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# A Modified Obesity Proneness Model in the Prediction of Weight Status Among High School Students

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A Modified Obesity Proneness Model in the Prediction of Weight Status  
Among High School Students

by

Joyce E. (Jen) Nickelson

A dissertation submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy  
Department of Community and Family Health  
College of Public Health  
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Keywords: childhood obesity, restrictive feeding practices, weight concerns, maternal concerns, maternal comments about weight

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## DEDICATION

This work is dedicated to Reg Albritton, the vocational counselor who told me I could be anything I wanted to be. Thank you for giving me the confidence to pursue my dreams and the unwavering support and encouragement while I did so.

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# A MODIFIED OBESITY PRONENESS MODEL IN THE PREDICTION OF WEIGHT STATUS AMONG HIGH SCHOOL STUDENTS

Joyce E. (Jen) Nickelson

## ABSTRACT

The health and well-being of U.S. children is challenged by the immense crisis of obesity. The obesity proneness model, first described by Costanzo and Woody (1985), describes one mechanism by which parents influence obesity development. This model suggests that parents become concerned about their children's weight if their children show signs of becoming overweight and parents value weight highly. Parents communicate their concerns to their children and restrict their children's eating. Children internalize parents' concerns and become unable to regulate their eating. Hence, parents socialize children to be concerned about their weight but do not equip them to regulate eating, thus contributing to the development of obesity. Previous research has examined model components, primarily from parents' perspectives. This study examined the model from the adolescents' perspectives and employed structural equation modeling to test and refine a modified model and determine the best predictors of obesity among adolescents.

The study was non-experimental in design, employing a secondary analysis of cross-sectional data collected as part of a modified Youth Risk Behavior Survey (YRBS) administered in Sarasota County, Florida, high schools during fall 2006. Models were

tested and modified in a training sample, Sample A (N = 784); final models were cross-validated in a hold-out sample, Sample B (N = 749).

Findings suggested that a refined model was plausible ( $\chi^2 / df = 331.97/64$ , TLI = 0.94, RMSEA = 0.07;  $\chi^2 / df = 226/64$ , TLI = 0.95, RMSEA = 0.06, Samples A and B, respectively). Many paths were statistically significant; e.g., students who perceived mothers to be concerned about their weight were likely to think mothers perceived them as heavier, valued weight highly, had restrictive feeding practices, and made comments about their weight. Students with greater internalized concern about weight were likely to think mothers made comments about their weight and were heavier. Girls were more likely than boys to think mothers were concerned about their weight. Internalized concern about weight, but not inability to self-regulate eating, was predictive of weight status. Interventions addressing some of the model's constructs may provide a partial solution to problems of weight and inability to self-regulate eating behaviors.

## CHAPTER I

### STATEMENT OF THE PROBLEM

*“Children are highly cherished in our society. The value we attach to our children is fundamentally connected to society’s responsibility to provide for their growth, development, and well-being”* (Koplan, Liverman, & Kraak, 2005, xiv).

#### Introduction

The health and well-being of U.S. children is challenged today by the immense crisis of obesity. Whereas childhood obesity is caused by a multitude of factors, the first and most profound influence upon children’s development is that of their parents. The research described in this study addresses parental influences on the development of obesity in adolescents. This chapter discusses the problem and this study’s significance. The study’s theoretical framework is described, followed by the study’s purpose and questions that guided the research. Chapter II provides a review of the literature, Chapter III describes the methods employed for this study, and Chapter IV provides the results of the study. Finally, Chapter V concludes the paper with a discussion of the results and implications for practice.

#### Statement of the Problem

Over 350,000 deaths each year in the U.S. are attributed to obesity – a primarily preventable condition (Mokdad, Marks, Stroup, & Gerberding, 2004). Two-thirds of U.S. adults are overweight, obese, or extremely obese; and one-third of U.S. children are

overweight or at risk for overweight (Ogden et al., 2006). The steep increase in the prevalence of obesity over the past several decades has sparked considerable concern among health professionals because of its association with serious, life-threatening illnesses (Koplan et al., 2005). Overweight children are becoming victims of diseases traditionally seen in adults, like type 2 diabetes, hypertension, and cardiovascular disease (Koplan et al.). Moreover, they are at risk for premature death because of these illnesses (Koplan et al.).

Countless factors in all realms of life may contribute to the obesity epidemic (see Koplan et al., 2005). Biological factors, such as genetics and hormonal regulation, are being explored fervently in an attempt to find a medical cure for the disease (Koplan et al.). Behavioral factors, such as excessive eating and inadequate physical activity, are often considered to be the root cause of obesity (Koplan et al.). However, a deeper examination of the problem has shown that more distal environmental factors, including issues such as urban design and food policy, may have a considerable role in the etiology of obesity (Koplan et al.). For children, the immediate family environment may have a significant impact on the development of obesity (Koplan et al.). In particular, parents have a significant role in influencing children's behaviors (Koplan et al.).

Parents contribute substantially to the socialization of their children's eating behaviors. Specific parenting practices, like restricting or limiting eating (e.g., Fisher & Birch, 1999), pressuring children to eat (e.g., Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002), or monitoring their intake (e.g., Blissett, Meyer, & Haycraft, 2006), impact children's eating behaviors. Parents may influence what their children eat by altering food availability (e.g., Neumark-Sztainer, Story, Perry, & Casey, 1999), accessibility

(e.g. Bere & Klepp, 2004), and preparation (e.g., Cullen et al., 2004). Eating meals together (e.g., Gillman et al., 2000) and parental modeling (e.g., Brown & Ogden, 2004) of eating also influence children's dietary intake and weight. Additionally, parents may unknowingly transmit their attitudes and feelings about their own weight to their children, which in turn, may affect their children's eating behaviors (e.g., Hood et al., 2000). A wide variety of parent factors in the eating domain may contribute to the obesity epidemic among children. One model – the obesity proneness model (Costanzo & Woody, 1985) – attempts to explain how some of these parental factors influence the development of disordered eating behaviors that lead to obesity.

The theoretical propositions that later became known as the obesity proneness model were first put forward by psychologists Philip Costanzo and Erik Woody in 1985. The model became the theoretical foundation for a widely used parent feeding survey instrument, called the Child Feeding Questionnaire (CFQ) (Birch et al., 2001), and many components of the model have been tested over the years. Although the obesity proneness model has not been tested in its entirety, many of its constructs have been examined in studies conducted primarily with parents and their young children (e.g., Birch & Fisher, 2000; Faith et al., 2004; Francis, Hofer, & Birch, 2001; Keller, Pietrobelli, Johnson, & Faith, 2006; Lee, Mitchell, Smiciklas-Wright, & Birch, 2001; Robinson, Kierman, Matheson, & Haydel, 2001; Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002; Tiggemann & Lowes, 2002; Vereecken, Keukelier, & Maes, 2004). Parent constructs are typically derived from a parent survey, whereas children's measures tend to be indicators of dietary intake and weight status, either observed behaviors or based on data provided by the parent. The children in the studies mentioned above were

primarily under the age of 8 years, and many were 5 years or younger. Understandably, parents are often the source of information for children this young. Whereas these studies suggest the obesity proneness model has great potential in explaining some parental influences on the development of childhood obesity, it has been limited by its reliance on parents for information about their own attitudes and practices and their children's dietary behaviors. Children as young as 6 or 7 years of age are able to give accurate accounts of their own health (Riley, 2004), and there is evidence that children as young as 10 years' old can report reliably on some parent behavior (Barnett, O'Loughlin, Paradis, & Renaud, 1997). It is expected that the adolescent's *perception* of parenting practices may actually exert a greater influence over the adolescent's eating behavior and weight status. This study will build on the model's potential but modify some of the constructs primarily for use in assessing youth perceptions of these variables.

#### Significance of the Study

The Healthy People 2010 Objective #19-3 is to “reduce the proportion of children and adolescents who are overweight . . .” to 5% from a 1988-94 baseline of 11% (U.S. Department of Health and Human Services [USDHHS], 2000). Unfortunately, instead of declining, the proportion of adolescents who are overweight has risen dramatically. Approximately 17% of adolescents aged 12-19 years are now overweight, and another 17% are at risk of overweight (Ogden et al., 2006). The Institute of Medicine (IOM) (Koplan et al., 2005) has called for a multi-faceted approach to the prevention of childhood obesity, including interventions at the local, state, and federal government levels, the marketplace and media environments, in communities, in schools, and in the home.

Children first learn eating behaviors that might lead to obesity in the home where parents have a profound influence on what they eat. The child of just one obese parent is 2-3 times more likely to become obese as an adult than a child of normal weight parents (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Although genetics and other biological factors play a role in this family link to obesity, behavioral and environmental factors probably account for most of the association (Koplan et al., 2005).

The obesity proneness model suggests a mechanism for how certain parenting practices develop and lead to disordered eating behaviors and obesity among children. A modified version of the model was examined that allowed constructs to be assessed from adolescents' perspectives. The findings from this study suggest potential parental intervention strategies to help prevent life-threatening obesity in the future.

#### Theoretical Framework

The basic premises of the obesity proneness model suggested by Costanzo and Woody (1985) are that:

1. Parents become highly concerned about their children's weight if: (a) they detect signs their children are becoming overweight; and (b) they value weight highly, particularly as it is related to appearance.
2. Because of the societal value placed on women's weight, parents become especially concerned if they detect signs of overweight in their daughters.
3. Parents communicate these concerns to their children.
4. Children internalize their parents concerns about becoming overweight and therefore attempt to control their intake.
5. Parental concern leads to restrictive and constraining parent feeding strategies.



6. Restrictive and constraining practices lead to children's inability to self-regulate eating behaviors.
7. Because of the inability to self-regulate intake, attempts to control intake are ineffective, leading to weight gain.

The obesity proneness model suggests a mechanism for how certain parenting practices develop and lead to disordered eating behaviors and obesity among children. Modifications to the model include: (1) addressing some of the constructs from the adolescent's viewpoint, (2) considering some current perspectives on obesity correlates, and (3) identifying adolescents' perceptions specific to *maternal* influences.

#### Purpose of the Study

Using existing survey data collected from Sarasota County high school students in fall 2006, the primary purpose of this study was to determine the ability of the modified obesity proneness model to predict weight status among adolescents. If the modified obesity proneness model does not adequately predict adolescents' weight status, a secondary purpose of the study was to determine the ability of an alternate model to predict adolescents' weight status. A final study objective was to determine the best predictors of weight status and, thus, the best candidates for intervention.

This study contributes to the literature in an important way: This is the first study known to examine multiple constructs of the model from the adolescents' perspectives. Prior studies that have used components of the model have typically surveyed parents (usually mothers). However, adolescents' perception of what their parents believe, feel, or do may have a greater impact on them than what parents say they, themselves, believe, feel, or do.

## Research Questions

This study addressed the following research questions:

1. Is the modified obesity proneness model adequate for predicting weight status among adolescents?
2. If the modified obesity proneness model is not adequate, what is the adequacy of a refined or alternative model?
3. Which variables in the final model are the best predictors of weight status and, thus, the best candidates for intervention foci?

## Assumptions

The following assumptions applied in this study:

1. Surveys were administered according to protocol.
2. Students are truthful in their survey responses.
3. Students' answers are independent of each other.
4. Students completed only one survey each.

## Limitations

This study was limited by the following:

1. This study analyzed cross-sectional data, from which it is not possible to infer cause and effect relationships.
2. Although the survey protocol called for a random cluster sample of students, almost half of the students expected to participate did not return surveys and it is unclear which students did not participate. Therefore, students surveyed were essentially a sample of convenience, and as such, are not representative

of the population as a whole. Therefore, findings cannot be generalized to the larger adolescent population.

3. Although the Youth Risk Behavior Survey is considered a valid and reliable instrument, the items added to the survey were not subjected to rigorous psychometric testing. A large amount of measurement error increases the chance of making a Type II error – failing to find a relationship when one, in fact, exists.
4. This study relied on self-reported data, and as such, frequencies may be under- or over-estimated.
5. The study is limited to existing survey data which precluded the use of an ideal combination of items for addressing the research questions.

#### Delimitations

The scope of this study was intentionally delimited as follows:

1. This study was an examination of existing survey data collected from students who participated in the 2006 Youth Risk Behavior Survey conducted in Sarasota County high schools. As such, the study was delimited to:
  - a. high school students who participated in the survey and
  - b. the specific items on the survey.
2. Surveys were included in analysis if:
  - a. there was no visual evidence of deliberate or patterned responses,
  - b. there was no excess of missing responses (> 75%), and
  - c. students reported that they told the truth and read the survey carefully at least half of the time on survey items assessing these dimensions.

## Definitions

Some terms used in this paper are defined below:

1. At risk of overweight (children/adolescents): Body mass index (BMI)-for-age at or above the 85<sup>th</sup> percentile and below the 95<sup>th</sup> percentile on the sex-specific growth charts (Centers for Disease Control and Prevention [CDC], 2006b).
2. Body mass index (BMI): Weight (in kilograms) divided by the square of height (in meters) (CDC, 2006a). An indicator of weight status.
3. Extreme obesity (adults): BMI of 40.0 or greater (National Institutes of Health [NIH], 1998).
4. Obesity (adults): BMI of 30.0-39.9 (NIH).<sup>1</sup>
5. Overweight (adults): BMI of 25.0-29.9 (NIH).
6. Overweight (children/adolescents): BMI-for-age at or above the 95<sup>th</sup> percentile on the sex-specific growth charts (CDC, 2006b).
7. Parenting practices (or parenting strategies): Specific behaviors used by parents to control or socialize their children; some practices may be specific to the eating/feeding domain.
8. Parenting style: A broad pattern of parenting practices used to control and socialize children; often categorized as authoritative, authoritarian, indulgent, and uninvolved (Darling, 1999).

---

<sup>1</sup> In this paper, the terms overweight and obesity will be used interchangeably to refer to excess body fat except when the more specific definitions of the terms are more appropriate.

## CHAPTER II

### LITERATURE REVIEW

#### Introduction

The prevalence of overweight among youth and adults in the United States has been rising dramatically over the last three decades (Ogden et al., 2006). Because children learn eating behaviors in the context of a family environment, there is a clear need for understanding how the family environment influences the development of overweight and obesity among children. The obesity proneness model (Costanzo & Woody, 1985) is one framework that may help explain the influence parents have on the development of disordered eating that may lead to obesity. However, constructs of the model have traditionally been examined from the parents' perspective, whereas the model could be built to portray and examine the constructs from the adolescents' perspective.

This chapter is comprised of three main sections. The first section describes the problem of obesity among youth and provides an overview of the causes of childhood obesity. The next section reviews the obesity proneness model and the constructs of the model. The final section describes modifications to the model.

#### Childhood Obesity

The prevalence of obesity among youth and adults in the United States has been rising dramatically over the last several decades and has become a major public health concern (USDHHS, 2001). Since the *Surgeon General's Call to Action to Prevent and*

*Decrease Overweight and Obesity* was published in 2001 (USDHHS), obesity rates have continued to rise. Nationally, approximately 34% of children aged 2-19 are considered overweight or at risk for becoming overweight, and about 66% of adults over the age of 19 years in the United States are considered overweight, obese, or extremely obese (Ogden et al., 2006).

In their report, *Preventing Childhood Obesity. Health in the Balance* (Koplan et al., 2005), the IOM summarized the major physical, psychosocial, and economic consequences of childhood obesity. According to their report, the increased prevalence of obesity among youth has sparked concern not only because of its relationship with disease in later life, but also because of increased risk factors and illness during childhood. Obesity among children has been linked to hypertension, glucose intolerance/insulin resistance, dyslipidemia, and other conditions – disorders more traditionally seen in adults (Koplan et al.). The incidence of type 2 (“adult-onset”) diabetes among youth has risen dramatically, and scientists are forecasting premature death for young people who develop major diabetes complications -- neuropathy, nephropathy, and retinopathy (Koplan et al.). However, the greatest physical health threat of childhood obesity is feared to be a dramatic increase in the metabolic syndrome, which has been related to type 2 diabetes, cardiovascular disease, and increased mortality (Koplan et al.). Approximately 30% of obese youth have the metabolic syndrome (Koplan et al.).

Whereas obesity is most notably associated with physical health problems, the psychosocial problems related to this condition cannot be ignored. Obese youth are subject to stigmatization, negative stereotyping, and discrimination by peers, parents,

teachers, and health-care professionals (Koplan et al., 2005). The negative treatment experienced by obese youth is hypothesized to result in negative body image, poor self-esteem, and depression (Koplan et al.). Long-term, obese young women may experience economic consequences because they tend to have a lower educational attainment level, lower earnings, and be unmarried (Koplan et al.).

The great physical and psychosocial consequences of obesity have given rise to a national economic burden (Koplan et al., 2005). The combined direct and indirect health-care costs of obesity for the nation have been estimated to be between \$98-\$129 billion annually (Koplan et al.). For youth aged 6-17 years, the direct hospital costs related to obesity are estimated to be about \$127 million annually (Koplan et al.). Because of the great physical, psychosocial, and economic consequences of obesity, the causes of this disorder must be identified and addressed.

It is commonly understood that obesity occurs when energy intake exceeds energy output. However, those who have studied the obesity problem or reviewed the literature on obesity correlates elsewhere (e.g. Center for Weight and Health, 2001; Davison & Birch, 2001, Koplan et al.) know that the causes are more complex than this simplistic explanation suggests.

The ecological model outlined by Davison and Birch (2001) provides helpful categories for the multiple predictors of childhood obesity. The three ecological levels they identify are “child characteristics and child risk factors,” “parenting styles and family characteristics,” and “community, demographic, and societal characteristics” (p. 161). Child-level determinants of obesity include biological factors, (e.g., age, sex, and genetic predisposition to weight gain) and behavioral factors (e.g., dietary intake,

physical activity, and sedentary behavior). Parent/family-level determinants include child feeding practices, the availability of certain foods in the home, nutrition knowledge, parental dietary and physical activity patterns, parental preferences for food and physical activity, parental weight status, parental encouragement of child's activity, parental monitoring of child's television viewing, the family's television viewing habits, and peer and sibling interactions. Determinants in the community/demographic/societal level include ethnicity, socioeconomic status, school lunch and physical education programs, work hours, leisure time and family leisure time activity, accessibility of recreational facilities, convenience foods and restaurants, and crime rates and neighborhood safety. Clearly, the causes of childhood obesity are complex and require a multifactorial approach to prevent. The IOM report on *Preventing Childhood Obesity* (2005) recommends action at numerous environmental levels: the national, state, and local governments, the marketplace and media environments, communities, schools, and the home.

The research described herein focused on family influences on energy intake (eating). Although important, energy output (physical activity) will not be explored in this study. For children, eating behaviors are learned primarily within a family environment. Parents, in particular, have a profound influence on children's eating behaviors and potential development of obesity, as a child of just one obese parent is approximately 2-3 times more likely to become obese as an adult than a child of normal weight parents (Whitaker et al., 1997). Parents may influence children's eating behaviors and, perhaps, obesity development in a variety of manners.



One of parents' primary roles is to socialize their children, including their eating behaviors that contribute to obesity. The relatively consistent association seen between parent and child weight and dietary intake (e.g., Cooke et al., 2003; Feunekes, de Graaf, Meyboom, & van Staveren, 1998; Fisher et al., 2002; Gibson, Wardle, & Watts, 1998; Laskarzewski et al., 1980; Oliveria et al., 1992; Vauthier, Lluch, Lecomte, Artur, & Herbeth, 1996) suggests parents have considerable influence on their children's eating behaviors and obesity development. The link between parent and child dietary intake is seen for both healthy and less-healthy foods and beverages. For example, fruit and/or vegetable intake is correlated between parent and child (Cooke et al., 2003; Fisher et al., 2002; Gibson et al., 1998; Vereecken et al., 2004; Wardle, Carnell, & Cooke, 2005; Woodward et al., 1996), as is soft drink consumption (Fisher, Mitchell, Smiciklas-Wright, & Birch, 2000; Grimm, Harnack, & Story, 2004; Vereecken et al., 2004), and dietary fat and/or cholesterol intake (Feunekes et al., 1998; Laskarzewski et al., 1980; Lee et al., 2001; Oliveria et al., 1992).

The concordance in weight and dietary intake between parent and child may be due, in part, to genetic factors, but the relationship is thought to be primarily behavioral or environmental in nature (e.g., Vauthier et al., 1996). The behavioral and environmental factors that might explain this concordance include: food availability and accessibility, eating meals together, food preparation, and parental modeling of dietary behaviors. These factors, in turn, may influence children's eating behaviors or dietary intake (Bere & Klepp, 2004; Brown & Ogden, 2004; Cullen et al., 2000; Cullen et al., 2001; Cullen et al., 2004; Gillman et al., 2000; Grimm et al., 2004; Kusano-Tsunoh et al., 2001; Matheson, Robinson, Varady, & Killen, 2006; Neumark-Sztainer et al., 1999;

Neumark-Sztainer, Hannan, Story, Croll, & Perry, 2003; Videon & Manning, 2003; Young, Fors, & Hayes, 2004).

Parents also may influence children's eating behaviors or weight by establishing food rules (Zabinski et al., 2006), using food as a tool to manipulate child behavior (Vereecken et al., 2004), and exerting control over eating behaviors (Arredondo et al., 2006; Brown & Ogden, 2004; Cullen et al., 2001; Faith et al., 2003; S. L. Johnson & Birch, 1994; J. Ogden, Reynolds, & Smith, 2006; Robinson, Kiernan, Matheson, & Haydel, 2001; Zive et al., 1998). Three dimensions of controlling feeding practices were identified by Birch and her colleagues (2001) – pressure, restriction, and monitoring. Pressure refers to attempts to get the child to eat, where restriction would be attempts by the parents to get the child to not eat. Monitoring refers to attempts to keep track of what the child is eating. Each of these have been related to children's eating behaviors or weight in one way or another (Arredondo et al., 2006; Blissett et al., 2006; Bourcier, Bowen, Meischke, & Moinpour, 2003; Brann & Skinner, 2005; Drucker, Hammer, Agras, & Bryson, 1999; Faith et al., 2004; Fisher & Birch, 1999; Fisher & Birch, 2000; Fisher et al., 2002; Kaur et al., 2006; Keller, et al., 2006; Klesges et al., 1983; Klesges, Stein, Eck, Isbell, & Klesges, 1991; Lee et al., 2001; Matheson et al., 2006; Spruijt-Metz et al., 2002; Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002; Young & Fors, 2001; Zabinski et al., 2006).

Furthermore, parents' attitudes and feelings about their own eating behaviors and weight may also influence their children's dietary habits through the transmission of their values to the child (Birch & Fisher, 2000; Francis & Birch, 2005; Hood et al., 2000). Finally, the broad concept of parenting style may have an impact on children's eating

behaviors (Cullen et al., 2000; Kremers, Brug, de Vries, & Engels, 2003; Lytle et al., 2003). These parental factors are often intertwined and difficult to disassociate from one another. The obesity proneness model acknowledges these interactions and attempts to explain how some of these parental factors influence the development of disordered eating behaviors that lead to obesity. This model is described in the following section.

#### Theoretical Framework: The Obesity Proneness Model

Psychologists Philip Costanzo and Erik Woody first described what has become known as the “obesity proneness model” in 1985. Although Costanzo’s and Woody’s purpose was to illustrate how domain-specific parenting styles influence deviant child behavior, the more eminent result of their work has been the example of obesity proneness used to illustrate their propositions. In this section, basic premises of the obesity proneness model will be outlined, followed by a description of the earlier works leading to the primary assumptions of the model. Later applications of the model will be described, including the development of a questionnaire designed to measure some constructs of the model, a more detailed description of each of the model’s constructs, how they are measured or inferred, and some of their correlates.

#### *Premises of the Obesity Proneness Model*

The basic premises of the model suggested by Costanzo and Woody in 1985 are the following:

1. Parents become highly concerned about their children’s weight if: (a) they detect signs their children are becoming overweight; and (b) they value weight highly, particularly as it is related to appearance.

2. Because of the societal value placed on women's weight, parents become especially concerned if they detect signs of overweight in their daughters.
3. Parents communicate these concerns to their children.
4. Children internalize their parents concerns about becoming overweight and therefore attempt to control their intake.
5. Parental concern leads to restrictive and constraining parent feeding strategies.
6. Restrictive and constraining practices lead to children's inability to self-regulate eating behaviors.
7. Because of the inability to self-regulate intake, attempts to control intake are ineffective, leading to weight gain.

In summary, because of a highly constrained / highly concerned parenting style, children internalize their parents' values regarding weight but are unable to self-regulate their eating behaviors that would lead to the desired effects. Costanzo and Woody (1985) suggested that in these cases children are socialized to feel guilty and anxious about their eating behaviors but have little ability to control their eating behaviors; these are characteristics of disordered eating that may lead to obesity. A graphic representation of the obesity proneness model is provided in Figure 1.

#### *Early Works Leading to Model Development*

Although Costanzo and Woody (1985) were particularly interested in the development of deviant eating behaviors, their early work used the example of obesity proneness to explain what they referred to as "domain-specific parenting styles and their impact on the child's development of particular deviance" (p. 425). In the case of the obesity proneness model, "domain" encompasses the conditions under which children eat

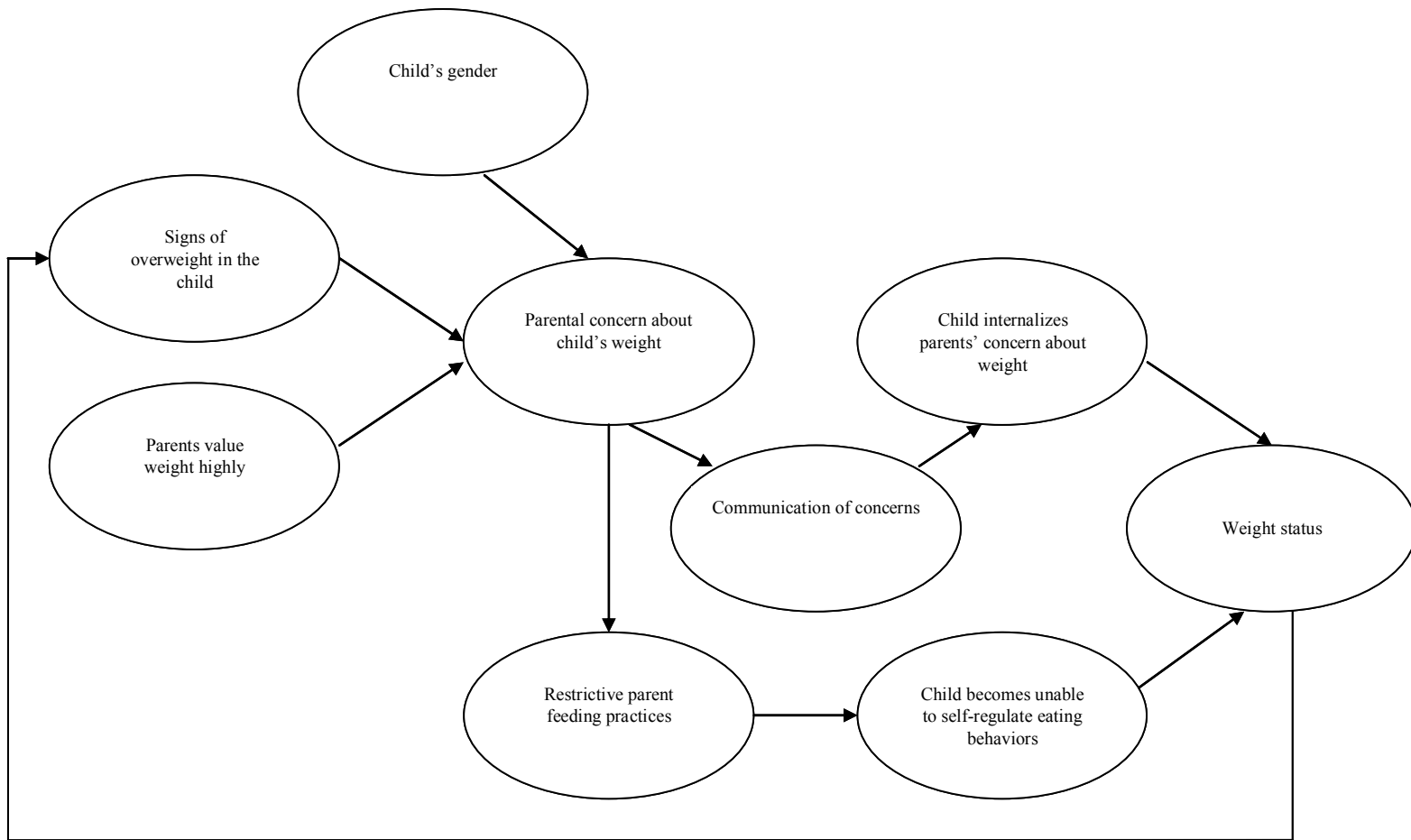


Figure 2.1. A graphic representation of the obesity proneness model described by Costanzo and Woody (1985)

or are fed, and “deviance” refers to disordered eating that may lead to obesity. Parenting style can be defined as a broad pattern of parenting practices used to control and socialize children (Darling, 1999).

Simons-Morton and Hartos (2002) described the four types of parenting styles suggested by Baumrind (1967, 1971, 1991) and Maccoby and Martin (1983). These four parenting styles are based upon varying degrees of demandingness and responsiveness. According to Simons-Morton and Hartos, demandingness refers to the extent to which parents expect or demand certain responsible behaviors and, in turn, discipline misbehavior. Responsiveness refers to the extent to which parents respond to their children’s needs and provide support for their development. A high level of both demandingness and responsiveness results in an *authoritative* parenting style, whereas a high level of demandingness with a low level of responsiveness results in an *authoritarian* parenting style. Low demandingness with high responsiveness results in an *indulgent* parenting style, and low levels of both demandingness and responsiveness results in an *indifferent* or *uninvolved* (sometimes called ‘neglectful’) parenting style. The authoritative parenting style has been associated with a wide variety of positive outcomes for children (Simons-Morton & Hartos).

The primary assumption of the obesity proneness model is that parenting styles vary depending on the context, domain, and child. Costanzo and Woody (1985) suggested that parents do not just “emit” certain degrees of demandingness and responsiveness that result in these four types of parenting styles. Rather, they vary depending on the context, domain, and child. To support this claim, they cited the personality and psychopathology works of Hersen and Bellack (1981) and Mischel

(1973) showing that behavior tends to be consistent *within* relatively equal contexts but not *across* different types of contexts. They also cite the work of bulimia researchers (Boskind-White & White, 1983; C. L. Johnson, Stuckey, Lewis, & Schwartz, 1983) to support their notion that behaviors vary between domains. For instance, they explained that bulimic individuals tend to appear relatively “normal” psychologically and “highly successful and well controlled in the noneating” (p. 427) domains, but they exhibit relatively little self-control in the domain of eating. Finally they rely on personality traits research (Goldsmith, 1983; Rowe & Plomin, 1981) to support the claim that parental responses reflect differences between siblings, differences that reflect variance within the family environment. In effect, Costanzo and Woody contend that parenting style is a “state” variable, one that can change based on various conditions, rather than “trait” variable, one that is relatively stable for a given person.

Costanzo and Woody (1985) placed a great deal of emphasis on the development of the notion that the children themselves may affect parenting style. They believed that parenting style within a particular domain and context may be influenced by the parents’ observations and characterizations of their children’s personality and behaviors. Furthermore, they suggested that parenting style is influenced by parental desires to promote the best outcomes for their children, and these desires are influenced, at least in part, by the parents’ own values. Ethnographic research has suggested that parents see their children as having certain latent traits that become evident as the child develops (Fischer & Fischer, 1963). Parents see their role as influencing their child’s development so that the good traits are maximized and the bad traits are minimized.

Parents must continually assess their children so that they might be able to predict the children's traits and guide their development appropriately (Costanzo & Woody).

Although parents' efforts to guide their children's behavior are usually well-intentioned, Costanzo and Woody (1985) proposed that sometimes these efforts may result in unintended negative consequences for their children. They suggested, based on the work of Goodnow, Knight, and Cashmore (1983), that parents who, in other domains are not normally overinvolved, may be "more likely to constrain and control a child's behavior when the particular content area is high in importance and strongly valued by the parent" (p. 430) and when the parent does not trust the child to learn the appropriate concepts or skills on his/her own. They added that parents might also exert more control because of what the parents foresee as future consequences of the behavior – in this case, improper eating might lead to obesity and other health problems. The theoretical basis for these hypotheses is derived from the works of Goodnow, Knight, and Cashmore (1983), Ryan, Chandler, Connell, and Deci (1983), Lepper and Gilovich (1981), Lepper and Green (1975), Aronfreed (1964), and Hoffman (1970). This research would suggest that a high level of parental constraint may not allow for learning that occurs naturally through self-discovery, and therefore, interferes with the child's ability to learn self-control. Furthermore, it suggests that a high level of parental concern may lead to highly emotional parenting strategies that can result in the child's internalizing parental standards. This line of reasoning forms the basic premises of their theoretical framework that became known as the obesity proneness model.

In their 1985 paper, Costanzo and Woody describe four of their own studies (Costanzo & Woody, 1979; Costanzo & Woody, 1984; Morgan & Costanzo, 1985;



Woody, Costanzo, & Laubgross, 1984) that support the model. In short, although these four studies do not necessary “prove” the model, they provide some evidence that, as the model proposes, (1) overweight children tend to be unable to exhibit self-control in the eating domain, (2) the transmittal of parental concern over weight status and subsequent constraining practices in the eating domain may be exhibited more prominently among females than males, (3) overweight status among females tends to be related to parental concern and constraint; and (4) women with restrained eating behaviors seem to have internalized earlier parental concerns over weight.

#### *Applications of the Obesity Proneness Model*

The obesity proneness model was later used in research on parental effects on children’s eating behaviors and obesity and contributed to the development of a parent questionnaire (CFQ) used to study these effects. Although no studies have been identified that addressed the entire model, some studies have used significant portions of the model (e.g., Birch & Fisher, 2000; Francis, Hofer, & Birch, 2001; Tiggemann & Lowes, 2002), and many studies have addressed some constructs of the model, even when the model itself was not identified as a theoretical framework. This section of the literature review will first review the CFQ and then individual constructs of the model.

#### *Child Feeding Questionnaire*

The CFQ was designed to be used with parents of children aged approximately 2-11 years (Birch et al., 2001). This instrument was originally developed (Johnson & Birch, 1994) based on a parent interview designed by Costanzo and Woody (1985). Over time, it was revised to measure seven factors within two main categories, (1) parental concerns and perceptions that may influence controlling feeding practices and (2)

parental feeding control attitudes and practices. The first category was comprised of the following four factors: “perceived parent weight, perceived child weight, parental concern about child weight, and parental responsibility” (Birch et al., p. 203). The second category was comprised of the following three factors: “the use of restriction, pressuring children to eat more, and monitoring” (Birch et al., p. 203). The questionnaire consists of 31 items measured on a 5-point Likert-type scale, and reportedly (Anderson, Hughes, Fisher, & Nicklas, 2005) is one of the most widely-used measures in the study of parental influences on children’s eating behaviors. Research by Anderson et al. indicated that a modified version of the questionnaire may be appropriate for use among Hispanic and African American populations. The CFQ also has been modified for use with parents of adolescents (Kaur et al., 2006).

Although the CFQ was developed based upon the obesity proneness model, it only measures three obesity proneness model constructs: *signs of overweight in the child*, *parental concerns about the child’s weight*, and *restrictive feeding practices* (Table 2.1). Therefore, it cannot be the only instrument used if all of the model’s constructs are to be examined.

#### *Model Constructs*

Many of the model’s constructs have been examined empirically, but not always explicitly as components of the obesity proneness model. These factors are linked to one another in many ways and the complex interactions are difficult to untangle. However, this section of the literature review will attempt to outline each of these constructs individually.

Table 2.1

*Comparison of the Constructs or Variables of the Obesity Proneness Model with Corresponding Factors and Items from the CFQ*

Constructs or Variables of the Obesity Proneness Model	Corresponding Factors from the CFQ	Corresponding CFQ Items (Birch et al., 2001, p. 210)	
		Items	Response Options
<i>Child's gender</i>	N/A	N/A	N/A
<i>Signs of overweight in the child</i>	Perceived child weight	<i>Your child:</i> <ul style="list-style-type: none"> <li>○ <i>During the first year of life</i></li> <li>○ <i>As a toddler</i></li> <li>○ <i>As a pre-schooler</i></li> <li>○ <i>From kindergarten through 2<sup>nd</sup> grade</i></li> <li>○ <i>From 3<sup>rd</sup> through 5<sup>th</sup> grade</i></li> <li>○ <i>From 6<sup>th</sup> through 8<sup>th</sup> grade</i></li> </ul>	<ol style="list-style-type: none"> <li>1. Markedly underweight</li> <li>2. Underweight</li> <li>3. Normal</li> <li>4. Overweight</li> <li>5. Markedly overweight</li> </ol>
<i>Parents value weight highly</i>	N/A	N/A	N/A
<i>Parental concern about child's weight</i>	Parental concern about child weight	<i>How concerned are you about your child eating too much when you are not around her?</i>  <i>How concerned are you about your child having to diet to maintain a desirable weight?</i>  <i>How concerned are you about your child becoming overweight?</i>	<ol style="list-style-type: none"> <li>1. Unconcerned</li> <li>2. A little concerned</li> <li>3. Concerned</li> <li>4. Fairly concerned</li> <li>5. Very concerned</li> </ol>
<i>Restrictive parent feeding practices</i>	Use of restriction	<i>I have to be sure that my child does not eat too many sweets (candy, ice cream, cake or pastries)</i>  <i>I have to be sure that my child does not eat too many high-fat foods</i>  <i>I have to be sure that my child does not eat too much of her favorite foods</i>  <i>I intentionally keep some foods out of my child's reach</i>  <i>I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behavior</i>  <i>I offer my child her favorite foods in exchange for good behavior</i>  <i>If I did not guide or regulate my child's eating, she would eat too many junk foods</i>  <i>If I did not guide or regulate my child's eating, she would eat too much of her favorite foods</i>	<ol style="list-style-type: none"> <li>1. Disagree</li> <li>2. Slightly disagree</li> <li>3. Neutral</li> <li>4. Slightly agree</li> <li>5. Agree</li> </ol>
<i>Communication of concerns</i>	N/A	N/A	N/A
<i>Child internalizes parents' concerns</i>	N/A	N/A	N/A
<i>Inability to self-regulate eating</i>	N/A	N/A	N/A
<i>Weight status</i>	N/A	N/A	N/A

*Gender.* Gender in this case refers to both the child's biological sex and how the parent identifies the child as either a boy or girl. It takes on all the connotations of what being a boy or girl means in this society. This variable is typically operationalized by asking the child's sex. The model suggests that parents will be more concerned about their daughters' weight because of the societal value placed on women's weight. The increased concern about daughters' weight would theoretically lead to increased restrictive feeding practices among girls compared to boys. Evidence from some studies (e.g. Arredondo et al., 2006; Blissett et al., 2006; Robinson et al., 2001; Spruijt-Metz et al., 2002; Tiggemann & Lowes, 2002) suggests that associations between other constructs of the model may be moderated by gender. However, one study found no difference in mothers' concerns about weight between boys and girls (Spruijt-Metz et al., 2002).

*Signs of overweight in the child.* Signs of overweight in the child can be conceptualized as parents' perception of their children being overweight, or "perceived child weight." This construct has been operationalized on the CFQ by items ranking the child on a 5-point scale from markedly underweight to markedly overweight at six different periods of the child's life, depending on the age of the child at the time of the survey (Table 1). Intuitively, perceived weight should be directly related to actual weight. Perceived child weight is thought to be linked to later obesity through its effect on parental concerns about the child's weight and the results of these concerns. Indeed, one study of mothers and their 5-year-old daughters (Francis et al., 2001) found that perceived child weight was positively related to concern for child weight, restrictive feeding practices, and child's BMI. A measure of mothers' perception of daughters' overweight risk, which included both perceived child weight and concerns for child

weight, was also associated with restrictive feeding practices among mothers of 5-year-old girls (Birch & Fisher, 2000). Perceived child weight at age 5 predicted increased weight status at age 7 among children born at high risk for obesity based upon maternal prepregnancy weight (Faith et al., 2004). This effect was thought to be due to restrictive feeding practices, also associated with increased weight status. Perceived child weight was related to maternal monitoring of food intake among both boys and girls aged 5-8 years, but only among boys when the effects of other variables were controlled for (Tiggemann & Lowes, 2002).

*Parents' values regarding weight.* This construct can be thought of as the importance parents place on weight. The model suggests that parents will be concerned about children's weight if they value weight highly. No studies have been identified that examine the relationship between parental values about weight and concerns about weight or children's actual weight. However, Levine, Smolak, and Hayden (1994) studied a similar construct they called "parental investment in daughter's shape." This construct was inferred by the 4-item Parent Involvement Scale (PIS) (Levine et al.), designed to be self-administered by adolescent girls. This instrument asks two questions about each parent: "How important is it to your mother/father that you be thin?" and "How concerned is your mother/father about whether you weigh too much or are too fat or might become too fat?" (Thompson, Heinberg, Altabe, & Tantleff-Dunn, 1999, p. 202). Parental investment in daughter's shape was not a predictor of adolescent girls' body dissatisfaction, investment in thinness, weight management, or disturbed eating (Levine et al.). However, this scale might actually be inferring two distinct constructs: parental values and parental concerns. Furthermore, mothers' investment in their

daughters' shape or their values or concerns about weight may differ from fathers' and, therefore, should not be measured in the same scale.

*Parental concern.* Parental concern might combine with values to create a “parental investment in daughters' shape” construct as Levine et al. (1994) suggest, but it is distinctly different than values. Parental concern is worry or fear that the child may suffer consequences because of their weight. Parental concern is inferred by three items on the CFQ (Birch et al., 2001) (Table 1): “How concerned are you about your child eating too much when you are not around her,” “How concerned are you about your child having to diet to maintain a desirable weight,” and “How concerned are you about your child becoming overweight” (p. 210). The PIS, mentioned previously, also has one concern item that infers parental investment in child's weight. Concern is a central concept of the obesity proneness model. According to the model, parental concern is thought to be caused by both signs of overweight in the child and the value parents place on weight. Consistent with the model's propositions, in one study, mothers were significantly more concerned about their heavier children's weight than they were of their thinner children's (Keller et al., 2006). Concerns about children's weight were positively associated with children's weight status in other studies with children ranging in age from 7-19 (Brann & Skinner, 2005; Kaur et al., 2006; Spruijt-Metz et al., 2002). However, in another study of families with obese and non-obese siblings aged 7-12 years, there was no relationship between parental concern for weight and children's weight status (Saelens, Ernst, & Epstein, 2000). In a study of infants and preschoolers, concern about children being or becoming overweight *or* underweight was negatively associated with children's weight (Baughcum et al., 2001). Parental concern for the child's weight is

thought to be connected to children's weight through its effect on restrictive feeding practices and concerns have been related to restrictive feeding practices empirically (Francis et al., 2001). A longitudinal study showed that parental concern for children's weight predicted an increase in children's weight status when children were at risk for obesity at baseline (Faith et al., 2004).

*Restrictive feeding practices.* Restrictive feeding practices refer to parents' attempts to prevent their children from eating certain foods or from eating too much. Four components of restriction are inferred by eight items on the CFQ (Birch et al., 2001) (Table 1): The first reflects the need to ensure the child does not eat too much and is inferred by three items: "I have to be sure that my child does not eat too many sweets (candy, ice cream, cake or pastries)," "I have to be sure that my child does not eat too many high fat foods," and "I have to be sure that my child does not eat too much of her favorite foods" (Birch et al., p. 210). The second reflects parents' preventing the child from accessing some foods and is inferred by one item: "I intentionally keep some foods out of my child's reach" (Birch et al., p. 210). The third is an indication of parents' offering food treats as a reward and is inferred by two items: "I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behavior," and "I offer my child her favorite foods in exchange for good behavior" (Birch et al., p. 210). The fourth component of restriction indicates the parents' doubt in their child's ability to self-regulate intake and is inferred by two items: "If I did not guide or regulate my child's eating, she would eat too many junk foods," and "If I did not guide or regulate my child's eating, she would eat too much of her favorite foods" (Birch et al., p. 210).

The obesity proneness model proposes that restrictive parental feeding practices are a result of parental concern for children's weight and lead to children's inability to self-regulate their eating behaviors. In one study (Francis et al., 2001), the best predictors of mothers' restrictive dietary practices with 5-year-old daughters were mothers' perception of their daughters' weight (*signs of overweight in the child*) along with concern about their *own* weight and their *own* restrained eating. Consistent with the obesity proneness model, concern for daughters' weight was also predictive of restriction, but only among overweight mothers. Restriction has been positively associated with the consumption of the restricted food under experimental conditions (Fisher & Birch, 1999; Fisher & Birch, 2000), fat intake (Lee et al., 2001), and weight status (Fisher & Birch, 1999; Kaur et al., 2006; Lee et al., 2001). Mothers' (but not fathers') restrictive practices were positively related to boys' BMI and girls' bulimic behavior (Blissett et al., 2006). Another study showed no differences in mothers' or fathers' restrictive practices with overweight or average weight sons (Brann & Skinner, 2005). However, although restriction was strongly linked to parental concern over the child's weight in another study, only parental concern was associated with the child's total fat mass (Spruijt-Metz et al., 2002). These authors suggested that "restrictive practices and concern for child's weight explain a similar part of the variance in total fat mass (or that) . . . restrictive practices may be indirectly related to total fat mass as a behavioral product of concern for child's weight" (p. 584) (as suggested by the obesity proneness model). In a longitudinal study, restriction was predictive of an increase in weight status among children who were at risk for obesity but not among those who were not at risk (Faith et al., 2004). Restriction was not associated with children's fruit, vegetable, soft drink, or sweets intake



in a study by Vereecken et al. (2004). These findings were confirmed in another study examining Mexican-American families in food-secure and food-insecure households (Matheson et al., 2006).

Discouragement and limit-setting are conceptually similar to restriction. Discouragement using rationale was not related to children's fruit, vegetables, soft drinks, or sweets intake (Vereecken et al., 2004), and limit-setting was not associated with either healthy eating or unhealthy eating among children in another study (Arredondo et al., 2006). Varying degrees of parental limitation may exist, and when compared to children whose parents impose no limits on soft drink consumption, children whose parents exert strict limits on soft drink intake tend to consume *fewer* soft drinks and children of parents who impose minor limits tend to consume *more* soft drinks (Nickelson, Roseman, & Forthofer, 2007). Gender and age may moderate the effects of limit setting on dietary intake. Boys ate significantly less unhealthy than girls when parents set limits (Arredondo et al., 2006). Fruit and vegetable consumption of younger children (ages 11-12 years), but not older children (ages 13-15 years), was linked to parents setting limits on the intake of sweets, desserts, and soda (Zabinski et al., 2006). Perhaps as children get older and have more autonomy, parents' effectiveness in restricting their children's diet diminishes.

*Communication of concerns.* Parents may have concerns about their children's weight, but unless they communicate these concerns, their children may not be aware of them. Communication may be verbal or non-verbal and overt or covert. Although "communication of concerns" is not a construct found in the literature, "comments to children about their weight" has been examined. In one study (Smolak, Levine, &

Schermer, 1999), direct parental comments were inferred by a survey item that assessed “how frequently (parents) mentioned their child’s weight to the child” (p. 266) on a 4-point scale. In the obesity proneness model, communication is the link between parental concerns and the child’s internalization of these concerns. This communication also may lead to the inability to self-regulate eating. Negative comments about weight, shape, or eating from family members have been associated with binge eating disorder among women aged 16-35 years (Fairburn et al., 1998) and negative parental comments about weight or eating was more likely among diabetic adolescent girls with disordered eating behaviors than those without disordered eating behaviors (Mellin, Neumark-Sztainer, Patterson, & Sockalosky, 2004). Consistent with the obesity proneness model, elementary school children were more likely to be concerned about weight gain when both parents made comments about their weight than when neither parent mentioned their weight (Smolak et al.). Girls’ own concern about their weight was associated with maternal comments about their weight, and boys’ concern about weight was associated with paternal comments about weight (Smolak et al.).

*Internalized concern.* Internalization is “the socialization process by which children come to learn, value, and acquire the beliefs and behaviors of their parents” (Flor & Knapp, 2001, p. 627). Internalization is a difficult concept to measure. One study of adolescents’ internalization of parents’ *religious* values (Flor & Knapp) measured parents’ religious values and behaviors, adolescents’ religious values and behaviors, and discussions about faith between parents and adolescents. Adolescents’ own religious values and behavior were considered evidence of internalization of their parents’ religious values. If parents exhibit concerns about weight and their children exhibit

concerns about weight, we may infer that parents' concerns are internalized by the children. However, there is no real proof that the children's concerns are an internalization of their parents concerns. Some theorists (e.g., Bandura, 1986) would argue that "values and standards arise from diverse sources of influence" (p. 346), not just from the transmission from parent to child. Although the obesity proneness model acknowledges that parents' values may be derived at least in part from society, it suggests that children's concerns about weight are derived directly from their parents.

The model suggests that internalized concerns combined with the inability to self-regulate intake leads to obesity through the process of ineffective attempts to self-control eating. Although a key concept in the obesity proneness model, *internalized concerns* is infrequently measured. In their early work, Morgan and Costanzo (1985) found that women who exhibited restrained eating behaviors reported a higher frequency of dieting among their fathers and siblings, that their parents were focused on physical attractiveness and dieting, their parents were more likely to have controlled their own eating, and their parents placed a high value on the child's and child's friends' weight. These women also showed evidence of body dissatisfaction and tended to eat under conditions of negative arousal, which the researchers reported was evidence that parents' concerns with weight were internalized. As mentioned previously, children's concerns about their own weight were associated with parents' comments about children's weight (Smolak et al., 1999). Otherwise, little is found in the literature on the topic of internalized parental concerns.

*Inability to self-regulate eating behaviors.* Costanzo and Woody (1985) defined *the inability to self-regulate eating behaviors* as the reliance on external, physical cues to

eat, rather than on internal cues of hunger. Evidence of external responsiveness was an observed preference for shelled nuts that were easier to eat rather than nuts in the shell (Costanzo & Woody, 1979) and the tendency to eat more when left alone and to eat less in the presence of others (Woody et al., 1985). The inability to self-regulate eating behavior was measured more objectively by Birch and Fisher (2000) by a composite measure of a short-term energy-compensation procedure and a free-access procedure. The energy-compensation procedure measured how well 5-year-old girls self-adjusted their lunch-time dietary intake 20 minutes after consuming a low-calorie versus a high-calorie beverage. The free-access procedure monitored the amount of snack-foods consumed by these girls who reported they were not hungry after eating lunch.

Consistent with the obesity proneness model, in this study, mothers' restrictive practices were linked positively to children's inability to self-regulate eating behaviors, which in turn, was linked to dietary intake, which was associated with children's weight. The inability to self-regulate eating behaviors, when defined as overeating in the absence of hunger, is similar to binge eating disorder (BED). BED is a condition characterized by binge eating (eating a large amount of food in a short period of time with an associated feeling of lack of control) without the resulting purging of calories that is characteristic of bulimia nervosa (American Psychiatric Association, 1994). As the obesity proneness model links the inability to self-regulate eating behaviors to weight status, BED is also associated with weight status (see Wilfley, Wilson, & Agras, 2003, for review). As many as 16% of obese individuals screened positive for BED in one study (Grucza, Przybeck, & Cloninger, 2007).

*Weight status.* Weight status measures for children and adolescents are fairly standard, typically based upon age, sex, and measured or self-reported height and weight, (CDC, 2006b). Weight status has been linked to several obesity proneness model constructs, directly and indirectly, although not always consistently. For example, parental concerns about weight and restrictive feeding practices are sometimes (Blissett et al., 2006; Brann & Skinner, 2005; Faith et al., 2004; Fisher & Birch, 1999; Kaur et al., 2006; Keller et al., 2006; Lee et al., 2001; Spruijt-Metz et al., 2002) but not always (Baughcum et al., 2001; Brann & Skinner, 2005; Saelens et al., 2000; Spruijt-Metz et al., 2002) positively associated with the child's weight status. The lack of a consistent relationship between these variables may be due to the many proposed mediating factors suggested by the obesity proneness model.

#### *Summary of the Theoretical Model*

In summary, the obesity proneness model was developed based on the assumption that parenting style may vary by domain, context, and child. Parents may attempt to influence their children's development to minimize bad traits and maximize good traits; and in the eating domain, some evidence suggests that the control parents exert on their children's eating behaviors coupled with concern about weight may be related to disordered eating and overweight among children. Studies have utilized components of the model in an attempt to describe the effect parenting behaviors have on children's eating behaviors and weight, but none have been identified that used the entire model. The next section proposes specific modifications to the model.

## Modifications to the Model

As noted, most research using components of the obesity proneness model has been conducted with parents or with parents and their children. The CFQ, which was developed based upon the obesity proneness model, was designed to be self-administered by parents (Birch et al., 2001). To determine how adolescents view the attitudes and behaviors of interest, the obesity proneness model must be modified. The primary modification was to outline the model from the adolescents' perspective. Adolescents' views of parental influence may differ from parental self-assessment. For example, studies of food availability and accessibility in the home provide evidence of discordance between children's and parents' perceptions. Youth-reported availability and accessibility of foods like fruits, vegetables, and soft drinks in the home has been positively correlated with the children's intake of these foods (Bere & Klepp, 2004; Cullen et al., 2001; Grimm et al., 2004; Young et al., 2004). However, parent-reported availability and accessibility of certain foods is negatively associated (Cullen & Zakeri, 2004) or not associated at all (Bere & Klepp, 2004; Cullen et al., 2000; Cullen & Zakeri, 2004) with children's intake. This discordance may be evidence of parents' providing socially desirable responses or a difference in parents' and children's perceptions. Although parent and child reports of food accessibility were correlated in one study, parents perceived a higher level of accessibility on average than did their children (Bere & Klepp).

The other modifications made to the obesity proneness model consider some obesity correlates identified since the model was proposed in 1985. For example, evidence suggests ethnic differences in parenting practices or styles (Dornbusch, Ritter,

Leiderman, Roberts, & Fraleigh, 1987; Radziszewska, Richardson, Dent, & Flay, 1996; Spruijt-Metz et al., 2002), the prevalence of eating disorders (Striegel-Moore et al., 2003) or eating disorder symptoms (Wildes & Emery, 2001), obesity (Ogden et al., 2006), body image and weight concerns (Miller et al., 2000; White, Kohlmaier, Varnado-Sullivan, & Williamson, 2003), perceptions of acceptable weight (DiGiacchino, Sargent, & Topping, 2001), and parental perceptions of children's weight (Hodes, Jones, & Davies, 1996) exist. Therefore, ethnicity was added to the model as a factor that may influence parental concerns.

In addition, the similarity between the construct *inability to self-regulate eating behaviors* and BED, which was first identified by the American Psychiatric Association as a condition requiring further study in 1994 (American Psychiatric Association, 1994), highlights the need to consider correlates of BED. Several parental or familial correlates of BED have been identified, one of which was “critical comments by family about shape, weight, or eating” (Fairburn et al., 1998). This correlate of BED is similar to the obesity proneness model's *communication of concerns*. Because of the association seen between comments about weight and BED and the similarity of these constructs with existing obesity proneness model constructs, a path was added between *communication of concerns* and *child becomes unable to self-regulate eating behaviors*. It was impractical to add all correlates of BED and other constructs to the model.

Finally, because mothers and fathers may exert influences differently on their children (e.g., Blissett et al., 2006; Brann & Skinner, 2005; May, Kim, McHale, & Crouter, 2006), examining adolescents' perceptions of mothers' and fathers' influences separately was necessary. For this study, adolescents' perceptions of their *mothers'*

influences was examined. Mothers have often been singled out for their influence on children's eating behaviors (e.g. Baughcum et al., 2001; Birch & Fisher, 2000; Drucker et al., 1999; Faith et al., 2003; Francis & Birch, 2005; Keller et al., 2006; Klesges et al., 1991; Matheson et al., 2006; Saelens et al., 2000; Spruijt-Metz et al., 2002), although fathers' influences, particularly on the development of eating disorders, may also be profound (e.g., Keery, Boutelle, van den Berg, & Thompson, 2005; Schwartz, Phares, Tantleff-Dunn, & Thompson, 1999).

The modified obesity proneness model is represented in Figure 2.2. Consistent with path diagram graphical notation convention (Raykov & Marcoulides, 2006), circles or ovals represent latent variables or constructs that *cannot* be directly measured, whereas squares or rectangles represent observed or manifest variables that *can* be directly measured. One-headed arrows represent suggested causal paths, where the variable at the beginning of the arrow is thought to cause the variable at the end of the arrow. Double-headed arrows represent correlation between the variables without a suggested causal path.

### Conclusion

The childhood obesity problem is a national health priority. The increased prevalence of overweight among youth is of concern because of its potential for great physical, psychosocial, and economic costs. Numerous diverse and interrelated factors are most likely the cause of the obesity epidemic. Of these, parental influences on the development of childhood obesity are of particular interest. One theoretical framework, the obesity proneness model, attempts to describe one mechanism by which parents may



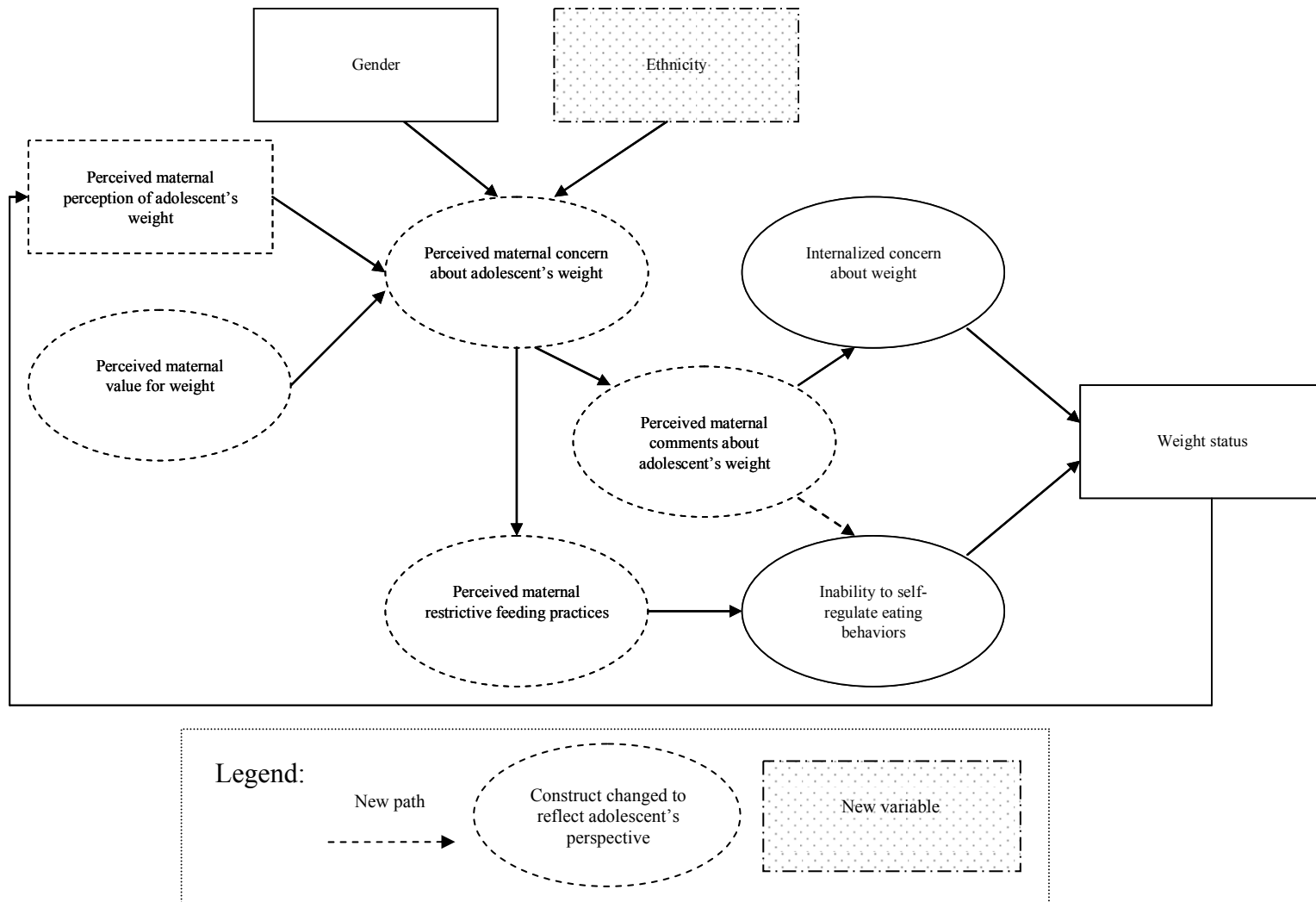


Figure 2.2. A modified obesity proneness model

influence obesity development. The model warranted some modification: (1) to be from the adolescent's point of view, (2) to consider some current perspectives on obesity correlates, and (3) to identify perceptions specific to *maternal* influences. This study examined how well the modified model predicts obesity among adolescents.

## CHAPTER III

### METHODS

This chapter describes the methods used in the study. The chapter is organized into six main sections: a review of the study's purpose, the research questions, the study design, scale of variables, data analysis, and hypotheses.

#### Purpose of the Study

Childhood obesity is a public health problem that has reached epidemic proportions (Koplan et al., 2005). The increased prevalence of overweight among youth is of concern because of its potential for great physical, psychosocial, and economic costs (Koplan et al.). Innumerable factors are associated with childhood obesity (Koplan et al.), and of these, the parental influences on the development of childhood obesity are of particular interest. One theoretical framework, the obesity proneness model (Costanzo & Woody, 1985), attempts to describe a mechanism by which parents may influence the development of obesity. A modified obesity proneness model addresses the constructs of the original model from the adolescents' viewpoint and considers some advancement in knowledge since the original model was proposed. The primary purpose of this study was to determine the ability of the modified obesity proneness model to predict weight status among adolescents. If the modified obesity proneness model did not adequately predict adolescents' weight status, a secondary purpose of the study was to determine the ability of an alternate model to predict adolescents' weight status. A final purpose of this

study was to determine the best predictors of weight status and, thus, the best candidates for intervention. This study used existing survey data collected from public high school students from Sarasota County, Florida, in fall 2006. The purpose of the larger study was to monitor health-risk behaviors of Sarasota County public high school students.

### Research Questions

The study was designed to answer the following research questions:

1. Is the modified obesity proneness model plausible for predicting weight status among adolescents?
2. If the modified obesity proneness model is not plausible, what is the plausibility of a refined or alternative model?
3. Which variables in the final model are the best predictors of weight status and, thus, the best candidates for intervention foci?

### Study Design

The study was non-experimental in design, employing a secondary analysis of cross-sectional data collected as part of a modified Youth Risk Behavior Survey (YRBS) administered in Sarasota County, Florida, high schools during the fall of 2006. The YRBS is a school-based classroom survey of adolescent risk behaviors developed by the CDC (CDC, 2004). Although the cross-sectional survey design did not allow for the inference of cause and effect, it did offer the benefits of being able to reach a large sample of the population and to examine many variables in a short period of time (Neuman, 2003). Survey research is appropriate for the examination of participants' behaviors, attitudes and beliefs, characteristics, and self-classifications (Neuman).

### *Study Sample*

According to the Florida Department of Education (FDOE), 13,225 students attended Sarasota County high schools during the fall 2006, including 3,848 (29.1%) 9<sup>th</sup> graders, 3,477 (26.3%) 10<sup>th</sup> graders, 3,194 (24.2%) 11<sup>th</sup> graders, and 2,706 (20.5%) 12<sup>th</sup> graders (FDOE, 2006). The modified YRBS was administered primarily to 9<sup>th</sup> and 11<sup>th</sup> grade students in Sarasota County public high schools during the fall of 2006, although some 10<sup>th</sup> and 12<sup>th</sup> grade students also responded to the survey because of their presence in classes typically populated by 9<sup>th</sup> or 11<sup>th</sup> graders.

A non-probability sample was surveyed, based largely on willingness of school faculty to administer the survey, followed by students' willingness to participate in the survey. A total of 1,951 modified YRBS surveys were submitted from 9<sup>th</sup>-12<sup>th</sup> grade students in Sarasota County's six public high schools, representing approximately 14% of the 9<sup>th</sup>-12<sup>th</sup> grade public school population in the county. Surveys were included in analysis if there was no visual evidence of deliberate or patterned responses that would invalidate the information, if there was no excess of missing responses, and if students reported, by responding to survey items, that they told the truth and read the survey carefully at least half of the time.

A total of 74 surveys were excluded for evidence of deliberate or patterned responses. Another 28 were excluded for excessive missing data, defined as more than 75% of the items missing – similar to criteria used by the CDC (CDC, 2004). Another 56 surveys were excluded because students indicated by their response to survey items that they answered untruthfully or didn't read the survey carefully more than half of the time. Excluded cases were not different from included cases with respect to gender, weight

status, or school, but were more likely to be older, white, Asian, Hispanic/Latino, or multi-ethnic. The final sample size was 1,533 students.

### *Data Collection*

The modified YRBS was administered during the fall of 2006 in all five of Sarasota County's public high schools plus an additional school that houses students in grades 2-12. The modified YRBS was administered simultaneously with a different survey (not pertinent to the present study) primarily to 9<sup>th</sup> and 11<sup>th</sup> grade students. Approximately half of the students were selected by classroom clusters at random to take the modified YRBS and the other half were selected to take the other survey. This monitoring process in the school district is typical of Sarasota County, including the bifurcation of surveys, so as to minimize burden on students and minimize time off task from ordinary didactic experiences. The school district sends a form to the home of each student at the beginning of the school year, asking parents to give or deny permission for their child to participate in anonymous surveys (passive permission). The school district ensures that only students who have parental permission participate in survey administration. The self-administered survey was conducted during one regular class period. Classroom teachers were given written instructions for survey administration. Teachers distributed and collected the survey and read instructions aloud to the students. Students were informed that survey participation was voluntary and that no identifying information was being collected, making the survey anonymous. Responses were recorded on standard optical scan forms ("bubble sheets"). Data were then read by an optical scanner and transferred to an electronic spreadsheet. Approval for data analysis was obtained from the Institutional Review Board at the University of South Florida.

### *Instrument*

Specific items from the modified YRBS were used to address the research questions. The variables and constructs measured are outlined below, followed by a description of the original instruments from which items were derived.

#### *Variables and Constructs*

The variables or constructs in the obesity proneness model measured or inferred by items on the survey instrument include: the adolescent's gender and ethnicity; assessment of their mothers' perceptions of the adolescent's weight; perceptions of the value their mothers place on weight, assessment of their mothers' concern about the adolescent's weight; perceptions of their mothers' restrictive feeding practices; recall of their mothers' comments about the adolescent's weight; internalized concern about weight; perceived ability to self-regulate eating behaviors; and weight status based on stated height and weight, age, and sex. The variables or constructs and survey items used to measure them are listed in Table 3.1. The original instrument from which the item was derived is also noted, along with the original wording of the item when applicable.

#### *Youth Risk Behavior Survey*

The YRBS is a school-based classroom survey developed by the CDC to monitor health risk behaviors among students in 9<sup>th</sup> through 12<sup>th</sup> grades (CDC, 2004). The national survey is conducted by the CDC, and state and local surveys are typically conducted by health and education departments (CDC, 2004). The core questionnaire is comprised of 87 multiple-choice questions that monitor health-risk behaviors among youth in six categories: (1) unintentional injuries and violence, (2) tobacco use, (3) alcohol and other drug use, (4) sexual behaviors that contribute to unintended

pregnancies and sexually transmitted diseases, (5) unhealthy dietary behaviors, and (6) physical inactivity (CDC, 2004). The YRBS used at the high school level also includes questions about demographics, suicide, body weight, AIDS education, and asthma (CDC, 2004). Questions may be added to or deleted from the core questionnaire (CDC, 2004). The YRBS has two limitations important to this study. First, because the data are self-reported, they are prone to errors of underreporting or overreporting (CDC, 2004). For example, students tend to overreport height and underreport weight, which would result in an underestimate of BMI (Brener, McManus, Galuska, Lowry, & Wechsler, 2003). However, despite these trends, the weight status of 94% of adolescents was correctly classified based upon self-reported height and weight in one national study (Strauss, 1999) and BMI status did not differ between children who self-reported height and weight and those who had measured height and weight in another (Strauss, 2000).

Second, because the survey is administered in schools, the data are not representative of adolescents who do not attend school (CDC, 2004). Evidence suggests that adolescents who do not attend school are more likely to engage in health-risk behaviors than students who do attend school (CDC, 1994). The literature proposes that the authoritative parenting style is negatively associated with adolescent health-risk and other problem behaviors (Simons-Morton & Hartos, 2002); therefore parental behaviors (and youths' perceptions of these behaviors) may differ between adolescents who do or do not attend school.

Despite these limitations, in general, the YRBS has yielded reliable data from students in grades 7-12 (Brener, Collins, Kann, Warren, & Williams, 1995; Brener et al., 2002), although it is more appropriate for students in grades 8 or above (Brener et al.,



Table 3.1

*Operationalization of Variables and Constructs of Modified Obesity Proneness Model*

Variable or Construct	#	Survey Items and Response Options	Original Instrument	Original Wording of the Item	
				Item	Response
<b>Gender</b>	D2	<i>What is your sex?</i> A. Female B. Male	YRBS	<i>unchanged</i>	<i>unchanged</i>
<b>Ethnicity</b>	D3	<i>What is your race? (select one or more responses)</i> A. American Indian or Alaska Native B. Asian C. Black or African American D. Hispanic or Latino E. Native Hawaiian or Other Pacific Islander F. White	YRBS	<i>unchanged</i>	<i>unchanged</i>
<b>Views of maternal perception of adolescent's weight</b>	PW1	<i>How would your mother describe your weight now?</i> A. Very underweight B. Underweight C. About the right weight D. Slightly overweight E. Very overweight	CFQ	<i>Your child:</i> ○ <i>During the first year of life</i> ○ <i>As a toddler</i> ○ <i>As a pre-schooler</i> ○ <i>From kindergarten through 2<sup>nd</sup> grade</i> ○ <i>From 3<sup>rd</sup> through 5<sup>th</sup> grade</i> ○ <i>From 6<sup>th</sup> through 8<sup>th</sup> grade</i>	1. Markedly underweight 2. Underweight 3. Normal 4. Overweight 5. Markedly overweight
<b>Perceived maternal value for weight</b>	V1	<i>How important is <b>your</b> weight to your mother?</i> A. Not important at all B. A little important C. Very important D. I don't know	N/A	N/A	N/A
<b>(V)</b>	V2	<i>How important is it to your mother that <b>you</b> be thin?</i> A. Not important at all B. A little important C. Very important D. I don't know	PIS	<i>How important is it to your <b>mother</b> that <b>you</b> be thin?</i>	Not applicable 1. Not at all important 2. Important 3. Very important

YRBS = Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2004)

CFQ = Child Feeding Questionnaire (Birch et al., 2001)

PIS = Parent Involvement Scale (Levine et al., 1994)

EAT-26 = Eating Attitudes Test (Garner, Olmstead, Bohr, & Garfinkel, 1982)

Table 3.1 (continued)

Variable or Construct	#	Survey Items and Response Options	Original Instrument	Original Wording of the Item	
				Item	Response
<b>Perceived maternal concern about adolescent's weight</b> (MC)	MC1	<p><i>How concerned (or worried) is your mother about you watching what you eat in order for you to look good?</i></p> <p>A. Not concerned at all B. A little concerned C. Very concerned D. I don't know</p>	CFQ	<p><i>How concerned are you about your child having to diet to maintain a desirable weight?</i></p>	<p>1. Unconcerned 2. A little concerned 3. Concerned 4. Fairly concerned 5. Very concerned</p>
	MC2	<p><i>How concerned (or worried) is your mother about whether you weigh too much?</i></p> <p>A. Not concerned at all B. A little concerned C. Very concerned D. I don't know</p>	PIS	<p><i>How concerned is your mother about whether you weigh too much or are too fat or might become too fat?</i></p>	<p>Not applicable 1. Not at all important 2. Important 3. Very important</p>
<b>Perceived maternal comments about adolescent's weight</b> (C)	C1	<p><i>Has your mother ever told you she thought you weighed too much?</i></p> <p>A. Yes B. No</p>	N/A	N/A	N/A
	C2	<p><i>Has your mother ever encouraged you to lose weight?</i></p> <p>A. Yes B. No</p>	N/A	N/A	N/A

YRBS = Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2004)  
CFQ = Child Feeding Questionnaire (Birch et al., 2001)  
PIS = Parent Involvement Scale (Levine et al., 1994)  
EAT-26 = Eating Attitudes Test (Garner, Olmstead, Bohr, & Garfinkel, 1982)

Table 3.1 (continued)

Variable or Construct	#	Survey Items and Response Options	Original Instrument	Original Wording of the Item	
				Item	Response
<b>Perceived maternal restrictive feeding practices</b>  (R)	R1	<p><i>How often does your mother try to keep you from eating too much junk food?</i></p> <p>A. Never B. Rarely or once in a while C. Sometimes D. Most of the time E. Always</p>	CFQ	<i>I have to be sure that my child does not eat too many sweets (candy, ice cream, cake or pastries)</i>	
	R2	<p><i>How often does your mother try to keep you from eating too much in general?</i></p> <p>A. Never B. Rarely or once in a while C. Sometimes D. Most of the time E. Always</p>		<i>I have to be sure that my child does not eat too many high-fat foods</i>	<ol style="list-style-type: none"> <li>1. Disagree</li> <li>2. Slightly disagree</li> <li>3. Neutral</li> <li>4. Slightly agree</li> <li>5. Agree</li> </ol>
	R3	<p><i>How often does your mother try to keep you from drinking too much soda or other sweetened beverage?</i></p> <p>A. Never B. Rarely or once in a while C. Sometimes D. Most of the time E. Always</p>		<i>I have to be sure that my child does not eat too much of her favorite foods</i>	
<b>Internalized concern about weight</b>  (IC)	IC1	<p><i>How concerned (or worried) are you about watching what you eat in order to look good?</i></p> <p>A. Not concerned at all B. A little concerned C. Very concerned</p>	CFQ	<i>How concerned are you about your child having to diet to maintain a desirable weight?</i>	<ol style="list-style-type: none"> <li>1. Unconcerned</li> <li>2. A little concerned</li> <li>3. Concerned</li> <li>4. Fairly concerned</li> <li>5. Very concerned</li> </ol>
	IC2	<p><i>How concerned (or worried) are you about whether you weigh too much?</i></p> <p>A. Not concerned at all B. A little concerned C. Very concerned</p>	PIS	<i>How concerned is your mother about whether you weigh too much or are too fat or might become too fat?</i>	<p>___ Not applicable</p> <ol style="list-style-type: none"> <li>1. Not at all important</li> <li>2. Important</li> <li>3. Very important</li> </ol>
				CFQ	<i>How concerned are you about your child becoming overweight?</i>

YRBS = Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2004)

CFQ = Child Feeding Questionnaire (Birch et al., 2001)

PIS = Parent Involvement Scale (Levine et al., 1994)

EAT-26 = Eating Attitudes Test (Garner, Olmstead, Bohr, & Garfinkel, 1982)

Table 3.1 (continued)

Variable or Construct	#	Survey Items and Response Options	Original Instrument	Original Wording of the Item	
				Item	Response
<b>Inability to self-regulate eating behaviors</b>  (I)	11	<p><i>How often have you eaten a large amount of food in a short period and felt that you might not be able to stop?</i></p> <p>A. Never B. Rarely or once in a while C. Sometimes D. Most of the time E. Always</p>	<i>EAT-26 (ChEAT)</i>	<i>Have gone on eating binges where I feel that I may not be able to stop</i>	<p>1. Always 2. Usually 3. Often 4. Sometimes 5. Rarely 6. Never</p>
	12	<p><i>How often do you eat even when you are not hungry?</i></p> <p>A. Never B. Rarely or once in a while C. Sometimes D. Most of the time E. Always</p>	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>
<b>Weight status</b>  (W)		<p><i>BMI for age/sex derived from the following questions:</i></p> <ul style="list-style-type: none"> <li><i>How tall are you without your shoes on?</i></li> </ul>	<i>YRBS</i>	<i>Unchanged</i>	<i>Unchanged</i>
		<ul style="list-style-type: none"> <li><i>How much do you weigh without your shoes on?</i></li> </ul>	<i>YRBS</i>	<i>Unchanged</i>	<i>Unchanged</i>

*YRBS = Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2004)*  
*CFQ = Child Feeding Questionnaire (Birch et al., 2001)*  
*PIS = Parent Involvement Scale (Levine et al., 1994)*  
*EAT-26 = Eating Attitudes Test (Garner, Olmstead, Bohr, & Garfinkel, 1982)*

1995). The data obtained from the YRBS are thought to be of “acceptable quality” (CDC, 2004, p. 11).

The Sarasota County school district has been administering a modified version of the YRBS for use locally every two years since 1999 (Nickelson, McCormack Brown, & McDermott, 2007). The YRBS conducted in Sarasota County during the fall of 2006 was modified to include 78 of the standard YRBS items and an additional 44 items added at the local level for a total of 122 questions. The 9 questions deleted from the standard

survey included 7 dietary behavior and 2 asthma questions. The questions added included 4 items on body weight and dietary behaviors; 11 items on adolescents' perceptions of their mother's beliefs and feeding practices; and additional items on demographics, general health, drug use, bullying and delinquent behaviors, recognition of a local social marketing campaign, and self-reported truthfulness and care in completing the survey.

A total of 18 items from the modified YRBS were used to address the research questions for the present study; 4 are standard YRBS items and the remaining 14 items are from those added at the local level. These particular items were added by the school district to address the maternal influence on the development of obesity among high school students, using the obesity proneness model as a theoretical framework. Many of these items were modified from other survey instruments, including the CFQ (Birch et al., 2001), the PIS (Levine et al., 1994), and the Eating Attitudes Test (EAT-26) (Garner et al., 1982). Other items were created by this researcher for the school district to add to this survey. The new and revised items underwent pilot-testing and revision with high school students and were reviewed for face validity by a panel of experts prior to adding them to the YRBS.

#### *Child Feeding Questionnaire*

The CFQ was developed by Johnson and Birch (1994) based on the obesity proneness model (Costanzo & Woody, 1985). The CFQ is a 31-item survey designed to be self-administered by parents of children 2-11 years of age (Birch et al., 2001). Confirmatory factor analysis revealed that the CFQ measures 7 factors related to parents' attitudes, beliefs, and practices concerning child feeding and obesity proneness:

perceived responsibility, perceived parent weight, perceived child weight, concern about child weight, restriction, pressure to eat, and monitoring (Birch et al.). The CFQ has been modified for use with parents of adolescents and found to have a similar factor structure (Kaur et al., 2006). A question concerning the monitoring of sweetened beverages was added to the parents-of-adolescents version of the questionnaire.

Several items from the CFQ – those that assessed *perceived child weight, concern about child weight, and restrictive feeding practices* – were modified to assess youths' *perceptions* of their mothers' views, concerns and behavior and added to the YRBS. A comparison of the original and modified items are provided in Table 3.1.

#### *Parent Involvement Scale*

The PIS is a 4-item, self-administered questionnaire designed to measure youths' perception of a construct Levine et al. (1994) call “parental investment in daughter's shape” (p. 477). The scale is comprised of two items inquiring about each parent: “How important is it to your mother/father that you be thin?” and “How concerned is your mother/father about whether you weigh too much or are too fat or might become too fat?” (Thompson et al., 1999). Both of these items were modified for inclusion in the YRBS, one as an indicator of perceived maternal value for weight, and the other as an indicator of perceived maternal concern about weight. The primary modification to these items was the addition of the “I don't know” response option (see Table 3.1).

#### *Eating Attitudes Test*

The Eating Attitudes Test (EAT-26) (Garner et al., 1982) and the Children's Eating Attitudes Test (Ch-EAT) (Maloney, McGuire, & Daniels, 1988) may be the most widely used instruments for assessing eating disorder symptoms. The instrument uses

26-items to create a total score and a score on each of five subscales. One item from the EAT-26 / Ch-EAT was modified and used on the YRBS as an indicator of inability to self-regulate eating behaviors. This item was modified primarily so that the question would refer more specifically to “eating binges.” See Table 3.1 for a comparison of the modified and original versions of this item.

#### Scale of Variables

The primary outcome variable, weight status, was the sole continuous, or interval-level, variable. Weight status was represented by BMI-for-age (and gender) which was calculated by entering students’ reported height, weight, age, and gender into the nutrition program of Epi Info, version 3.3.2--freeware available from the CDC. Two variables were nominal-level variables: gender and race/ethnicity. Dummy variables were created for each of the racial/ethnic categories. The remaining items were ordinal-level (or what *Mplus* calls ‘categorical’) variables.

#### Data Analysis

The data set was split into two random samples. The first sample, Sample A, was a training sample used to test and modify models. The second sample, Sample B, was a hold-out sample used to cross-validate models developed with Sample A, a method recommended by Anderson and Gerbing (1988). A replicable solution provides additional evidence as to the model’s viability in the population. After splitting the samples, only students who stated they were answering questions about their mothers (as opposed to step-mothers and other women) were selected for analysis.

Univariate procedures included frequency distributions and descriptive statistics for the measured variables (*gender, ethnicity, perceived maternal perception of*

*adolescent's weight, and weight status*), including individual survey items attempting to measure *perceived maternal value for weight, perceived maternal concern about adolescent's weight, perceived maternal restrictive feeding practices, perceived maternal comments about adolescent's weight, internalized concern about weight, and inability to self-regulate eating behaviors*. Bivariate correlation procedures were conducted to determine the associations between each of the variables to help inform item selection for subsequent analyses.

Structural equation modeling (SEM) was used to answer the research questions. According to Buhi, Goodson, and Neilands (2007), SEM offers several advantages over other analysis methods. For example, it allows for the simultaneous examination of the relationships between multiple independent and dependent variables while controlling for the inflation of experimentwise error. SEM also allows the researcher to specify the hypothesized relationships between variables, allowing specific paths to be examined and direct and indirect effects calculated. Another advantage of SEM is that it can control for measurement error (Buhi et al.).

A two-step modeling approach was employed per accepted methods (Anderson & Gerbing, 1988; Buhi et al., 2007). The first step, a “measurement model” task, is analogous to confirmatory factor analysis in that it determines how well the latent constructs are inferred by specified survey items. Item retention was partially based on the findings of this analysis. Global model fit was also examined to determine how well the measurement model matched the sample data. Numerous goodness-of-fit measures have been developed, but one good measure of fit is not appropriate for all situations (Buhi et al., 2007; Klem, 2000; Thompson, 2000). Measures of fit include the chi-square



test of exact fit, the root mean square error of approximation (RMSEA), the Tucker-Lewis Index (TLI), and the Comparative Fit Index (CFI), among others (Buhi et al.). The model may be considered plausible if the chi-square test of exact fit is *not* statistically significant (the null hypothesis is that the model holds in the population) (Raykov & Marcoulides, 2006). Large sample sizes often result in statistically significant chi-square tests (Klem, 2000). Therefore, a chi-square / degrees of freedom (df) ratio is often reported, and although guidelines for this ratio have not been established, a ratio in the 2-4 range is considered acceptable, with smaller values indicating a better fit (Klem). The cut-off value for RMSEA tends to be in the 0.05 to 0.08 range, with values closest to zero indicating a better fit (Buhi et al., 2007; Yu, 2002). The cut-off values for the TLI and CFI tend to be in the 0.95 range, with higher values, closest to 1, indicating a better fit (Buhi et al.; Yu). In short, fit values close to the recommended cutoff points suggest that the model might be useful, whereas those further away indicate potential inconsistency between the model and sample data (Buhi et al.; Yu). Researchers typically report a few model fit indices since “there is no general agreement on which index or indices are best” (Klem, p. 244). To reach a conclusion about a model’s adequacy, researchers “should be guided by the preponderance of the evidence” (Klem, p. 244). The measurement model was modified until acceptable factor loadings and model fit statistics were obtained. The measurement model step resulted in a model that denotes the relationships between the constructs and survey items, providing evidence of construct validity (Buhi et al.).

The goal of SEM is to test and refine theoretical models so they may be more useful in practice (Buhi et al., 2007). The second step, a “structural model” task, examined the relationships between the latent constructs and other variables proposed by

the theoretical model (Buhi et al.). Whereas the measurement model examined the relationships between constructs and survey items, the structural model examined relationships between constructs and other variables. The structural model step also involved an assessment of global model fit to determine how well the proposed modified obesity proneness model matches the sample data. Goodness-of-fit measures are described above.

As initial model fit statistics were not fully acceptable, the parameter estimates (i.e., standardized  $\beta$  weights) were examined to determine if some paths could be eliminated to improve model fit. The modification indices provided by the statistical analysis software package also were examined for suggestions to improve model fit (Raykov & Marcoulides, 2006). Modification indices provide an indication of how much the model's chi-square would change if a path were to be added or removed (Raykov & Marcoulides). Alternate models suggested by these analyses were then tested for global model fit.

Lastly, the parameter estimates (i.e., standardized  $\beta$  weights) for each path in the model were examined to determine the relationships between constructs in the model (Klem, 2000) and to determine which constructs were the best predictors of weight status.

Data cleaning and univariate and bivariate statistics were conducted with SPSS version 15.0 (Chicago, IL). SEM was conducted with *Mplus* version 4.21 (Los Angeles, CA). This software has the advantage of being robust under conditions of non-normality and maintains features which allow for the advanced treatment of incomplete data (Buhi et al., 2007).

### *Sample Size*

A sample size of at least 100-200 or 10-15 people per measured variable is generally recommended for SEM (Thompson, 2000). Using these guidelines, with 18 measured variables, a sample size of 180-270 participants should, therefore, be able to detect an adequate model fit. Larger sample sizes (not always defined, but may be as many as 800-1,200) have been recommended, particularly when the model will be modified (Hatcher, 1994) or when factors are defined by less than three items (Anderson & Gerbing, 1988), as was the case for most factors in the present study. Small samples limit power, or the ability to correctly reject the null hypothesis. Failing to correctly reject the null hypothesis for the chi-square test of exact fit means that the model might be considered plausible when, in reality, it is not. In short, small sample sizes may result in unreliable, nonreplicable models (Buhi et al., 2007). This study had 784 subjects in Sample A and 749 subjects in Sample B.

In summary, SEM was used to answer the research questions posed previously in this chapter. Despite the advantages of SEM, it cannot test the directionality of relationships between variables nor can it discriminate between poorly designed models (Buhi et al., 2007). Furthermore, a model can never be definitively proven (Thompson, 2000); however, if it is not rejected, it can be said to be a plausible model. The hypotheses are outlined below.

### Hypotheses

Hypotheses are:

1. The modified obesity proneness model will be found to be a plausible model for predicting weight status among adolescents.

- a. Girls will perceive greater maternal concern than boys.
  - b. White adolescents will perceive greater maternal concern than adolescents of other ethnic groups.
  - c. Perceived maternal concern will be directly associated with perceived communication of concern and perceived maternal restriction.
  - d. Perceived restriction will be directly associated with inability to regulate dietary intake.
  - e. Perceived communication of concerns will be directly associated with internalized concern and inability to self-regulate dietary intake.
  - f. Internalized concern and inability to regulate dietary intake will be directly associated with weight status.
2. If the modified obesity proneness model is not found to be plausible, a refined or alternative model will be found to be plausible.
  3. Internalized concerns about weight and inability to self-regulate eating behaviors will both be good predictors of weight status.

## CHAPTER IV

### RESULTS

The primary purpose of this study was to determine the ability of a modified obesity proneness model to predict weight status among adolescents. The study was non-experimental in design, employing a secondary analysis of cross-sectional data collected as part of a modified Youth Risk Behavior Survey (YRBS) administered in Sarasota County, Florida, high schools during the fall of 2006. The study was designed to answer three research questions:

1. Is the modified obesity proneness model plausible for predicting weight status among adolescents?
2. If the modified obesity proneness model is not plausible, what is the plausibility of a refined or alternative model?
3. Which variables in the final model are the best predictors of weight status and, thus, the best candidates for intervention foci?

This chapter presents the findings of this study, beginning with a description of the study population, followed by results of correlation analysis, and ending with results of structural equation modeling, which was employed to answer the three main research questions.

## Descriptive Results

The data set was split into two random samples. Models were tested and modified in one training sample, Sample A, and final models were cross-validated in the second hold-out sample, Sample B. After splitting the data set into two samples, only students who stated they were answering questions with their mother in mind were selected for analysis. There were 784 students in Sample A and 749 in Sample B. Demographic characteristics of each sample are listed in Table 4.1.

Table 4.1

*Demographic characteristics of samples.<sup>a</sup>*

	<b>Sample A (N = 784)</b>		<b>Sample B (N = 749)</b>	
<b>Gender</b>				
Female	438	(55.9%)	417	(55.9%)
Male	345	(44.1%)	329	(44.1%)
<b>Age<sup>b</sup></b>				
≤ 14 years	263	(33.6%)	252	(33.8%)
15 years	183	(23.4%)	169	(22.7%)
16 years	233	(29.8%)	204	(27.4%)
≥ 17 years	104	(13.3%)	120	(16.1%)
<b>Race/Ethnicity</b>				
Asian	14	(1.8%)	15	(1.9%)
Black / African American	47	(6.0%)	45	(6.0%)
Hispanic / Latino	64	(8.2%)	73	(9.8%)
White	607	(77.8%)	564	(75.6%)
Other <sup>c</sup>	18	(2.3%)	17	(2.3%)
Multi-ethnic	30	(3.8%)	32	(4.3%)
<b>BMI Category</b>				
Underweight	18	(2.7%)	15	(2.3%)
Healthy weight	485	(72.7%)	479	(74.6%)
At risk of overweight	89	(13.3%)	84	(13.1%)
Overweight	75	(11.2%)	64	(10.0%)

<sup>a</sup> Missing data not shown; percentages may not equal 100% due to rounding.

<sup>b</sup> Ages ≤ 12, 13, and 14 were collapsed into one category, and ages 17 and ≥ 18 were collapsed into one category for this table.

<sup>c</sup> Other includes American Indian/Alaska Native and Native Hawaiian/Other Pacific Islander.

The samples did not differ with respect to gender ( $\chi^2 = 0.10$ ,  $df = 2$ ,  $p = 0.578$ ), age ( $\chi^2 = 5.22$ ,  $df = 7$ ,  $p = 0.633$ ), race/ethnicity ( $\chi^2 = 2.41$ ,  $df = 7$ ,  $p = 0.934$ ), or BMI category ( $\chi^2 = 0.97$ ,  $df = 4$ ,  $p = 0.914$ ). Frequency distributions for all variables by sample are found in Appendix A.

The correlation matrices for all observed ordinal and continuous variables are provided in Tables 4.2 (Sample A) and 4.3 (Sample B).

### Structural Equation Modeling

SEM was used to answer the three research questions. This section will describe the results of the two steps in SEM (testing the measurement model and testing the structural model) and the results for each research question.

#### *Step One: Testing Measurement Model*

The first step in SEM is to establish and test the measurement model (Anderson & Gerbing, 1988; Buhi et al., 2007). This step is analogous to confirmatory factor analysis in that it determines how well the latent constructs are inferred by specified survey items. The initial confirmatory factor analysis (CFA) model, which contained 6 factors and 13 items, did not yield an identified model. *Mplus* output suggested problems with the factors *inability to self-regulate eating behaviors* and either *perceived maternal concern about adolescent's weight* or *perceived maternal value for weight*. The variance for *inability to self-regulate eating behaviors* was large (1148.72), and *perceived maternal concern about adolescent's weight* and *perceived maternal value for weight* were nearly perfectly correlated (0.925). Therefore, two additional CFA models were analyzed, each eliminating *inability to self-regulate eating behaviors* and either *perceived maternal concern about adolescent's weight* or *perceived maternal value for weight* (see

Table 4.2

*Bivariate Spearman correlation matrix for ordinal and continuous variables, Sample A (N = 784).*

	D2	PW1	V1	V2	MC1	MC2	C1	C2	R1	R2	R3	IC1	IC2	I1	I2	W
D2	1.000															
PW1	-0.098	1.000														
V1	-0.132**	0.219**	1.000													
V2	-0.132**	0.187**	0.487**	1.000												
MC1	-0.132**	0.184**	0.452**	0.439**	1.000											
MC2	-0.123**	0.278**	0.454**	0.495**	0.493**	1.000										
C1	-0.020	0.378**	0.237**	0.251**	0.286**	0.306**	1.000									
C2	-0.126**	0.375**	0.256**	0.180**	0.262**	0.303**	0.573**	1.000								
R1	-0.078*	0.176**	0.178**	0.112**	0.265**	0.207**	0.143**	0.215**	1.000							
R2	-0.138**	0.266**	0.233**	0.243**	0.357**	0.377**	0.303**	0.379**	0.531**	1.000						
R3	-0.026	0.151**	0.125**	0.100**	0.236**	0.177**	0.132**	0.134**	0.583**	0.449**	1.000					
IC1	-0.337**	0.153**	0.171**	0.160**	0.264**	0.242**	0.225**	0.283**	0.203**	0.284**	0.139**	1.000				
IC2	-0.306**	0.210**	0.212**	0.176**	0.305**	0.312**	0.274**	0.358**	0.206**	0.368**	0.157**	0.653**	1.000			
I1	-0.076**	0.011	0.030	0.056	0.169**	0.050	0.133**	0.123**	0.090*	0.181**	0.096**	0.223**	0.218**	1.000		
I2	-0.127**	0.024	0.016	0.021	0.076*	0.012	0.086*	0.071*	0.097**	0.144**	0.069	0.099**	0.092**	0.384**	1.000	
W	0.169**	0.316**	0.062	0.020	0.079*	0.077*	0.211**	0.257**	0.125**	0.193**	0.126**	0.053	0.109**	0.068	0.020	1.000

\*Correlation is significant at the 0.05 level (2-tailed)

\*\*Correlation is significant at the 0.01 level (2-tailed)

See Table 3.1 (p. 46) for description of variable names.



Table 4.3

*Bivariate Spearman correlation matrix for ordinal and continuous variables, Sample B (N = 749).*

	D2	PW1	V1	V2	MC1	MC2	C1	C2	R1	R2	R3	IC1	IC2	I1	I2	W
D2	1.000															
PW1	-0.062	1.000														
V1	-0.127**	0.156**	1.000													
V2	-0.164**	0.150**	0.496**	1.000												
MC1	-0.120**	0.182**	0.508**	0.470**	1.000											
MC2	-0.162**	0.280**	0.525**	0.497**	0.579**	1.000										
C1	-0.183*	0.271**	0.243**	0.221**	0.305**	0.366**	1.000									
C2	-0.127**	0.341**	0.306**	0.247**	0.341**	0.395**	0.590**	1.000								
R1	-0.092*	0.113**	0.221**	0.191**	0.300**	0.266**	0.169**	0.238**	1.000							
R2	-0.111**	0.232**	0.239**	0.209**	0.302**	0.353**	0.334**	0.420**	0.533**	1.000						
R3	-0.024	0.063	0.138**	0.153**	0.187**	0.191**	0.083*	0.121**	0.571**	0.445**	1.000					
IC1	-0.281**	0.154**	0.177**	0.154**	0.202**	0.217**	0.216**	0.268**	0.188**	0.246**	0.102**	1.000				
IC2	-0.297**	0.193**	0.191**	0.145**	0.213**	0.297**	0.303**	0.349**	0.207**	0.305**	0.137**	0.605**	1.000			
I1	-0.007	0.056	0.076*	0.073*	0.085*	0.126**	0.138**	0.079*	0.058	0.131**	0.070	0.176**	0.247**	1.000		
I2	-0.120**	0.053	0.085*	0.117**	0.119**	0.123**	0.103**	0.101**	0.094*	0.143**	0.057	0.032	0.086*	0.287**	1.000	
W	0.203**	0.175**	0.026	0.057	0.100**	0.101**	0.198**	0.185**	0.018	0.122**	0.040	0.038	0.101**	0.070	-0.008	1.000

\*Correlation is significant at the 0.05 level (2-tailed)

\*\*Correlation is significant at the 0.01 level (2-tailed)

See Table 3.1 (p. 46) for description of variable names.

Table 4.4). Both of these models converged and were identified. Although model fit statistics for both models were similar, model 1 (the model excluding *inability to self-regulate eating behaviors* and *perceived maternal concern about adolescent's weight*) was selected as the best model, because the  $\chi^2 / df$  ratio was slightly lower for model 1 than for model 2.

Table 4.4

*Estimated fit indices for modified CFA models, Sample A (N = 784).*

	$\chi^2 / df$	TLI	RMSEA
<i>Cut-off values</i>	2-4	$\geq 0.95$	$\leq 0.05-0.08$
<b>Model 1</b> (excludes I and MC)	169.04/15	0.95	0.12
<b>Model 2</b> (excludes I and V)	180.70/15	0.95	0.12
<i>I = inability to self-regulate eating behaviors</i>			
<i>MC = perceived maternal concern about adolescent's weight</i>			
<i>V = perceived maternal value for weight</i>			

Although TLI values met the criteria for adequate model fit,  $\chi^2 / df$  and RMSEA values did not. Examination of factor loadings revealed that one item (R3 - *How often does your mother try to keep you from drinking too much soda or other sweetened beverages*) fell below 0.7 and could be eliminated. Eliminating this item improved model fit substantially ( $\chi^2 / df = 42.61/11$ ; TLI = 0.99; RMSEA = 0.06). The final CFA model (model 1 with the R3 item eliminated) was cross-validated in Sample B. The CFA model in Sample B yielded similar model fit statistics and factor loadings, providing evidence of replicability.

The final CFA model included 4 factors with 8 items (Table 4.5). Model fit statistics suggested the model was acceptable in both samples. In addition, factor

Table 4.5

*Estimated factor loadings and measurement model fit for final CFA model.*

<b>Factors and Items</b>		<b>Sample A (N = 784)</b>	<b>Sample B (N = 749)</b>
<b>Internalized concern about weight</b>			
IC1.	How concerned (or worried) are you about watching what you eat in order to look good?	0.83	0.79
IC2.	How concerned (or worried) are you about whether you weigh too much?	0.94	0.95
<b>Perceived maternal comments about adolescent's weight</b>			
C1.	Has your mother <b>ever</b> told you she thought you weighed too much?	0.86	0.90
C2.	Has your mother <b>ever</b> encouraged you to lose weight?	0.96	0.92
<b>Perceived maternal restrictive feeding practices</b>			
R1.	How often does your mother try to keep you from eating too much junk food?	0.65	0.63
R2.	How often does your mother try to keep you from eating too much in general?	0.96	0.97
<b>Perceived maternal value for weight</b>			
V1.	How important is <b>your</b> weight to your mother?	0.87	0.79
V2.	How important is it to your mother that <b>you</b> be thin?	0.82	0.84
<b>Fit indices</b>			
	Cut-off values		
$\chi^2 / df$	2-4	42.61/11	29.73/11
TLI	$\geq 0.95$	0.99	0.99
RMSEA	$\leq 0.05$ -0.08	0.06	0.05

loadings in both samples were all greater than 0.7, with one exception (*How often does your mother try to keep you from eating too much junk food?*) at 0.66 (Sample A) and 0.63 (Sample B).

#### *Step Two: Testing Structural Model*

The second step, a “structural model” task, examined the relationships between the latent constructs and other variables proposed by the theoretical model (Buhi et al., 2007). This step provides answers to the research questions.

*Research Question 1: Is the modified obesity proneness model plausible for predicting weight status among adolescents?*

After cross-validating the 4-factor measurement model in Sample B, the structural model was tested in Sample A. Because *inability to self-regulate eating behaviors* and *perceived maternal concern about adolescent’s weight* were eliminated from the measurement model, single indicators of these factors were used. *Inability to self-regulate eating behaviors* was represented by the “How often do you eat even when you are not hungry?” item, and *perceived maternal concern about adolescent’s weight* was represented by the “How concerned (or worried) is your mother about you watching what you eat in order for you to look good?” item. Model fit indices suggested the initial model was not plausible, although they were close to the cut-off values ( $\chi^2/df = 459.778/68$ , TLI = 0.91, RMSEA = 0.09). Most of the parameter estimates were statistically significant ( $p < 0.05$ ). Those that were not statistically significant were ones describing the relationship between: (1) *perceived maternal comments about adolescent’s weight* and *inability to self-regulate eating behaviors*, (2) *inability to self-regulate eating behaviors* and *weight status*, and (3) all of the dummy variables for

*race/ethnicity* and *perceived maternal concern about adolescent's weight* except for the multi-ethnic dummy variable. See Figure 4.1 for a graphical representation of the model and the statistical relationships between constructs.

*Research Question 2: If the modified obesity proneness model is not plausible, what is the plausibility of a refined or alternative model?*

To improve model fit, non-significant paths were systematically eliminated, and paths suggested by *Mplus* modification indices were added. After eight iterations, a final model was selected that made theoretical sense and met cut-off criteria for acceptable model fit. The final model was one that excluded one path (i.e., between *perceived maternal comments about adolescent's weight* and *inability to self-regulate eating behaviors*) and added three paths suggesting direct relationships between (1) *gender* and *weight status*, (2) *gender* and *internalized concern about weight*, and (3) *perceived maternal perception of adolescent's weight* and *perceived maternal comments about adolescent's weight*. Model fit statistics improved to the extent that RMSEA met the cut-off criteria for acceptable fit ( $\chi^2/df = 331.97/64$ , TLI = 0.94, RMSEA = 0.07), and the parameter estimate for the association between *perceived maternal comments about adolescent's weight* and *inability to self-regulate eating behaviors* became statistically significant. Because this alternative model met the cut-off criteria, it is considered a *plausible* or *acceptable* model.

The final structural model was cross-validated in Sample B. In Sample B, both TLI and RMSEA met the cut off criteria for an acceptable model ( $\chi^2/df = 226.47/64$ , TLI = 0.95, RMSEA = 0.06). Parameter estimates for all paths were similar between the

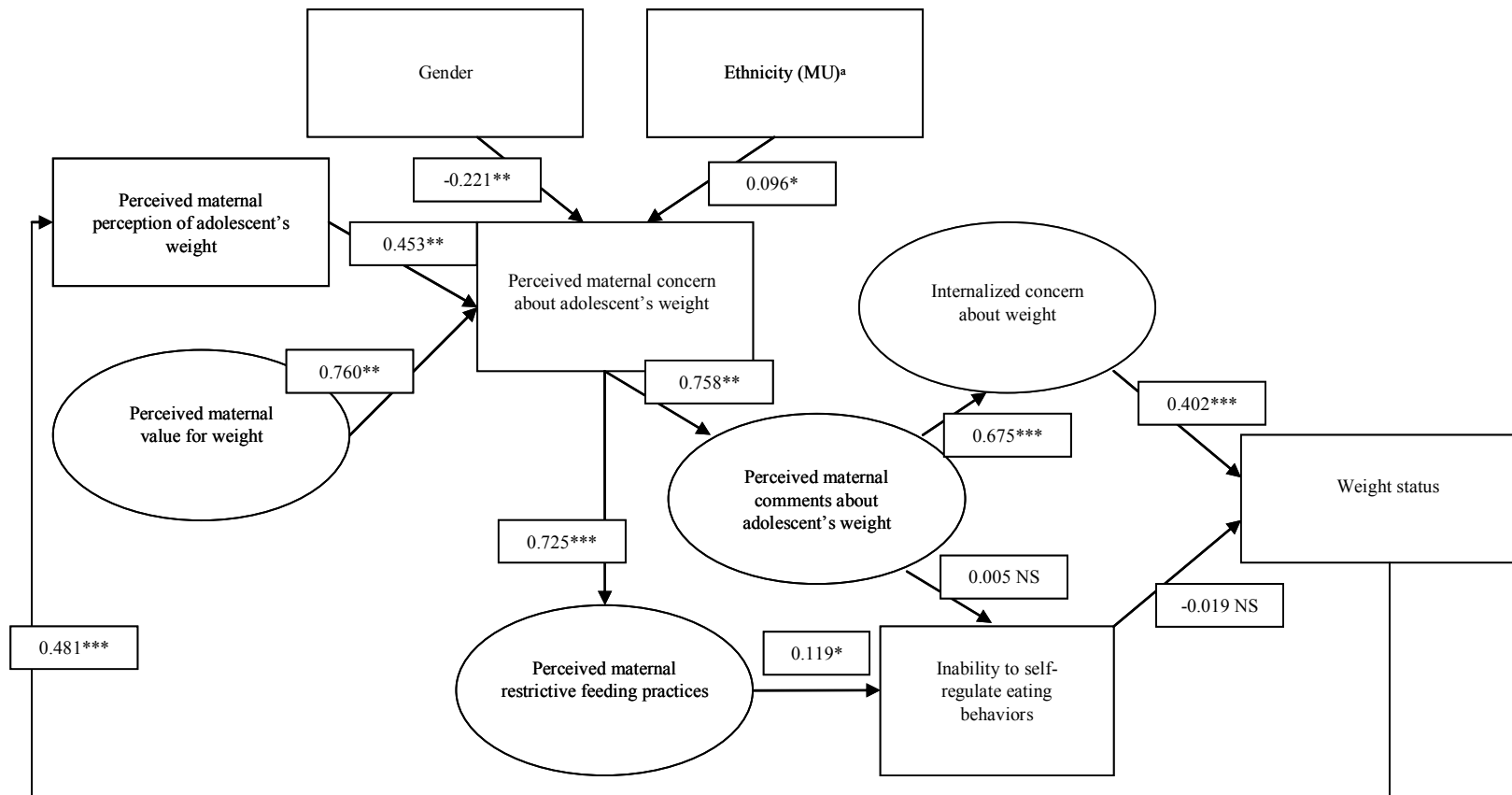


Figure 4.1. Results of SEM testing the modified obesity proneness model (Sample A).

NS = not statistically significant  
 \* $p < 0.05$   
 \*\* $p < 0.01$   
 \*\*\* $p < 0.001$   
 \*\*\*\* $p < 0.0001$

<sup>a</sup>Only multi-ethnicity was significantly associated with perceived maternal concern; paths between other ethnicities and perceived maternal concern were all NS.

samples, providing evidence of replicability. With one exception, all paths were similarly statistically significant or not statistically significant between samples. In Sample B, none of the ethnicity variables was significantly associated with perceived maternal concern about adolescent's weight, whereas in Sample A, students who described themselves as multi-ethnic were more likely than students who described themselves as white to report that their mothers were concerned about their weight. The replicability of the model provides evidence as to the model's viability in the population. The final model with parameter estimates included for Samples A and B is represented in Figures 4.2 and 4.3, respectively.

*Research Question 3: Which variables in the final model are the best predictors of weight status and, thus, the best candidates for intervention foci?*

Of the three predictors of weight status in the final model, the strongest was *internalized concern about weight* ( $\beta = 0.415$  and  $0.414$ , for Samples A and B, respectively;  $p < 0.0001$ ). *Gender* (being male) was also statistically significantly associated with weight ( $\beta = 0.322$  and  $0.328$ , for Samples A and B, respectively,  $p < 0.0001$ ), but *inability to self-regulate eating behaviors* was not.

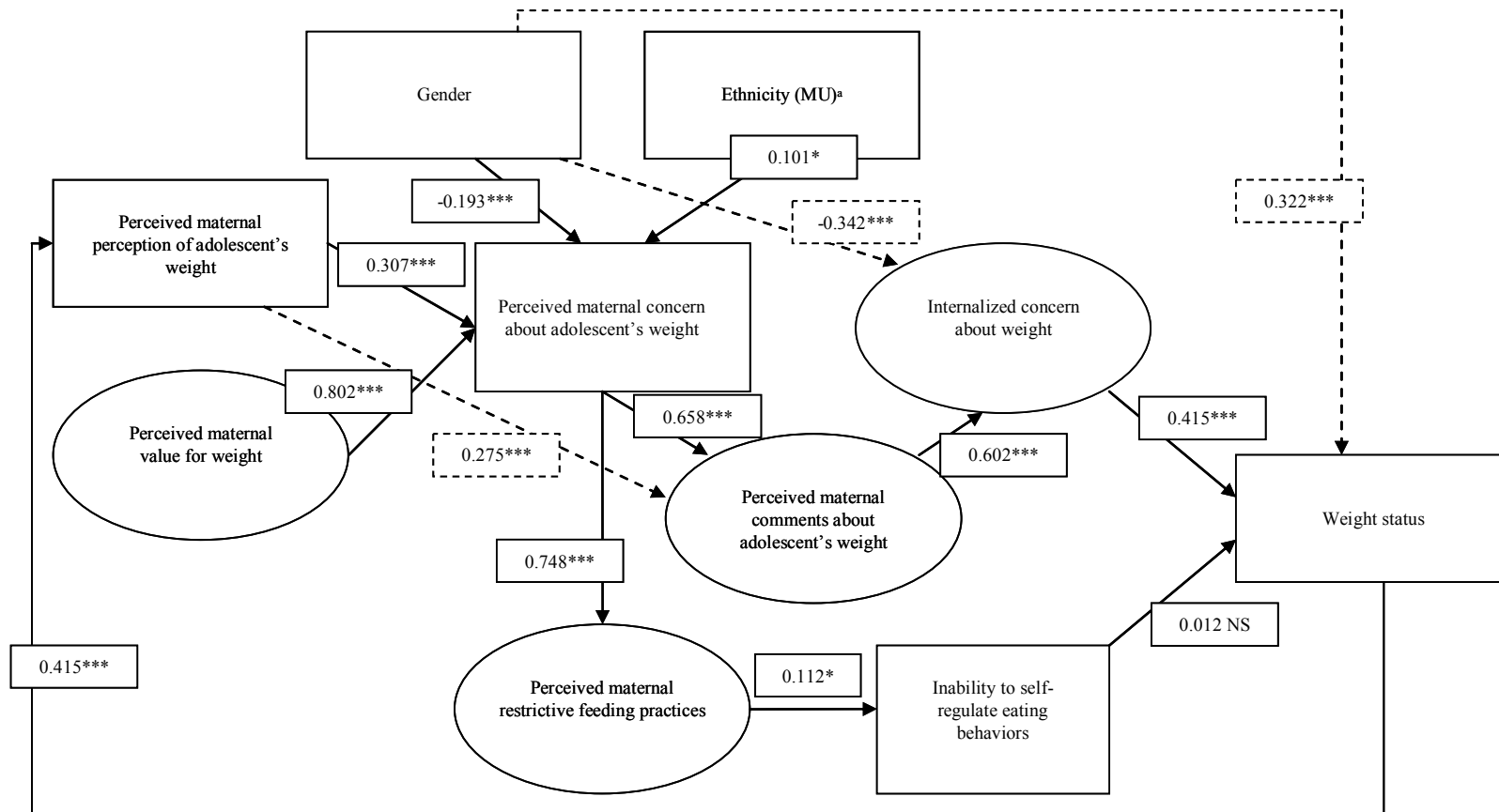


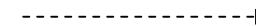
Figure 4.2 Final modified obesity proneness model, Sample A.

NS = not statistically significant  
 \* $p < 0.05$   
 \*\* $p < 0.01$   
 \*\*\* $p < 0.001$   
 \*\*\*\* $p < 0.0001$

<sup>a</sup>Only multi-ethnicity was significantly associated with perceived maternal concern; paths between other ethnicities and perceived maternal concern were all NS.

Legend:

Dashed lines represent paths that were added to the original model and their corresponding beta weights





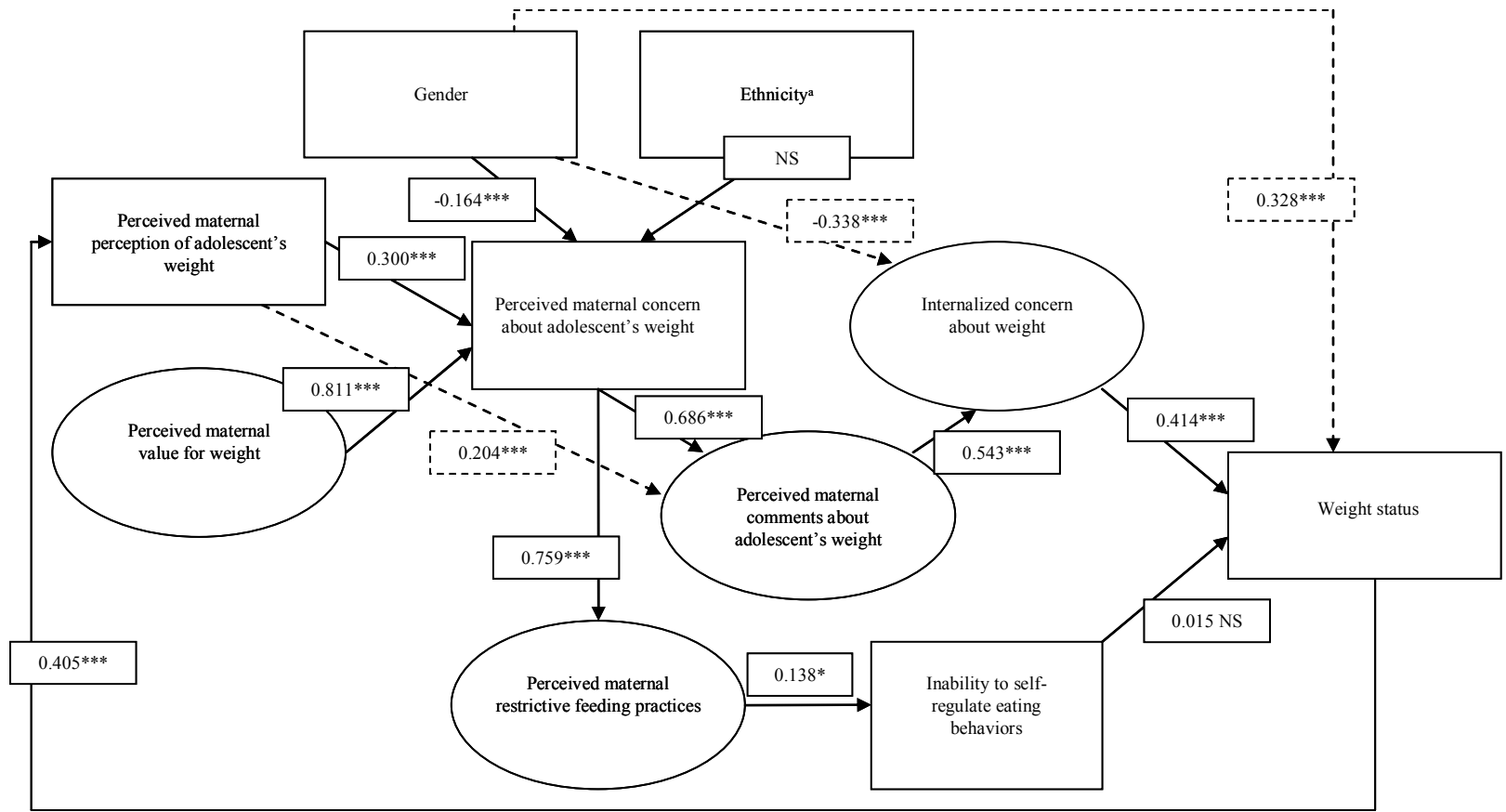


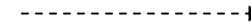
Figure 4.3 Final modified obesity proneness model, Sample B.

NS = not statistically significant  
 \* $p < 0.05$   
 \*\* $p < 0.01$   
 \*\*\* $p < 0.001$   
 \*\*\*\* $p < 0.0001$

<sup>a</sup>Paths between all ethnicities and perceived maternal concern were NS.

Legend:

Dashed lines represent paths that were added to the original model and their corresponding beta weights



## CHAPTER V

### DISCUSSION

This chapter includes a discussion of the results relative to the research questions and the literature. It is organized into the following sections: research summary, discussion of results, strengths and limitations of the study, implications for future research, implications for public health practice, suggestions for dissemination of findings, and summary and conclusions.

#### Research Summary

The prevalence of overweight among youth in the United States has been rising radically over the last three decades (C.L. Ogden et al., 2006). Research examining how the family environment influences the development of overweight and obesity among children may suggest opportunities for intervention. The obesity proneness model (Costanzo & Woody, 1985) is one framework that may help explain the influence parents have on the development of disordered eating that may lead to obesity. The primary purpose of this study was to examine the ability of a modified obesity proneness model to predict weight status among adolescents. A secondary purpose of the study was to examine the ability of an alternate model to predict adolescents' weight status should the original model be found implausible. The final study objective was to establish the best predictors of weight status and, thus, the best candidates for intervention concentration.

The study was non-experimental in design, employing a secondary analysis of cross-sectional data collected as part of a modified Youth Risk Behavior Survey (YRBS) administered in Sarasota County, Florida, high schools during the fall of 2006. The survey included demographic questions and height and weight questions from the YRBS, items created and pilot-tested by this researcher, and items modified from the Child Feeding Questionnaire (Birch et al., 2001), the Parent Involvement Scale (Levine et al., 1994), and the Eating Attitudes Test (Garner et al., 1982). Structural equation modeling was used to examine the ability of the model to predict weight status among adolescents. The model was tested and modified in one randomly selected sample (Sample A; N = 784) and cross-validated in a hold-out sample (Sample B; N = 749), for a total of 1533 students.

#### Discussion of Results

Based upon cut-off values for model fit statistics established a priori, the original modified obesity proneness model (see Figure 4.1) was determined to be implausible; but an alternate, plausible model was created and cross-validated in the hold-out sample (see Figures 4.2 and 4.3). The alternate model differed from the original model in four ways. First, compared to the original model, the alternate model did not include the path between *perceived maternal comments about adolescent's weight* and *inability to self-regulate eating behaviors*. This path was actually not a part of Costanzo and Woody's original propositions, but was added for this research project based on evidence that parental comments about weight are linked to binge eating disorder (Fairburn et al., 1998; Mellin, Neumark-Sztainer, Patterson, & Sockalosky, 2004), a condition deemed conceptually similar to the *inability to self-regulate eating behaviors*. In the original

model tested, the path between these two variables was statistically insignificant, and model fit improved when the path was removed. During development of the measurement model, one of the two items selected to infer *inability to self-regulate eating behaviors* was dropped because of the large variance associated with the factor. In exploring which item to retain as an indicator of this construct, the question, *How often have you eaten a large amount of food in a short period and felt that you might not be able to stop?*, was found to be associated with *perceived maternal comments about weight*, but was not associated with *perceived maternal restrictive feeding practices*. In contrast, *How often do you eat even when you are not hungry?* was not related to *perceived maternal comments about weight*, but was related to *perceived maternal restrictive feeding practices*. Because the latter relationship was consistent with the literature employing the obesity proneness model (Birch & Fisher, 2000), the *How often do you eat even when you are not hungry?* item was retained as the indicator for the *inability to self-regulate eating behaviors* construct. The lack of convergent validity is evidence that the two indicators do not infer the same underlying construct, which may mean that *inability to self-regulate eating behaviors* is not as similar to binge eating disorder as originally hypothesized. The unused item (*How often have you eaten a large amount of food in a short period and felt that you might not be able to stop?*) may be a better indicator of binge eating disorder, which, as noted earlier, is associated with parental comments about weight in other studies (Fairburn et al., 1998; Mellin, Neumark-Sztainer, Patterson, & Sockalosky, 2004).

Second, a direct path was added between *gender* and *weight status*, with results revealing that boys had higher BMIs than girls. These findings are consistent with state

and national trends, with 30.2% of boys and 20.3% of girls in Florida considered overweight or at risk of overweight, and 31.8% of boys and 25.5% of girls nationally are overweight or at risk of overweight (CDC, 2006c). Adding this direct path allowed for control of the effects of gender on weight and helped to improve model fit.

Third, a direct path was added between *gender* and *internalized concern about weight*, with results revealing that girls were more likely to internalize their mothers' concern about their weight than boys. *Internalized concern* is a difficult concept to measure and there is no way to prove that children's own concern about weight is evidence that they have internalized their mothers' concerns. Nonetheless, these findings are not surprising, as females (especially white females) tend to be more concerned about their weight (Richards, Casper, & Larson, 1990; Thompson, Raifiroiu, & Sargent, 2003) and display greater body dissatisfaction (Neighbors & Sobal, 2007) than males. Adding this direct path allowed for the control of the effects of gender on internalized concern and improved model fit.

Finally, a direct path was added between *perceived maternal perception of adolescent's weight* and *perceived maternal comments about adolescent's weight*. The original model proposes that these two constructs are indirectly related through the mediator *perceived maternal concern*. However, the modification index generated by *Mplus* suggested the addition of this direct path to improve fit. Results indicated that adolescents are more likely to perceive mothers making comments about their weight if they also perceive their mothers thinking they are heavier. The addition of this direct path allowed for control of the effects of perceived maternal perception of weight on perceived maternal comments and improved model fit.

Besides the revisions already discussed, most of the other paths in the original model were statistically significant. Consistent with the model's propositions, girls were more likely to report a higher level of perceived maternal concern about their weight than were boys. Costanzo and Woody (1985) suggested that parents would be more concerned about their daughters' weight than their sons' weight due to the value placed on women's weight by white, middle class American society. However, results from other studies have been inconsistent, with one showing no difference in mothers' concerns about weight between boys and girls (Spruijt-Metz et al., 2002), and another showing that only mothers with eating disorders were more concerned about their daughters' weight than their sons' weight (Agras, Hammer, & McNicholas, 1997). The present study was unable to assess maternal concern about weight directly, but rather measured the students' *perception* of their mothers' concern. Measuring students' perceptions of mothers' concern may be a more salient measure of mothers' concern because students are more likely to act on their perceptions of their mothers' concerns than on what their mothers actually report their level of concern to be.

Ethnicity was added to Costanzo and Woody's model, suggesting that youth of some ethnic backgrounds may perceive their mothers to be more concerned about their weight than youth of other ethnic backgrounds. In Sample A, only students of multi-ethnic backgrounds reported a higher level of *perceived maternal concern about adolescent's weight* (compared to whites), and this relationship was weak, though statistically significant. In Sample B, ethnicity was not linked to perceived maternal concern about weight. Although the literature suggests ethnic differences in parenting practices or styles (Dornbusch et al., 1987; Radziszewska et al., 1996; Spruijt-Metz et al.,

2002), the prevalence of eating disorders (Striegel-Moore et al., 2003) or eating disorder symptoms (Wildes & Emery, 2001), obesity (C. L. Ogden et al., 2006), and body size acceptance (DiGiacchino et al., 2001), the present study did not find any appreciable ethnic differences in adolescent perceptions of maternal concern about weight. In other words, youth of all ethnicities perceive similar maternal concerns about their weight. Although the total sample size was large, most of the students in the sample were white. Perhaps the various ethnic groups were not adequately represented to reveal a difference in perceived maternal concern. Removing ethnicity from the model did not improve model fit; therefore, ethnicity was retained as a variable in the model.

Consistent with the obesity proneness model, adolescents who believed their mothers thought they were heavier also believed their mothers were more concerned about their weight. The present study lends support to previous studies that showed that mothers tend to be more concerned about their heavier children's weight than they are of their thinner children's (Keller et al., 2006) and parental concerns about children's weight tend to be positively associated with children's actual weight (Brann & Skinner, 2005; Francis et al., 2001; Kaur et al., 2006; Spruijt-Metz et al., 2002). Some research has produced contrary results (Baughcum et al., 2001; Saelens et al., 2000).

Also consistent with the theory, adolescents who believed their mothers valued weight highly tended to believe their mothers were more concerned about their weight. This study may be the first to show a direct relationship between parental values about weight and parental concerns about their weight, albeit from the adolescents' perspectives. However, a similar construct called *parental investment in daughter's shape* (Levine et al., 1994) has been inferred by a 4-item instrument that asks two

questions about each parent: “*How important is it to your (mother/father) that you be thin?*” and “*How concerned is your (mother/father) about whether you weigh too much or are too fat or might become too fat?*” (Thompson et al., 1999, p. 202). This instrument seems to measure two distinct constructs – values and concerns. Interestingly, in developing the measurement model for the present study, these two constructs (*perceived maternal values* and *perceived maternal concerns*) were almost perfectly correlated, suggesting they were measuring the same construct. Using one indicator for *perceived maternal concern about adolescent’s weight (How concerned (or worried) is your mother about you watching what you eat in order for you to look good?)* eliminated the near perfect correlation between the two factors. Conceptually, values and concern are two different constructs; perhaps better indicators of these two constructs would clarify the difference between the two.

Adolescents also were more likely to report that their mothers made comments about their weight if they believed their mothers were more concerned about their weight. Whereas it is not surprising that these variables would be related, this study may be the first to document this relationship and suggest a mechanism for adolescents’ internalization of maternal concerns. Consistent with the literature (Smolak et al., 1999), *perceived maternal comments about weight* was directly related to *internalized concern about weight*. Furthermore, *internalized concern about weight* was associated with *weight status*, which was not surprising because heavier elementary-school aged girls and college-aged women are both more likely to report weight and shape concerns than their lighter peers (Low et al., 2003; Sherwood et al., 2004).



Also consistent with the literature (Francis et al., 2001; Spruijt-Metz et al., 2002), students who perceived greater *maternal concern about their weight* were more likely to perceive greater *maternal restrictive feeding practices* compared with others who did not think their mothers were concerned about their weight. Furthermore, students who were more likely to perceive greater *maternal restriction* also were more likely to be *unable to self-regulate* their eating behaviors. Birch and Fisher (2000) showed that mothers' self-reported restrictive practices were linked positively to an objective measure of children's inability to self-regulate eating behaviors, which, in turn, was linked to dietary intake. In the Birch and Fisher study, dietary intake was also associated with children's weight.

The most notable statistically non-significant relationship in the present study was that between *inability to self-regulate eating behaviors* and *weight status*. The lack of significance may be due to a missing mediating variable between *inability to self-regulate eating behaviors* and *weight status*, such as actual dietary intake as studied by Birch and Fisher (2000), a measure of disordered eating, or attempts to lose or control weight. No other studies have been found that attempt to relate inability to self-regulate eating behaviors and weight status directly. Binge eating disorder (BED) has been associated with weight status (see Wilfley et al., 2003, for review), but, as mentioned previously, the findings from this study suggest that *inability to self-regulate eating behaviors* may be distinctly different from BED. Costanzo and Woody (1985) themselves never explicitly stated that *inability to self-regulate eating behaviors* and *internalized concerns* would lead to increased weight. Their intention might indeed have been for the model to end at these two constructs rather than at weight. Weight status would instead be one of the first variables in the model, located prior to and linked to *perceived child weight*.

The third research question asked, “Which variables in the final model are the best predictors of weight status and, thus, the best candidates for intervention foci?” Both being male and *internalized concern about weight* were significant predictors of weight status. This finding suggests that males may be in greater need of a weight loss intervention than females; however, the rest of the model suggests that girls are more strongly affected by perceived maternal concerns and their own internalized concerns about their weight.

#### Strengths and Limitations of the Study

The results from the present study indicate that the modified obesity proneness model may be valuable in explaining adolescent weight status. This study contributes to the literature in several important ways. First, this is the only study known to examine multiple constructs of the model from adolescents’ perspectives. Moreover, results suggest that this perspective yields findings consistent with the obesity proneness model. Prior studies that have used components of the model typically have surveyed parents (usually mothers). However, adolescents’ perception of what their parents believe, feel, or do may have a greater impact on them than what parents say they, themselves, believe, feel, or do. In fact, other studies (Field et al., 2005; Keery, Eisenberg, Boutelle, Neumark-Sztainer, & Story, 2006) have shown that adolescent *perceptions* of maternal values and behaviors are more strongly associated with adolescent weight-related concerns and behaviors than are mothers’ own stated values and behaviors.

Second, this study has clarified or revealed relationships not previously reported in the literature. This study provides some evidence for the obesity proneness model’s proposition that parents are more concerned about their daughters’ weight than their sons’

weight, whereas previous studies have yielded mixed results. In addition, this study revealed a strong relationship between *perceived maternal value for weight* and *perceived maternal concern about adolescent's weight* as well as a link between *perceived maternal concern about adolescent's weight* and *perceived maternal comments about adolescent's weight*; these relationships have not been examined previously.

Finally, whereas other studies have examined components of the obesity proneness model, none have previously examined the Costanzo and Woody (1985) model in its entirety. This study is the first known attempt to measure the entire model, albeit from the adolescents' perspective and with some modifications suggested by the literature and by the *Mplus* output. The final modified model yielded acceptable fit indices and was replicated with similar results in a hold-out sample. Using SEM allowed for the simultaneous examination of the relationships between multiple independent and dependent variables while controlling for the inflation of experimentwise error as well as for measurement error (Buhi et al., 2007).

Despite these strengths, the study has important limitations. For example, this study relied on cross-sectional data, and therefore, it is not possible to infer cause and effect relationships from the results. Although the model's arrows suggest causal pathways, the temporal order cannot be established and the relationships seen can only be said to be correlational.

In addition, although the survey protocol called for a random cluster sample of students, almost half of the students expected to participate did not return surveys. In addition, only adolescents who attend school were able to participate in the survey. These factors result in a selection bias that may threaten both internal and external

validity (McDermott & Sarvela, 1999). Information is not available to compare non-respondents with respondents; however, a comparison of district and state enrollment data suggests some differences exist between the study sample and the general student population (see Appendix B). For example, compared to district enrollment data, a disproportionately smaller proportion of students from Booker and Riverview High Schools and a disproportionately greater proportion of students from Sarasota and North Port High Schools completed the survey. Booker High School, in particular, tends to have a much greater minority population compared to the rest of the county. However, approximately 23% of the sample as a whole reported minority status compared to 27% of all school-age students reporting minority status district-wide (FDOE, 2007a).

Although 53% of the school-age population statewide is minority (FDOE), about 24% of the entire population nationwide is minority (U.S. Census Bureau, 2007a). Furthermore, although the ethnic distributions of at risk for overweight and overweight were similar between the study sample and a nationally representative sample (see Appendix C – data not available for the district), the prevalence of overweight and at risk for overweight among white female students from the study sample was notably lower than that of the national sample (CDC, 2006c). In addition, slightly more females (56%) comprised the sample than exist in the state and national population (52% and 51%, respectively [U.S. Census Bureau, 2007b]). Collectively, these slight differences seen in the sample compared to persons comprising the Florida and national population may indicate the results are not generalizable to the larger adolescent population.

Furthermore, although the Youth Risk Behavior Survey is thought to yield valid and reliable data from students in grades 7-12 (Brener et al., 1995; Brener et al., 2002),

the items added to the survey were not subjected to rigorous psychometric testing. A large amount of measurement error increases the chance of making a Type II error – failing to find a relationship when one, in fact, exists. In this study, however, almost all of the parameter coefficients were statistically significant, reducing the likelihood that a Type II error was made. The new and revised items underwent pilot-testing and revision with high school students and were reviewed for face validity by a panel of experts prior to adding them to the YRBS. In addition, one benefit of SEM is its ability to control for measurement error. The measurement model was found to have high model fit statistics, and individual factor loadings were all  $> 0.7$ , with one exception--*How often does your mother try to keep you from eating too much junk food*--which loaded at 0.65 (Sample A) and 0.63 (Sample B). Also, the measurement model was cross-validated in a hold-out sample with similarly high model fit statistics and factor loadings to confirm the reliability and validity of the data further.

This study also relied on self-reported data, and thus, some responses may lead to underestimates or overestimates. Students tend to over-report height and under-report weight, which would result in an underestimate of BMI (Brener et al., 2003). However, despite these trends, the weight status of 94% of adolescents was correctly classified based upon self-reported height and weight in one national study (Strauss, 1999). BMI status did not differ between children who self-reported height and weight and those who had measured height and weight in another national study (Strauss, 2000). Furthermore, some researchers have found that children as young as 6 or 7 years of age are able to give accurate accounts of their own health (Riley, 2004), and those as young as 10 years' old can report reliably on some parent behavior (Barnett et al., 1997).

In addition, the formula for calculating BMI has been shown to misclassify some muscular people as overweight because muscle weighs more than fat. One study (Ode, Pivarnik, Reeves, & Knous, 2007) revealed that BMI correctly classified obese college athletes (high sensitivity), but incorrectly classified non-obese athletes as obese (low specificity). In another study of adolescents (Neovius, Linné, Barkeling, & Rossner, 2004), BMI did not incorrectly classify students as being overweight (high specificity) among both sexes, but did not correctly classify some females as overweight (low sensitivity among females). The implications of these measurement problems for this study are that overweight may be underestimated among girls and overestimated for athletes. Despite its limitations, BMI is widely accepted as a valid indicator of weight status and is more practical to use than objective measures of weight status in survey research.

One other limitation is that the study only examined the influence of mothers. Fathers may exert influences on children's weight concerns and eating behaviors differently than do mothers (e.g., Blissett et al., 2006; Brann & Skinner, 2005; May et al., 2006). Moreover, these influences may be profound, particularly on the development of eating disorders (e.g., Keery et al., 2005; Schwartz et al., 1999). The influence of other female caregivers also was not considered.

Finally, the study was limited to existing survey data which precluded the use of an ideal number and combination of items for addressing the research questions. Most researchers would recommend a minimum of three, and ideally more, questionnaire items to represent a theoretical construct. Two-indicator factors typically are not recommended because they tend to yield unstable results, particularly in small samples; and one-

indicator factors may actually be preferable to two-indicator factors because they are less likely to result in problems with estimation (Marsh, 2005). All but one of six factors in the original CFA model were inferred by two indicators (the exception was inferred by three indicators), but this model would not converge. The final CFA model with four two-indicator factors yielded excellent model fit statistics, with factor loadings greater than 0.8 for all but one indicator, which was still relatively high at 0.65 and 0.63 for Sample A and Sample B, respectively. Although the number and combination of indicators per factor was not optimal, the final SEM model yielded acceptable model fit, and most of the path coefficients were statistically significant.

#### Implications for Future Research

Future research is needed to build on this study's results and address its methodological limitations. For example, even with a cross-sectional sampling design, survey items might be designed to capture elements of time to establish the temporal sequencing of events and provide a stronger justification for cause-effect relationships. The order of events may, in fact, be reversed in some cases, and this order, in itself, is worthy of study. Selecting a nationally representative sample would enable the results to be generalized to the national population. A more objective measure of weight status may be used, although BMI is the most practical for survey research, especially with large samples. Future research is also needed to understand the role fathers play in obesity and test the obesity proneness model using adolescents' perceptions of their *fathers'* values, concerns, comments, and feeding practices. Creating multiple survey items for each factor may also strengthen or further clarify the results found in this study.

Future research also is needed to identify factors that mediate the relationship between the *inability to self-regulate intake* construct and *weight status* and elucidate the lack of relationship between these variables in this study. A likely mediator worthy of exploration is actual dietary intake as studied by Birch and Fisher (2000). Other suggestions include a measure of disordered eating or attempts to lose or control weight.

Further exploration is needed to distinguish between the two items that were originally thought to infer *inability to self-regulate eating behaviors* -- *How often have you eaten a large amount of food in a short period and felt that you might not be able to stop?* and *How often do you eat even when you are not hungry?* These items seem to be measuring two different concepts. Although the *inability to self-regulate eating behaviors* construct seemed conceptually similar to binge eating disorder, findings from this study suggest that these may be two different constructs.

Additionally, although the obesity proneness model suggests a mechanism by which *parents* influence the development of disordered eating behaviors that lead to overweight, it might be strengthened by controlling for the influences of peers and media. A generally well-accepted notion is that peers and media influence the development of weight concerns and disordered eating behaviors (Thompson et al., 1999).

Furthermore, parental role modeling and the opportunities to do so (e.g., via family meals) have an impact on children's eating behaviors and weight. (e.g. Brown & Ogden, 2004; Gillman et al., 2000; Kusano-Tsunoh et al., 2001; Videon & Manning, 2003; Young, Fors, & Hayes, 2004). Therefore, future research may control for variables such as youths' perceptions of their parents' weight and their parents' ability to self-



regulate eating, family structure (single-parent versus dual-parent homes, etc.), and the frequency of family meals.

Research is needed to determine if a “critical period of development” exists for the impact of parental behavior on youth. Does it matter, for instance, if parental restrictive feeding practices or comments about weight occur earlier or later in the child’s development? Girls as young as 8-10 are already showing signs of weight-related concerns and weight-control behaviors (Sherwood et al., 2004), and much of the research done with components of the obesity proneness model has been conducted with children 8 years old and younger (Birch & Fisher, 2000; Francis, Hofer, & Birch, 2001; Tiggemann & Lowes, 2002; Faith et al., 2004).

Future research also is needed to determine what parents *actually* say or do to influence adolescent perceptions about parental values, concerns, comments, and feeding practices. Longitudinal studies, observational studies, and other qualitative and quantitative methods are needed to understand the complex interaction between parents and their children and how their relationship influences obesity proneness.

Finally, future research is needed to design and test intervention programs based on the relationships discovered in this study. A great deal could be learned, for example, by evaluating an intervention program that addresses factors found significant in this study, e.g., the influence of *perceived maternal comments about weight* on *internalized concern about weight* and the influence of *perceived restrictive feeding practices* on *inability to self-regulate eating behaviors*.

## Implications for Public Health Practice

Obesity is, for the most part, a preventable condition, yet each year more than 350,000 people die in the U.S. because of its health consequences (Mokdad et al., 2004). Despite the public health call to “reduce the proportion of children and adolescents who are overweight . . .” (USDHHS, 2000), adolescents are more overweight than ever (C.L. Ogden et al., 2006). Whereas the causes of childhood obesity are complex and perhaps inseparable, the role of the family and parents upon children’s development is undeniable. The findings from this study suggest that at least some parents may in fact do more harm than good when their adolescents are showing signs of overweight. Although their intentions are probably good, their concern about their youth’s weight may lead to restrictive feeding practices which do not enable adolescents to regulate their own eating behavior. Parental concern is communicated to the youth, who then internalize the concern. As Costanzo and Woody (1985) proposed, the result is “an ‘eating-guilty’ individual with brittle self-mediated eating controls” (p. 432) – someone who has an unhealthy relationship with food. Dietitians and other health care professionals encounter these types of individuals regularly in practice.

Experts (e.g. Koplan et al., 2005) agree that the solution to the obesity problem will have to involve a multi-level approach, including a variety of interventions at all levels of influence. The social ecology model (e.g., Coreil, Bryant, & Henderson, 2001; Davison & Birch, 2001) suggests that these other levels cannot be ignored. Biological factors, (e.g., age, sex, and genetic predisposition to weight gain), behavioral factors (e.g., dietary intake, physical activity, and sedentary behavior), interpersonal factors (e.g., child feeding practices, the availability of certain foods in the home, nutrition knowledge,

parental dietary and physical activity patterns, parental preferences for food and physical activity, parental weight status, parental encouragement of child's activity, parental monitoring of child's television viewing, the family's television viewing habits, and peer and sibling interactions), and institutional (e.g., school lunch and physical education programs) and societal factors (e.g., ethnicity, socioeconomic status, work hours, leisure time and family leisure time activity, accessibility of recreational facilities, convenience foods and restaurants, crime rates, neighborhood safety, and agricultural policy) all play a role in the etiology of obesity (Davison & Birch, 2001).

However, the findings from this study suggest possible interventions at the level of the family. Because of the cross-sectional study design, these interventions should be studied empirically to further elucidate the directionality of the relationships between the variables. Parents must be given the tools for providing a healthy eating environment for their family. Parents should be encouraged to avoid making comments about their children's weight in an effort to minimize the internalization of weight concerns. Obesity among children is not only a threat to physical health, but also a threat to mental health (Koplan et al., 2005). Although peer and media influences probably play a substantial role in the development of weight-related concerns, parental influences could also be profound and should be mitigated as much as possible.

Parents also should be given guidance on appropriate, non-restrictive feeding practices. Parental control invades all aspects of children's lives, and current opinion is that the rigid structure imposed on today's children inhibits creativity and the learning of self-control. Ellyn Satter (2000) encourages the division of responsibility between parent and child. She recommends that parents take responsibility for providing a variety of

healthy foods and that they relinquish responsibility for choosing from these healthy foods to the child. Other healthy parental behaviors may include modeling of appropriate eating behaviors (Cullen et al., 2001; Fisher et al., 2002), making fruits and vegetables easily accessible in the home (Cullen et al., 2001), encouraging breakfast intake (Roseman, Yeung, & Nickelson, 2007), and having regularly-scheduled meals together as a family (Neumark-Sztainer et al., 2003). Together, as one component of a multi-level intervention, these behaviors may play a small roll in preventing childhood obesity.

#### Suggestions for Dissemination of Findings

These results of this study should be disseminated to the academic and lay community. To date, two abstracts describing this study's findings have been submitted: one was submitted to the annual Food and Nutrition Conference and Exposition of the American Dietetic Association, which reaches thousands of food and nutrition experts who may be able to apply this study's findings to their practice. For the same reason, a manuscript may be submitted to the *Journal of the American Dietetic Association*. Other possible journals that reach professionals who may be able to apply the study's findings and that have published similar studies include: *American Journal of Clinical Nutrition*, *Appetite*, *Health Education Research*, *International Journal of Eating Disorders*, *International Journal of Obesity*, *Journal of Adolescent Health*, *Journal of Developmental and Behavioral Pediatrics*, *Journal of Nutrition Education and Behavior*, and *Obesity Research*.

The second abstract was submitted to a local women's and girls' health initiative luncheon/lecture series, where current and future mothers may be educated on the importance of establishing healthy relationships with food and weight in the home. Other

avenues for reaching mothers include women's and parenting magazines, such as *Parents* magazine.

Finally, the findings of this study will be summarized and provided to the Sarasota County School Board, as agreed, in exchange for the use of their data.

### Summary and Conclusion

This study tested the ability of a modified obesity proneness model (Costanzo & Woody, 1985) to predict weight status among adolescents. Although the original model was not found to be plausible, an alternative model was deemed viable. Three paths were added to the original model that improved model fit: (1) a path between *perceived maternal perception of adolescent's weight* and *perceived maternal comments about weight* (positive association); (2) a path between *gender* and *internalized concern about weight* (girls more likely to be concerned); and (3) a path between *gender* and *weight status* (boys heavier). Additionally, one path in the original model, between *perceived maternal comments about weight* and *inability to self-regulate eating behaviors*, was removed. As hypothesized, girls were more likely to perceive their mothers to be concerned about their weight than were boys. In addition, compared to students who did not perceive their mothers to be concerned about their weight, those who did were more likely to think their mothers perceived them to be heavier, valued weight highly, were more restrictive in their feeding practices, and made more comments about their weight. Also as hypothesized, students with higher levels of internalized concern about weight were more likely to think their mothers made comments about their weight and were likely to be heavier. On the other hand, ethnicity was not strongly linked to perceived maternal concern about adolescent's weight, and inability to self-regulate eating

behaviors was not associated with weight status. Findings from this study suggest that the examination of interventions addressing some of the constructs in this model, such as *internalized concern about weight* and mothers' *restrictive feeding practices* may provide a partial solution to problems of weight and inability to self-regulate eating behaviors.

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## APPENDICES

## Appendix A

Table A.1

*Frequency Distributions for All Variables*

Variable or Construct	Survey Items and Response Options	Sample A (N/%)		Sample B (N/%)	
Views of maternal perception of adolescent's weight	PW1. How would your mother describe your weight now?				
	A. Very underweight	15	2.0	22	3.1
	B. Slightly underweight	83	11.3	89	12.6
	C. About the right weight	470	63.8	443	62.8
	D. Slightly overweight	143	19.4	122	17.3
	E. Very overweight	26	3.5	29	4.1
Perceived maternal value for weight	V1. How important is <i>your</i> weight to your mother?				
	A. Not important at all	237	38.3	205	34.8
	B. A little important	271	43.8	267	45.3
	C. Very important	111	17.9	117	19.9
	V2. How important is it to your mother that <i>you</i> be thin?				
	A. Not important at all	399	62.7	390	65.2
	B. A little important	193	30.3	160	26.8
	C. Very important	44	6.9	48	8.0
Perceived maternal concern about adolescent's weight	MC1. How concerned (or worried) is your mother about <i>you</i> watching what you eat in order for <i>you</i> to look good?				
	A. Not concerned at all	364	53.4	354	56.7
	B. A little concerned	245	35.9	214	34.3
	C. Very concerned	73	10.7	56	9.0
	MC2. How concerned (or worried) is your mother about whether <i>you</i> weigh too much?				
	A. Not concerned at all	417	61.9	383	61.0
	B. A little concerned	190	28.2	175	27.9
	C. Very concerned	67	8.5	70	11.1
Perceived maternal comments about adolescent's weight	C1. Has your mother ever told you she thought you weigh too much?				
	A. No	598	76.8	556	74.7
	B. Yes	181	23.2	188	25.3
	C2. Has your mother ever encouraged you to lose weight?				
	A. No	511	65.7	502	67.6
	B. Yes	267	34.3	241	32.4

Table A.1 continued

Variable or Construct	Survey Items and Response Options	Sample A (N/%)		Sample B (N/%)	
Internalized concern about weight	IC1. How concerned (or worried) are you about watching what you eat in order to look good?				
	A. Not concerned at all	292	37.3	277	37.2
	B. A little concerned	397	50.8	364	48.9
	C. Very concerned	93	11.9	103	13.8
	IC2. How concerned (or worked) are you about whether you weigh too much?				
	A. Not concerned at all	331	42.3	315	42.3
	B. A little concerned	284	36.2	278	37.4
	C. Very concerned	167	21.4	151	20.3
Perceived maternal restrictive feeding practices	R1. How often does your mother try to keep you from eating too much junk food?				
	A. Never	169	21.9	169	22.9
	B. Rarely or once in a while	181	23.5	165	22.4
	C. Sometimes	226	29.4	211	28.6
	D. Most of the time	137	17.8	141	19.1
	E. Always	57	7.4	51	6.9
	R2. How often does your mother try to keep you from eating too much in general?				
	A. Never	398	51.7	369	50.2
	B. Rarely or once in a while	179	23.2	162	22.0
	C. Sometimes	113	14.7	137	18.6
	D. Most of the time	55	7.1	45	6.0
	E. Always	25	3.2	22	3.0
	R3. How often does your mother try to keep you from drinking too much soda or other sweetened beverage?				
	A. Never	265	34.5	258	35.1
	B. Rarely or once in a while	159	20.7	141	19.2
C. Sometimes	172	22.4	184	25.0	
D. Most of the time	106	13.5	103	14.0	
E. Always	67	8.5	50	6.8	
Inability to self-regulate eating behaviors	II. How often have you eaten a large amount of food in a short period and felt that you might not be able to stop?				
	A. Never	454	58.1	423	56.6
	B. Rarely or once in a while	194	24.8	187	25.0
	C. Sometimes	98	12.5	101	13.5
	D. Most of the time	19	2.4	18	2.4
	E. Always	17	2.2	19	2.5
	I2. How often do you eat even when you are not hungry?				
	A. Never	197	25.2	160	21.4
	B. Rarely or once in a while	245	31.4	265	35.4
	C. Sometimes	255	32.7	240	32.1
D. Most of the time	53	6.8	57	7.6	
E. Always	31	4.0	26	3.5	

Table A.1 continued

Variable or Construct	Survey Items and Response Options	Sample A (N/%)		Sample B (N/%)	
Age	D1. What is your age?				
	A. 12 years old or younger	3	0.4	3	0.4
	B. 13 years old	5	0.6	5	0.7
	C. 14 years old	255	32.6	244	32.8
	D. 15 years old	183	23.4	169	22.7
	E. 16 years old	233	29.8	204	27.4
	F. 17 years old	99	12.6	112	15.0
	G. 18 years old or older	5	0.6	8	1.1
Gender	D2. What is your sex?				
	A. Female	438	55.9	417	55.9
	B. Male	345	44.1	329	44.1
Race/ethnicity	D3. What is your race (select one or more responses) <sup>a</sup>				
	A. American Indian or Alaska Native	10	1.3	7	0.9
	B. Asian	14	1.8	15	2.0
	C. Black or African American	47	6.0	45	6.0
	D. Hispanic or Latino	64	8.3	73	9.8
	E. Native Hawaiian or Other Pacific Islander	8	1.0	10	1.3
	F. White	607	77.8	564	75.6
	G. Multi-ethnic	30	3.8	32	4.3

<sup>a</sup>Students selecting more than one response were coded as multi-ethnic.

Appendix B

Table B.1

*Membership and Percent Minority in Sample and District by School.*

	Percent Minority (not White)		Membership	
	District 2006-2007 <sup>a</sup>	Sample	District 2005-2006 <sup>b</sup>	Sample
Booker HS	52%	63%	15%	5%
North Port HS	24%	30%	19%	22%
Pineview HS	17%	26%	N/A	9%
Riverview HS	20%	25%	24%	16%
Sarasota HS	21%	26%	24%	31%
Venice HE	8%	12%	20%	17%

<sup>a</sup>(FDOE, 2007b)  
<sup>b</sup>(FDOE, 2007c)



## Appendix C

Table C.1

*Prevalence of At Risk for Overweight and Overweight by Gender in Sample, State & Nation*

	At Risk for Overweight			Overweight		
	Female	Male	Total	Female	Male	Total
Sarasota Sample	10.1%	17.1%	13.2%	5.2%	17.3%	10.6%
Florida <sup>a</sup>	13.2%	15.6%	14.4%	7.1%	14.6%	10.9%
U.S. <sup>a</sup>	15.5%	15.8%	15.7%	10.0%	16.0%	13.1%

<sup>a</sup>(CDC, 2006c)

Table C.2

*Prevalence of At Risk for Overweight and Overweight by Race/Ethnicity and Gender in Sample and Nation*

	At Risk for Overweight			Overweight		
	Female	Male	Total	Female	Male	Total
White – Sample	8.9%	16.0%	12.1%	3.9%	16.5%	9.5%
White – U.S. <sup>a</sup>	13.8%	15.2%	14.5%	8.2%	15.2%	11.8%
Black – Sample	20.0%	12.8%	16.5%	15.0%	23.1%	19.0%
Black – U.S. <sup>a</sup>	22.6%	16.7%	19.8%	16.1%	15.9%	16.0%
Hispanic – Sample	13.3%	26.1%	18.9%	10.0%	28.3%	17.9%
Hispanic – U.S. <sup>a</sup>	16.8%	16.5%	16.7%	12.1%	21.3%	16.8%

<sup>a</sup>(CDC, 2006c)

## ABOUT THE AUTHOR

Jen Nickelson received her bachelor's and master's degrees in nutrition from Florida State University in 1993 and 1995. She practiced actively as a registered dietitian for over nine years.

The desire to learn more about developing and evaluating educational and other behavior change strategies motivated Ms. Nickelson to pursue a doctoral degree in public health education. During her experience at the University of South Florida, Ms. Nickelson worked as liaison for one of four demonstration projects at the Florida Prevention Research Center, which is funded by the Centers for Disease Control and Prevention. In this position, she worked with a community coalition to design a social marketing program designed for the prevention of youth obesity. Several presentations and manuscripts have resulted from this project.

Ms. Nickelson is presently Visiting Assistant Professor in the Nutrition Program at the Brooks College of Health at the University of North Florida in Jacksonville, Florida.