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Parental Involvement, Parenting Style, and Diet among Youth with Type 1 Diabetes

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Parental Involvement, Parenting Style, and Diet among Youth with Type 1 Diabetes

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Healthy dietary practices are crucial to the management of type 1 diabetes (T1D), yet quality of diet deteriorates during adolescence with teenagers exhibiting the poorest dietary adherence to the diabetes regimen of all age groups (Johnson, 1992). Continued parental involvement, which has been found to promote adherence to the diabetes regimen, may also support healthful dietary practices in adolescents with T1D. The current study investigated the effect of parental monitoring of meals and snacks on the quality of diet and BMI of adolescents with T1D. Data from baseline assessments from an ongoing longitudinal randomized controlled trial promoting adherence among adolescents with T1D were analyzed. Two-hundred thirteen adolescents (105 females) with T1D and one parent participated. Parental monitoring and dietary intake were assessed through parent and child interviews, and parenting style was assessed through child report. Demographic and medical data were also collected. Structural equation modeling was used to test the hypotheses that quality of diet would mediate the relationship between parental monitoring and BMI and that parenting style would moderate these relationships. Results indicated that more frequent parental monitoring was associated with a lower BMI. However, the mediation hypothesis was not supported; parental monitoring was not associated with quality of diet. Furthermore, the dietary items seemed to measure quality of diet differently for boys and girls, so the models were tested separately by gender. Results indicated that parental monitoring was

related to caloric intake for girls. The moderation hypothesis could not be tested because parenting style was not measured reliably in this sample. Implications for the measurement of dietary intake in adolescents are discussed. The importance of parental involvement in the dietary practices and BMI of youth with T1D is also explored.

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Introduction

Although healthful dietary practices are a central component of disease management in youth with type 1 diabetes (T1D), dietary behaviors often deteriorate during adolescence (Johnson, 1992; Wing, Epstein, & Nowalk, 1984). As adolescents assume greater responsibility for their food choices, the quality of their diet often declines. Unhealthy dietary choices, along with poor adherence to other components of the diabetes regimen, contribute to the poor metabolic control common among teenagers (Gowers, Jones, Kiana, North, & Price, 1995). Continued parental involvement through practices such as sharing responsibility for and monitoring diabetes-related tasks has been associated with greater adherence to the diabetes regimen among adolescents with T1D (Ellis, Podolski, Frey, Naar-King, et al., 2007; Helgeson, Reynolds, Siminerio, Escobar, & Becker, 2008; Wiebe, 1995). However, the effects of continued parental involvement on dietary behaviors, in particular, has not yet been investigated among youth with T1D.

Type 1 Diabetes

Type 1 diabetes (T1D), a chronic, lifelong condition, is the most common metabolic disorder affecting youth (La Greca & Skyler, 1991). The Centers for Disease Control and Prevention (2008) estimate that 15,000 youth are newly diagnosed with T1D each year in the United States. In T1D, the pancreas is unable to produce the insulin the body needs to convert glucose into energy. In healthy individuals the pancreas produces a basal level of insulin to convert glucose in the bloodstream to energy the cells can use to perform bodily

functions as well as bursts of insulin after the individual eats to convert sugars from the food. In individuals with diabetes the pancreas cannot produce insulin for either situation. Consequently, the body cannot adequately regulate blood glucose levels, and exogenous insulin must be used to maintain glycemic control.

Proper management of diabetes requires a complex regimen of disease care behaviors designed to control blood glucose levels including paying careful attention to diet and physical activity, blood glucose monitoring, and insulin administration. The goal of diabetes management is to keep blood glucose levels in the normal range (between 70-110 milligrams of glucose per deciliter (mg/dl) of blood, for school-aged children and adolescents; Silverstein et al., 2005). Hyperglycemia, or when blood glucose levels exceed 180 mg/dl, increases the risk for blindness, high blood pressure, cardiovascular disease, and stroke, and can result in more immediate, life-threatening complications such as diabetes ketoacidosis (which occurs when the body does not have enough insulin, and can lead to coma and even death; Rovet, 2000). Hypoglycemia, or when blood glucose levels are below 60 mg/dl, can result in unconsciousness, seizures, brain damage, and death. Despite the possibility of these complications, adherence to the diabetes regimen often declines during adolescence with estimates as high as 50% of teenagers being under poor metabolic control (Gowers et al., 1995). Given the severity of the risks associated with poorly controlled diabetes, it is important to understand the factors that contribute to adherence to the diabetes regimen among youth.

Dietary Practices in Youth with Type 1 Diabetes

One component of diabetes management that is critical in avoiding disease complications (Wing, Epstein, & Nowalk, 1984) is maintaining a healthy diet. Diet is significantly related to hemoglobin A1C levels, a measure of the average of blood glucose levels over the past two to three months (Delameter et al., 1988). The composition, calories, and timing of meals have important implications for blood glucose levels. Carbohydrates that are consumed are converted to sugars, which greatly affect blood glucose levels, while fats and proteins consumed have a smaller effect on blood glucose levels. Therefore, youth with type 1 diabetes are required to match carbohydrate intake with insulin dosage to maintain optimal blood glucose levels.

Specific dietary prescriptions vary by regimen; those on the conventional regimen of taking up to three predetermined shots of insulin a day must adhere to a strict schedule of meals and snacks and ensure their carbohydrate intake falls within a specified range for each meal. Basal-bolus therapy (via multiple injections or the insulin pump) offers a greater degree of flexibility in the timing and carbohydrate content of meals. In these regimens, individuals can calculate how much insulin to administer based on a predetermined carbohydrate to insulin ratio when they are ready to eat. This allows them to adjust their insulin based on the timing and size of their meals. While these regimens offer greater flexibility in dietary choice, they also require the youth to have the skill level and responsibility necessary to properly adjust insulin based on his or her diet and the results of blood glucose monitoring.

Although specific dietary prescriptions vary by regimen, the American Diabetes Association (ADA) has stated that the 2005 Dietary Guidelines for Americans (USDA, 2005) are appropriate for youth with T1D. According to these guidelines, carbohydrates should comprise 45-65% of total caloric intake, and individuals should choose carbohydrates that are whole grain, fiber-rich, and with little added sugar whenever possible. Total fat intake should fall between 25-35% of total caloric intake for adolescents, and consumption of saturated and trans fats should be kept to a minimum. Saturated fat intake should be less than 7 % of total calories.

Although dietary practices are an integral part of managing diabetes, adolescents have a particularly difficult time adhering to the dietary regimen and maintaining a healthy diet. Johnson and colleagues (1992) reported that adolescents have the worst dietary adherence of all age groups. Gowers and colleagues (1995) have estimated that as many as 50% of teens are under poor metabolic control, and that poor dietary choices are likely a leading cause of such poor control. This decline in dietary adherence is especially concerning as adolescence is recognized as a period during which long-lasting eating patterns are established (Iannotti & Bush, 1993).

Recent investigations examining the diets in youth with T1D have revealed that although youth with diabetes consume less sugar than peers without diabetes, they consume more fat, saturated fat, and cholesterol and fail to meet the USDA issued dietary guidelines in terms of fruit and vegetable intake (Helgeson, 2006; Rovner & Nansel, 2009). The increased fat consumption is alarming given the increased risk for cardiovascular disease due to a

propensity for elevated lipid and lipoproteins in individuals with T1D (Atabek et al, 2006; Diabetes Complications and Control Trial: DCCT, 1996; Kershner et al, 2006). Individuals with T1D are two to four times more likely to die from heart disease than individuals without diabetes (CDCP, 2008). One explanation for their increased fat consumption may stem from misconceptions about what constitutes a healthy diet. Through interviews with focus groups, Gellar and colleagues (2008) found that youth with T1D often perceive “free foods,” which are foods that are low in carbohydrates and thus have a minimal effect on blood glucose levels such as cheese and meats, as “good for diabetes management.” These poor dietary habits may also place youth with diabetes at risk for being overweight. In a cross-sectional study of 6-16 year olds, children and adolescents with T1D were found to be more overweight than their nondiabetic peers (Sandh et al., 2008). Given the importance of dietary adherence and the heightened risk associated with a poor diet among these youth, it is necessary to identify what factors contribute to their dietary practices in order to design interventions that can promote a healthy diet.

A few factors related to poor dietary adherence in adolescents have been previously examined in research. For example, the deterioration of dietary practices during adolescence may stem from their changing social environment; as children become teenagers they spend increasing time with friends and less time with parents. As adolescents spend more time with friends with reduced parental oversight, they are often inclined to follow their peers’ dietary habits in an attempt to fit in (Allen, Tennen, McGrade, Affleck, and Ratzan, 1983). Whereas parents are generally responsible for what their young children eat, adolescents take

increasing responsibility for their food choices. For adolescents with diabetes, this shift in responsibility may occur prematurely given the complexity of the dietary regimen.

Delameter and colleagues (1988) found that youth find it particularly difficult to adhere to their dietary regimen at school and restaurants and have trouble selecting appropriate foods for their afternoon snack. These situations represent times when adolescents may be more likely to be with peers, and parents may be less likely to be involved in making and observing food choices. Given that reduced parental involvement may play a role in the decline in dietary adherence, maintaining parental involvement may help teens sustain healthy dietary practices.

Parental Involvement in Diabetes Management and Diet

Not only is parental involvement likely an important contributor to healthy dietary practices in adolescence for youth with T1D, but continued parental involvement is also one robust factor that has been identified as attenuating the deterioration in disease care behavior common in adolescence (Wiebe et al., 2005; Wysocki et al, 1996). For example, the manner in which families divide responsibility for diabetes management tasks, and how much involvement parents maintain as youth age, has important implications for adherence and metabolic control (Wiebe et al., 2005). It is expected that youth will take greater responsibility for diabetes management tasks as they get older; however, for many teens this shift occurs prematurely. Palmer (2004) found that parents of youth with T1D often transfer increasing responsibility for diabetes management tasks before the adolescent has the skill level and maturity to successfully complete such tasks on his/her own. Adolescents who

assume more responsibility for diabetes management tasks have been found to be under poorer metabolic control (Allen, Tennen, McGrade, Affleck, and Ratzan, 1983). In contrast, adolescents who share responsibility for diabetes tasks with their parents exhibit better self-care behaviors and metabolic control, both concurrently and three years later, as compared to families in which the parent or the child assumed primary responsibility for such tasks (Helgeson et al., 2008). Furthermore, this association between shared responsibility and good metabolic control was particularly strong among older adolescents relative to younger ones (Helgeson et al., 2008).

The level of parental involvement required for successful diabetes management also depends on the needs and competence of the adolescent. For adolescents who do not perceive themselves to be efficacious in managing their diabetes, high levels of parental responsibility for diabetes tasks, as opposed to shared responsibility, are associated with improved metabolic control (Palmer, Berg, Butler, Fortenberr, et al., 2009). It appears that youth with parents who stay involved in the diabetes regimen are better equipped to complete their diabetes management tasks.

Whereas shared responsibility of general diabetes management tasks appears to be associated with better adherence to the diabetes regimen, little is known about how division of responsibility for food choices affects dietary practices in youth with T1D. A construct that has received a great deal of attention in the broader literature that may be germane is the degree to which parents control what their children eat. Parents who assume greater responsibility for food choices may be thought to have greater control over what their youth

eat. There are conflicting findings in the literature on the effects of parental control on dietary intake among youth. Some research on parental control of youths' eating supports the idea that some structure may be beneficial (e.g. Savage, Fisher, & Birch, 2007). Parental practices such as structuring the eating environment through their choices of what foods to make available to children may be effective ways of controlling youths' intake; parents can organize the food environment in such a way as to promote healthy eating and discourage the consumption of high-fat foods by choosing what foods are available. Consistent with this speculation, adolescents from homes with food-related rules have healthier diets (De Bourdeaudhuij & Van Oost, 2000).

However, although how parents structure the food environment may have beneficial effects on adolescent's diets, many studies have found that certain forms of control carry the risk of unintended consequences (Savage et al., 2007). For example, strict feeding practices have been found to have paradoxical effects on youth's food preferences and self-regulation of energy intake (Brown et al, 2004; Savage et al., 2007). Many parents restrict access to "junk" food while pressuring children to consume nutrient dense foods (e.g., "eat your veggies") in an attempt to promote a healthy diet. However, these coercive feeding practices may actually increase children's preference for the forbidden foods (Fisher & Birch, 1999) and decrease their acceptance of the healthy foods (Fisher, Mitchell, Smiciklas-Wright & Birch, 2002). Studies such as these have led to the conclusion that parents who exert greater control over their children's food intake have children who are less capable of regulating their intake (Scaglioni, Salvioni, & Galimberti, 2008). One explanation offered for this

relationship is that by imposing external control of eating, parents do not allow children to develop self-regulatory strategies to manage their eating and children learn to ignore internal cues of satiety (Costanzo & Wood, 1985). Although control is not the same as division of responsibility, division of responsibility may share elements with control in that when parents take high levels of responsibility for food choices, they may restrict certain foods and pressure their children to eat others. Thus, the same relationships that have been found between control, food preferences, and intake in the broader literature may apply when division of responsibility is studied as a form of parental control in youth with T1D. A qualitative study of dietary adherence in youth with hyperlipidemia supports the idea that there is a point at which parents may become over-involved in dietary choices. Behaviors perceived as parental over-involvement, such as extreme monitoring and criticism of food choices, were cited as a frequent source of conflict by these youth and thought to promote behavior contrary to what was desired (Kools, Kennedy, Engler, & Engler, 2008).

It is important to note that most of the studies on restriction and pressuring have examined these parenting practices among young children, so the effects of such forms of control on adolescents' diets are unclear. As adolescents are further along in their development of self-regulation strategies, they may be less susceptible to the negative influences of coercive feeding practices. Also, controlling feeding practices among adolescents may take the form of strict food related rules, which have been found to be effective in promoting a healthful diet (Van der Horst, Kremers, Ferreira, Singh, Oenema, &

Brug, 2007), whereas parents may use different feeding practices such as pressuring and restricting with younger children.

Another construct that has been recognized to promote both adherence to the diabetes regimen and healthy dietary practices among adolescents is parental monitoring, defined as parents' knowledge of their youth's doings (Kerr & Stattin, 2000). Ellis and colleagues (2007) have even argued that it is not parental involvement, per se, that is related to better outcomes, but rather parental monitoring of whether adolescents complete their diabetes management tasks that is associated with better adherence. Diabetes-specific monitoring has been shown to predict adherence to a greater degree than does parental support for diabetes care (Ellis et al., 2007). In regards to diet, parental monitoring of food choices was the most commonly reported facilitator of healthy eating by youth with T1D (Gellar, Schrader, Nansel, 2008). Consistent with what teens reported, Videon and Manning (2000) found that when parents are present at mealtimes, there is a lower risk of inadequate consumption of fruits and vegetables and teens are less likely to skip breakfast.

As with parental control and involvement with dietary behaviors in adolescence, although parental monitoring appears to have many beneficial effects, there is evidence of a curvilinear relationship between monitoring and adolescents' eating practices: Mellin, Neumark-Sztainer, Story, Ireland, and Resnick (2002) found that parental monitoring promoted a healthy diet to a certain point after which it began to affect eating habits in a negative way. The authors postulate that adolescents require a certain degree of independence in making decisions about food choices given their developmentally

appropriate need to feel autonomous. Alternatively, adolescent behavior may be driving this finding in that youth with more disturbed eating habits may prompt a higher degree of parental monitoring. Laessle and colleagues (2001) also found evidence of the negative effects of parental monitoring; in a sample of preadolescents, obese youth were found to eat larger bites more quickly when their mothers were present compared to when their mothers were not in the room. The authors offered two potential explanations for this finding; the mother may act as a stimulus for eating as a result of parental feeding practices such as pressuring their children to eat, or the mother may represent a social stressor and eating may be a coping response.

There are a number of reasons why parental involvement in the dietary behaviors of adolescents with diabetes may be associated with different outcomes than in adolescents without diabetes. While teenagers are striving towards autonomy and independence from their parents, many teens with diabetes recognize that parental involvement is necessary for successful diabetes management. Although parental involvement in self-care behaviors in normal adolescents may be perceived as intrusive, teens with diabetes may recognize parental involvement as more legitimate given the complex, demanding nature of their dietary regimen.

The effect of specific feeding practices may also differ based on the nature of T1D. Feeding practices that focus on attuning youth to internal signals of hunger and satiety are touted in the broader literature, whereas practices that teach youth to ignore such signals (e.g. pressure to finish one's plate) have been associated with negative outcomes such as

overeating and overweight status. Scaglioni and colleagues (2008) offer recommendations to help parents foster healthy eating habits including “allowing children with normal body mass index to self-regulate total caloric intake” and avoiding the use of pressuring children to eat and restricting access to foods. These recommendations may be less helpful for parents of youth with T1D, however. Youth with T1D must at times ignore their internal states by eating snacks to avoid low blood sugar or practicing strict portion control to avoid hyperglycemia. Thus, it is unclear whether the same parental strategies that are adaptive among the general population would be most effective in parenting a youngster with diabetes. The current study aims to examine the role of parental involvement and monitoring in dietary behaviors of youth with T1D in order to enhance the understanding of these relationships in youth with T1D.

Parenting Style, Diabetes Management, and Diet

Parenting practices, such as parental involvement and monitoring, are important components of understanding adherence behaviors in youth with T1D. However, the relationship of parenting practices to adherence behaviors may also vary by parenting style. Parenting style, or the degree of involvement and warmth that characterizes parent-child interactions, has been shown to be associated with adherence and metabolic control in youth with diabetes, as well as dietary practices in the general adolescent population (e.g. Davis et al, 2001; Cullen et al., 2000).

For example, a few studies have found that authoritative parenting, characterized by high levels of warmth and involvement and high levels of firm control, is associated with improved adherence and metabolic control in youth with T1D (Davis et al., 2001; Sherifali & Ciliska, 2006). Similarly, Hanson (1992) found that children from families which are high in adaptability and exhibit few behaviors that are unsupportive of diabetes care adhere better to their dietary regimen than children from families lower in adaptability and exhibiting more unsupportive behaviors. Although parenting style was not directly assessed in this study, families which are high in adaptability and exhibit few unsupportive behaviors may best characterize authoritative parenting, in that parents are responsive to their child's individual needs and provide warmth and support in helping their child manage their diabetes tasks. The flexibility and support characteristic of this style of parenting may help youth adhere to their dietary regimen.

Furthermore, the use of coercive parenting practices, such as coaxing and physical prompts, during mealtimes has been related to poorer diabetes health outcomes in children (Patton, Dolan & Powers, 2006). However the findings in this area are inconsistent, with other studies demonstrating that families characterized by rigid, controlling environments (e.g. authoritarian parenting) have youth under better metabolic control. It may be that a more controlling, structured environment can better promote adherence to the diabetes regimen given that the demands of successful diabetes management are so complex (Seiffge-Krenke, 1998).

The literature examining the role of parenting styles on dietary practices in the general population, however, tends to support the superiority of an authoritative parenting style in promoting proper nutrition (e.g. Cullen, Baranowski, Rittenberry, & Olvera, 2000). It has been speculated that an authoritative parenting style in which parents are responsive to their child's cues and needs can promote nutrition to a greater degree than authoritarian practices. Some evidence supports this hypothesis, in that children from families with authoritative parenting styles have a lower rate of obesity and consume more fruits and vegetables than those from families with authoritarian parenting styles, who have the highest risk of overweight of all four parenting styles (authoritative, authoritarian, neglectful, and permissive; Cullen et al., 2000; Rhee, Lumeng, Appugliese, Kaciroti, & Bradley, 2006). It is not clear what drives these findings but the authors present two possible explanations: children from authoritarian households may have difficulty with self-regulation of intake as a result of their parents' failure to be sensitive to their needs, or authoritarian households may engender more stress which leads children to eat as a stress response.

Furthermore, certain parenting practices may be more effectively delivered in the context of an authoritative parenting style. For example, restrictive practices were found to be more effective in controlling sugar sweetened beverage consumption when parents used an authoritative parenting style (marked by high warmth and moderate control) rather than an authoritarian style (marked by high control and low warmth; Van der Horst, 2007). Whereas the evidence is inconsistent as to which style of parenting leads to better adherence to the diabetes regimen among youth with T1D, the literature on parenting style and diet

consistently points to the superiority of an authoritative parenting style in promoting healthy dietary practices. However, there is evidence that the benefits associated with an authoritative parenting style are seen mainly in Caucasian families (Leung, Lau, & Lam, 1998). Therefore, it is unclear whether authoritative parenting would have positive effects on diabetes management or diet across ethnicities. It is important to examine the role of parenting style, particularly within the context of specific parenting behaviors such as involvement and monitoring, and its relationship with dietary practices in adolescents with T1D with careful attention to the role of ethnicity in this relationship.

The Current Study

In summary, adolescents' poor dietary practices, including their failure to meet nutritional guidelines and nonadherence to dietary prescriptions, put them at heightened risk for a range of short and long-term complications including cardiovascular disease. One factor that has been associated with improved adherence to the diabetes regimen in youth with T1D is continued parental involvement (Wiebe et al., 1995). For example, shared responsibility for diabetes management tasks and parental monitoring of diabetes-related tasks have been associated with improved adherence and metabolic control among adolescents with T1D (Ellis et al., 2007; Helgeson et al., 2008). Given that adolescents' increasing independence in making meal and snack related decisions appears to contribute to the poor quality of their diet, maintaining parental involvement may be useful in promoting healthful dietary practices. However, little is known about the effects of parental involvement behaviors, such as division of responsibility and parental monitoring, on the dietary

behaviors of adolescents with T1D. Furthermore, the effects of parenting behaviors among youth with diabetes and feeding practices in the general population may vary based on parenting style (Davis et al., 2001; Vander Horst, 2007). Specifically, authoritative parenting practices have been associated with improved diet in children in the general population, whereas the evidence is mixed regarding whether an authoritative or authoritarian parenting style is associated with better adherence behaviors in youth with T1D.

To address the aforementioned gap in the literature on the effects of parenting practices on dietary behaviors the current study will examine the relationship between continued parental involvement and diet in adolescents with T1D. More specifically, this study will investigate the effects of allocation of responsibility for dietary behaviors and parental monitoring of meals and snacks on the dietary intake and BMI of adolescents with T1D. The current study will also test whether the effects of allocation of responsibility and parental monitoring are moderated by whether parents use an authoritative parenting style although high correlations among parenting variables may make such an inquiry difficult.

Hypotheses

Specific predictions include

1. Families in which parents and adolescents share responsibility for dietary behaviors will have adolescents who consume a healthier diet (lower saturated fat intake, lower sugar intake, and smaller calorie discrepancy) as compared to families in which parent or child assume primary responsibility.

2. Higher parental monitoring of meals and snacks will be associated with a healthier quality of diet (lower percentage of fat intake, lower total calories, and higher percentage of carbohydrate intake) and a lower body mass index. Furthermore, quality of diet will mediate the relationship between parental monitoring and BMI.
3. Parenting style will moderate the effect of monitoring such that high levels of parental monitoring will be associated with a healthier diet to a greater extent among parents reported to be authoritative compared to those reported nonauthoritative.

Method

Participants

Data were collected from 213 adolescents (105 females) aged 11 to 15 ($M = 12.87$, $SD = 1.22$) with type 1 diabetes and their caregivers (86% mothers) enrolled in longitudinal randomized clinical trial promoting adherence among adolescents. The majority of participants were Caucasian (66.2%; 18.7% African American; 5.5% Latino; 2.3% Asian-American, 4% Other). Thirty-six percent of adolescents were on a conventional regimen (2-3 injections per day), 22% were on a basal bolus regimen via multiple daily injections, and 40% were on the insulin pump.

Procedure

This study was approved by the Institutional Review Boards at Children's National Medical Center in Washington, DC and Virginia Commonwealth University. Adolescent-caregiver dyads were recruited through outpatient diabetes services at one of two Mid-Atlantic pediatric hospitals to participate in an ongoing longitudinal randomized controlled trial promoting adherence among adolescents with type 1 diabetes. Letters explaining the program were sent home and a follow-up phone call was made to identify interested and eligible participants. Families were screened to determine eligibility based on the following criteria: (a) the adolescent was between 11 and 14 years of age upon participation in the baseline assessment, (b) fluency in English, (c) illness duration of at least one year, and (d) absence of severe diabetes-related complications or other medical diagnoses. Participants were enrolled in the study by a research assistant who obtained written informed consent and

assent from the parent and adolescent. The data used for this study was obtained from baseline assessments conducted at the enrollment visit. During this visit, parents and adolescents each completed a set of self-report measures and a 24 hr recall interview with the research assistant. A second 24 hr recall interview was conducted with the parent and adolescent via telephone within the following three weeks. Dyads were compensated \$25 for completing the baseline assessment, and free parking was made available to study participants.

Measures

Sociodemographics. Parents completed a 39-item self-report questionnaire assessing child and family characteristics including gender, age, ethnicity, family composition, parental marital status, parental occupation and highest education level attained, as well as medical information including date of diagnosis and diabetes regimen (e.g. basal bolus, pump). The Hollingshead four factor index (Hollingshead, 1975) was used to calculate SES scores. Heights and weights were obtained from the medical appointment. Trained research assistants verified medical data through medical record review.

Division of responsibility. Parent and adolescent perceptions of who has responsibility for food-related tasks were assessed through three items from the parent and child versions of the Diabetes Family Responsibility Questionnaire (DFRQ; Anderson, Auslander, Jung et al., 1990). The items come from a scale of 21 items for which each respondent independently rates on a scale of 1 (parent initiates responsibility for this almost all the time) to 5 (child initiates responsibility for this almost all the time) who takes

responsibility for each diabetes management task. Two of the tasks are new items added to address important diabetes management behaviors not included on the original scale (“Deciding what to eat at meals or snacks” and “Finding healthy food choices”). Higher scores indicate more parental responsibility, lower scores indicate more child responsibility, and mid-range scores indicate shared responsibility. The DFRQ has demonstrated good psychometric properties (Anderson et al., 1990).

Parental monitoring. Parental monitoring of meals and snacks was assessed via the 24 hour recall interview (Johnson, Silverstein, Rosenbloom, Carter, & Cunningham, 1986). The 24 hr recall interview (Johnson et al., 1986) was designed to assess adherence behaviors in youth with diabetes. The adolescent and parent are interviewed separately about diabetes care behaviors performed over the previous 24 hrs. During each interview the previous day’s activities were reviewed in a chronological sequence and all diabetes related activities (blood glucose checks, insulin administration, food consumed, and physical activity) were recorded. The interviewer inquired about these areas if not spontaneously generated. For each diabetes related behavior, the participant was asked if a parent observed and/or discussed the event with the adolescent. Each interview lasted approximately 20 minutes. Two interviews with each the parent and the adolescent were conducted within a three week period. Monitoring of meals and snacks was assessed by measuring the percentage of meals that were monitored by the parent through observing or discussing the target behavior. Scores ranged from 1-100 with higher scores indicating a higher degree of parental monitoring.

Quality of diet. Quality of dietary intake from the 24 hr recall interview was analyzed by entering the food consumed into a computer scoring program (The Food Processor TM).

Total calories and saturated fat and sugar grams consumed as well as the percentage of calories from carbohydrates were calculated. Food data reported by the parent and adolescent were combined based on decision rules put forth by Johnson (1985).

Parenting style. Adolescent perceptions of their parents' level of authoritative parenting were assessed through the Parenting Style Index (PSI; Steinberg, Lamborn, Dornbusch, & Darling, 1992). Adolescents indicated the degree to which they agreed with each of 18 statements about their parents on a 4-point Likert Scale (strongly agree (1) to strongly disagree (4)). Items load onto one of three scales: strictness/supervision, psychological autonomy granting, and acceptance/involvement. Composite scores were calculated for each scale. Families who scored above the median for two or three of the scales were classified as authoritative, while families who scored above the median for only one or none of the scales were classified as non-authoritative. Steinberg and colleagues (1992) found the scale to have good psychometric properties (α for scales ranging from .72 to .86).

Results

Statistical Analysis

Data were entered into SPSS 18.0 for Windows. Descriptive statistics were conducted on all study variables. Structural modeling analyses were performed using Mplus software (Mplus Version 3.12, Munthen & Munthen, 2005). The data were screened for outliers, normality and missingness prior to analysis. Data normality was examined by examining skew, a measure of the symmetry of the distribution, and kurtosis, a measure of how peaked or flat a distribution is. Kline (2005) suggests that values above 2.0 for skew and 7.0 for kurtosis are suspect for violations of normality. All values of skew and kurtosis for all study variables fell within the normal range. Mplus allows for the analysis of cases with missing data. Full information maximum likelihood procedure was utilized to include all participants, including those whose data was presumed to be missing at random.

To test model fit several fit indices were examined. The Chi-square (X^2) statistic represents the difference between the predicted covariance matrix based on parameter estimates and the sample covariance matrix. Thus, it reflects the amount of the relationship between the variables that is unexplained by the model. A larger value denotes a poorer fit and a nonsignificant X^2 indicates that the model is a good representation of the data. Root-mean-square error of approximation (RMSEA) measures the error of approximation and estimation in a model. Lower values denote a better fit and an $RMSEA \leq .08$ suggests a close to reasonable approximate fit. The comparative fit index (CFI) assesses the relative

improvement in fit of a specified model compared to the null model. A CFI value greater than .90 indicates a good model fit. Finally the standardized root mean square residual (SRMR) is a measure of the mean absolute correlation residual, and values less than .10 indicate a good model fit.

Descriptive Analyses

Table 1 summarizes the means, standard deviations, and internal consistency estimates of the indicator variables. The results of the *t* tests to examine agreement between parent and youth reports on observed variables are also presented. Parent and youth reports of allocation of responsibility for the three food-related items were significantly different from each other, and only one (“finding healthy food choices”) was significantly, yet mildly, correlated between parents and adolescents. Parent reported scores ($M = 2.86-3.08$) tended to be slightly higher than adolescent reported scores ($M = 2.43- 2.9$), suggesting that adolescents believe they take greater responsibility for their food choices than parents believe they do. However, overall, both parents and adolescents view the adolescent as taking greater responsibility for food choices than the parent. Twenty-seven percent of adolescents endorse that the adolescent is mainly responsible for choosing meals and snacks, whereas only 12% of parents endorse that the adolescent is primarily responsible for the task. Similarly, although 52% of parents reported a complete sharing of responsibility for food choices, only 35% of adolescents endorsed such a division of responsibility. In regards to parental monitoring, parents ($M = 60\%$ and 49%) reported observing and discussing a greater percentage of these eating events than did adolescents ($M = 56\%$ and 39%).

Descriptive information on nutrition variables suggests that adolescents tend to eat less than the recommended number of calories based on their size and activity level. The mean calorie discrepancy was -708.38, indicating that adolescents, on average, consumed 708 fewer calories than would be recommended based on their age, gender, weight, and height. Average sugar consumption was 83.49 grams (SD = 40.65 g) per day. The average saturated fat consumption was 26.06 grams (SD = 11.68 g), which represented 12% of daily caloric intake. A one-sample t-test revealed that this number is significantly above the USDA recommendation to limit saturated fat intake to less than 7% of total calories ($t(206) = 22.39, p < .01$).

For analyses of BMI in children and adolescents, it is most meaningful to interpret BMI percentile -which is calculated based on the child's gender and age-instead of the simple BMI score because a child's body fat changes with age, and the amount of body fat varies for boys and girls. The BMI percentile can then be classified by weight status as underweight (< 5%), healthy weight (5%-85%), overweight (85% - 95%), and obese (> 95%). In this sample, 20% of the children could be classified as overweight and 13% could be classified as obese. In other words, one third of the sample (33%) was above a healthy weight (> 85). Furthermore, in this sample, BMI percentile and overweight status varied by ethnicity, $F(4, 210) = 3.74, p < .01$; $F(4, 210) = 4.769, p < .01$. Seventy-five percent of Hispanics were overweight compared to 44.2% of African Americans and 25.34% of Caucasians.

Table 2 shows the correlations between the observed variables included in the final model. Results revealed several significant bivariate associations. Parental monitoring was related to several other variables. For example, youth who took greater responsibility for

deciding what to eat when away from home reported greater parental monitoring of meals and snacks. Also, scores on the involvement scale of the Parenting Style Index were related to both parent and adolescent reports of the frequency of parental presence for and discussion of meals and snacks. Adolescent report of greater frequency of parental presence for and adolescent and parent report of the frequency of discussion of meals and snacks were related to lower BMI percentile.

Saturated fat and calorie discrepancy were related to BMI. Adolescents who consumed more saturated fat tended to occupy higher BMI percentiles. Surprisingly, calorie discrepancy was significantly negatively correlated with BMI percentile. A more positive calorie discrepancy was associated with a lower BMI percentile. Since most of the sample reported undereating (a negative caloric discrepancy), this could represent a caloric intake closer to the recommended amount. Adolescents with greater BMI percentiles were more likely to report undereating.

Table 3 displays correlations between observed study variables and demographic and medical variables. Age was significantly related to a number of study variables including the parental monitoring variables, adolescent report of division of responsibility, and parental involvement. Older adolescents were less likely to have meals and snacks monitored. They reported greater responsibility for food choices and less involvement from parents. Regimen was significantly related to adolescent report of parental observation of meals and snacks. Adolescents on a basal/bolus regimen or the insulin pump were more likely to report parental presence at meals and snacks than those on standard insulin regimens.

Several diet variables were related to demographic variables. Older adolescents were more likely to report undereating than younger adolescents. Gender was related to sugar and saturated fat consumption in that males consumed more sugar and saturated fat. Ethnicity was related to calorie discrepancy and saturated fat intake: non-white adolescents consumed less saturated fat and were more likely to consume fewer calories than recommended. Regimen was significantly correlated with sugar intake: teens on basal/bolus or pump regimens consumed more sugar than teens on conventional insulin regimens. Regimen was significantly related to BMI ($r = -.157, p < .05$). Adolescents on conventional regimens tended to have greater BMIs.

Measurement Model

A confirmatory factor analysis using Maximum Likelihood (ML) estimation was conducted to determine if the observed indicators loaded onto the hypothesized factors (see figure 1). The two factors were permitted to correlate with one another. The proposed measurement model fit the data well [$\chi^2 = 13.92 (12), p = .31$, RMSEA = .03 (CI= 0.0 - .08), CFI = .99, SRMR = .03]. All the indicators loaded significantly onto the factors (see Table 4). The percentage of meals and snacks that were observed and discussed based on parent and adolescent reports from the 24 hour recall interview loaded onto a Monitoring latent variable, which included four observed variables. The nutritional variables calorie discrepancy, total sugar consumed, and total saturated fat consumed from the 24 hour recall interview loaded onto a latent variable representing Diet Moderation. The calorie discrepancy variable was divided by 1000 because its scale was much larger than that of the

other variables that loaded onto the diet factor. The transformation resulted in a calorie discrepancy variance that was comparable to that of total sugar and saturated fat.

The items from the DFRQ could not be used in the model due to the categorical nature of the variable. Although a weighted least squares estimator could be used to load the indicators onto a factor, this factor could only be used as an outcome variable, not a predictor (UCLA Statistical Consulting Group, n.d.) . To test hypotheses with categorical predictors it is recommended a multiple group analysis based upon category membership be used. This was not possible due to the small number of subjects when divided into the five or, even a composite of three, categories. To address this problem, composite scores from the DFRQ parent and adolescent items were created, but the two indicators would not load adequately onto a factor representing division of responsibility. The DFRQ indicators were thus excluded from all models.

According to Kline (2005), it is permissible to add correlated errors suggested by the modification indices to improve model fit when the addition is theoretically justified and does not change the causal model. As such, a correlated error between two monitoring indicators, the child's and parent's report of frequency of discussing meals, was included in the final model. Shared variance would be expected among these variables given that they are referring to each respondent's view of the same event.

Hypothesized Model 1: Diet as a Mediator of the Effects of Parental Monitoring on BMI

The next step was to test the structural model, which posited that quality of diet mediated the relationship between parental monitoring and body mass index. First, the

model was tested without covariates. The first step was to establish that there was a relationship between parental monitoring and BMI percentile. This model fit the data adequately [$\chi^2 = 15.64$ (4), $p < .01$, RMSEA = .117 (CI = .06 - .18), CFI = .91, SRMR = .05]. Parental monitoring was significantly associated with BMI percentile ($\beta = -.18$) in that more frequent monitoring was related to a lower BMI. Next, Diet was added to the model as an intervening variable to test whether Diet mediates the relationship between Monitoring and BMI. Model results indicated an adequate fit to the data [$\chi^2 = 34.04$ (17), $p < .01$, RMSEA = .07 (CI = .03 - .1), CFI = .93, SRMR = .05]. The model including standardized path coefficients is presented in Figure 1. Significant path coefficients are bolded. The significant path between Monitoring and BMI was not retained with the addition of Diet. Unexpectedly, the latent variable representing Diet was significantly negatively related to BMI percentile such that higher consumption of calories, sugar, and saturated fat was associated with a lower BMI. However, the Monitoring variable was not significantly related to Diet. To test whether there was an indirect relationship between Monitoring and BMI via its effect on Diet, a test of indirect effects was conducted. The rationale behind this test is that monitoring has a direct effect on diet, but only part of this effect is transmitted to BMI. A significant indirect effect did not emerge.

Next, demographic covariates were added to the model to control for the effects of gender, age, and race. Demographic variables were included as covariates if they were found to be significantly correlated with at least one of the indicators measuring monitoring or diet or with BMI percentile. For the sake of model parsimony, only paths with significant or close to significant path loadings were included. When paths from gender and age were

added to the Diet latent variable, the model would not converge. To test for direct effects of gender on each of the diet indicators, a model in which no direct effects were included was compared to a model that included a path from gender onto each indicator individually. Comparisons were conducted using a chi square difference test. Results indicated that only the direct effect from gender onto the calorie discrepancy variable was significant ($\chi^2\Delta = 25.86 (1), p < .01$). This suggests that calorie discrepancy measures the diet factor differently for girls and boys. The same procedure was used for testing for direct effects of age on the diet indicators. Results indicated that the direct effect from age onto calorie discrepancy was also significant ($\chi^2\Delta = 25.86 (1), p < .01$). Therefore, in the mediation model with covariates, these discrepancies were controlled for by adding paths from gender and age to the calorie discrepancy indicator. This addition permitted the model to converge, and improved model fit [$\chi^2 = 42.05 (28), p < .05$, RMSEA = .05 (CI = .01 - .08), CFI = .96, SRMR = .05]. Age significantly predicted Monitoring in that parental monitoring of meals and snacks became less frequent with increasing age. Gender significantly predicted diet in that males consumed more calories, sugar, and saturated fat. Race was not significantly associated with diet or BMI percentile, so it was not included as a covariate. In the final model with covariates, the significant relationship between diet and BMI percentile remained; greater consumption of calories, sugar, and saturated fat was associated with a lower BMI percentile. In addition, the relationship between monitoring and BMI percentile became significant at the trend ($p = .08$) level such that more frequent monitoring was associated with a lower BMI percentile. This final model explained 32% of the variance in diet and 10% of the variance in BMI.

To further examine the measurement variance for girls and boys, gender was used as a grouping variable to test whether the measurement model assessed the constructs equivalently among males and females. The model would not converge when factor loadings were permitted to vary by gender. Examination of separate measurement models for each gender revealed that the calorie discrepancy variable yielded a negative (albeit non-significant, $p = .13$) residual variance in females, suggesting the Diet factor does not adequately measure dietary intake in girls. Therefore, separate models were tested for each gender. For boys, the mediational model described above was tested. However, with the addition of BMI percentile to the structural model, calorie discrepancy no longer loaded adequately onto the diet factor for boys.

Thus, for each gender three models were examined that included each of the observed nutritional variables instead of combining them into the latent variable representing diet. Age was included in all models because increasing age was associated with less frequent monitoring. Race was included in all female models as it was significantly related to BMI percentile- non-white girls were more likely to have a higher BMI percentile.

In girls, the model including calorie discrepancy fit the data well [$\chi^2 = 21.01$ (17), $p = .23$, RMSEA = .065 (CI = .00 - .11), CFI = .96, SRMR = .06]. The path for Monitoring on calorie discrepancy ($\beta = .30$) was significant. More frequent monitoring was associated with less undereating relative to the recommended caloric intake.

The model including saturated fat in females fit the data well [$\chi^2 = 19.74$ (17), $p = .29$, RMSEA = .04 (CI = .00 - .10), CFI = .97, SRMR = .06]. Saturated fat intake was not

significantly related to monitoring or BMI percentile. The model including sugar also fit the data well [$\chi^2 = 19.22$ (17), $p = .32$, RMSEA = .04 (CI = .00 - .10), CFI = .97, SRMR = .06].

Sugar intake was not significantly associated with monitoring or BMI percentile.

In boys, the model including calorie discrepancy with covariates provided a marginal fit the data [$\chi^2 = 125.26$ (27), $p = .00$, RMSEA = .08 (CI = .02 - .13), CFI = .89, SRMR = .06]. Calorie discrepancy was significantly, negatively correlated with age and race. Older, non-white boys reported consuming fewer calories than recommended to a greater extent than younger, white males. BMI percentile was related to age in that older boys had lower BMI percentiles. Monitoring was not related to calorie discrepancy or BMI percentile. Calorie discrepancy was negatively related to BMI percentile. Boys with greater BMI percentiles reported eating fewer calories relative to their ideal calories.

The model for boys including sugar with covariates did not fit the data well [$\chi^2 = 39.52$ (17), $p < .01$, RMSEA = .11 (CI = .06 - .15), CFI = .76, SRMR = .09]. Therefore, significant paths will not be discussed. The model including saturated fat with covariates fit the data marginally [$\chi^2 = 25.26$ (12), $p < .05$, RMSEA = .10 (CI = .04 - .15), CFI = .83, SRMR = .06]. Saturated fat was not significantly related to parental monitoring or BMI percentile.

Hypothesized Model 2: Parenting Style as a Moderator of the Effects of Parental Monitoring on Dietary Intake.

The autonomy and involvement subscales on the PSI yielded reliabilities of .65 and .70, respectively. To achieve acceptable reliability (.70) for the autonomy scale, 4 items had

to be dropped from the scale. Given the low reliabilities of the subscales and the lack of correlation with other study variables, a moderation analysis with the PSI was not undertaken.

Alternate Model

Since causality cannot be examined in a cross-sectional study, the direction of influence may differ from the hypothesized model. Therefore, it is important to investigate the fit of an alternate model to better interpret these results. An alternate model was tested in which BMI percentile predicted parental monitoring which predicted dietary intake (see figure 5). This model fit the data adequately; [$\chi^2 = 41.02$ (18), $p < .01$, RMSEA = .08 (CI = .04 - .11), CFI = .90, SRMR = .06]. BMI percentile was significantly associated with monitoring; parents of children with higher BMI percentiles were less likely to monitor snacks and meals. The path between diet and monitoring was not significant. Next, gender and age covariates were added to the alternate model (see figure 5). The model provided an adequate fit to the data; [$\chi^2 = 57.35$ (27), $p < .01$, RMSEA = .07 (CI = .05 - .10), CFI = .91, SRMR = .05]. The path between BMI percentile and monitoring retained significance. No other paths became significant with the addition of covariates. This model explained 22% of the variance in monitoring and 6% of the variance in diet.

Discussion

Parental involvement has been cited as a key protective factor in the deterioration of adherence to the diabetes regimen as children become adolescents (Ellis et al., 2007; Wiebe, 1995). However, most of these studies have only examined A1C levels and blood glucose testing and insulin injection frequency as adherence outcomes (e.g. Anderson et al., 2002). Although diet is recognized as a central component to adherence, dietary patterns are often ignored in these studies. The current study examined the influence of parental monitoring on dietary patterns and BMI in adolescents with type 1 diabetes. Specifically, this study tested whether diet mediates the relationship between parental monitoring and BMI in adolescents with type 1 diabetes. Furthermore, the influence of gender and parenting style on this relationship was explored. Although parental monitoring was found to be associated with BMI, the results provided little support for the role of diet as mediator between parental monitoring and BMI. However, certain limitations regarding the assessment of dietary patterns in these youth may limit the current study's potential for generating significant findings.

The findings of this study contribute to the literature in this field in two ways. First, this study offered a snapshot of specific dietary patterns of adolescents with type 1 diabetes. Second, it provided additional data on the use of the RI for collecting dietary intake information as well as for assessing parental monitoring through a recent adaptation to the RI. This adaptation includes additional questions about parental presence during, and discussion of, eating events.

Descriptive findings for parental monitoring, diet, and BMI

The current study relied on both the parents' and the adolescents' perception of parental monitoring. In this study parents tended to report a higher frequency of monitoring than was reported by adolescents. Adolescents may have consumed additional meals or snacks of which their parents were entirely unaware, so their parents would not have taken these meals into account in reporting how often they discussed and observed their adolescent's meals. In addition, parents may report monitoring more eating events due to social desirability concerns. Doctors frequently recommend that parents continue to monitor their teenager's diabetes management. Since this study was conducted through the hospital in which families received their diabetes care, parents may have been inclined to overreport the frequency with which they monitored meals and snacks in order to be viewed as adherent to medical advice.

This study also shed light on the dietary patterns and weight status of adolescents with type 1 diabetes. The descriptive information on the nutritional variables from the RI in this study was consistent with previous investigations on the diet of youth with T1D. Helgeson and colleagues (2006), who also used the RI with adolescents and their parents, observed similar dietary issues. Adolescents consumed less than the recommended daily allowance for energy intake, and consumed more fat than recommended. Helgeson et al. (2006) found that females and males tended to consume 12.86% to 13.26% of their daily energy intake from saturated fat, which is similar to the 12% reported in the current study. This is particularly alarming due to the increased cardiovascular risks that individuals with type 1 diabetes face.

This study also assessed BMI, which allowed for the investigation of the association between weight status and dietary patterns. One-third of the adolescents in the current sample were overweight, and 13% were obese. Data from the National Health and Nutrition Examination Survey 2007-2008 reveal similar estimates: 34.2% of adolescents were above the 85th percentile, and 18.1% of adolescents aged 12-19 were above the 95th percentile and classified as obese (Ogden, Carroll, Curtin, et al., 2010). These figures are also comparable to estimates specific to youth with T1D, although these findings also indicate a higher prevalence of overweight in diabetic youth. In the national study the rates of obesity and overweight were found to vary by ethnicity. Similarly, in this sample, rates of overweight varied by ethnicity as well. Three-quarters of Hispanics were overweight compared to nearly half of African Americans and one-quarter of Caucasians. The sample size for Hispanic teens did, however, include only 12 participants; results should therefore be interpreted cautiously.

Interestingly, non-whites tended to consume fewer calories and less saturated fat than Caucasians. This is consistent with previous research, which finds that African American adults consume fewer calories and less fat than Caucasian adults (Block, Rosenberger, & Patterson, 1988) and that Hispanic toddlers consume less saturated fat than non-Hispanic toddlers (Ziegler, Hanson, Ponza, Novak, & Hendricks, 2006). There are several possible explanations for the discrepancy between weight status and energy intake. Differences in metabolic efficiency between ethnicities have been proposed as one explanation. Block and colleagues (1988) found that divergent caloric intake remained even after accounting for differences in weight and physical activity. Alternatively, non-white participants may have

underreported their food intake to a greater extent than white participants. Champagne (1996) found that African-American children underreported energy intake to a greater degree on RIs than Caucasian children. Furthermore, youth who are overweight are more likely to underreport energy intake (Fisher, Johnson, Lindquist, Birch, & Goran, 2000). One reason may be that overweight individuals may be more sensitive to others' scrutiny of their diet as a result of the stigma associated with overweight. Since a greater number of non-white participants were classified as overweight compared to white participants, these minority participants may have felt more sensitive to the interviewer's perceptions of their diet.

Measurement Model for Parental Monitoring and Diet

The results of the current study provided limited support for the hypothesized measurement model. Although the measurement model supported the hypothesis that parent and adolescent perceptions of parental monitoring could be combined into a single latent factor, the factor representing diet was more complex. When the sample was dichotomized by gender, the measurement model did not hold up for the diet factor. This suggests that the most effective ways to measure diet may be distinct for boys and girls. This is not surprising given the many gender differences in dietary patterns that abound in the literature (Block, Rosenberger, & Patterson, 1988; Helgeson et al., 2006). For example, boys are consistently found to consume more calories, fat, and cholesterol (Block et al., 1988). Another reason that the diet variables may assess distinct constructs for each gender is due to differential reporting biases. Girls often feel greater pressure to be thin or maintain their weight than boys. Adolescent girls in the current study may have been less likely to honestly report

unhealthy food choices to the interviewers (who were often young females) than boys due to this social pressure.

Mediating model for monitoring, diet, and BMI.

Results of modeling provided only very limited support for the hypothesis that parental monitoring would influence dietary patterns, which, in turn, would be related to BMI. Parental monitoring was significantly associated with BMI as hypothesized: increased parental monitoring was associated with a lower BMI. This is consistent with other research highlighting the protective influence of parental monitoring on a number of health related behaviors, including BMI (Ellis et al., 2007; Faith et al., 2004). In a sample of elementary school children, Faith and colleagues (2004) found that parental monitoring of fat intake predicted a decreased BMI at a two year follow-up. However, in the present study when the diet factor was added to the model in the entire sample, parental monitoring was not significantly related to diet, and diet was, unexpectedly, negatively significantly related to BMI. A higher calorie discrepancy and greater consumption of sugar and fat appeared to be related to a lower BMI. Although this was counter to expectations, this is consistent with other studies on dietary intake of adolescents, including those with T1D. Wilson and Smith (2003) found that females on the insulin pump had the highest BMIs in the sample despite reporting the lowest calorie intake. As discussed later, this may represent a subject-specific bias in which individuals with higher BMIs tend to underreport calorie consumption to a greater degree than individuals with lower BMIs. Alternatively, Wilson and Smith (2003) suggest that this unexpected finding may be due to restricted eating in these girls. There is

some evidence that females with T1D, especially those with greater BMIs, may be at higher risk for disordered eating (Meltzer, Johnson, Prine, Banks, Desrosiers, & Silverstein, 2001).

The mediation model was also tested with the inclusion of key demographic variables. Significant paths were found between age and parental monitoring, diet, and calorie discrepancy. As would be expected, increasing age was associated with less frequent parental monitoring. As adolescents become more mature, the need for parental monitoring diminishes. Many times, however, parental involvement deteriorates as a function of age rather than maturity level (Palmer, 2004). Older adolescents tended to report undereating to a greater extent than younger adolescents. Paths between gender and diet and calorie discrepancy were also significant. The model converged and better fit the data when a direct effect for age and gender on calorie discrepancy was included in the model. This suggests that the number of calories reported varies based on the age and gender. Furthermore, the calorie discrepancy variable appeared to measure diet distinctly for different ages and genders, and the overall diet factor did not measure the constructs equivalently for each gender. These associations highlight the importance of considering age and gender when investigating dietary patterns and parental involvement.

Models Examined Separately By Gender

Since the data suggested that the nutritional indicators measured diet differently in girls and boys, separate models were tested in each gender for each nutritional indicator (calories, sugar, and saturated fat). The models tended to provide a better fit to the data among females than males. For females, parental monitoring was associated with calorie

discrepancy. More frequent monitoring was associated with less undereating. Parents may be more likely to notice and be concerned about restrained eating in girls than in boys since girls are more likely to develop eating disorders (Hoek & van Hoeken, 2003; LaPorte, 1996). Also, parental monitoring may represent a greater protective factor in girls than boys due to their vulnerability to disordered eating. The effect of different parenting practices on diet may differ by gender due to the significant differences between the eating habits of girls and boys. In addition, the greater risk for eating disturbances among females may make parents more sensitive to speaking about food related issues with girls.

Alternatively, the effect may actually be a product of the fact that if parents monitor their teen's eating more frequently, they are better able to accurately report their food intake. The parents who monitored their children's food intake may have reported the dietary intake more accurately, thus leading to less underreporting. When the teenager is the more reliable source for dietary intake, reports of undereating may be more common since teens tend to underestimate portion sizes, they forget to report snacks, and they are more vulnerable to social desirability biases (Livingstone, Robson, & Wallace, 2004). However, it is unclear why this effect would be found only in girls. It may be that there was insufficient power to detect the relationship in boys.

Alternate Model

An alternative model, in which BMI predicted parental monitoring, which predicted dietary patterns, was tested with the full sample because the direction of causality cannot be determined from data at a single time point. The data fit the model adequately. However, it

makes more theoretical sense to assume that parental monitoring influences BMI rather than vice versa, since more frequent monitoring was associated with a lower BMI. One alternate explanation that has been proposed is that parents may be more inclined to monitor thinner children due to concerns about inadequate food intake (Faith et al., 2004). This explanation seems to be more appropriate for younger children, whose nutrient intake and growth is a more salient issue, than for teenagers. Furthermore, given that most of the sample was at a normal weight and that there were few individuals who were underweight, this explanation may not be as relevant to this sample.

Parenting Style as a Moderator

The PSI subscales demonstrated poor internal consistency in the current study, which differed from the standardization sample (Steinberg et al., 1992). Parenting style has been reliably measured in adolescents with T1D with the Child Report of Parent Behavior Inventory (CRPBI) (Butler et al. 2007), although a separate study using the Parenting Dimensions Inventory (PDI) in a sample of elementary school-aged children (Davis et al., 2001) did show poor internal consistency of the strictness scale ($\alpha = .41$). It is unclear why the PSI achieved such poor internal consistency in the current sample. It may be that the construct of autonomy from parents is somewhat different in adolescents with T1D, and thus certain items on autonomy scales may behave differently in this population compared with nondiabetic youth. Parents often must stay involved with personal choices to a greater degree in these youth in order to help with diabetes management. As a result of the poor internal consistencies, it was not possible to test whether the effect of parental monitoring on diet varied based on parenting style. Since many studies have found that a controlling style

of parental feeding practices is associated with overweight status and dysregulated eating (e.g. Van der Horst et al., 2007), monitoring done in an authoritative rather than authoritarian manner may be more effective. Future studies should assess this with a measure of parenting style that is reliable and valid in this population.

Limitations

A major limitation to the current study was the sample size. Although the sample size was adequate for structural equation modeling with the entire sample, when dichotomized into groups based on gender, there may not have been sufficient power to detect associations between constructs. As a rule of thumb, sample sizes above 200 are considered “large” and are above the recommended minimum for SEM analyses (Kline, 2005). A post-hoc power analysis of the model by gender indicated that a sample size of 237 participants would be needed to achieve a power of 0.8 (80%), which indicates that the analyses dichotomized by gender may not have sufficient power to detect significant relationships. The limited sample size also prevented the examination of these relationships among different ethnicities or individuals of different weight status, which could be important for future work.

Another limitation was the method used to assess dietary intake. Although the RI has been shown to be a reliable and valid method of assessing diabetes related adherence behaviors through demonstrated agreement with parent report and direct observation of children’s behaviors, it has also been acknowledged that children tend to underreport many dietary behaviors (Freund, Johnson, Silverstein, & Thomas, 1991; Reynolds, Johnson, & Silverstein, 1990). Most studies of dietary patterns in youth are plagued by methodological

difficulties associated with reporting errors. Recently, validation studies have been conducted in which biomarkers can be used to gauge energy intake and expenditure. Results from these studies consistently show that adolescents are prone to error, most notably underestimation, in reporting their energy intake (Livingstone, Robson, & Wallace, 2004). There are several reasons why teens tend to underreport their food intake. First, youth and even adults are notorious for underestimating portion sizes (Matheson et al., 2002, Chambers et al., 2000). They may believe that they ate less food than they actually did, even if they do not have any problems with recall. Furthermore, teens do not always pay a great deal of attention to what they are eating, so they may not realize how much they ate. This makes it difficult for them to accurately recall portion sizes at a later time. Additionally, the reliance on memory makes dietary recall prone to error, especially among youth. Fries and colleagues estimated that up to 30% of food intake for the previous day may be forgotten (1995). As the number of foods at a certain meal increase, youth may be less able to recall each food as the memory load increases. Furthermore, the irregular eating schedules and patterns of teenagers make it even more difficult for them to remember and accurately capture their dietary intake.

Further complicating dietary assessment, underreporting tends to vary by a number of respondent characteristics such as age, gender, and overweight status. Studies of older adolescents tend to find more frequent underreporting of energy intake than studies of younger adolescents (Livingstone, Robson, & Wallace, 2004). This is likely due to the fact that parents are often asked to report on their children's diets and may be better reporters for younger adolescents. As adolescents get older and spend less time at home, parents are no

longer as knowledgeable regarding their meals and snacks. Parents may be less susceptible to memory errors, underestimating portion sizes, and social desirability bias. Individuals with higher BMIs have been found to underreport energy intake, as well (Fisher et al., 2000).

Given the prevalence of weight concerns among adolescents, teens with greater body fat may feel more stigmatized and may underreport consciously or unconsciously to garner social approval. Also, teens with higher BMIs are more likely to diet, so their underreports may reflect, at least in part, an unrepresentative day/s in which they did restrict food intake or how they intend to eat. They may be more motivated to believe that they ate less in an attempt to appear congruent with their intention to diet. Since females tend to experience more pressure to be thin and more frequent weight concerns, they may be especially vulnerable to social desirability bias that may lead them to underreport unhealthful food choices.

Another possible reason for why we failed to find an association between monitoring and the dieting variables is that certain forms of monitoring and discussing food options may be more effective than others. Our measure assessed whether parents observed and discussed meals and snacks with their child. Merely observing and speaking about food may be insufficient to prompt healthier eating. It may be that specific strategies, such as discussing the saturated fat content or suggesting alternative options, are associated with a healthier diet, while monitoring in general is not. Parents may be unaware of how to effectively broach the topic of what to eat with their children. In a qualitative study on developing effective health messages, Borra and colleagues (2003) found that many parents would welcome guidance for discussing and providing positive reinforcement for healthy eating. Furthermore, the authors concluded that parents need to learn how to talk to their children about healthful eating in a

positive, encouraging manner. In the literature on parenting practices and eating, controlling practices are often cited as factors that lead to dysregulated eating patterns. Parents should therefore learn to discuss food choices in a positive manner, which their children will not perceive as controlling.

Future Directions

This study highlights a number of important avenues for future investigations into the familial influences on dietary patterns and BMI in adolescents with T1D. First and foremost, is the development of a measure that can reliably and validly assess dietary intake in adolescents. Alternate ways of scoring the RI may be more effective in capturing the quality of diet in these youth. For example, assessing adequacy (the number of foods eaten in each food group), variety, and the consumption of unhealthy foods (foods fried or foods high in added sugar) may lead to a more valid measure of healthy eating (Niklas, 2004). Another option is to rely on more technological methods for accurately assessing dietary information. Boushey and colleagues (2009) found that teenagers preferred dietary assessment measures that used technology such as personal digital assistants (pdas) and digital cameras. The authors stated their intention to develop a mobile computing device that can capture food images and use image analysis to quantify the amount of food consumed.

Once a more valid instrument has been developed to assess dietary intake, the relationship between parental involvement constructs and diet should be investigated. Constructs to be considered include parental monitoring, sharing of responsibility, and measures of specific feeding practices, such as restrictive practices, to better understand the

influences of such parenting practices on diet. Future studies can also investigate the effect of parenting style on the relationship between parenting practices and diet. These studies should include a parenting style measure that has been shown to reliably assess the construct in the families of adolescents with T1D. Furthermore, given the higher prevalence of overweight and distinct dietary patterns among ethnic minorities, future investigations should focus on a more diverse sample of adolescents with T1D in order to better understand the influence of the family and possible strategies to address overweight in this population.

Clinical Implications

The results of this study offer various clinical implications for those working with the families of teenagers with T1D. The finding that teens on basal bolus regimens consume more sugar than teens on a conventional regimen suggests that clinicians must be attuned to how teens and their parents view the transition to basal bolus regimens. Clinicians must be sure that adolescents understand that switching to a basal bolus regimen does not give them license to consume as much sugar as they wish. Although this regimen does offer greater flexibility in their diet, sugar intake still needs to be carefully monitored and limited. Furthermore, nutritionists once emphasized that a “carb is a carb,” regardless of whether it comes from fruit, bread, legumes, dairy. Carbohydrate counting diets imply that all carbohydrates have the same effect on blood glucose levels. Today, clinicians better understand that certain carbohydrates affect blood sugar in different ways (Gilbertson et al., 2001; Jenkins, Wolever, & Taylor, 1981). Refined sugars tends to have more immediate effects on blood sugar and can cause more severe spikes in blood sugar than do complex carbohydrates. Clinicians should ensure that teenagers and their families understand these

principles before they transition to more flexible regimens such as basal bolus or the insulin pump.

Another area in which families need further education is the importance of limiting saturated fat intake. While parents may be vigilant about monitoring the amount of carbohydrates their teens consume, they may be less concerned about saturated fat intake. Saturated fat consumption may seem less critical since it does not have the immediate effects on health that carbohydrates do. Nevertheless, parents must understand the negative long-term effects associated with high saturated fat intake. In regards to saturated fat, and healthy eating in general, parents may need more tools for discussing dietary choices with teenagers in a sensitive, positive, and encouraging manner.

Healthcare workers meeting with adolescents with T1D should be aware of the difficulty inherent in obtaining accurate reports of their dietary intake. They should try to minimize social desirability bias and rely on parents in addition to adolescents to try to accurately capture the dietary patterns of their teenage patients.

The results of this study highlight the need for valid instruments for assessing dietary intake in adolescents with T1D. In addition, the results from this and other studies suggest that parental monitoring can be a protective factor for preventing high BMI. It may be useful to teach parents effective communications strategies to discuss healthy eating with their teens, especially concerning saturated fat intake. Interventions that promote parental involvement in the diabetes care regimen, such as the one from which the current data was drawn, may be ideal settings to impart these skills.

APPENDIX 1

Table 1. Means, standard deviations, and reliability estimates of observed variables

	Parent			Child			
	M	SD	α	M	SD	α	
DFRQ 11	2.86	1.03	-	2.50	1.21	-	
DFRQ 19	2.86	1.00	-	2.43	1.13	-	
DFRQ 20	3.08	1.00	-	2.90	1.11	-	
PSI-A	-	-	-	16.68	4.28	.65	
PSI-I				29.84	4.14	.71	
24RI Cal Disc	-708.38	688.1	-	-	-	-	
24RI Sat Fat	26.06	11.68	-	-	-	-	
24RI Tot Sugar	83.49	40.65	-	-	-	-	
24RI Observe	60.66	23.22	-	56.12	25.21	-	
24RI Discuss	48.86	30.68	-	39.35	32.08	-	

DFRQ- Allocation of Responsibility Measure, PSI-A- Parenting Style Inventory Autonomy-Granting Subscale, 24RI- 24 HR Recall Interview, Cal Disc-Calorie Discrepancy, Sat Fat-Saturated Fat, Tot Sugar- Total Sugar, Observe- % Meals Observed, Discuss- % Meals Discussed

Table 2. Correlations between observed variables.

	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. <i>PDFRQ 11</i>	.40**	.20*	.02	.04	.07	-.03	.04	-.05	-.07	-	-.07	-.01	.00	-.06
2. <i>PDFRQ 19</i>	--	.33**	.03	.06	.05	-.02	.05	.01	.01	-	-.04	-.04	-.04	-.05
3. <i>PDFRQ 20</i>		--	.10	.20*	.17*	-.12.	.07	-.12	-.05	.05	.03	-.06	-.04	-.11
4. <i>CDFRQ 11</i>			--	.34*	.41*	.08	.09	.14*	.11	-	-.13	-.01	.01	-.04
5. <i>CDFRQ 19</i>				--	.41*	.05	.07	.08	.09	-	-.10	-.10	.02	-.19*
6. <i>CDFRQ 20</i>					--	.05	.06	.12	.08	-	.06	.03	.06	-.04
7. <i>P24RI Dis</i>						--	.30**	.45**	.23**	.10	.06	-.03	.20*	.02
8. <i>P24RI Obs</i>							--	.27**	.44**	.14	.03	.08	.24**	.02
9. <i>C24RI Dis</i>								--	.38**	.08	.01	-.04	.28**	.09
10. <i>C24RI Obs</i>									--	.12	-.05	.06	.26**	.08
11. <i>Cal Disc</i>										--	.30**	.52**	.09	.04
12. <i>Sugar</i>											--	.286*	-.05	.00
13. <i>SatFat</i>												--	-.14	.04
14. <i>PSI Inv</i>													--	.19**
15. <i>PSI Aut</i>														--

PDFRQ- Parent-report Allocation of Responsibility Measure, CDFRQ- Child-report Allocation of Responsibility Measure, P24RI- Parent 24-hr recall interview, C24RI- Child 24-hr recall interview, Dis-% Meals Discussed, Obs- % Meals Observed, Cal Disc- Calorie Discrepancy, SatFat- Saturated Fat, PSI Aut- Parenting Style Inventory Autonomy-Granting Subscale.

Table 3. Demographic correlates of observed variables.

	<i>Gender</i>	<i>Age</i>	<i>Ethnicity</i>	<i>SES</i>	<i>Marital Status</i>	<i>BMI %</i>	<i>Regimen</i>
1. <i>PDFRQ 11</i>	.01	.00	-.06	.02	-.02	.13	-.10
2. <i>PDFRQ 19</i>	.00	.03	.06	-.03	.08	.12	-.14*
3. <i>PDFRQ 20</i>	-.08	-.05	.09	.02	.13	.02	-.29**
4. <i>CDFRQ 11</i>	-.06	-.20**	.07	-.23**	.20**	-.04	-.21**
5. <i>CDFRQ 19</i>	-.13	-.24**	.11	-.29**	.31**	-.11	-.25**
6. <i>CDFRQ 20</i>	-.16*	-.14*	.04	-.25*	.12	.00	-.06
7. <i>P24RI Dis</i>	.01	-.20**	-.12	.13	-.03	-.20**	.07
8. <i>P24RI Obs</i>	-.06	-.30**	-.00	-.03	.09	.02	.02
9. <i>C24RI Dis</i>	-.05	-.24**	-.09	.09	-.04	-.18*	.09
10. <i>C24RI Obs</i>	-.07	-.26**	-.08	-.07	.06	-.15*	.23**
11. <i>Cal Disc</i>	.02	-.27**	-.16*	.09	.04	-.26**	-.02
12. <i>Sugar</i>	-.28**	.09	-.11	.12	-.06	.09	.18**
13. <i>SatFat</i>	-.22**	.06	-.15*	-.13	.08	.15*	-.08
14. <i>PSI Inv</i>	.03	-.30**	-.15*	.12	-.08	-.10	.13
15. <i>PSI Aut</i>	.05	-.09	-.16*	.00	-.13	-.06	.18*

PDFRQ- Parent-report Allocation of Responsibility Measure, CDFRQ- Child-report Allocation of Responsibility Measure, P24RI- Parent 24-hr recall interview, C24RI- Child 24-hr recall interview, Dis-% Meals Discussed, Obs- % Meals Observed, Cal Disc- Calorie Discrepancy, SatFat- Saturated Fat, PSI Aut- Parenting Style Inventory Autonomy-Granting Subscale, SES- Socioeconomic Status, BMI%- Body Mass Index Percentile.

Table 4. Summary of Measurement Model

Latent Variable	Factor Loadings (male/female)	Standard Error (male/female)
1) Parental Monitoring (RI)		
Parent Report: Observed Meals/Snacks	.62 (.60/.66)	.00 (.00/.00)
Parent Report: Discussed Meals/Snacks	.36 (.38/.32)	.20 (.27/.29)
Child Report: Observed Meals/Snacks	.74 (.83/.61)	.29 (.52/.31)
Child Report: Discussed Meals/Snacks	.46 (.42/.51)	.24 (.34/.33)
2) Quality of Diet (RI)		
Saturated Fat	.68	.00
Calorie Discrepancy	.77	.02
Total Sugar	.40	.05

RI- Recall Interview.

Figure 1. Basic Measurement and Structural Model

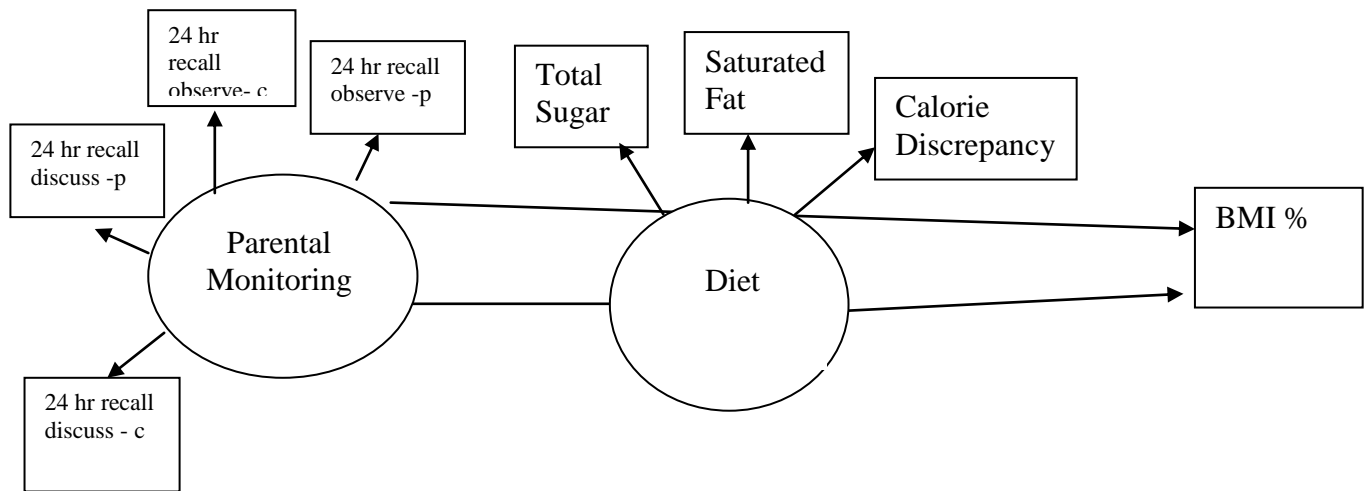
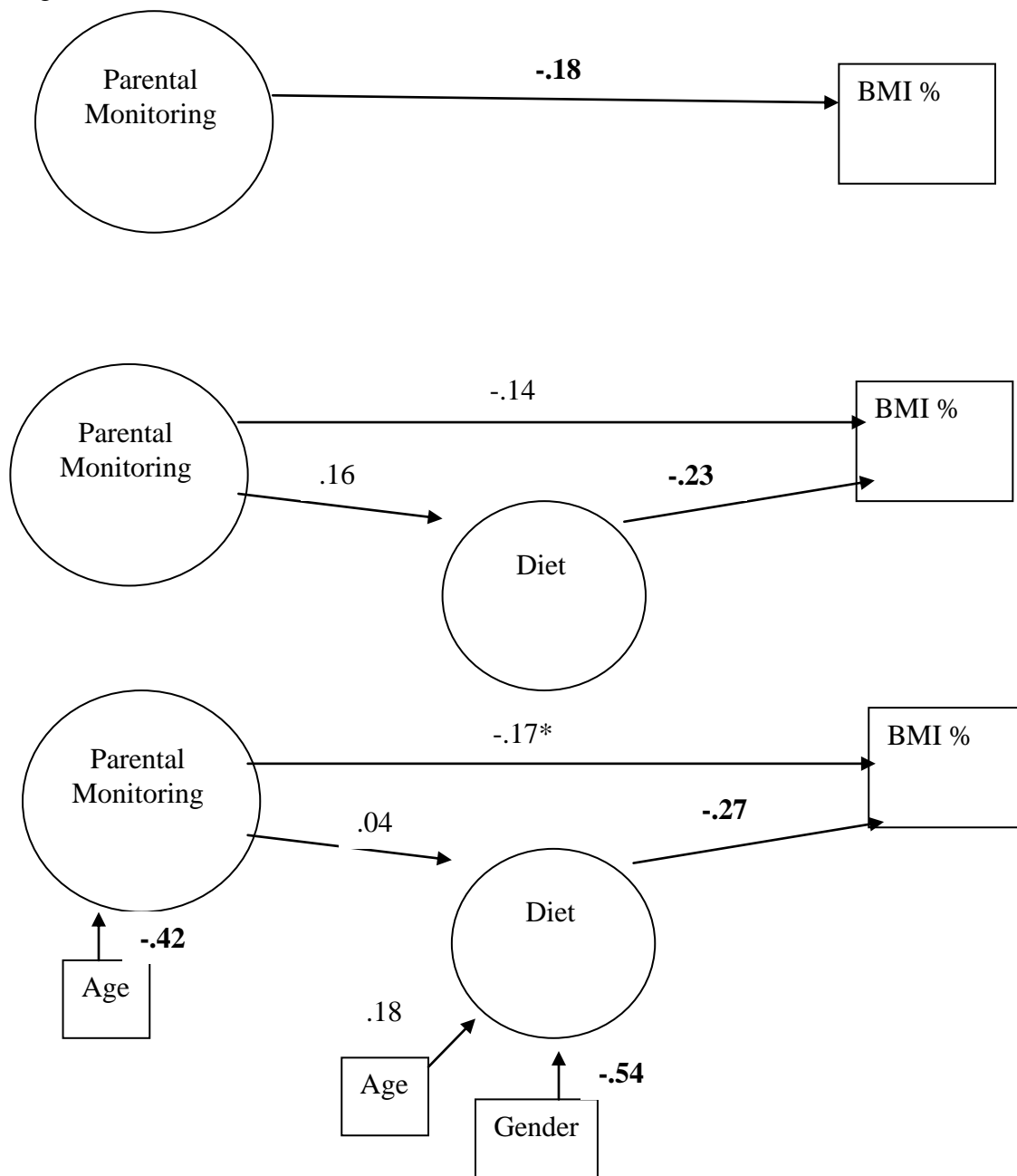


Figure 2. Mediation Model

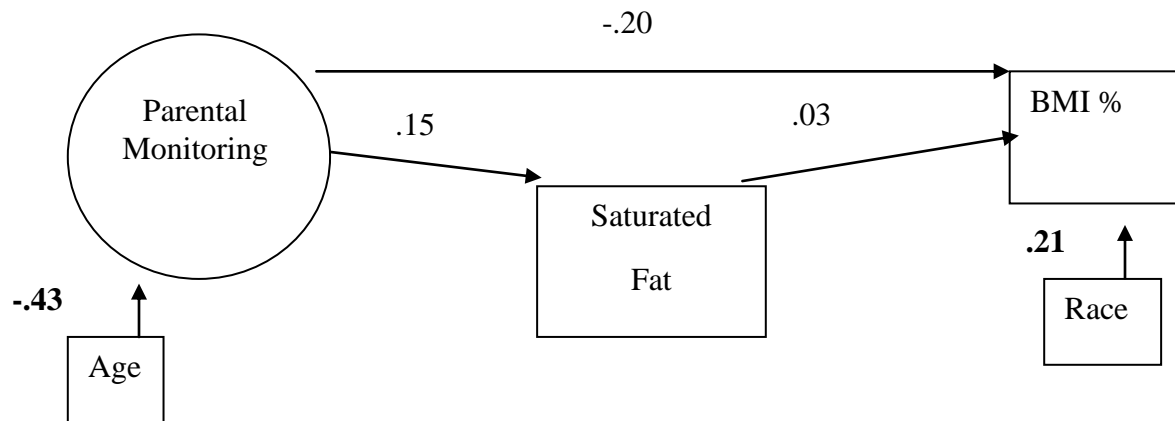
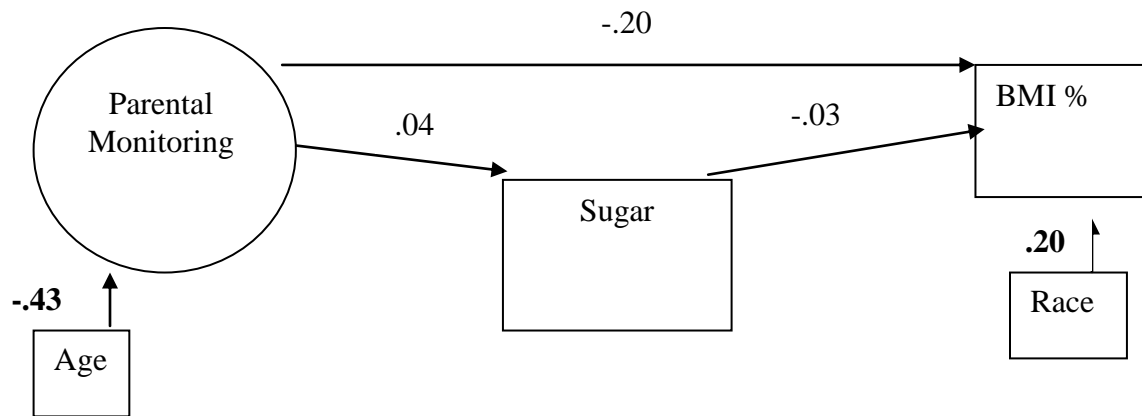
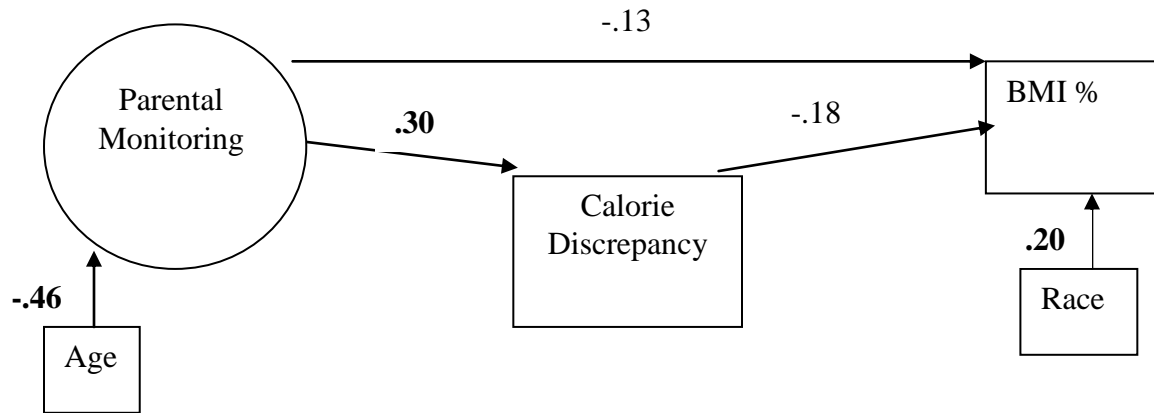


*trend at $p < .08$ level

$p < .05$

Figure 3: Nutritional Indicator Model by Gender

Female



Male

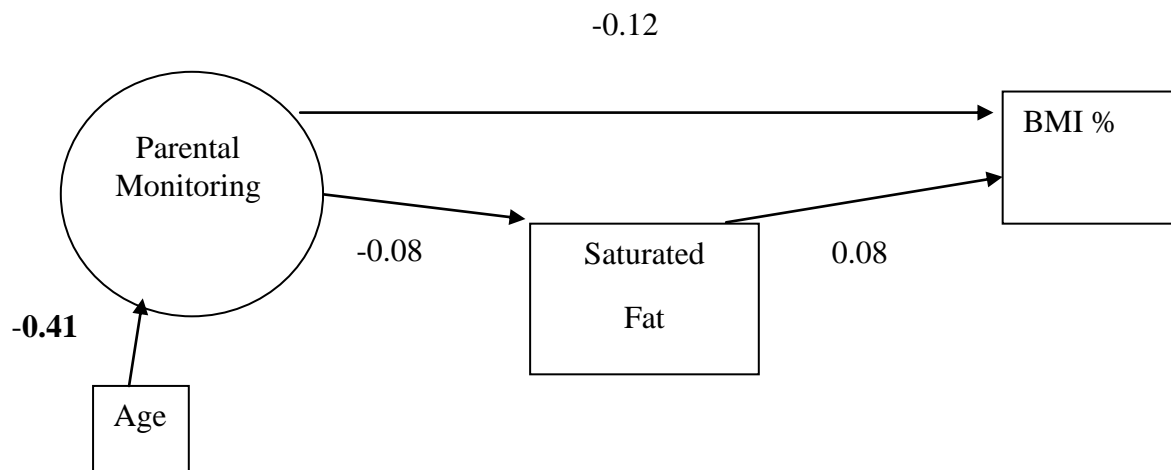
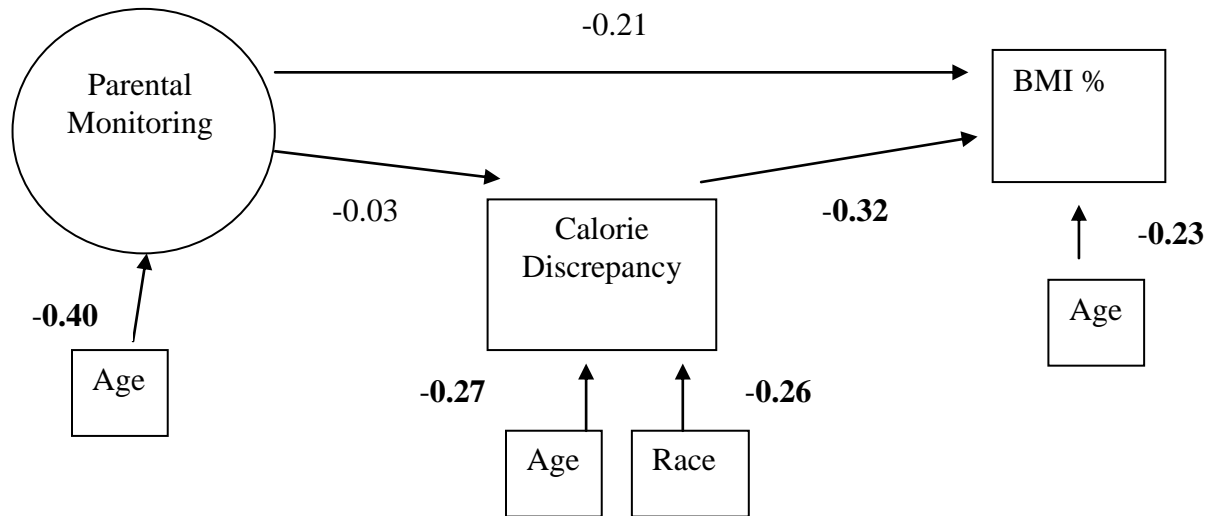
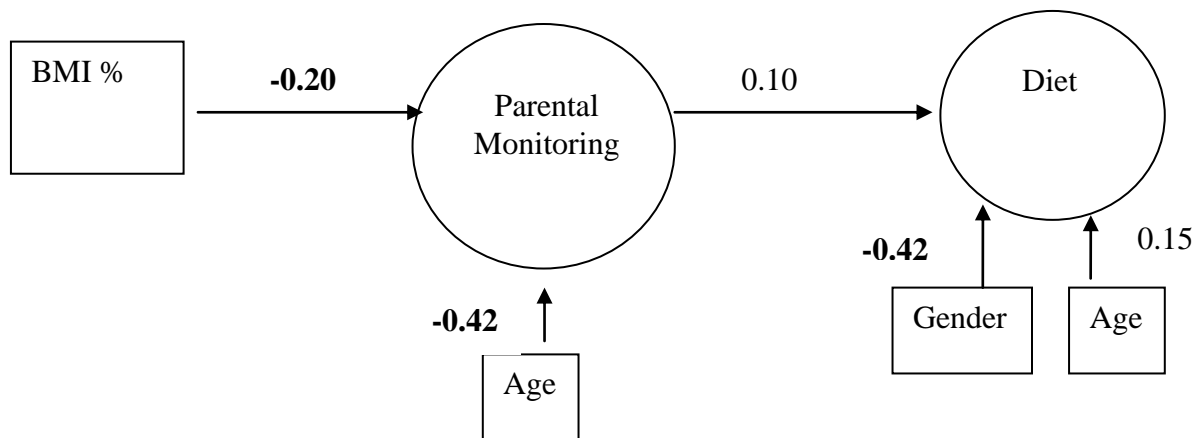


Figure 4. Alternate Model with BMI Predicting Monitoring and Diet



References

- Anderson, B. J., Auslander, W. F., Jung, K. C., Miller, J. P., & Santiago, J. V. (1990). Assessing family sharing of diabetes responsibilities. *Journal of Pediatric Psychology, 15*, 477–492.
- Block, G., Rosenberger, W., Patterson, B. (1988). Calories, fat and cholesterol: Intake patterns in the US population, by race, sex and age. *Am J Public Health, 78*, 1150-1155.
- Borra, S. T., Kelly, L., Shirreffs, M. B., Neville, K., & Geiger, C. J. (2003). Developing health messages: Qualitative studies with children, parents, and teachers help identify communications opportunities for healthful lifestyles and the prevention of obesity. *Journal of the American Dietetic Association, 103*, 721-728.
- Boushey, C. J., Kerr, D. A., Wright, J., Lutes, K. D., Ebert, D. S., & Delp, E. J. (2009). Use of technology in children's dietary assessment. *European Journal of Clinical Nutrition, 63*, S50-57.
- Butler, J. M., Skinner, M., Gelfand, D., Berg, C. A., & Wiebe, D. J. (2007). Maternal Parenting Style and Adjustment in Adolescents with Type I Diabetes. *Journal of Pediatric Psychology, 32*, 1227-1237.
- Centers for Disease Control and Prevention. National diabetes fact sheet: general information and national estimates on diabetes in the United States, 2007. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2008.
- Chambers Iv, E. (2000). Cognitive Strategies for Reporting Portion Sizes Using Dietary Recall Procedures. *Journal of the American Dietetic Association, 100*, 891-897.

- Champagne, C. M., Baker, N. B., DeLany, J. P., Harsha, D. W., & Bray, G. A. (1998). Assessment of energy intake underreporting by doubly labeled water and observations on reported nutrient intakes in children. *Journal of the American Dietetic Association*, 98, 426-433.
- Champagne, C. M., Delany, J. P., Harsha, D. W., & Bray, G. A. (1996). Underreporting of energy intake in biracial children is verified by doubly labeled water. *Journal of the American Dietetic Association*, 96, 707-709.
- Davis, C. L., Delamater, A. M., Shaw, K. H., La Greca, A. M., Eidson, M. S., Perez-Rodriguez, J. E., & Nemery, R. (2001). Parenting Styles, Regimen Adherence, and Glycemic Control in 4- to 10-Year-Old Children With Diabetes. *Journal of Pediatric Psychology*, 26, 123-129.
- Cullen K. W., Baranowski T., Rittenberry L., and Olvera N. (2000). Social-environmental influences on children's diets: results from focus groups with African-, Euro- and Mexican-American children and their parents. *Health Educ. Res.*, 15, 581 - 590.
- Diabetes Control and Complications Trial Research Group (1996). Effects of intensive diabetes therapy on neuropsychological function in adults in the diabetes control and complications trial. *Annals of Internal Medicine*, 124, 379-388.
- Ellis, D. A., Podolski, C. L., Frey, M., Naar-King, S., Wang, B., & Moltz, K. (2007). The role of parental monitoring in adolescent health outcomes: Impact on regimen adherence in youth with type 1 diabetes. *Journal of Pediatric Psychology*, 32, 907-917.

- Ellis, D.A., Templin, T., Podolski, C.L., Frey, M., Naar-King, S., & Moltz, K. (2008). The parental monitoring of diabetes care scale: Development, reliability and validity of a scale to evaluate parental supervision of adolescent illness management. *Journal of Adolescent Health, 42*, 146-153.
- Faith, M. S. (2004). Parental Feeding Attitudes and Styles and Child Body Mass Index: Prospective Analysis of a Gene-Environment Interaction. *PEDIATRICS, 114*, e429-e436.
- Fisher, J. O., Johnson, R. K., Lindquist, C., Birch, L. L., & Goran, M. I. (2000). Influence of body composition on the accuracy of reported energy intake in children. *Obesity Research, 8*, 597-603.
- Freund, A., Johnson, S. B., Silverstein, J., & Thomas, J. (1991). Assessing daily management of childhood diabetes using 24-hour recall interviews: Reliability and stability. *Health Psychology, 10*, 200-208.
- Fries, E., Green, P., & Bowen, D. J. (1995). What did I eat yesterday? Determinants of accuracy in 24-hour food memories. *Applied Cognitive Psychology, 9*, 143-155.
- Gilbertson, H. R., Brand-Miller, J. C., Thorburn, A. W., Evans, S., Chondros, P., & Werther, G. A. (2001). The Effect of Flexible Low Glycemic Index Dietary Advice Versus Measured Carbohydrate Exchange Diets on Glycemic Control in Children With Type 1 Diabetes. *Diabetes Care, 24*, 1137-1143.
- Gowers, S. G., Jones, J. C., Kiana, S., North, C. D., & Price, D. A. (1995). Family functioning: A correlate of diabetic control? *Journal of Child Psychology and Psychiatry, 36*, 996-1001.

- Helgeson, V. S. (2006). Diet of Adolescents With and Without Diabetes: Trading candy for potato chips? *Diabetes Care*, 29, 982-987.
- Helgeson, V. S., Snyder, P. R., Escobar, O., Siminerio, L., & Becker, D. (2007). Comparison of adolescents with and without diabetes on indices of psychosocial functioning for three years. *Journal of Pediatric Psychology*, 32, 794-806.
- Hoek, H. W., & van Hoeken, D. (2003). Review of the prevalence and incidence of eating disorders. *The International Journal of Eating Disorders*, 34, 383-396.
- Iannotti, R.J., Bush, P.J. (1993). Toward a developmental theory of compliance. In Krsnegor, N.A., Epstein, S.B., Johnson, S.B. & Yaffe, S.J. eds Developmental Aspects of Health Compliance Behavior. Hillsdale, NJ, Lawrence Erlbaum, 59-76.
- Jenkins, D. J., Wolever, T. M., Taylor, R. H., Barker, H., Fielden, H., Baldwin, J. M., Bowling, A. C., et al. (1981). Glycemic index of foods: a physiological basis for carbohydrate exchange. *The American Journal of Clinical Nutrition*, 34, 362-366.
- Johnson, S.B. (1992). Methodological issues in diabetes research: Measuring adherence. *Diabetes Care*, 15, 1658-1667.
- Johnson, S. B., Silverstein, J., Rosenbloom, A., Carter, R., & Cunningham, W. (1986). Assessing daily management in childhood diabetes. *Health Psychology*, 5, 545-564.
- La Greca, A. M., Follansbee, D., & Skyler, J. S. (1990). Developmental and behavioral aspects of diabetes management in youngsters. *Children's Health Care*, 19, 132-139.
- LaPorte, D. J. (1996). Influences of gender, amount of food, and speed of eating on external raters' perceptions of binge eating. *Appetite*, 26, 119-127.

- Leung, k., Lau, S., & Lam, W. (1998). Parenting styles and academic achievement: A cross-cultural study. *Merrill-Palmer Quarterly*, 44, 157-172.
- Livingstone, M. B. E., Robson, P. J., & Wallace, J. M. W. (2007). Issues in dietary intake assessment of children and adolescents. *British Journal of Nutrition*, 92, S213.
- Matheson, D. M., Hanson, K. A., McDonald, T. E., & Robinson, T. N. (2002). Validity of children's food portion estimates: A comparison of 2 measurement aids. *Arch Pediatr Adolesc Med*, 156, 867-871.
- McDonald, R. P., & Ho, M. R. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods*, 7, 64-82.
- Mellin, A., Neumark-Sztainer, D., Story, M., Ireland, M., & Resnick, M. (2002). Unhealthy behaviors and psychosocial difficulties among overweight adolescents: The potential impact of familial factors. *Journal of Adolescent Health*, 31, 145-153.
- Meltzer, L. J., Johnson, S. B., Prine, J. M., Banks, R. A., Desrosiers, P. M., & Silverstein, J. H. (2001). Disordered Eating, Body Mass, and Glycemic Control in Adolescents With Type 1 Diabetes. *Diabetes Care*, 24, 678-682.
- Nicklas, T. (2004). Assessing diet quality in children and adolescents. *Journal of the American Dietetic Association*, 104, 1383-1384.
- Ogden, C. L., Carroll, M. D., Curtin, L. R., Lamb, M. M., & Flegal, K. M. (2010). Prevalence of High Body Mass Index in US Children and Adolescents, 2007-2008. *JAMA: The Journal of the American Medical Association*, 303, 242-249.

- Park, H., & Bauer, S. (2002). Parenting Practices, Ethnicity, Socioeconomic Status and Academic Achievement in Adolescents. *School Psychology International*, 23, 386-396.
- Reynolds, L. A., Johnson, S. B., & Silverstein, J. (1990). Assessing Daily Diabetes Management by 24-Hour Recall Interview: The Validity of Children's Reports. *Journal of Pediatric Psychology*, 15, 493-509.
- Rovet, J.F. (2000). Diabetes. In R.A. Bornstein (Series Ed.) & K.O Yeates, M.D. Ris, H.G. Taylor (Vol. Eds.), *The Science and Practice of Neuropsychology: Vol 2. Pediatric Neuropsychology: Research, Theory, and Practice* (pp.336-365). New York: Guilford.
- Sandhu, N., Witmans, M. B., Lemay, J., Crawford, S., Jadavji, N., & Pacaud, D. (2008). Prevalence of overweight and obesity in children and adolescents with type 1 diabetes mellitus. *Journal of Pediatric Endocrinology & Metabolism: JPEM*, 21, 631-640.
- Savage, J., Fisher, J.O., & Birch, L. (2007). Parental influence on eating behavior: Conception to adolescence. *Journal of Law, Medicine, & Ethics*, 22- 34.
- Seiffge-Krenke, I. (1998). The highly structured climate in families of adolescents with diabetes: Functional or dysfunctional for metabolic control? *Journal of Pediatric Psychology*, 23, 313-322.
- Sherifali, D., & Ciliska, D. (2006). Parenting children with diabetes and Belsky's determinants of parenting model: Literature review. *Journal of Advanced Nursing*, 55, 636-642.

- Steinberg, L., Lamborn, S., Dornbusch, S., & Darling, N. (1992). Impact of parenting practices on adolescent achievement: Authoritative parenting, school involvement, encouragement to succeed. *Child Development*, 63, 1266-1281.
- Van der Horst, K., Kremers, S., Ferreira, I., Singh, A., Oenema, A., & Brug, J. (2007). Perceived parenting style and practices and the consumption of sugar-sweetened beverages by adolescents. *Health Education Research*, 22, 295-304.
- What did I eat yesterday? Determinants of accuracy in 24-hour food memories. Elizabeth Fries. 2006; Applied Cognitive Psychology - Wiley InterScience. (n.d.). . Retrieved August 4, 2010, from <http://www3.interscience.wiley.com/journal/112417029/abstract?CRETRY=1&SRETRY=0>
- Wiebe, D. J., Berg, C. A., Korbel, C., Palmer, D. L., Beveridge, R. M., Upchurch, R., et al. (2005). Children's appraisals of maternal involvement in coping with diabetes: Enhancing our understanding of adherence, metabolic control, and quality of life across adolescence. *Journal of Pediatric Psychology*, 30, 167-178.
- Wilson, M. A., & Smith, C. B. (2003). Nutrient Intake, Glycemic Control, and Body Mass Index in Adolescents Using Continuous Subcutaneous Insulin Infusion and Those Using Traditional Insulin Therapy. *The Diabetes Educator*, 29, 230-238.
- Wysocki, T., Taylor, A., Hough, B. S., Linscheid, T. R., Yeates, K.O., & Naglieri, J. A. (1996). Deviation from developmentally appropriate self-care autonomy: Association with diabetes outcomes. *Diabetes Care*, 19, 119-125.

Ziegler, P., Hanson, C., Ponza, M., Novak, T., & Hendricks, K. (2006). Feeding Infants and Toddlers Study: meal and snack intakes of Hispanic and non-Hispanic infants and toddlers. *Journal of the American Dietetic Association*, 106, S107-123.