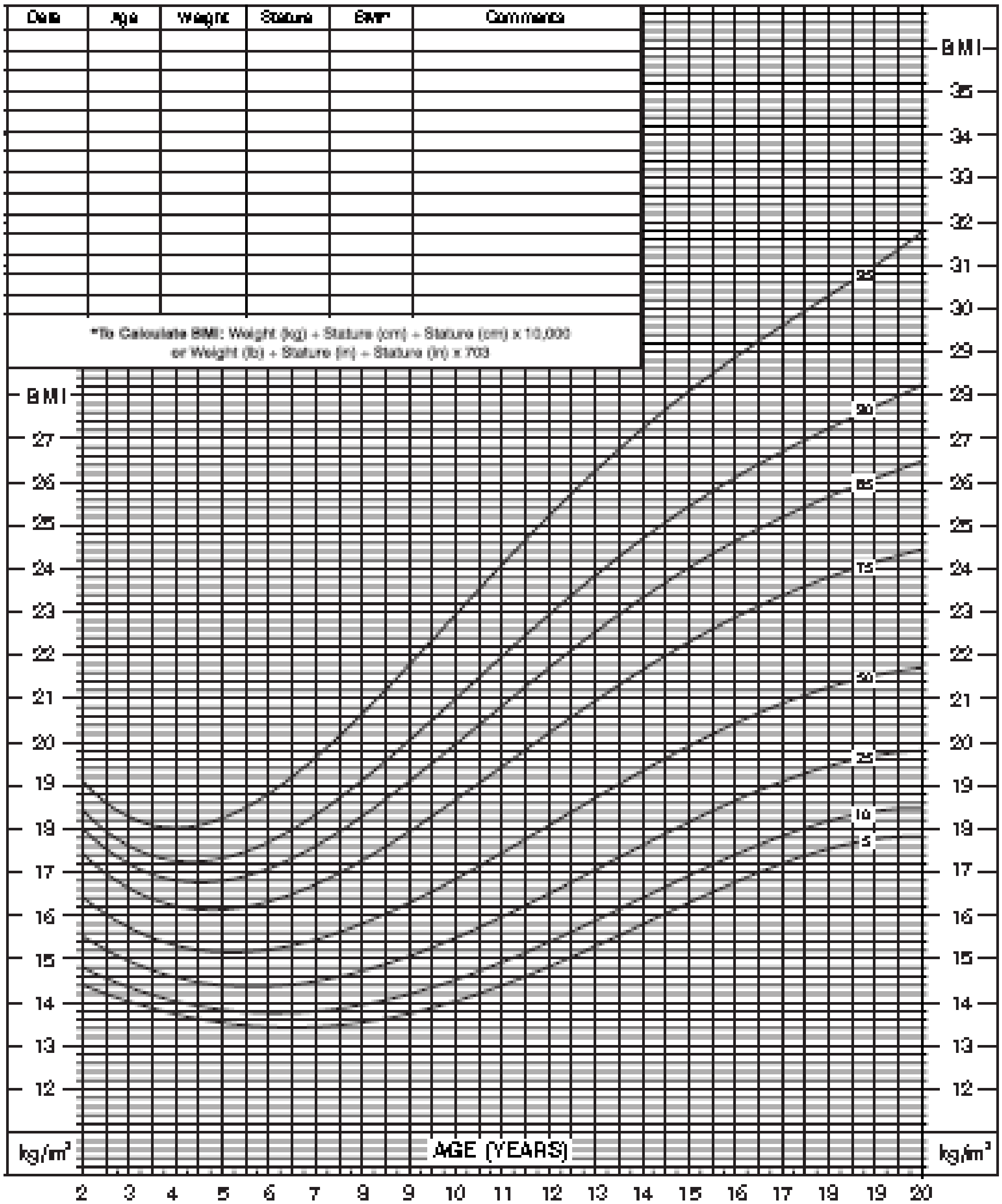
2 to 20 years: Girls
Body mass index-for-age percentiles

NAME ______________________

RECORD # ____________



Published May 30, 2000 (modified 10/16/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

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Appendix F: Summary of School Health Guidelines to Promote Healthy Eating and Physical Activity

Summary of School Health Guidelines to Promote Healthy Eating and Physical Activity

Guideline 1: Use a coordinated approach to develop, implement, and evaluate healthy eating and physical activity policies and practices

- Coordinate healthy eating and physical activity policies and practices through a school health council and school health coordinator.
- Assess healthy eating and physical activity policies and practices.
- Use a systematic approach to develop, implement, and monitor healthy eating and physical activity policies.
- Evaluate healthy eating and physical activity policies and practices.

Guideline 2: Establish school environments that support healthy eating and physical activity

- Provide access to healthy foods and physical activity opportunities and to safe spaces, facilities, and equipment for healthy eating and physical activity.
- Establish a climate that encourages and does not stigmatize healthy eating and physical activity.
- Create a school environment that encourages a healthy body image, shape, and size among all students and staff members, is accepting of diverse abilities, and does not tolerate weight-based teasing.

Guideline 3: Provide a quality school meal program and ensure that students have only appealing, healthy food and beverage choices offered outside of the school meal program

- Promote access to and participation in school meals.
- Provide nutritious and appealing school meals that comply with the *Dietary Guidelines for Americans*.
- Ensure that all foods and beverages sold or served outside of school meal programs are nutritious and appealing.

Guideline 4: Implement a comprehensive physical activity program with quality physical education as the cornerstone

- Require students in grades K--12 to participate in daily physical education that uses a planned and sequential curriculum and instructional practices that are consistent with national or state standards for physical education.
- Provide a substantial percentage of each student's recommended daily amount of physical activity in physical education class.
- Use instructional strategies in physical education that enhance students' behavioral skills, confidence in their abilities, and desire to adopt and maintain a physically active lifestyle.

- Provide ample opportunities for all students to engage in physical activity outside of physical education class.
- Ensure that physical education and other physical activity programs meet the needs and interests of all students.

Guideline 5: Implement health education that provides students with the knowledge, attitudes, skills, and experiences needed for lifelong healthy eating and physical activity

- Require health education from prekindergarten through grade 12.
- Implement a planned and sequential health education curriculum that is culturally and developmentally appropriate, addresses a clear set of behavioral outcomes that promote healthy eating and physical activity, and is based on national standards.
- Use curricula that are consistent with scientific evidence of effectiveness in helping students improve healthy eating and physical activity behaviors.
- Use classroom instructional methods and strategies that are interactive, engage all students, and are relevant to their daily lives and experiences.

Guideline 6: Provide students with health, mental health, and social services to address healthy eating, physical activity, and related chronic disease prevention

- Assess student needs related to physical activity, nutrition, and obesity, and provide counseling and other services to meet those needs.
- Ensure students have access to needed health, mental health, and social services.
- Provide leadership in advocacy and coordination of effective school physical activity and nutrition policies and practices.

Guideline 7: Partner with families and community members in the development and implementation of healthy eating and physical activity policies, practices, and programs

- Encourage communication among schools, families and community members to promote adoption of healthy eating and physical activity behaviors among students.
- Involve families and community members on the school health council.
- Develop and implement strategies for motivating families to participate in school-based programs and activities that promote healthy eating and physical activity.
- Access community resources to help provide healthy eating and physical activity opportunities for students.
- Demonstrate cultural awareness in healthy eating and physical activity practices throughout the school.

Guideline 8: Provide a school employee wellness program that includes healthy eating and physical activity services for all school staff members

- Gather data and information to determine the nutrition and physical activity needs of school staff members and assess the availability of existing school employee wellness activities and resources.

- Encourage administrative support for and staff involvement in school employee wellness.
- Develop, implement, and evaluate healthy eating and physical activity programs for all school employees.

Guideline 9: Employ qualified persons, and provide professional development opportunities for physical education, health education, nutrition services, and health, mental health, and social services staff members, as well as staff members who supervise recess, cafeteria time, and out-of-school--time programs

- Require the hiring of physical education teachers, health education teachers, and nutrition services staff members who are certified and appropriately prepared to deliver quality instruction, programs, and practices.
- Provide school staff members with annual professional development opportunities to deliver quality physical education, health education, and nutrition services.
- Provide annual professional development opportunities for school health, mental health, and social services staff members and staff members who lead or supervise out-of-school--time programs, recess, and cafeteria time.