FACTORS INFLUENCING METABOLIC CONTROL
IN ADOLESCENTS WITH
INSULIN-DEPENDENT DIABETES MELLITUS

BY
LYNN ANN REYNOLDS

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF THE
UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1991
In loving memory of my grandfathers,

Hamilton L. McNichol and Paul E. Reynolds
ACKNOWLEDGEMENTS

This project could not have been accomplished without the combined efforts of many individuals. I would first like to express my admiration and appreciation to my chairperson, Dr. Suzanne Bennett Johnson, who has truly been a mentor in every sense of the word, as a teacher, a counselor, and a friend. Her patience, encouragement, and endless support made it possible for me to complete this project.

I would also like to thank my committee members, Dr. Janet Silverstein, Dr. Stephen Boggs, Dr. Constance Shehan, and Dr. Hugh Davis (to whom I feel special appreciation for his important influence on my graduate training), for their contributions to this endeavor. Dr. Gary Geffken also deserves special gratitude for his input to this project, and as the supervisor of my therapy with several adolescents with IDDM.

I would like to thank Michael Kelly for his patience in enduring endless computer questions, and for his hospitality as I was completing this project. Michael Nurick, Lucretia Mann, Dr. Deborah Ader, David Goodwin, and David Saliwanchik also have my appreciation for their hospitality during that memorable summer in Gainesville.
The essential ingredients of a research project are the participants and the research assistants. My thanks go to both: to the adolescents and families who willingly gave their time to participate, and to my research assistants, who contributed to every stage of this project, from data collection to typing references for the final draft. Special thanks go to Martha McCallum, R.N., whose help recruiting participants was essential to the success of this project. Financial support for this project came from the Geoffrey Clark-Ryan Memorial Research Award in Pediatric Psychology; the founders and contributors to the fund have my greatest appreciation.

My family, especially my parents, have my continuing love and gratitude for their support (emotional and financial!), encouragement, and constant belief in my abilities.

Finally, I want to express my appreciation to Dr. Alan C. Homans, whose tolerance, generosity, and nurturing enabled me to successfully complete this endeavor. He has my deepest gratitude and my endless love for his involvement in this project and, more importantly, for his presence in my life.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>vi</td>
</tr>
<tr>
<td>INTRODUCTION AND REVIEW OF THE LITERATURE</td>
<td>1</td>
</tr>
<tr>
<td>Adherence</td>
<td>2</td>
</tr>
<tr>
<td>Stress</td>
<td>3</td>
</tr>
<tr>
<td>Pubertal Status</td>
<td>4</td>
</tr>
<tr>
<td>Psychological Adjustment and Family Functioning</td>
<td>5</td>
</tr>
<tr>
<td>METHODS</td>
<td>39</td>
</tr>
<tr>
<td>Participants</td>
<td>39</td>
</tr>
<tr>
<td>Measures</td>
<td>40</td>
</tr>
<tr>
<td>Procedures</td>
<td>50</td>
</tr>
<tr>
<td>RESULTS</td>
<td>53</td>
</tr>
<tr>
<td>Adjustment Measures</td>
<td>53</td>
</tr>
<tr>
<td>Stress Measures</td>
<td>56</td>
</tr>
<tr>
<td>Family Measures</td>
<td>58</td>
</tr>
<tr>
<td>Adherence Measures</td>
<td>75</td>
</tr>
<tr>
<td>Metabolic Control</td>
<td>78</td>
</tr>
<tr>
<td>Multiple Regression Analyses</td>
<td>78</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>102</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>121</td>
</tr>
<tr>
<td>BIOGRAPHICAL SKETCH</td>
<td>133</td>
</tr>
</tbody>
</table>
Abstract of the Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

FACTORS INFLUENCING METABOLIC CONTROL IN ADOLESCENTS WITH INSULIN-DEPENDENT DIABETES MELLITUS

By

Lynn Ann Reynolds

December 1991

Chairperson: Dr. Suzanne Bennett Johnson
Major Department: Clinical and Health Psychology

Adolescence has been identified as a period of life when metabolic control is likely to be unstable for persons with insulin-dependent diabetes mellitus (IDDM). A variety of explanations have been proposed. They include poor adherence to the treatment regimen, stress, pubertal effects on physiology, poor psychological adjustment, and family factors. This study examined the validity of a model of the associations among these factors and metabolic control in adolescents with IDDM.

In addition to attempting to delineate a more comprehensive model of these associations, this investigation differed from other studies in its use of standardized questionnaire and behavioral measures from multiple respondents to assess psychosocial factors; 24-hour recall methodology, on multiple occasions with both
adolescent and parent respondents, to assess adherence; a measure of pubertal development; and indices of both glucose and lipid metabolism to assess diabetes control.

Hierarchical multiple regression techniques were used to examine relationships among these variables. Fifty-six adolescents with a mean age of 14.4 years participated in the study. Due to sample size constraints, three sections of the proposed model were separately tested.

Results were consistent with previous research in finding significant relationships between family relations and psychological adjustment. An unexpected finding was the positive relationship between maternal stress and adolescent social competence.

Adolescent psychological adjustment was found to be associated with three measure of adherence to the treatment regimen: insulin injections, consumption of concentrated sweets, and exercise. Family behavior was associated with exercise and calorie consumption. Consistent with previous research, age was related to several measure of adherence.

Models of diabetes control relationships found gender to be significantly associated with all measures of metabolic control; girls were in poorer control than boys. Few associations between measures of adherence and diabetes control were found. Stronger relationships between adherence behaviors and diabetes control were found for indices of lipid metabolism than of glucose metabolism. For
most, these associations appeared to differ depending on gender. This suggests a need for future research to attempt to identify underlying mechanisms, including hormonal changes, that may be influencing adherence-control relationships differentially between girls and boys.
INTRODUCTION AND REVIEW OF THE LITERATURE

Adolescence is the stage of development characterized by physiological, emotional, and cognitive changes. Separation from the family unit increases as the adolescent begins to function more independently. These changes can lead to stress and turmoil, both intrapsychically and interpersonally, as maturation from childhood to adulthood occurs (Hoette, 1983). The addition of a chronic health problem, such as insulin-dependent diabetes mellitus (IDDM), can increase the problems of adjustment associated with adolescence. For a person with IDDM, maintaining good diabetes control may also become increasingly difficult (Amiel, Sherwin, Simonson, Lauritano, & Tamborlane, 1986; Blethen, Sargeant, Whitlow, & Santiago, 1981; Cacciari, Salardi, Ballardini, Righetti, Zucchini, & Natali, 1985; Mann & Johnston, 1982).

Diabetes is a chronic illness that results from insufficient insulin production by the pancreas; insulin is necessary for the efficient metabolism of glucose. The disease is the most common endocrine disorder of childhood (Tarnow & Silverman, 1981-1982). Management of IDDM is complex and demanding for the patient and family. Careful attention must be paid to diet and exercise to aid in the
control of blood glucose levels. Daily insulin injections must be administered, and frequent blood glucose testing is encouraged in an effort to maintain patients in good diabetes control (i.e., maintenance of the patient’s blood glucose levels within the normal range; Fisher, Delamater, Bertelson, & Kirkley, 1982). Maintaining good control is important in order to avoid the short-term complications of diabetes: hypoglycemia, hyperglycemia, and ketoacidosis. Equally important is the effect good control is thought to have on the onset and seriousness of the long-term complications associated with this disease: heart disease, kidney failure, blindness, neuropathy, and other vascular changes (Cahill, Etzwiler, & Freinkel, 1976; D’Antonio et al., 1989; Leslie & Sperling, 1986; Tchobroutsky, 1978).

Both the clinical literature (Tattersall & Lowe, 1981) and empirical studies (Amiel, Sherwin, Simonson, Lauritano, & Tamborlane, 1986; Blethen, Sargeant, Whitlow, & Santiago, 1981; Cacciari et al., 1985; Mann & Johnston, 1982) have identified adolescence as a period of life when metabolic control is likely to be unstable. A variety of explanations have been proposed. They include poor adherence to the treatment regimen, stress, pubertal effects on physiology, poor psychological adjustment, and family factors.

Adherence

The role of adherence to the diabetes treatment regimen in maintaining good glycemic control has frequently been identified in the clinical literature but has not been
subjected to rigorous empirical investigation. Of the studies which have been reported, some suggest a link between adherence behavior and diabetes control, at least in adolescent patients (Christensen, Terry, Wyatt, Pichert, & Lorenz, 1983; Hanson, Henggeler, & Burghen, 1987a, 1987c; Johnson, Freund, Silverstein, Hansen, Malone, 1990; Schafer, Glasgow, McCaul, & Dreher, 1983), while others have failed to find a significant relationship (Hanson, Henggeler, & Burghen, 1987b; Schafer, McCaul, & Glasgow, 1986). Other studies provide evidence that adolescents with diabetes, as compared with their younger and older counterparts, are less adherent to the diabetes regimen (Allen, Tennen, McGraw, Affleck, & Ratzan, 1983; Bobrow, AvRuskin, & Siller, 1985; Christensen et al., 1983; Jacobson, Hauser, Lavori, et al., 1990; Jacobson, Hauser, Wolfsdorf, et al., 1986; Johnson, Silverstein, Rosenbloom, Carter, & Cunningham, 1986).

**Stress**

Psychological stress is a second factor which is thought to be related to glycemic control in patients with diabetes. Data suggests that adolescents, in general, experience an increase in normal life stresses. Several studies cite the peak incidence of life stressors as occurring during middle adolescence (Coddington, 1972; Johnson, 1982; Newcomb, Huba, & Bentler, 1986).

Research has demonstrated that parameters commonly used to measure diabetes control (i.e., ketones, glucose, free
fatty acids) are influenced by life stress. Reviews of the literature indicate that the impact of stressful life events affects both physical health and psychological adjustment in both normal and patient populations (Compas, 1987; Johnson, 1986). Some studies with IDDM children and adolescents have supported this relationship (Barglow, Hatcher, Edidin, & Sloan-Rossiter, 1984; Brand, Johnson, & Johnson, 1986; Chase & Jackson, 1981; Hanson & Pichert, 1986; Tarnow & Silverman, 1981-1982) while other studies have failed to find a significant association (Delamater, Kurtz, & Bubb, 1984; Delamater et al., 1985; Gilbert, Johnson, Silverstein, & Malone, 1989).

**Pubertal Status**

More recently, investigators have recognized that physiological changes during adolescence are important in the metabolic control of diabetes. The most notable physiological change is an increased resistance to insulin which occurs during puberty in both normal children and in children with diabetes. Amiel et al. (1986) reported an impairment in insulin-stimulated glucose metabolism in adolescent patients at Tanner Stages II-IV (i.e., the middle stages of pubertal development, marked by breast development and pubic hair growth in girls, and genital development and pubic hair growth in boys) but not in those at Tanner Stage I (pre-pubertal stage of adolescent development). Pubertal (Tanner II-IV) children, as compared with prepubertal (Tanner I) children, also had significantly greater
glycosylated hemoglobin values. Glycosylated hemoglobin is a measure of metabolic control which reflects the percentage of glucose molecules that attach to the body's hemoglobin over the course of 60 days; higher levels are indicative of poorer metabolic control. Other studies have noted the same pattern of better metabolic control in prepubertal as compared with pubertal children, although the mechanism for the observed effect was not identified (Anderson, Miller, Auslander, & Santiago, 1981; Kaar, Akerblom, Huttunen, Knip, & Sakkinen, 1984).

Psychological Adjustment and Family Functioning

Two additional variables which have received research attention in patients with diabetes are psychological adjustment and family functioning. These psychosocial factors have generally been hypothesized to be related to metabolic control indirectly, by interfering with adherence to the medical regimen, although a direct relationship of stress on glucose homeostatis has also been suggested (Barcai, 1970; Newbrough, Simpkins, & Maurer, 1985; Schafer et al., 1983; Simonds, 1979; Tarnow & Silverman, 1981-1982).

A review of the literature by Johnson (1985) organized relevant studies into these three areas: a) the relationship between the child's adjustment and physical health, b) the relationship between family characteristics and the child's health, and c) the relationship between family factors and the child's adjustment. The same organization will be used here.
Psychological Adjustment and Physical Health

Early investigators focused their research on looking for a personality specific to persons with diabetes. A thorough review of the literature by Dunn and Turtle (1981) concluded that there is no evidence of a characteristic personality that distinguishes patients with diabetes from any other chronically ill group or from the normal population. However, children in poorer diabetes control have been consistently found to have more emotional and behavioral problems than their well-controlled counterparts.

In an early study reported by Simonds (1977), 40 children (aged 6-18 years) in good metabolic control, matched on age, sex, and duration of diabetes, with 40 children in poor metabolic control, were interviewed by an examiner who was blind to the children's diabetes status. In addition, each child's mother completed a behavioral checklist of emotional and behavioral characteristics regarding her child. Psychometric data on the questionnaire was not reported. Metabolic control was measured by physician ratings based on medical history, urine test records, physical examination, and urine and blood test results at the time of the clinic visit. Results indicated that while there was minimal psychiatric disturbance in any of the children, the children in poor diabetes control reported more interpersonal conflicts than those in good control. Their mothers also reported significantly more behavioral and emotional problems in those children.
In a similar study, Gath, Smith, and Baum (1980) assessed the emotional and educational status of a group of 76 IDDM children (aged 5-16 years) in order to investigate the interaction of those factors with diabetes control. Information was obtained through interviews at the clinic and questionnaires (one which was described as "widely used") completed by the school, which assessed attitude, academic performance and behavior of the child. Diabetes control was clinically assessed using daily records of urine analysis, symptoms of hypo- and hyperglycemia, and a record of the child's growth. Psychiatric disorders were not more common in diabetic children than in healthy controls. However, among the children with diabetes, a correlation was found between poor diabetes control and the presence of psychiatric disorders. Poor metabolic control was also found to be associated with the presence of adverse psychosocial factors in the family background, although these adverse factors were not described.

A more recent study of 31 IDDM adolescents (aged 12-19 years) investigated the relationship between personality factors, assessed using standardized personality measures, and metabolic control, measured by glycosylated hemoglobin (Lane et al., 1988). Measures of trait anger, anxiety, and curiosity, as well as extraversion, neuroticism, impulsivity, and sociability, were obtained. Negative correlations between metabolic control and measures of extraversion ($r = -0.36$) and trait curiosity ($r = -0.42$) were
reported; poorer control was associated with lower curiosity, more introversion, and poorer sociability. Adherence was measured as the number of recorded blood glucose tests per day; no relationship was found between adherence to blood glucose testing and glycosylated hemoglobin values.

Simonds, Goldstein, Walker, and Rawlings (1981) also investigated the relationship between psychological and personality variables and metabolic control, as measured by HbA1c (i.e., a measure of glycosylated hemoglobin; HbA1 = HbA1a + HbA1b + HbA1c). A level of 9.5% was chosen as the cutoff for adequate vs. inadequate control. Subjects in the study were 52 adolescents, aged 13-19 years, with 5 or more years duration of IDDM. Anxiety, locus of control, self-concept, and several personality variables were assessed with standardized self- and mother-report questionnaires. Unlike previous studies, no significant differences were found between high and low HbA1c levels for any of the psychological variables examined. However, female subjects were significantly more likely than males to have high HbA1c values.

While it has been assumed that psychological factors may influence metabolic control indirectly, through an association with adherence to the diabetes regimen, few investigators have studied this relationship. Jacobson and colleagues (1987, 1990) recently reported on results of a four-year longitudinal study in which one of the
relationships assessed was the association between psychological adjustment and adherence behaviors. Sixty-one children, aged 9-16 years, with recent onset IDDM were studied over the four-year period. Self-esteem, locus of control, ego defense mechanisms, adaptive strengths, behavioral symptoms and social functioning, and self-reported attitudes, feelings, and behaviors directed primarily towards diabetes, were measured using standardized self- and parental report instruments, with reported reliability and validity, and semistructured clinical interviews. Psychometric data on questionnaire measures for the study sample were not reported. These variables were examined in relationship to clinical indices of adherence provided by ratings from the health provider. At both 9- and 18-month follow-ups, higher self-esteem, diabetes adjustment, social functioning, and fewer parental reports of behavioral symptoms were correlated with higher levels of adherence. Adolescents (aged 13-15 years) were less adherent than pre-adolescents (aged 9-12 years). Higher initial adjustment was significantly associated with better adherence over the four-year study, as were the use of more mature defenses and greater adaptive capacity. No variables were found to be associated with change in adherence. Results of analyses examining the relationships of metabolic control to psychosocial variables and to adherence were not reported in these studies. However, the authors reported
that they have found that these aspects of patient functioning also predict metabolic control.

Several problems are evident with the research to date on the relationship between psychological adjustment and metabolic control. Measurement problems abound, both in assessing adjustment and in determining diabetes control. Often psychometric data on the measures used to examine psychological adjustment are not reported. When they are reported, authors often refer to norms from earlier literature on questionnaire development, and do not report psychometric data on their study sample. Measures of metabolic control range from relatively subjective physician ratings to objective laboratory results. Adherence, when measured at all, is also often poorly assessed with measures lacking in reliability and validity.

Frequently studies have failed to report the influence of relevant variables, including age, gender, disease duration, and socioeconomic status, on their findings. Most studies have been correlational and cross-sectional, precluding any statement about the direction of observed effects. The mechanism by which psychological adjustment may be related to health outcome has not been elucidated; it may that adjustment influences metabolic control through an influence on adherence. However, this association has not been carefully investigated. Only Jacobson et al. (1987, 1990) have examined adolescent adjustment longitudinally, and while they have looked at its relationship to adherence,
they have not reported on the relationship of adherence to metabolic control.

In spite of these problems, some consistencies in the literature have been reported. The research has generally supported a relationship between psychological adjustment, measured as emotional, behavioral, and social functioning, and metabolic control. Better adjustment has been found to be associated with better diabetes control. While studies have not examined the relationship by which adjustment is thought to be related to control, the investigation of adjustment-adherence relationships is the first step in that direction.

Family Factors and Physical Health

Several reviews have been published which describe the literature relating family factors to the metabolic control of diabetes (Anderson & Auslander, 1980; Fisher et al., 1982; Hauser & Solomon, 1985; Johnson, 1980; Wishner & O'Brien, 1978). In her review, Johnson (1980) described five specific family patterns which are seen by clinicians as particularly detrimental to patients' health: a) overanxious patterns; b) overindulgent patterns c) overcontrolling patterns d) patterns of resentment and rejection and e) disinterest and neglect. Citing data from the Simonds (1976-77) study, she suggested that good control may be associated with unusually healthy or well-integrated families; even "normal" family conflicts may be related to poor control in some adolescents with diabetes.
Minuchin and his colleagues described a psychophysiological model of the relationship between parental or family patterns and a child's diabetes condition (Baker, Minuchin, Milman, Leibman, & Todd, 1975; Minuchin, Rosman, & Baker, 1978). They suggested that psychological factors may influence diabetes in two ways: 1) emotional or psychological disturbances may result in behavior problems and non-adherent behavior which can have metabolic consequences, or 2) emotional disturbances may cause metabolic instability directly through psychophysiological mechanisms. This second effect was termed "psychosomatic"; and the role of the family in producing psychosomatic diabetes has been the subject of much interest and study by Minuchin and colleagues. They defined a psychosomatic family by four characteristics, which are: 1) enmeshment to such an extent that the individual identities and roles of family members are unclear, 2) overprotectiveness toward all family members, 3) rigidity in maintaining the status quo, and 4) lack of conflict resolution. They hypothesized that the sick child plays a role in the family's attempts to avoid conflict. When family conflict, which is unavoidable, does occur, it leads to emotional and physiological arousal. This is described as the "turn-on" phase. In a psychosomatic family, the "turn-off" phase (i.e., the return to baseline homeostatic levels) is hindered by the family's attempts to avoid conflict; the result is a lack of conflict resolution.
Newbrough, Simpkins, and Maurer (1985) reviewed the literature on family factors as they affect diabetes management and metabolic control in children with IDDM. They also hypothesized that psychosocial factors in families of children with diabetes have an impact both on management of the diabetes (adherence) as well as on metabolic stability. Five aspects of family that have been identified in the literature as affecting blood glucose levels were reviewed: 1) parent and child characteristics, including parental and child self-esteem, and parental involvement in the treatment regimen; 2) family group relationships, including family conflict, stability, cohesion, communication, and marital satisfaction; 3) parenting style; 4) adaptation to the new life-style, including acceptance of diabetes; and 5) relationship with the community, including good social support. The authors suggested a developmental model for understanding diabetes management in terms of the stages of family development and adjustment to the illness. They presented a framework for organizing information on family functioning and its relationship to the control of diabetes in children.

A number of investigators have examined the relationship between metabolic control and various aspects of the family. An early study by Swift, Seidman, & Stein (1967) of 50 IDDM children (aged 7-17 years) obtained information through semistructured interview and standardized measures, conducted with both the children and
their parents. Better metabolic control, as rated by diabetes specialists, were found to be related to the following family characteristics: 1) few conflicts at home, 2) a low level of stress in the relationship between the parent and the child with diabetes, 3) satisfactory home adjustment by the child with diabetes and 4) an absence of economic problems. Also, the child with diabetes tended not to be the oldest in the family.

One of the early, and few, longitudinal studies investigating family factors and metabolic control was reported by Koski and Kumento (1977). They described a 5-year follow-up study of 60 children, aged 10-21 years, with diabetes. Information was obtained through ophthalmologic, pediatric, and psychiatric evaluations. Metabolic control was assessed by clinical judgement based on growth, fasting blood glucose, 24-hour urine glucose, acetonuria, and number of hospitalizations. Eight children were identified as having poorly controlled diabetes; families of these children were described as chaotic and having severe conflicts. In cases where diabetes control had worsened over time, a stressful life event had occurred. Eleven children were identified as having well-controlled diabetes. Five aspects were found to be related to good control: 1) the family composition was stable, 2) clear, distinct boundaries between generations were recognized by all family members, 3) family members were realistic and cooperative in implementing the treatment plan, 4) marital conflict was
low, 5) and both parents were present or a competent single
parent headed the family.

Cerreto and Mendlowitz (1983) used five standard
measures of family functioning and HbA1c to investigate the
relationship between family functioning and metabolic
control. Subjects were 84 children and adolescents with
diabetes (aged 7-17 years) and their parents. Family
measures were completed by the parents. Correlations
between family measures were low. Only the dimensions of
Control and Cohesiveness differentiated children in good
metabolic control from those in poor control. Children from
families with more rules and procedures demonstrated better
metabolic control.

Waller et al. (1986) reported on the development of a
disease-specific family support scale used to identify
family behaviors that correlate with metabolic control in
children and adolescents with IDDM. Subjects were 42
children and adolescents, aged 7-17 years, who were
attending a summer camp and completed the Diabetes-Specific
Family Behavior Scale (DSFB). Internal consistency, test-
retest reliability, and parent-child agreement for the scale
were adequate. The group of items which measured the
dimension of "guidance and control" correlated with
metabolic control, as measured by HbA1c, for the younger age
group (7-12) while "warmth and caring" items correlated with
metabolic control for both adolescents and children.
However, one item--"My parent gets angry with me when I make
a slip in taking care of my diabetes"--had an inverse relationship for adolescents as compared with children. It was associated with better control in the younger group and worse control in the older group. The dimension of problem-solving was not found to have a relationship with metabolic control for either age group.

Schafer and her colleagues completed two studies that looked at the relationship of family support, and additional family factors, to metabolic control. They hypothesized that family factors affect control indirectly through an impact on adherence behaviors. The first study investigated the relationship between family support, perceived family environment, "barriers" to adherence, adherence, and metabolic control (Schafer et al., 1983). Subjects were 34 adolescents with IDDM (age 12-14 years). Adherence was assessed with a self-report measure; psychometric data on the measure was not reported. HbA1 was used to assess metabolic control. Three of seven adherence measures (i.e., extent to which diet was followed, care in measuring insulin doses, number of daily glucose tests) were significantly related to HbA1 levels; the measures were unrelated to each other, indicating that adherence to one area of the IDDM regimen is not highly related to compliance in other areas. Family measures, as assessed by validated, standardized questionnaires, were not highly related to metabolic control. However, high family conflict was related to poor adherence to glucose testing, while increased "barriers" to
adherence appeared to be most highly related to poor adherence to diet and insulin injections. In general, specific measures of psychosocial family variables were better predictors of adherence than were more global measures.

In their second study, Schafer et al. (1986) investigated the relationship between family support, as measured by the Diabetes Family Behavior Checklist (DBFC); adherence, assessed by self-report, self-monitoring, and 24-hour dietary recall interviews; and metabolic control, measured with HbA1 values. Fifty-four adults and 18 adolescents (aged 12-18) with IDDM took part in this study. Reliable differences between adolescents and adults were found. Adolescents were in poorer metabolic control, and reported more negative interactions with family members, than did adults. However, negative family interactions did not predict adherence or metabolic control for adolescents. Adherence and metabolic control were not found to be related in this study; the relationship between family factors and metabolic control was not assessed.

In a study reported by Marrero, Lau, Golden, Kershnar, and Myers (1982), participants were 40 adolescents, aged 13-18 years, with IDDM. Information was obtained through clinical interview and a "parent behavior description scale" (no psychometric data was reported). Metabolic control was rated based on clinical history. Results indicated that perceived paternal behavior, rather than maternal behavior,
was related to metabolic control. Specifically, paternal behavior which was seen as dominant and controlling was associated with poor control, while paternal behavior which was perceived as supportive and encouraging of autonomy was associated with good control. There were no differences reported between groups of adolescents in good versus poor control in their perceptions of maternal behavior.

One recent study (Kovacs, Kass, Schnell, Goldston, Marsh, 1989) of 85 children and early adolescents (aged 8-13 years) followed longitudinally over a 6-year span found no relationship between measures of family functioning and metabolic control. Overall quality of family life was assessed with a standardized parental-report measure; the authors reported good internal consistency and mother-father agreement for the sample. Marital satisfaction was assessed less reliably, using four items derived from two different psychosocial measures. HbA1 and weight-adjusted insulin dosage were measures of metabolic control. In contrast to other studies, no associations between family measures and metabolic control were found whether or not demographic variables, including age, gender, race, and SES, were included in the analyses.

While most studies of the relationship between family functioning and metabolic control used interview and self-report measures of family interaction, Baker et al. (1975) employed a behavioral family task interview. This was a method of observing family members interacting with
one another; structured family tasks were assigned, then videotaped and rated. Tapes were scored for over-
protectiveness, enmeshment, rigidity, and lack of conflict resolution. A family diagnostic interview was also used to assess the involvement of the child in family conflict. During the interview, an attempt was made to intensify spouse conflict. At that point, the child was instructed to enter the room and a measurement of free fatty acids in the child during the interview was obtained. Of ten families studied, six were found to fit the psychosomatic group, as previously described. Treatment with a beta adrenergic blockade (propranolol) was found to be most effective in children in which excessive arousal was the problem.

In a prospective study of 43 newly diagnosed diabetic children (age 7-17 years), the relationship between metabolic control and family factors described as family competence, adaptational capacity, and emotional supportiveness, were examined (Baker, Rosman, Sargent, Nogueira, & Stanley, 1982; Sargent, Rosman, Baker, Nogueira, & Stanley, 1985). Measures of family functioning were obtained with a structured family interview, a standardized self-report inventory, and ratings by a diabetes educator. Each interview was taped and rated by blind raters for the following qualities of family interaction: emotional supportiveness, availability, role flexibility, communication and decision making. These measures were used to predict HbA1 at 12-18 months and 36-48 months post
diagnosis. Results indicated that positive parental and parent-child emotional support, and family competence and effectiveness were strongly related to good metabolic control at both 12-18 and 36-48 month follow-ups. Positive parent-child and sibling interaction were related to good metabolic control only at the 36-48 month follow-up. The authors concluded that factors relating to family emotional supportiveness, competence in managing the child's behavior, and effectiveness were significant predictors of the degree of metabolic control achieved in a child with diabetes and that the influence of parent-child and sibling interaction on metabolic control increased over time.

Several studies attempted to investigate the link between family factors and adherence. Shouval, Ber, & Galatzer (1982) studied the relationship between perceived family environment and adherence to the medical regimen. Subjects were 97 Israeli children and adolescents with IDDM (aged 10-20). Adherence was assessed based on subjective reports from the psychosocial staff of the medical unit. Family environment was assessed with two measures, including a frequently-used standardized scale (the Family Environment Scale), which the authors reported had poorer internal consistency for their sample than has been previously reported. Results indicated that patients who were more adherent described their family atmosphere as supportive and organized. Patients' metabolic control was not assessed in this study.
Kurtz and Delamater (1984) described a study in which they looked at family interaction patterns among groups of chronically-ill mother-adolescent dyads, including 15 IDDM pairs (mean age=14.7). The relationship between family functioning and adherence was also assessed. The family measures used were specific to parent-adolescent interactions and conflict (i.e., Issues Checklist, Conflict Behavior Questionnaire). Adolescents with diabetes additionally completed disease-specific measures of family conflict and family support. Adherence with glucose testing was measured by recovering all chemstrips used in a 14-day period; adherence to other aspects of the diabetes treatment regimen was not assessed. Metabolic control was measured with HbA1 assays. Results indicated that for adolescents with diabetes, supportive family behavior and calm discussions, rather than angry arguments, were associated with better adherence to glucose testing. Positive attributions regarding the behavior of the other and the interaction of the mother-adolescent dyad were also highly related to good adherence. The relationship between family factors and HbA1 was not reported; however, adherence and HbA1 were significantly correlated.

The relationship between mother-daughter behavioral interaction and adherence among IDDM adolescents was examined in a study by Bobrow et al. (1985). Participants were 50 adolescent girls, aged 12-17 years, and their mothers. Following an interview with the adolescent to
identify conflict issues, the mother and daughter were brought together to discuss the three most salient issues for five minutes each. After the third discussion, each dyad was then asked to discuss their feelings about diabetes together. Adherence was assessed with a Likert-type questionnaire (interview) completed by the mother, the adolescent, and the physician. Each discussion was recorded and then scored with two interaction scoring systems. The first method provided statement-by-statement ratings of type of interaction (conventional, assertive, speculative, and confrontive) and the second provided global ratings of empathy, expressiveness, clarity, permeability, responsibility, closeness, goal-directed negotiation, mood and tone, and conflict. While the authors expressed caution in interpretation of results due to small sample size and lack of norms for their questionnaires, they did report several interesting findings. Adolescents who were less adherent were involved in more emotionally charged interactions, were more directly confrontive, and were less efficient at negotiating issues with their mothers. In their statements about themselves on questionnaires, adolescents confirmed the observations that poor adherers, more than good adherers, had difficulty discussing feelings, problems, and concerns with their mothers.

Most recently, Hauser and colleagues (1990) reported on the results of their four-year longitudinal project in which the relationship between family functioning and adherence
was one of the areas examined. The data analyzed was obtained from 52 youngsters, aged 9-16 years, with IDDM and their parents. Family functioning was assessed with a frequently-used standardized paper and pencil measure, with reported reliability and validity (the Family Environment Scale), and adherence was measured by ratings from the health provider. Separate ratings for diet, glucose testing, and insulin injections were obtained. Results of the study indicated that family conflict, as perceived by both parents and patient, cohesion, as perceived by the patient, and organization, as perceived by the parent, were significantly correlated with a composite score of adherence, as well as with individual aspects of adherence, over the first year of the study. Children in families in which conflict was low, and cohesion and organization were high, demonstrated better adherence to the diabetes regimen. Families who described themselves as initially more cohesive also had children who showed improved adherence over time, as well as demonstrating good adherence overall, for the four years of the study. Initial family conflict was also associated with overall adherence; poorer adherence was noted in youngsters whose family conflict was high. No measure of metabolic control was reported in this study.

As with the literature investigating the relationship between psychological adjustment and metabolic control, several problems are evident with the research on the relationship between family factors and health outcome in
adolescents with diabetes. Once again, measurement problems are prevalent. Family variables have been assessed with a variety of different measures, including self-report questionnaires and behavioral observations of family interactions which makes it difficult to compare results across studies. Again, psychometric data are frequently not reported, or are reported only from the original studies on questionnaire development and not from the study sample.

Metabolic control and adherence are often poorly assessed. Measures of metabolic control have ranged from the relatively subjective to the very objective, although in recent studies, glycosylated hemoglobin seems to be the standard measure of diabetes control. Measurement of adherence is often limited to one aspect of the treatment regimen, or is assessed as a unitary rather than a multidimensional construct. Again, the influence of relevant variables, including age, gender, disease duration, and socioeconomic status, has not been examined. Mediating variables are often not specified (i.e., adherence, stress), or even if they are specified, they may not be assessed.

As with the psychological adjustment-health outcome research, most studies investigating the relationship between family factors and metabolic control have been correlational and cross-sectional, precluding firm conclusions about causation. While a conflictual, unsupportive family environment may negatively influence metabolic control, it is just as likely that living with an
adolescent in poor health may provoke family conflict. Current research does not effectively address this issue. Again it is Jacobson and colleagues (Hauser et al. (1990) who have followed adolescents longitudinally, in an attempt to examine the relationship between family factors and health outcome, and again, they have looked only at adherence, and not at metabolic control, as a health outcome measure.

The results on studies investigating the relationship between family factors and metabolic control have shown some consistency, however, and suggest that several family variables may be important. In particular, family conflict, cohesion, organization, adaptability, supportiveness, and parents' marital satisfaction were consistently found to be related to metabolic control, and less consistently, to adherence. The relationship between family variables, adherence, and metabolic control needs further investigation.

**Psychological Adjustment and Family Factors**

Although not specific to diabetes, Pless, Roghmann, and Haggerty (1972), in a classic study, examined the relationship between child adjustment, family functioning, and chronic illness in a large sample of youngsters, aged 6-11 years, in Monroe County, NY. The sample consisted of 209 children with chronic illness and 113 healthy controls. Information was obtained using semistructured household interviews, symptom checklists of child behavior completed
by a parent, information obtained from the child's teacher, and the child's self-report on a standardized self-esteem inventory. Each child then received an overall mental-health adjustment index, based on these measures, and each family was rated on a family-functioning index, based on the household interview. Results indicated that both family functioning and physical health seemed to contribute to a child's psychological adjustment; youngsters in poor health and those from poorly functioning families showed more adjustment problems. The highest incidence of psychological disturbance occurred in children who were ill and lived in dysfunctional families, with older children showing the most disturbance. The authors conclude that chronically ill children who live in poorly functioning families may be especially at risk for developing social and emotional problems.

Hauser and his colleagues recently completed a four-year longitudinal study of adolescents with IDDM and their families. One of the first reports of their research described the cross-sectional findings from the first year of the study; the relationship between family functioning and adjustment was examined with 30 IDDM adolescents aged 9-17 (Hauser, Jacobson, Wertlieb, Brink, & Wentworth, 1985). Using a standardized self-report measure of family social environment (the Family Environment Scale; FES), family factors were compared to adjustment to diabetes and perceived competence, also assessed with frequently used
standardized self-report measures. Psychometric data on these measures for the study sample were not reported. Results from the study indicated that, controlling for age and SES, family emphases on independence, participation in social/recreational activities, and organization were significantly associated with the patient's perceived competence and diabetes adjustment. Aspects of adolescent diabetes adjustment were also predicted by family achievement orientations; better adjustment was related to a family emphasis on achievement.

In an extension of their first study, the authors (Hauser, Jacobson, Wertlieb, Wolfsdorf, et al. 1985) reported results which used a larger sample (52 IDDM adolescents, mean age=12.82), followed the parent's perspectives separately from child's, and included additional individual indices of self-esteem. In addition, multiple regression analyses, controlling for age, gender, and SES, were performed to identify the special contribution of family orientations to individual patient characteristics. They again found an association between specific dimensions of the family on the Family Environment Scale, this time as described by the parent, and the child's perception of competence, as measured by a well-validated self-report instrument. The most important family dimensions were organization and independence; higher self-esteem was associated with greater family organization and an emphasis on independence. The child's adjustment to
diabetes was also significantly related to parental perceptions of the family, better adjustment was associated with greater family cohesion and an emphasis on intellectual/cultural activities.

The most recent report from Hauser and his colleagues (Wertlieb, Hauser, & Jacobson, 1986) included 46 children, aged 9 to 16 years, studied longitudinally from the time of diagnosis. Family environment and its relationship to behavior symptomatology was examined. A comparison of 29 children with recent acute illness served as a comparison group. The results of the study indicated that higher levels of internalizing and externalizing child behavior symptoms were reported by the mothers of children with diabetes; however, the differences were nonsignificant when social class was controlled. A range of family environment variables was found to be related with behavioral symptoms. For both groups, there was an positive association between behavior symptomatology and levels of family conflict, although more so for children with diabetes. For children with diabetes, social and recreational family activities and clear routines and organization were related to fewer behavior problems. A moral/religious emphasis correlated positively with internalizing symptoms in youngsters with diabetes, but not in the acute illness group.

Few investigators have examined the relationship between psychological adjustment and family functioning in adolescents with diabetes. The studies described here
address many of the methodological issues plaguing the literature on adjustment/health outcome and family factors/health outcome relationships. They used standardized measures and multiple respondents, and controlled for the effects of variables including gender, age, and SES. Again, however, psychometric data on the assessment measures for the study samples are lacking, and data is limited to self-report questionnaires. In spite of these limitations, results from these studies have shown a relationship between psychological adjustment and family functioning. In general, various family dimensions have been related to better psychological adjustment, as measured by behavior symptomatology, self-esteem, and adjustment to diabetes. Additional research is needed to identify consistent relationships between specific family factors and adjustment variables.

Multiple Psychosocial Factors and Physical Health

Recently, several investigators have examined the relationship between multiple psychosocial variables, including childhood adjustment, life stress, and family functioning, and physical health, in adolescents with diabetes. White, Kolman, Wexler, Polin, & Winter, (1984), in a retrospective review of 30 children and adolescents (ages not given) with recurrent diabetic ketoacidosis (DKA), reported that only a minority of episodes of DKAs (i.e.; a complication of diabetes caused by insufficient insulin, which is marked by high blood glucose levels, a large amount
of urine ketones, pH imbalance, and symptoms of polydypsia, polyuria, vomiting, abdominal pain, and rapid breathing) were found to be related to intercurrent illness or poor (as subjectively rated) compliance. Most of the subjects lived in very dysfunctional families; problems included chronic unresolved interpersonal conflict, inadequate parenting, lack of a father in the home, financial stress, and lack of family involvement with diabetes. Additionally, many of the children displayed behavioral and personality problems which seemed to have existed prior to the onset of IDDM. The authors concluded that emotional or psychological stress can act alone or together with poor compliance to make the child more susceptible to DKA episodes. The retrospective nature of this study requires that these conclusions be accepted cautiously. However, these results are consistent with other research findings.

Anderson et al. (1981), in a more well-controlled study, examined the family environments of 58 adolescents (aged 11-19) with IDDM. Metabolic control was measured using HbA1c levels; three categories of control were derived based on the distribution of HbA1c values. Family environment was assessed with a frequently-used standardized questionnaire (i.e., the Family Environment Scale). Structured interviews were also conducted with adolescents and parents separately. Psychometric data on these measures were not reported for the study sample. Consistent with previous findings, a trend was noted for middle-adolescent
(14-16 years) girls to have HbA1c values higher, indicating poorer control, than either younger (11-13 years) or older adolescent (17-19 years) girls, which the authors attributed to physiologic changes of puberty, psychological or social factors, or an interaction unique to girls in middle adolescence that may have a detrimental influence on their metabolic control. Middle adolescent girls also had higher HbA1c values than did middle adolescent boys. Other results included higher scores on total self-concept and less anxiety in well-controlled adolescents. Parents, who were predominantly mothers, of those in good control reported greater family cohesion, less conflict, and more encouragement of independence. Parents of children in poor control indicated that diabetes had had a significantly negative impact on their child’s school experience and social functioning.

A longitudinal study of 84 adolescents and adults with IDDM (age 13-41 years), who were followed at 6-week intervals for 36 weeks, investigated the relationship between personality dimensions, emotional problems, life stress, and metabolic control (Mazze, Lucido, & Shamoon, 1984). Psychological variables were measured by standardized self-report instruments. Metabolic control was assessed by HbA1 assays. Gender, age, and SES, were controlled in analyses. Personality variables were not found to be related to glycemic control, while anxiety, depression, and quality of life variables (ie, amount of
daily stress) were found to be significantly related to metabolic control. Poorer control was related to significantly greater anxiety, depression, and problems of daily living than good control. Over the course of the study, improvement in control was associated with improvement in anxiety, depression, and quality of life, while worsening control tended to be related with increased anxiety, depression, and problems of daily living. These findings seem to suggest that better metabolic control leads to better adjustment; however, the authors expressed caution in making that conclusion and encouraged further studies.

Grey, Genel, and Tamborlane (1980) investigated the relationship between psychosocial adjustment, self-esteem, family functioning, and metabolic control in 20 children and young adolescents with diabetes (age 7-13 years) and their families. The measures used were a standardized interview and paper and pencil inventories. Psychometric data on psychosocial measures were not reported. Diabetes control was assessed using a 24-hour urinary glucose excretion measure. Better psychosocial adjustment was significantly correlated with higher parental and child self-esteem and with optimal family functioning, and these measures significantly discriminated between the maladjusted group and the adjusted group. The maladjusted group also had significantly greater 24-hour urinary glucose excretion, indicating poorer control, compared with the
adjusted group. This study did not directly relate the measure of family functioning to metabolic control.

In a study designed to examine developmental differences in the relationships among a variety of psychosocial factors, adherence, and metabolic control in children and adolescents with diabetes, several significant results were obtained (Burns, Green, & Chase, 1986). Participants in the study were 72 youngsters, aged 8-16 years, and their parents. Information was obtained by mother, father, and child report; data from parents was examined both separately and combined. Measures for the patient included diabetes knowledge, locus of control, diabetes adjustment, self-esteem, social competence and behavior problems, perceived competence, and adherence, and for the parents, depression, anxiety, family functioning, daily life stress, and parental discipline. These patient and family measures were assessed through structured interview, standardized and normed self- and parental-report instruments, and research measures. Psychometric data were not reported. Due to the number of measures, tests of age-based sets of correlations were made; only when those were significant were individual correlations within sets examined. Results showed that for all ages combined, there was a trend for the number of mother-reported behavior problems to correlate positively with HbA1. For middle adolescents, (aged 11-13), greater parental laxity and fewer family rules were associated with worse control. No
correlation was noted between daily life stress and metabolic control. Better adherence seemed to be associated with better metabolic control, although the measure of adherence was not described.

Hanson and colleagues described results from a large research project which also investigated the relationship between several psychosocial variables, adherence, and metabolic control. Subjects in this study were 104 adolescents with IDDM (mean age=14.5) and their mothers (Hanson, Henggeler, & Burghen, 1987c). The variables assessed were life stress, social competence, and family support. HbA1c was used as a measure of metabolic control and self-report and observational methods were used to measure adherence. Validity and reliability of the adherence measure were not reported. Several standardized paper and pencil measures were used to assess psychosocial factors. Both stress and adherence were found to be related to metabolic control; higher stress and poorer adherence were associated with poorer metabolic control. Stress was not significantly related to adherence. Social competence significantly buffered the negative association between stress and metabolic control. Adolescents with poor social competence were in poor control under conditions of high stress, while the metabolic control of adolescents with good social competence was not influenced by stress. Parental support was significantly related to adherence, and adolescent age was significantly related to parental
support, with younger adolescents receiving more support than older adolescents. The authors concluded that adolescent age was indirectly linked to adherence through parental support.

Subjects in a second report by these authors (Hanson, Henggeler, & Burghen, 1987a) were 93 IDDM adolescents (mean age=14.4) and their families. The psychosocial variables assessed in this study were family knowledge about IDDM, parents' marital satisfaction, family cohesion and adaptability, family support of the diabetes regimen, life stress, and the adolescent's social competence. Adherence and metabolic control were also measured, using self-report and observational items, and HbA1c values, respectively, as in the previous study. Psychosocial measures were obtained from both the adolescent and the parents, using validated paper and pencil questionnaires. Measures were combined, where necessary, to provide a single global index of seven conceptual domains: family knowledge about IDDM, family relations, chronic stress, social competence, adherence, metabolic control, and adolescent age. Multiple regression analyses showed that good adherence and low stress were predictive of good metabolic control, while high family knowledge about IDDM, positive family relations, and young adolescent age were directly associated with good adherence.

Finally, in a study designed to investigate race and sex differences in metabolic control, Hanson and colleagues (1987b) again looked at the relationship between
psychosocial variables, adherence, and metabolic control. Subjects in the study were 27 black and 27 white adolescents with IDDM who were similar in age (mean=14.7 years), age at diagnosis, and social class. The black female group had worse metabolic control, as measured by HbA1c, than each of other groups. In order to determine which of several psychosocial variables were associated with their poor metabolic control, multivariate analyses of variance were performed. The variables of interest were knowledge of diabetes, perceived competence, coping patterns, family adaptability and cohesion, family support, life stress, maternal social support, and satisfaction with the health care system, obtained by self-report measures. Adherence was measured by self-report and observation. Results from this study, unlike those previously reported by these authors, found no significant correlations between any of these factors and metabolic control or between adherence and control. The relationship between adherence and psychosocial variables was not reported.

As has been indicated, previous research has suffered from a variety of methodological problems including reliance on self-report or interview data, measures of metabolic control which vary from study to study, failure to report reliability and validity of measures, and failure to equate comparison groups on variables such as age, pubertal development, duration of disease, and socioeconomic status. While many studies have examined individual relationships
between psychosocial variables and health outcome measures, few have attempted to examine the relationships among all significant parameters. Of those which have, valid and reliable measurement of relevant variables, particularly of adherence, has been lacking.

The purpose of the current research study was to examine the relationships among psychological adjustment, family functioning, adherence, and metabolic control in adolescents with IDDM and their families. This study attempted to correct for problems of previous studies by using multiple measures of adjustment, family functioning, adherence, and metabolic control which are reliable and well-validated. Multiple respondents were used (i.e., mother, father, adolescent), and observational, as well as questionnaire data, was collected.

A thorough review of the literature suggested a possible model of the relationships between the various factors associated with metabolic control (See Figure 1). Three factors appeared to be directly related to metabolic control; they were stress, adherence behaviors, and the physiological changes of puberty. Two factors, psychological adjustment and family functioning, appeared to be indirectly related to glycemic control, through the intervening variable of adherence, although some family variables (i.e., conflict) may fall more easily under the heading of stress. At least initially, however, family variables were hypothesized to affect metabolic control
indirectly. Finally, family factors also seemed to be related to the psychological adjustment of the child. This study investigated the validity of this model.

Figure 1
Model of Factors Influencing Metabolic Control
METHODS

Participants

Participants in the study were 56 adolescents with insulin-dependent diabetes mellitus (IDDM), and their parent(s). Fifty-five mothers and 41 fathers participated in the study. Adolescents' mean (+/-SD) age was 14.4 +/- 1.7 years (range = 12 to 18 years) and their mean duration (+/-SD) of IDDM was 6.2 +/- 3.6 years (range = 2-16 years). Fifty-seven percent of the adolescents were male, and all but one adolescent were white. Most (79.6%) of the adolescents were from two-parent households. The sample was predominantly middle class, as determined by the Hollingshead (1957) two-factor index of socioeconomic status (Class I = 9.4%, Class II = 18.9%, Class III = 28.3%, Class IV = 35.8%, Class V = 7.5%).

Adolescents with diabetes of less than 2 years were excluded from the study because these patients may have been producing some endogenous insulin. Also excluded were adolescents from families who did not own telephones (needed for data collection purposes), adolescents with other significant medical problems in addition to diabetes, and adolescents from families where more than one child had diabetes or another significant medical problem. Approximately seventy percent of adolescents and families
contacted agreed to participate in the study. The most common reasons for refusal included lack of time and prior participation in a research project.

**Measures**

**General Information**

A general information questionnaire was given to obtain basic demographic information about the adolescent and his/her family, including age, gender, family structure, and socioeconomic status.

**Adjustment Measures**

**Child Behavior Checklist.** The Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983) was given to assess behavior problems or symptoms as reported by parent or child (A teacher version is also available). The CBCL is a 118-item list of behaviors which are rated as 0, 1, or 2 in terms of severity. The instrument generates a total symptom count (number of problems checked), a severity score (sum of ratings) and subscale scores for "Internalizing" symptomatology and "Externalizing" symptomatology. The subscales have been developed through prior, large scale factor analyses; broad-band factors--internalizing and externalizing--hold up across age, sex, and version of checklist, while narrow-band factors vary according to sample. Internalizing symptoms include behaviors such as depression and withdrawal. Externalizing symptoms include impulsive behavior, conduct problems, and aggressive behavior.
In addition to symptoms, twenty items are used to assess a range of social competencies, including school, peer-related, and social activities. Extensive data on the reliability and validity of the parent, teacher, and youth report forms have been presented (Achenbach & Edelbrock, 1983, 1987).

**Stress Measures**

**Hassles Scale.** (Kanner, Coyne, Schaefer, & Lazarus, 1981). This scale was developed to assess daily sources of stress. The scale consists of 117 "hassles" such as problems with money, school or work difficulties, and social concerns. Respondents determined which items were hassles to them during the preceding month, and then indicated the frequency and severity of the hassle on 3-point scales. Frequency and severity ratings were thus obtained from the instrument.

Two versions of the Hassles Scale were used in this study. The original version, developed by Kanner et al. (1981) was used with parents, while adolescents completed a modified version which rewords certain items to increase understanding, and replaces irrelevant items with more relevant "hassles". The Hassles Scale has been shown to be reliable and valid in studies with adults (Kanner et al., 1981; Cox et al., 1984).

**Life Events Checklist.** (LEC; Johnson & McCutcheon, 1980). This measure was designed to assess major life stress; it consists of 46 life events (plus 4 spaces
provided for indicating significant events experienced but not included on the scale) which were chosen to represent life changes frequently experienced by children and adolescents. Respondents were asked to indicate which of the events they have experienced in the past year, and to rate each of these events as good or bad. A positive life change score is obtained by summing the events rated as desirable; events rated as undesirable are summed to obtain a negative life change score. Reliability and validity of this measure have been demonstrated (Brand & Johnson, 1982; Gad & Johnson, 1980; Greene, Walker, Hickson, & Thompson, 1985; Johnson, 1982, 1986; Johnson & McCutcheon, 1980).

Social Readjustment Rating Scale. (Holmes & Rahe, 1967). This measure was also designed to assess major life stress; 54 items are listed which describe significant life events relevant to adults, such as births, deaths, or major changes in employment or marital status. Respondents determined which events they had experienced during the past year, and rated each of the events as positive or negative. Adequate reliability and validity have been reported for this measure (Grant, Sweetwood, Gerst, & Yager, 1978; Lei & Skinner, 1980).

Family Measures

Family Environment Scale. (FES; Moos & Moos, 1981, 1983). This instrument was used to assess the social environment of families as perceived by individual family members. It is a 90-item true-false test which yields
standard scores on 10 subscales. The subscales are divided into three dimensions. The Personal Development (Personal Growth) dimension includes five subscales: Independence, Achievement Orientation, Intellectual-Cultural Orientation, Activity-Recreational Orientation, and Moral-Religious Orientation. The Relationship dimension, which provides a description of interpersonal relationships among family members, consists of the Cohesion, Expressiveness, and Conflict subscales. The Organization and Control subscales make up the System Maintenance dimension, which measures the basic structure or "system" of the family.

Adequate reliability and validity have been reported for the FES (Moos & Moos, 1981). Average subscale intercorrelations are approximately .20; these indicate that the scales are measuring distinct, though somewhat related, facets of the family social environment.

Family Behavior Checklist. (Glasgow, McCaul, & Schafer, 1985). This instrument was designed to assess the frequency of both supportive and nonsupportive behaviors directed towards persons with diabetes by family members. The measure is specific to behaviors related to the diabetic regimen. It consists of 16 items which are rated for frequency on a 5-point Likert scale; from these a positive (supportive) score and a negative (nonsupportive) score can be obtained. The authors have provided data on the reliability and validity of this measure. Although the authors have urged caution in use of this instrument with
adolescents (Schafer et al., 1986), other investigators have demonstrated its utility with this population (Hanson et al., 1987b; Kurtz & Delamater, 1984).

**Conflict Behavior Questionnaire.** (Prinz, Foster, Kent, & O'Leary, 1979). The Conflict Behavior Questionnaire was designed to obtain evaluations of parent and adolescent communication. It consists of 75 dichotomous (yes-no) items assessing communication-conflict behavior. For each family member, the CBQ provides two types of information: 1) appraisal of the other member's behavior and 2) appraisal of the dyadic interaction. High scores represent negative appraisals and low scores represent positive appraisals. Data on the reliability and validity of the CBQ have been presented (Foster & Robin, 1988; Prinz et al., 1979; Robin & Foster, 1989; Robin & Weiss, 1980).

**Issues Checklist.** (Prinz et al., 1979). The Issues Checklist was designed to assess the frequency and intensity of discussions associated with specific family issues. Parents and adolescents are asked to recall disagreements about 44 specific issues such as curfew, chores, smoking, and drugs. For each topic, the respondent indicates whether the issue had been discussed during the previous four weeks; if affirmative, the respondent rates the intensity of the discussions on a 5-point scale ranging from calm to angry, and estimates how often the topic was raised.

The Issues Checklist yields three scores for each family member: 1) the quantity of issues discussed, 2) the
mean anger-intensity level of the issues endorsed, and 3) the weighted average of the frequency and anger-intensity level of the issues endorsed. High anger-intensity and weighted frequency by anger-intensity scores are indicative of angry arguments while low scores are indicative of calm discussions. Several studies have presented data on the reliability and validity of this measure (Foster, Prinz, & O'Leary, 1983; Prinz et al., 1979; Robin & Foster, 1984; Robin & Weiss, 1980).

Diabetes Issues Checklist. (Johnson, 1986). The Diabetes Issues Checklist is a modified version of the Issues Checklist; it was designed to assess the frequency and intensity of discussions associated with issues specifically related to diabetes. Similar to the Issues Checklist, parents and adolescents were asked to recall disagreements about 40 issues specific to diabetes, such as diet, exercise, and injections. The same procedure as for the Issues Checklist was then followed; the frequency and intensity of the discussions regarding each relevant issue were rated and three scores were generated.

Behavioral Interaction Task. A sample of each family's problem-solving communication behavior was collected by asking a parent and the adolescent to discuss and attempt to resolve two problems for 10 minutes each. One item each from the Issues Checklist and Diabetes Issues Checklist was selected for discussion; specific guidelines for choosing the most conflictual item were followed. When
possible, the parent who acted as primary caretaker participated in the problem-solving discussions.

Each problem-solving discussion was tape-recorded and then rated using the Interaction Behavior Code (IBC; Prinz & Kent, 1978). Several coders, who were blind to family status, listened to an entire discussion, then completed dichotomous (yes-no) or trichotomous (no-a little-a lot) ratings of 31 discrete problem-solving communication behaviors. Also completed were Likert ratings of degree of insult, friendliness, communication, and problem resolution. From these scores, eight summary scores were obtained: Negative Parental Behavior, Positive Parental Behavior, Negative Adolescent Behavior, Positive Adolescent Behavior, Degree of Resolution, Insult, Friendliness, and General Problem-Solving Effectiveness. Reliability and validity with this coding method have been demonstrated (Foster et al., 1983; Prinz & Kent, 1978; Prinz, Rosenblum, & O'Leary, 1978).

Dyadic Adjustment Scale. (Spanier, 1976). This measure was developed to assess the quality of marriage and other similar dyads. It consists of 32 items which assess four components of dyadic adjustment—dyadic satisfaction, dyadic cohesion, dyadic consensus, and affectional expression. Higher scores are indicative of better marital adjustment. Evidence of content, criterion-related, and construct validity, as well as of high scale reliability has been reported (Spanier, 1976).
Adherence Measures

Twenty-four Hour Recall Interview. (Johnson et al., 1986). This measure is a modified version of the 24-hour recall interview used to assess dietary intake. Information regarding the adolescent's usual daily diabetes management behaviors was obtained by asking the patient to recall the day's events in temporal sequence, beginning with the time he/she woke up in the morning and ending with retiring to bed. All diabetes relevant behaviors are recorded by the interviewer. Three interviews were conducted with each respondent to obtain a more representative sample of the patient's usual behavior, two focusing on weekday activities and one on weekend behavior. Both the adolescent and the primary caretaker were interviewed separately regarding the adolescent's behaviors.

From the data obtained on the interview forms, thirteen separate adherence measures were calculated as described by Johnson et al. (1986). All measures were constructed so that a range of scores was possible, with higher scores indicating relative noncompliance and scores close to zero indicating relative compliance. Previous factor-analytic work suggested that these 13 measures should be grouped into six adherence factors (Johnson et al., 1986; Johnson, Tomer, Cunningham, & Henretta, 1990).

Factor scores were calculated by first standardizing the relevant adherence measures to the 1982 sample described by Johnson et al. (1986), on which the original factor-
analytic work was based, and then averaging the standardized scores, to correct for those factors which required combining several adherence measures based on different measurement scales.

The Injection factor was composed of four measures: injection regularity (the degree to which injections are given at the same time every day), injection interval (the degree to which the time between injections approaches ideal), injection-meal timing (the degree to which injections are given 30 to 60 minutes before eating), and regularity of injection-meal timing (the degree to which the time between injection and eating is consistent across days).

The Exercise factor was composed of three measures: exercise frequency (how often the adolescent exercised), exercise duration (how long the adolescent exercised), and exercise type (the strenuousness of the adolescent's exercise).

The Diet Type factor was composed of two measures: percentage of calories from carbohydrates (in relation to the 60% ideal recommended by the American Diabetes Association; Nuttall & Brunzall, 1979) and percentage of calories from fat (in relation to the 25% ideal recommended by the American Diabetes Association; Nuttall & Brunzall, 1979).

The Testing/Eating Frequency factor was composed of two measures: testing frequenting (how often the adolescent
conducted a glucose test on a daily basis) and eating frequency (how often a adolescent ate on a daily basis).

The Calories Consumed factor consisted of the adolescent’s ideal total number of daily calories (based on age, sex, and height) subtracted from the adolescent’s reported daily calorie consumption.

The Concentrated Sweets factor consisted of the average number of concentrated sweet exchange units eaten on a daily basis (40 calories of any concentrated sweet was equivalent to one concentrated sweet exchange unit).

Data on the reliability and validity of these measures have been presented (Freund, Johnson, Silverstein, & Thomas, 1991; Johnson et al., 1986; Johnson, Freund, Silverstein, Hansen, & Malone, 1990; Johnson, Tomer, Cunningham, & Henretta, 1990; Reynolds, Johnson, & Silverstein, 1990).

**Pubertal Status**

Pubertal status was assessed by obtaining a physician’s judgement as to the Tanner stage (Tanner, 1962; Marshall & Tanner, 1969, 1970) of pubertal development which the adolescent had reached. In girls, breast development and pubic hair growth were assessed and rated into one of five stages ranging from Tanner I (i.e., prepubertal) to Tanner V (mature adult). In boys, genitalia (i.e., testes, scrotum, and penis) and pubic hair growth were similarly rated into one of five stages.
Metabolic control

Metabolic control was assessed in several ways. Glycosylated hemoglobin (Hemoglobin A1c) values, which reflect the percentage of glucose molecules that attach to the body's hemoglobin over the course of 60 days, and which are generally considered the best overall measure of metabolic control, were obtained. This measure provides an index of average blood glucose levels over the past 2 to 3 months (Ziel & Davidson, 1987). HbA1c was assayed using column chromatography (BIO-RAD). Normal values in our laboratory range from 3.5% to 6.1%.

Triglyceride and cholesterol levels were also used as measures of metabolic control, as they are often elevated in youngsters with poorly controlled diabetes (Glasgow, August, & Hung, 1981; Lopes-Virella, Wohltmann, Loadholt, & Buse, 1981; Peterson, Koenig, Jones, Saudek, & Cerami, 1977; Sosenko, Breslow, Miettinen, & Gabbay, 1980). Triglyceride levels were determined by SmithKline Laboratories using the Technicon enzymatic method; normal adult values range from 33 to 111 mg/dl. Cholesterol levels were also assayed by SmithKline Laboratories using the Technicon enzymatic method; normal adult values range from 120 to 200 mg/dl.

Procedures

Participants in the study were recruited through the Pediatric Endocrinology Clinic at Shands Hospital and through the 1989 and 1990 sessions of Florida's Camp for Children and Youth with Diabetes. Participants and their
parents were initially contacted by telephone, approximately one month prior to their clinic visit or to the beginning of camp, to explain the study and to obtain permission to participate. Once verbal consent was obtained, the participants were mailed a packet containing an informed consent form and several questionnaires, to be completed by each adolescent and both parents, when possible: a General Information Form, the Child Behavior Checklist (both Youth Report and Parent Report versions), the Family Environment Scale, the Diabetes Family Behavior Checklist, and the Life Events Checklist (adolescent) and Social Readjustment Rating Scale (parents). In two-parent households, the Dyadic Adjustment Scale was also included. Participants were asked to return the completed forms in pre-addressed, stamped envelopes included with their packets.

During the month prior to the clinic visit (or the beginning of camp), each adolescent and the primary caretaker were telephoned to obtain three 24-hour recall interviews. Approximately one week before the clinic visit (or the beginning of camp), a second packet of questionnaires was sent which included: the Issues Checklist, Diabetes Issues Checklist, Conflict Behavior Questionnaire, and Hassles Scale, for each adolescent and his/her parent(s) to complete, relative to the previous four weeks. During the clinic visit, a blood sample was drawn, in order to obtain HbA1c, triglycerides, and cholesterol levels, and relevant information, including Tanner stage,
insulin dosage, and duration of diabetes, were obtained from the physician. All adolescents were asked to bring in recorded chemstrip results for the past four weeks, as well; however, compliance with that request was minimal. In addition, the adolescent and one parent (preferably the primary caregiver) participated in a behavioral interaction task. A teacher report form of the Child Behavior Checklist, and a questionnaire regarding school absences and course grades, were initially to one teacher of each adolescent, after obtaining a release of information from the adolescent and parents. However, the return rate was so low that the attempt to obtain school information was abandoned.
RESULTS

Adjustment Measures

Adjustment was measured with the parent report and adolescent self-report versions of the Child Behavior Checklist. Relative to the normative samples, adolescent adjustment in this sample fell within the normal range (Achenbach & Edelbrock, 1983). Table 1 presents means and standard deviations of social competence and behavior problem scores as obtained from mothers, fathers, and adolescents.

Agreement among respondents was assessed by using Pearson product moment correlations and repeated measures analyses of variance (ANOVAS). Significant correlations were found between mothers' and fathers' T-scores of total competence \( (r=.50, p<.001, n=40) \), total behavior problems \( (r=.72, p<.0001, n=40) \), total internalizing problems \( (r=.70, p<.0001, n=40) \), and total externalizing problems \( (r=.74, p<.0001, n=40) \). Significant correlations between mothers' and adolescents' T-scores were found for total behavior problems \( (r=.29, p<.03, n=54) \) and total externalizing problems \( (r=.41, p<.002, n=54) \). Only one significant correlation was found between fathers' and adolescents' T-scores: total externalizing problems \( (r=.33, p<.04, n=40) \).
Table 1
Means and Standard Deviations of CBCL T-Scores

<table>
<thead>
<tr>
<th>CBCLa</th>
<th>Mothers (n=55)</th>
<th>Fathers (n=41)</th>
<th>Adolescents (n=55)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Total Social Competence</td>
<td>43.6 (20.0)</td>
<td>43.1 (18.2)</td>
<td>54.0 (12.2)</td>
</tr>
<tr>
<td>Total Behavior Problems</td>
<td>56.8 (9.6)</td>
<td>56.2 (10.4)</td>
<td>46.3 (10.9)</td>
</tr>
<tr>
<td>Total Internalizing Problems</td>
<td>56.6 (8.5)</td>
<td>55.2 (9.7)</td>
<td>47.3 (11.0)</td>
</tr>
<tr>
<td>Total Externalizing Problems</td>
<td>55.7 (8.2)</td>
<td>55.6 (9.0)</td>
<td>45.7 (10.3)</td>
</tr>
</tbody>
</table>

aCBCL = Child Behavior Checklist
bFor normalized T-scores, Mean = 50 and SD = 10.

Table 2
Means and Standard Deviations of Life Events and Daily Hassles Scores

<table>
<thead>
<tr>
<th></th>
<th>Mothers (n=53)</th>
<th>Fathers (n=36,38)</th>
<th>Adolescents (n=56,51)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Positive Life Events</td>
<td>3.5 (2.4)</td>
<td>2.9 (2.1)</td>
<td>3.8 (2.0)</td>
</tr>
<tr>
<td>Negative Life Events</td>
<td>1.9 (2.6)</td>
<td>1.3 (1.7)</td>
<td>2.8 (2.6)</td>
</tr>
<tr>
<td>Total Life Events [KR20]</td>
<td>5.6 (3.6)</td>
<td>4.5 (3.0)</td>
<td>6.7 (3.8)</td>
</tr>
<tr>
<td></td>
<td>[.67]</td>
<td>[.62]</td>
<td>[.65]</td>
</tr>
<tr>
<td>Quantity of Hassles [KR20]</td>
<td>21.2 (16.4)</td>
<td>16.5 (12.1)</td>
<td>25.3 (24.2)</td>
</tr>
<tr>
<td></td>
<td>[.96]</td>
<td>[.94]</td>
<td>[.99]</td>
</tr>
<tr>
<td>Severity of Hassles [Co-Alpha]</td>
<td>1.5 (0.4)</td>
<td>1.5 (0.5)</td>
<td>1.5 (0.5)</td>
</tr>
<tr>
<td></td>
<td>[.97]</td>
<td>[.89]</td>
<td>[.96]</td>
</tr>
<tr>
<td>Severity by Frequency of Hassles</td>
<td>2.5 (1.4)</td>
<td>2.5 (1.7)</td>
<td>2.8 (1.6)</td>
</tr>
</tbody>
</table>

Note. n’s are variable as some forms were not completed by all.
There were significant respondent effects for T-scores of total social competence, $F(2,35)=8.86$, $p<.0008$, total behavior problems, $F(2,37)=16.81$, $p<.0001$, total internalizing problems, $F(2,37)=12.08$, $p<.0001$, and total externalizing problems, $F(2,37)=16.19$, $p<.0001$.

Adolescents reported significantly greater social competence than did mothers' (mean difference=11.14, $t=3.58$, $p<.0008$) and fathers' (mean difference=11.70, $t=3.62$, $p<.0009$), while mothers' and fathers' scores were not significantly different from each other. A similar pattern was found for total problem scores and externalizing scores: adolescents reported significantly fewer total problem scores and externalizing scores than did mothers (mean difference for total=-10.30, $t=-6.07$, $p<.0001$; mean difference for externalizing=-9.74, $t=-6.91$, $p<.0001$), and fathers (mean difference for total=-8.23, $t=-3.68$, $p<.0007$; mean difference for externalizing=-8.69, $t=-4.46$, $p<.0001$), while mothers and fathers did not differ. Mothers reported significantly more internalizing problems than did adolescents (mean difference=-9.17, $t=-4.92$, $p<.0001$) or fathers (mean difference=2.72, $t=2.35$, $p<.02$). Fathers also reported significantly more internalizing problems than did adolescents (mean difference=-6.59, $t=-2.91$, $p<.006$).

Across measures of adjustment, adolescents reported greater social competence and fewer problems than did their parents.
Stress Measures

Major life events were measured with the Life Events Checklist for adolescents, and the Social Readjustment Rating Scale for parents. Daily stresses were measured with the Hassles Scale. Internal consistencies for Total Life Event scores on the Life Events Checklist and on the Social Readjustment Rating Scale were adequate (KR20 for adolescents = .65, KR20 for parents = .65; see Table 2). Internal consistencies for the Quantity and Severity scores of the Hassles Scales were excellent (overall, KR20 for Quantity of Hassles = .96, and coefficient alpha for Severity of Hassles = .96; see Table 2).

Relative to a normative sample, adolescents in this sample reported major life event scores within the normal range (Brand & Johnson, 1982; Johnson & McCutchen, 1980). No normative data is available on adolescents' daily hassles scores. Parents in this sample obtained major life event scores and daily hassles scores within the normal range (Grant et al., 1978; Kanner et al., 1981). Table 2 presents means and standard deviations of positive, negative, and total life events, and quantity, severity, and severity by frequency of daily hassles, as obtained from mothers, fathers, and adolescents.

Agreement among respondents was assessed by using Pearson product moment correlations and repeated measures analyses of variance (ANOVA's). Significant correlations were found between mothers' and fathers' scores of positive
(r=.53, p<.001, n=35), negative (r=.38, p<.02, n=35), and total (r=.46, p<.006, n=34) life events. Significant correlations were also found between mothers’ and fathers’ scores of quantity (r=.34, p<.05, n=36) and severity by frequency (r=.37, p<.03, n=35) of daily hassles. Trends for agreement were found between mothers’ and adolescents’ negative (r=.25, p<.07, n=53) and total (r=.24, r<.09, n=52) life events. Mothers’ and adolescents’ scores of quantity of daily hassles were significantly correlated (r=.31, p<.03, n=49). No significant correlations were found between fathers’ and adolescents’ life event scores or daily hassles scores. (However, the correlation between fathers’ and adolescents’ total life events scores was r=.27, p<.11, n=35.)

There were significant respondent effects for positive, F (2,33)=3.35, p<.05, negative, F (2,33)=3.70, p<.04, and total life events, F (2,32)=6.25, p<.005. Adolescents reported significantly more positive (mean difference=1.14, t=2.61, p<.01), negative (mean difference=1.25, t=2.41, p<.02), and total life events (mean difference=2.35, t=3.24, p<.003) than did fathers. Mothers reported significantly more total life events (mean difference=1.15, t=2.06, p<.05) than did fathers.

A significant respondent effect was found for the severity by frequency score of daily hassles, F (2,30)=3.36, p<.05. Further analysis revealed only a trend for difference between adolescents and mothers (mean
difference = .53, $t = 1.72$, $p < .09$), and no differences between adolescents and fathers, or mothers and fathers.

Adolescents reported more life events, both positive and negative, and more hassles, than their parents. Mothers reported more life events than fathers.

**Family Measures**

**Family Environment Scale**

Family social environment was measured with the Family Environment Scale. Internal consistencies for subscales of this measure for this sample were extremely poor, ranging from $KR20 = -.13$ for Control to $KR20 = .34$ for Independence, for the combined sample of adolescents and parents (see Table 3 for $KR20$s for individual respondents). Relative to the normative sample, the scores of individual family members in this sample fell within the normal range on this measure, with the exception of the subscale of Independence, where scores fell significantly below average (Moos & Moos, 1981). Table 3 presents means and standard deviations of subscale scores as obtained from mothers, fathers, and adolescents.

Agreement among respondents was assessed by using Pearson product moment correlations and repeated measures analyses of variance (ANOVAS). Significant correlations were found between mothers’ and fathers’ subscale scores for Cohesion ($r = .39$, $p < .02$, $n = 39$), Conflict ($r = .35$, $p < .03$, $n = 39$), Intellectual/Cultural ($r = .39$, $p < .01$, $n = 39$), and
<table>
<thead>
<tr>
<th>FES&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Mothers (n=55)</th>
<th>Fathers (n=40)</th>
<th>Adolescents (n=56)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Cohesion [KR20]</td>
<td>5.85 (0.97)</td>
<td>5.65 (1.27)</td>
<td>5.66 (1.56)</td>
</tr>
<tr>
<td></td>
<td>[-.24]</td>
<td>[.09]</td>
<td>[.31]</td>
</tr>
<tr>
<td>Expressiveness [KR20]&lt;sub&gt;F&lt;/sub&gt;</td>
<td>5.49 (1.30)</td>
<td>5.15 (1.35)</td>
<td>4.68 (1.34)</td>
</tr>
<tr>
<td></td>
<td>[-.06]</td>
<td>[-.13]</td>
<td>[-.09]</td>
</tr>
<tr>
<td>Conflict [KR20]</td>
<td>3.0 (1.17)</td>
<td>3.25 (1.13)</td>
<td>3.46 (1.35)</td>
</tr>
<tr>
<td></td>
<td>[-.11]</td>
<td>[.05]</td>
<td>[-.24]</td>
</tr>
<tr>
<td>Independence [KR20]</td>
<td>3.76 (1.39)</td>
<td>4.13 (1.47)</td>
<td>3.98 (1.66)</td>
</tr>
<tr>
<td></td>
<td>[.36]</td>
<td>[.27]</td>
<td>[.40]</td>
</tr>
<tr>
<td>Achievement Orientation [KR20]</td>
<td>4.56 (1.21)</td>
<td>4.20 (1.38)</td>
<td>4.96 (1.33)</td>
</tr>
<tr>
<td>Intellectual/Cultural [KR20]</td>
<td>4.92 (1.37)</td>
<td>5.23 (1.37)</td>
<td>4.50 (1.33)</td>
</tr>
<tr>
<td></td>
<td>[-.009]</td>
<td>[-.02]</td>
<td>[-.10]</td>
</tr>
<tr>
<td>Activity/Recreational [KR20]</td>
<td>4.84 (1.30)</td>
<td>4.75 (1.53)</td>
<td>5.13 (1.39)</td>
</tr>
<tr>
<td></td>
<td>[-.16]</td>
<td>[.18]</td>
<td>[.001]</td>
</tr>
<tr>
<td>Moral/Religious [KR20]</td>
<td>4.93 (1.09)</td>
<td>5.03 (1.19)</td>
<td>4.98 (1.42)</td>
</tr>
<tr>
<td></td>
<td>[.18]</td>
<td>[-.04]</td>
<td>[.15]</td>
</tr>
<tr>
<td>Organization [KR20]</td>
<td>4.91 (1.31)</td>
<td>4.43 (1.60)</td>
<td>5.41 (1.44)</td>
</tr>
<tr>
<td></td>
<td>[.04]</td>
<td>[.22]</td>
<td>[.19]</td>
</tr>
<tr>
<td>Control [KR20]</td>
<td>4.91 (1.31)</td>
<td>4.43 (1.60)</td>
<td>5.41 (1.44)</td>
</tr>
<tr>
<td></td>
<td>[-.13]</td>
<td>[.05]</td>
<td>[-.21]</td>
</tr>
</tbody>
</table>

<sup>a</sup>FES = Family Environment Scale
Moral/Religious (r=.47, p<.003, n=39). They showed trends for agreement for Expressiveness (r=.27, p<.09, n=39), Achievement Orientation (r=.29, p<.08, n=39), Activity/Recreational (r=.27, p<.09, n=39), and Organization (r=.30, p<.06, n=39). Significant correlations between mothers' and adolescents' subscale scores were found for Moral/Religious (r=.46, p<.0004, n=55) and Organization (r=.34, p<.01, n=55), with trends for Independence (r=.23, p<.10, n=55) and Activity/Recreational (r=.24, p<.08, n=55). Only one significant correlation was found between fathers' and adolescents' subscale scores: Moral/Religious (r=.33, p<.04, n=40). However, there were trends for Independence (r=.28, p<.08, n=40) and Intellectual/Cultural (r=-.27, p<.09, n=40).

There were significant respondent effects for Expressiveness, F (2,37)=4.21, p<.02, Achievement Orientation, F (2,37)=7.63, p<.002, and Organization, F (2,37)=4.07, p<.03, subscale scores. Adolescents reported lower Expressiveness than did their mothers (mean difference=-.74, t=-3.28, p<.002), higher Achievement Orientation than did their fathers (mean difference=1.0, t=3.70, p<.0007), and greater Organization than did their mothers (mean difference=.48, t=2.2, p<.03) and their fathers (mean difference=.79, t=2.6, p<.01).

Mothers and fathers reported similar perceptions of their family environment. Adolescents, in contrast to their parents, viewed their families as less open to emotional
expression, more oriented towards achievement, and more organized and structured.

**Diabetes Family Behavior Checklist**

Family supportive behaviors were measured with the Diabetes Family Behavior Checklist. Internal consistencies for subscale score with this measure were adequate (overall, coefficient alpha for positive scores = .77, coefficient alpha for negative scores = .67; see Table 4). Relative to normative samples, the scores of individual family members' in this sample fell within the normal range on this measure (Glasgow et al., 1985; Schafer et al., 1983; McCaul, Glasgow, & Schafer, 1987). Table 4 presents means and standard deviations of subscale scores as obtained from mothers, fathers, and adolescents.

Agreement among respondents was assessed by using Pearson product moment correlations and repeated measures analyses of variance (ANOVAS). A significant correlation was found between mothers' and fathers' subscale scores for negative behaviors (r=.42, p<.007, n=40). They showed a trend for agreement for positive behaviors (r=.26, p<.10, n=40). Significant correlations between mothers' and adolescents' subscale scores were found for both negative (r=.55, p<.0001, n=53) and positive (r=.57, p<.0001, n=53) behaviors. Fathers' and adolescents' subscale scores for negative behaviors were not significantly correlated (r=.25, p<.12, n=39). However, there was a significant correlation between fathers' and adolescents' subscale scores for
### Table 4
Means and Standard Deviations of Family Measures Subscale Scores

<table>
<thead>
<tr>
<th></th>
<th>Mothers</th>
<th>Fathers</th>
<th>Adolescents about Mothers</th>
<th>Adolescents about Fathers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DFBC(^a)</strong></td>
<td>(n=55)</td>
<td>(n=41)</td>
<td>(n=54)</td>
<td>(n=41)</td>
</tr>
<tr>
<td>Positive Behaviors</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td></td>
<td>25.29 (5.16)</td>
<td>21.02 (6.12)</td>
<td>23.13 (6.42)</td>
<td>20.05 (6.80)</td>
</tr>
<tr>
<td>[Coefficient Alpha]</td>
<td>[.64]</td>
<td>[.79]</td>
<td>[.75]</td>
<td>[.79]</td>
</tr>
<tr>
<td>Negative Behaviors</td>
<td>17.89 (5.27)</td>
<td>15.80 (3.78)</td>
<td>16.11 (5.25)</td>
<td>14.24 (4.68)</td>
</tr>
<tr>
<td>[Coefficient Alpha]</td>
<td>[.74]</td>
<td>[.50]</td>
<td>[.69]</td>
<td>[.58]</td>
</tr>
<tr>
<td><strong>CBQ(^b)</strong></td>
<td>(n=54)</td>
<td>(n=40)</td>
<td>(n=55)</td>
<td>(n=41)</td>
</tr>
<tr>
<td>Appraisal of Other</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>[KR20]</td>
<td>6.78 (5.34)</td>
<td>7.13 (6.51)</td>
<td>5.93 (5.44)</td>
<td>6.02 (5.72)</td>
</tr>
<tr>
<td>Appraisal of Dyad</td>
<td>2.28 (2.54)</td>
<td>3.48 (3.22)</td>
<td>3.04 (3.11)</td>
<td>3.37 (3.63)</td>
</tr>
<tr>
<td><strong>IC(^c)</strong></td>
<td>(n=55)</td>
<td>(n=40)</td>
<td>(n=54)</td>
<td>(n=41)</td>
</tr>
<tr>
<td>Quantity of Issues</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>[KR20]</td>
<td>18.11 (10.16)</td>
<td>15.45 (10.18)</td>
<td>13.46 (10.20)</td>
<td>8.29 (8.73)</td>
</tr>
<tr>
<td>Intensity of Issues</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>[Coefficient Alpha]</td>
<td>1.83 (.72)</td>
<td>1.93 (.71)</td>
<td>1.78 (.89)</td>
<td>1.79 (.94)</td>
</tr>
<tr>
<td>[Coefficient Alpha]</td>
<td>[.91]</td>
<td>[.92]</td>
<td>[.91]</td>
<td>[.85]</td>
</tr>
<tr>
<td>Intensity by Frequency of Issues</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td></td>
<td>14.90 (16.73)</td>
<td>10.67 (11.56)</td>
<td>10.91 (11.81)</td>
<td>9.23 (10.30)</td>
</tr>
<tr>
<td></td>
<td>Mothers</td>
<td>Fathers</td>
<td>Adolescents about Mothers</td>
<td>Adolescents about Fathers</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td><strong>DIC^d</strong></td>
<td>(n=55)</td>
<td>(n=40)</td>
<td>(n=53)</td>
<td>(n=41)</td>
</tr>
<tr>
<td><strong>Quantity of Diabetes Issues</strong></td>
<td>15.47 (11.07)</td>
<td>10.48 (9.47)</td>
<td>9.36 (9.62)</td>
<td>5.95 (10.29)</td>
</tr>
<tr>
<td><strong>Intensity of Diabetes Issues</strong></td>
<td>1.60 (.72)</td>
<td>1.58 (.69)</td>
<td>1.64 (.82)</td>
<td>1.62 (.93)</td>
</tr>
<tr>
<td><strong>[Coefficient Alpha]</strong></td>
<td>[.92]</td>
<td>[.90]</td>
<td>[.91]</td>
<td>[.96]</td>
</tr>
<tr>
<td><strong>Intensity by Frequency of Diabetes Issues</strong></td>
<td>11.72 (16.33)</td>
<td>7.77 (8.18)</td>
<td>8.88 (9.11)</td>
<td>9.01 (11.45)</td>
</tr>
</tbody>
</table>

^aDFBC = Diabetes Family Behavior Checklist

^bCBQ = Conflict Behavior Questionnaire

^cIC = Issues Checklist

^dDIC = Diabetes Issues Checklists
positive behaviors (r=.42, p<.008, n=39). Adolescents' viewed their parents as similar. Their subscale scores rating their mother's behaviors were significantly correlated with those rating their father's behaviors for both negative (r=.79, p<.0001, n=41) and positive (r=.87, p<.0001, n=41) behaviors.

There were significant respondent effects for both negative, F(3,35)=6.99, p<.0008, and positive, F(3,35)=.0001, behaviors. Adolescents reported significantly fewer negative (mean difference=-1.72, t=-2.48, p<.02), and positive (mean difference=-2.3, t=-3.18, p<.003) behaviors than did their mothers, and mothers reported significantly more negative (mean difference=2.28, t=2.87, p<.007) and positive (mean difference=4.49, t=4.18, p<.0002) behaviors than did fathers. Adolescents' viewed their mothers as exhibiting significantly more negative (mean difference = 1.80, t=3.60, p<.0009) and positive (mean difference=2.59, t=4.76, p<.0001) behaviors than their fathers.

While adolescents acknowledged that their mothers exhibit more supportive and unsupportive behaviors than their fathers, they did not view their mothers as exhibiting as many positive and negative behaviors as their mothers themselves report. Fathers did report fewer supportive and fewer unsupportive behaviors than did mothers.
Conflict Behavior Questionnaire

Evaluation of parent and adolescent communication was assessed with the Conflict Behavior Questionnaire. Internal consistencies for this measure with this sample were adequate to good (for adolescents, KR20 for appraisal of parent = .86, KR20 for appraisal of dyad = .79; for parents, KR20 for appraisal of adolescent = .88, KR20 for appraisal of dyad = .76; see Table 4). Relative to the normative sample, the scores of individual family members' in this sample fell within normal limits on this measure (Robin & Foster, 1989). Table 4 presents means and standard deviations of subscale scores as obtained from mothers, fathers, and adolescents. Higher scores are indicative of more negative parent/adolescent interactions.

Agreement among respondents was assessed by using Pearson product moment correlations and repeated measures analyses of variance (ANOVAS). Significant correlations were found between mothers' and fathers' subscale scores for appraisal of adolescent (r=.60, p<.0001, n=39) and appraisal of dyad (r=.38, p<.02, n=39). Significant correlations between mothers' and adolescents' subscale scores were also found for appraisal of other (r=.28, p<.04, n=53) and appraisal of dyad (r=.51, p<.0001, n=53). Fathers' and adolescents' subscale scores for appraisal of other (r=.41, p<.009, n=39) and for appraisal of dyad (r=.48, p<.002, n=39) were significantly correlated. Adolescents viewed their interactions with their parents
similarly. Their subscale scores rating their mothers were significantly correlated with those rating their fathers for both appraisal of other (r=.48, p<.001, n=41) and appraisal of dyad (r=.33, p<.03, n=41).

There were no significant respondent effects for either the appraisal of other, F(3,35)=.48, p<.70, or the appraisal of dyad, F(3,35)=2.30, p<.09, subscale scores.

Adolescents and their parents were alike in their perceptions of their communication with each other. Mothers and fathers were perceived by adolescents as behaving similarly in their interactions.

Issues Checklist

Aspects of family discussions associated with specific issues were assessed with the Issues Checklist and the Diabetes Issues Checklist. Internal consistencies for the Issues Checklist with this sample were excellent (overall, KR20 for Quantity of Issues = .92, Coefficient Alpha for Intensity of Issues = .91; see Table 4). Relative to the normative sample, the scores of individual family members' in this sample fell within one standard deviation of the nonclinic sample on this measure (Robin & Foster, 1989). Only for the quantity of issues endorsed by fathers was the mean score closer to the clinic sample mean (M=18.38, SD=5.05) than for the nonclinic sample mean (M=11.6, SD=4.6). Table 4 presents means and standard deviations of subscale scores as obtained from mothers, fathers, and adolescents.
Agreement among respondents was assessed by using Pearson product moment correlations and repeated measures analyses of variance (ANOVAS). A significant correlation was found between mothers’ and fathers’ score for quantity of issues ($r=.53$, $p<.0005$, $n=39$). They showed a trend for agreement for intensity of issues ($r=.30$, $p<.07$, $n=39$). Significant correlations between mothers’ and adolescents’ scores were found for both quantity ($r=.55$, $p<.0001$, $n=53$) and intensity ($r=.36$, $p<.007$, $n=53$) of issues. Fathers’ and adolescents’ scores for quantity of issues were not significantly correlated ($r=.30$, $p<.06$, $n=39$). However, there were significant correlations between fathers’ and adolescents’ scores for intensity ($r=.43$, $p<.007$, $n=38$) and intensity by frequency ($r=.53$, $p<.0006$, $n=38$) of issues. Adolescents perceived their interactions with their parents as similar. Their scores rating their mothers were significantly correlated with those rating their fathers for quantity ($r=.69$, $p<.0001$, $n=41$), intensity ($r=.86$, $p<.0001$, $n=40$), and intensity by frequency ($r=.62$, $p<.0001$, $n=40$) of issues.

There was a significant respondent effect for quantity of issues, $F(3,35)=17.43$, $p<.0001$. Adolescents reported significantly fewer issues than their mothers (mean difference=$-5.09$, $t=-3.82$, $p<.0004$) and their fathers (mean difference=$-7.38$, $t=-4.08$, $p<.0002$). Adolescents’ reports of the quantity of issues discussed with their mothers were significantly greater than their reports of those discussed
with their fathers, as well (mean difference=5.10, t=3.99, p<.0003).

Adolescents reported fewer issues than did both their mothers and their fathers. They reported more issues with their mothers than with their fathers, although this difference was not reported by their parents. Adolescents and parents reported similar intensity and frequency in their discussions of issues.

**Diabetes Issues Checklist**

As with the Issues Checklist, internal consistencies for this measure with this sample were excellent (overall, KR20 for Quantity of Diabetes Issues = .94, Coefficient Alpha for Intensity of Diabetes Issues = .94; see Table 4). No normative data on this measure is currently available. Relative to the normative sample for the Issues Checklist, the scores of individual family members' in this sample fell within one standard deviation of the nonclinic sample, with the exception of the adolescents' reports of quantity of diabetes issues discussed with both mother and father. These scores were significantly less than those from the normative sample for the Issues Checklist (Robin & Foster, 1989). Table 4 presents means and standard deviations of subscale scores as obtained from mothers, fathers, and adolescents.

Agreement among respondents was assessed by using Pearson product moment correlations and repeated measures analyses of variance (ANOVAS). Significant correlations
were found between mothers' and fathers' scores for quantity 
(r=.55, p<.0003, n=39) and intensity (r=.53, p<.002, n=32) 
of diabetes issues. A significant correlation between 
mothers' and adolescents' scores were found for quantity of 
diabetes issues (r=.49, p<.0002, n=52). Trends for 
agreement were found for fathers' and adolescents' scores 
for quantity (r=.31, p=.06, n=39) and intensity by frequency 
(r=.38, p<.06, n=25) of diabetes issues. Again, adolescents 
viewed their interactions with their parents as similar. 
Their scores rating their mothers were significantly 
correlated with those rating their fathers for quantity 
(r=.78, p<.0001, n=41), intensity (r=.45, p<.02, n=27), and 
intensity by frequency (r=.68, p<.0001, n=27) of diabetes 
issues.

There was a significant respondent effect for quantity 
of diabetes issues, F(3,35)=11.69, p<.0001. Adolescents 
reported significantly fewer issues than their mothers (mean 
difference=-6.19, t=-4.21, p<.0001) and than their fathers 
(mean difference=-4.36, t=-2.31, p<.03), and mothers 
reported significantly more issues than fathers (mean 
difference =5.13, t=2.97, p<.005) in their report of 
quantity of diabetes issues. Adolescents' reports of the 
quantity of diabetes issues discussed with their mothers 
were significantly greater than their reports of those 
discussed with their fathers, as well (mean difference=3.27, 
t=2.98, p<.005).
In comparing scores on the Issues Checklist with those on the Diabetes Issues Checklist, when the respondents were mothers, significant correlations were found for quantity (r=.80, p<.001, n=57), intensity (r=.62, p<.0001, n=55), and intensity by frequency (r=.82, p<.0001, n=55) of issues. Mothers reported that general issues were significantly greater in quantity (mean difference=2.59, t=2.80, p<.007), intensity (mean difference=.25, t=2.95, p<.005), and intensity by frequency (mean difference=4.68, t=3.39, p<.001) than were diabetes issues.

When the respondents were fathers, a similar pattern was found. Significant correlations between scores on the Issues Checklist and the Diabetes Issues Checklist were found for quantity (r=.67, p<.0001, n=41), intensity (r=.62, p<.0001, n=35), and intensity by frequency (r=.70, p<.0001, n=35) of issues. Fathers also reported significantly greater quantity (mean difference=5.35, t=4.18, p<.0002), intensity (mean difference=.41, t=4.21, p<.0002), and intensity by frequency (mean difference=4.11, t=2.77, p<.009) of general issues than diabetes issues.

When adolescents were the respondents, significant correlations between scores on the Issues Checklist and the Diabetes Issues Checklist were found for quantity (r=.60, p<.0001, n=55), intensity (r=.83, p<.0001, n=53), and intensity by frequency (r=.72, p<.0001, n=53) of issues, and for quantity (r=.83, p<.0001, n=43), intensity (r=.39, p<.04, n=29), and intensity by frequency (r=.59,
p<.005, n=29) of issues with fathers. Adolescents reported significantly more general issues than diabetes issues both with mothers (mean difference=3.96, t=3.37, p<.001) and with fathers (mean difference=2.40, t=2.76, p<.009), but did not report significant differences in intensity (mother: mean difference=.09, t=1.33, p<.19; father: mean difference=.08, t=.43, p<.67) or intensity by frequency (mother: mean difference=1.62, t=1.46, p<.15; father: mean difference=.83, t=.39, p<.70) of issues with either parent.

As with general issues, adolescents reported fewer diabetes issues than did both their mothers and their fathers. They reported more diabetes issues with their mothers than with their fathers; this difference was also reported by their parents. Adolescents and parents reported similar intensity and frequency in their discussions of diabetes issues.

Both adolescents and parents reported fewer diabetes issues than general issues. Parents reported that discussions about general issues happened more frequently and were greater in intensity than diabetes issues, as well.

Behavioral Interaction Task

For this measure, the mean of four raters scores was used to represent the family's communication. Interobserver agreement was estimated using the Spearman-Brown correction for multiple raters (Winer, 1971). Reliabilities on summary scores for this sample ranged from .79 for Positive Adolescent Behavior, Degree of Resolution, and Friendliness,
Table 5
Means, Standard Deviations, and Interrater Reliabilities for Behavioral Interaction Task Summary Scores

<table>
<thead>
<tr>
<th>Summary Score</th>
<th>General Issues</th>
<th>Diabetes Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=46)</td>
<td>(n=46)</td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td></td>
<td>[Spearman-Brown]</td>
<td>[Spearman-Brown]</td>
</tr>
<tr>
<td>Positive Adolescent Behavior</td>
<td>.240 (.134)</td>
<td>.234 (.144)</td>
</tr>
<tr>
<td></td>
<td>[.79]</td>
<td>[.81]</td>
</tr>
<tr>
<td>Negative Adolescent Behavior</td>
<td>.119 (.083)</td>
<td>.088 (.059)</td>
</tr>
<tr>
<td></td>
<td>[.81]</td>
<td>[.83]</td>
</tr>
<tr>
<td>Positive Parental Behavior</td>
<td>.413 (.212)</td>
<td>.431 (.196)</td>
</tr>
<tr>
<td></td>
<td>[.84]</td>
<td>[.76]</td>
</tr>
<tr>
<td>Negative Parental Behavior</td>
<td>.117 (.100)</td>
<td>.071 (.046)</td>
</tr>
<tr>
<td></td>
<td>[.84]</td>
<td>[.63]</td>
</tr>
<tr>
<td>Degree of Resolution</td>
<td>3.22 (1.13)</td>
<td>2.80 (1.21)</td>
</tr>
<tr>
<td></td>
<td>[.79]</td>
<td>[.87]</td>
</tr>
<tr>
<td>Insult</td>
<td>1.55 (0.69)</td>
<td>1.23 (0.35)</td>
</tr>
<tr>
<td></td>
<td>[.83]</td>
<td>[.35]</td>
</tr>
<tr>
<td>Friendliness</td>
<td>2.57 (0.78)</td>
<td>2.81 (0.77)</td>
</tr>
<tr>
<td></td>
<td>[.79]</td>
<td>[.74]</td>
</tr>
<tr>
<td>Problem-Solving Effectiveness</td>
<td>3.22 (1.05)</td>
<td>2.95 (1.15)</td>
</tr>
<tr>
<td></td>
<td>[.81]</td>
<td>[.83]</td>
</tr>
</tbody>
</table>
to .84 for Positive Parental Behavior and Negative Parental Behavior, for general issues, and from .35 for Insult to .87 for Degree of Resolution, for diabetes issues (see Table 5).

Summary scores for behavioral interactions about general issues for this sample fell closer to the mean scores for a clinic-referred sample than to those for a nonclinic sample for all scores except Friendliness, Degree of Resolution, and Problem-Solving Effectiveness, which fell within the normative range (Prinz et al., 1979; Prinz & Kent, 1978). Summary scores for behavioral interactions about diabetes issues for this sample fell within the normative range, with the exception of Positive Adolescent Behavior and Positive Maternal Behavior, which were closer to the mean for a clinic-referred sample. Table 5 presents means and standard deviations of summary scores for both general and diabetes-related behavioral interactions. Higher summary scores indicate a higher rate of the identified behavior, with the exception of higher scores indicating poorer Degree of Resolution and poorer Problem-Solving Effectiveness.

In comparing scores from the behavioral interactions about general issues to those about diabetes issues, significant correlations were found for all scores, and ranged from $r = .48, p < .0008, n=45$, for Negative Parental Behavior to $r = .83, p < .0001, n=44$, for Positive Parental Behavior. There were significant differences between behavioral interactions about general issues and those about
diabetes issues for five of the eight summary scores. Discussions about general issues, as compared to diabetes issues, had higher Negative Parental Behavior (mean difference=.04, t=3.32, p<.002), higher Negative Adolescent Behavior (mean difference=.02, t=2.63, p<.01), higher Insult (mean difference=.27, t=3.32, p<.002), less Friendliness (mean difference=-.20, t=-2.66, p<.01) and poorer Degree of Resolution (mean difference=.33, t=2.17, p<.04). There was a trend for discussions about general issues to show poorer Problem-solving Effectiveness than those about diabetes issues, as well (mean difference=.18, t=1.73, p<.09).

Behavioral interactions were consistent with adolescent and parental reports about general and diabetes-related issues. Behavioral interactions about general issues, in contrast to those about diabetes issues, had higher negative behavior from both adolescent and parent, more insults, and poorer resolution and effectiveness of problem-solving.

**Dyadic Adjustment Scale**

Marital satisfaction and adjustment was assessed with the Dyadic Adjustment Scale. Internal consistencies of this measure with this sample were excellent (Coefficient alphas for mothers = .95, for fathers = .93, for parents combined = .94). The mean total scores obtained by this sample were 111.8 (SD=16.8) for mothers and 115.3 (SD=14.1) for fathers, which, relative to the normative sample, fell within the normal range (Spanier, 1976).
Agreement between respondents was assessed by using Pearson product moment correlations and paired comparison T-tests. A significant correlation was found between mothers' and fathers' scores of dyadic adjustment ($r=.48$, $p<.003$, $n=37$). There was not a significant difference between mothers' and fathers' scores (mean difference=1.14, $t=.46$, $p<.65$).

**Adherence Measures**

Adherence with the daily diabetes regimen was assessed with 24-hour recall interviews. Relative to the normative sample, adherence measures in this sample fell within one standard deviation of the norm, with the exception of the measures of Carbohydrate Consumption and Fat Consumption. Scores on these two measures were significantly below average, indicating better adherence in those areas. Table 6 presents means and standard deviations of adherence scores as obtained from parents, adolescents, and the combined sample. Higher scores on these measures were indicative of poorer adherence.

Agreement between respondents was assessed by using Pearson product moment correlations and paired comparison T-tests. Significant correlations were found between parents' and adolescents' scores for Exercise Frequency, Exercise Type, Injection Regularity, Injection Interval, Injection Meal Timing, Eating Frequency, Carbohydrate Consumption in Relation to Ideal, Fat Consumption in Relation to Ideal,
Table 6
Means and Standard Deviations of Adherence Scores

<table>
<thead>
<tr>
<th>Adherence Measure</th>
<th>Parents (n=50,54)</th>
<th>Adolescents (n=55)</th>
<th>Combined (n=54,55)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Exercise Frequency [per day]</td>
<td>29.7 (20.4)</td>
<td>33.9 (20.1)</td>
<td>61.0 (21.7)</td>
</tr>
<tr>
<td></td>
<td>[4.2]</td>
<td>[4.0]</td>
<td>[2.3]</td>
</tr>
<tr>
<td>Exercise Duration [minutes]</td>
<td>.12 (.22)</td>
<td>.10 (.19)</td>
<td>.07 (.07)</td>
</tr>
<tr>
<td></td>
<td>[22.53]</td>
<td>[24.32]</td>
<td>[23.83]</td>
</tr>
<tr>
<td>Exercise Type [kilocalories/minute]</td>
<td>.972 (.017)</td>
<td>.969 (.017)</td>
<td>.970 (.017)</td>
</tr>
<tr>
<td></td>
<td>[.029]</td>
<td>[.033]</td>
<td>[.032]</td>
</tr>
<tr>
<td>Injection Regularity [minutes]</td>
<td>.59 (.53)</td>
<td>.71 (.56)</td>
<td>.67 (.51)</td>
</tr>
<tr>
<td></td>
<td>[35.4]</td>
<td>[42.6]</td>
<td>[40.2]</td>
</tr>
<tr>
<td>Injection Interval [minutes]</td>
<td>1.36 (1.13)</td>
<td>1.34 (1.06)</td>
<td>1.26 (1.04)</td>
</tr>
<tr>
<td></td>
<td>[81.6]</td>
<td>[80.4]</td>
<td>[75.6]</td>
</tr>
<tr>
<td>Injection-Meal Timing [minutes]</td>
<td>.82 (.54)</td>
<td>.80 (.46)</td>
<td>.79 (.44)</td>
</tr>
<tr>
<td></td>
<td>[10.8]</td>
<td>[12.0]</td>
<td>[12.6]</td>
</tr>
<tr>
<td>Regularity of Injection-Meal</td>
<td>24.3 (46.5)</td>
<td>20.9 (20.7)</td>
<td>20.1 (18.2)</td>
</tr>
<tr>
<td>Timing [minutes]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eating Frequency [per day]</td>
<td>20.0 (12.9)</td>
<td>26.6 (12.5)</td>
<td>22.9 (11.5)</td>
</tr>
<tr>
<td></td>
<td>[4.8]</td>
<td>[4.4]</td>
<td>[4.6]</td>
</tr>
<tr>
<td>Glucose Testing Frequency [per day]</td>
<td>65.5 (25.8)</td>
<td>62.6 (25.3)</td>
<td>58.3 (25.9)</td>
</tr>
<tr>
<td></td>
<td>[1.4]</td>
<td>[1.5]</td>
<td>[1.7]</td>
</tr>
<tr>
<td>% Calories: Carbohydrate</td>
<td>14.9 (6.5)</td>
<td>13.0 (6.9)</td>
<td>12.9 (6.8)</td>
</tr>
<tr>
<td></td>
<td>[45.1]</td>
<td>[47.1]</td>
<td>[47.1]</td>
</tr>
<tr>
<td>% Calories: Fat</td>
<td>12.9 (5.9)</td>
<td>13.2 (7.3)</td>
<td>14.0 (7.2)</td>
</tr>
<tr>
<td></td>
<td>[37.9]</td>
<td>[38.2]</td>
<td>[39.0]</td>
</tr>
<tr>
<td>Calories Consumed (compared to ideal)</td>
<td>-1187 (676)</td>
<td>-625 (812)</td>
<td>-437 (751)</td>
</tr>
<tr>
<td>Concentrated Sweets (per day)</td>
<td>1.1 (1.5)</td>
<td>1.3 (1.9)</td>
<td>1.7 (2.2)</td>
</tr>
</tbody>
</table>

Note. Values in brackets provide the reader with an interpretation of each adherence measure using a familiar measurement scale.
<table>
<thead>
<tr>
<th>Adherence Score</th>
<th>r (n)</th>
<th>p &lt;</th>
<th>Adherence Score</th>
<th>r (n)</th>
<th>p &lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise Frequency</td>
<td>.73 (54)</td>
<td>(.0001)</td>
<td>Eating Frequency</td>
<td>.63 (54)</td>
<td>(.0001)</td>
</tr>
<tr>
<td>Exercise Duration</td>
<td>.12 (54)</td>
<td>(.38)</td>
<td>Concentrated Sweets</td>
<td>.64 (54)</td>
<td>(.0001)</td>
</tr>
<tr>
<td>Exercise Type</td>
<td>.64 (54)</td>
<td>(.0001)</td>
<td>*% Calories: Carbs</td>
<td>.48 (54)</td>
<td>(.0002)</td>
</tr>
<tr>
<td>Injection Regularity</td>
<td>.71 (51)</td>
<td>(.0001)</td>
<td>% Calories: Fat</td>
<td>.56 (54)</td>
<td>(.0001)</td>
</tr>
<tr>
<td>Injection Interval</td>
<td>.73 (51)</td>
<td>(.0001)</td>
<td>Calories Consumed</td>
<td>.28 (54)</td>
<td>(.04)</td>
</tr>
<tr>
<td>Injection-Meal Timing</td>
<td>.73 (53)</td>
<td>(.0001)</td>
<td>Testing Frequency</td>
<td>.81 (54)</td>
<td>(.0001)</td>
</tr>
<tr>
<td>Regularity of Injection-Meal</td>
<td>.25 (51)</td>
<td>(.08)</td>
<td>*% Calories: Carbohydrate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Calorie Consumption in Relation to Ideal, and Testing Frequency (see Table 7).

There were significant differences between parents' and adolescents' scores on four of the thirteen measures. Parents reported greater Exercise Frequency (mean difference=5.11, t=2.60, p<.01), better Injection Regularity (mean difference=.12, t=2.00, p<.05), greater Eating Frequency (mean difference=6.83, t=4.58, p<.0001), and fewer Calories Consumed (mean difference=577.32, t=4.63, p<.0001). There were trends for differences on two of the measures: Parents reported less strenuous Exercise Type (mean difference= -.0004, t=-1.94, p<.06) and greater deviation of Carbohydrate Consumption in Relation to Ideal (mean difference=-1.69, t=-1.81, p<.08). With the exception of the difference in Calorie Consumption, these differences are of questionable clinical significance.

Metabolic Control

HbA1c averaged 9.5% (SD=1.9%), triglyceride levels averaged 71 mg/dl (SD=32 mg/dl), and cholesterol levels averaged 173 mg/dl (SD=31 mg/dl) for the adolescents in this sample. HbA1c was significantly correlated with both triglycerides (r=.30, p<.04, n=47) and cholesterol (r=.34, p<.02, n=44). Triglycerides and cholesterol were significantly correlated (r=.50, p<.0004, n=45).

Multiple Regression Analyses

Three conceptual domains (i.e., psychological adjustment, stress, and family relations) were hypothesized
to be important in the proposed model of the associations among psychosocial variables, adherence, and diabetes control. Pubertal development was an additional factor considered in the model. Due to the relatively small sample size, and the large number of potential predictor variables, psychosocial variables within each conceptual domain were combined to provide global measures of important constructs. Prior to combining variables, variables with poor reliability and those with significant correlations to other subscale scores from the same measure were dropped. These included Family Environment Scale subscale scores because of their extremely poor internal consistencies; Negative Parental Behavior and Insult from the diabetes-related Behavioral Interaction Task due to poor interrater reliability; and the Intensity by Frequency scores from the Issues Checklist (IC) and the Diabetes Issues Checklist (DIC), and the Appraisal of Other score from the Conflict Behavior Questionnaire (CBQ) because of their significant correlations with other subscales scores from those measures. Father scores were not included based on results from correlation analyses and repeated measure ANOVAs; mothers and adolescents were correlated on most measures while fathers and adolescents were not. Also, there were fewer actual differences between mother and adolescent scores as compared with father and adolescent scores. Sample size considerations also precluded the use of father
scores, as there were fewer fathers than mothers and adolescents in the study.

Subscale scores from each measure were standardized and combined, prior to combining across measures, thus ensuring equal weighting for each measure. For adjustment and family relations measures, mother and adolescent scores were standardized and combined to yield aggregate scores. Mother and adolescent scores were not combined for the stress measures, as each score represented the respondent’s own life stress.

The conceptual domain of adjustment consisted of two scores: social competence, from the Child Behavior Checklist, and behavior problems, from the same measure.

Two scores were also produced for stress: adolescent stress and maternal stress. These scores were the combination of the Quantity score from the Hassles Scale and the Total Score from the Life Events Checklist, for adolescents, or the Social Readjustment Rating Scale, for mothers.

Family relations consisted of two scores: positive family relations and negative family relations. The positive family relations score included these measures: positive subscale score from the Diabetes Family Behavior Checklist (DFBC), Positive Adolescent Behavior, Positive Parental Behavior, and Friendliness (from both general and diabetes-related discussions) from the Behavioral Interaction Task, and the Dyadic Adjustment Scale (DAS)
score. The negative family relations score included these measures: negative subscale score from the DFBC, Negative Adolescent Behavior, Negative Parental Behavior, Degree of Resolution, Insult, and Problem-Solving Effectiveness, from the general discussions, and Negative Adolescent Behavior, Degree of Resolution, and Problem-Solving Effectiveness, from the diabetes-related discussions, Quantity and Intensity scores from the IC and from the DIC, and Appraisal of Dyad score from the CBQ.

Hierarchical multiple-regression techniques (Cohen & Cohen, 1983) were used to examine relationships among measures of adjustment, stress, family, adherence, and health outcome. The first step of this approach is to test an initial set of predictor variables, such as adolescent's gender, age, disease duration, Tanner Stage, and socioeconomic status (SES). Next, the psychosocial variables are added to the initial model, and the resulting $R^2$ is statistically compared to the initial model's $R^2$ to determine whether there has been a significant increase in variance accounted for. The hierarchical progression continues from tests of simple main effects to tests of more complex models with interaction terms. Only when a more complex model accounts for significant variance beyond that provided by a preceding, simpler model is it retained. In order to ensure a fair comparison between hierarchical models, each hierarchical progression is based on the same data set. Due to sample size constraints, three sections of
the proposed model were separately tested: adjustment relationships (see Figure 2), adherence relationships (see Figure 3), and diabetes control relationships (see Figure 4). Only adjusted $R^2$ values are reported as they correct for the small sample size.

Adjustment

Due to sample size constraints, separate series of hierarchical regressions were used to examine predictors of social competence and of behavior problems (see Figure 2). Gender, age, disease duration, Tanner stage, and SES were first entered into the analyses. None were significantly predictive for either adjustment score, so all were removed. Next, family scores were entered together, followed by the addition of stress scores, both separately from family scores, and then simultaneously with them. For social competence, positive family behavior was a significant predictor ($R^2 = .03$), $F(1,52) = 2.80, p < .10$; higher positive family behavior was associated with better social competence. The mother stress measure contributed additional significant predictive power as a main effect, $t(51) = 3.72, p < .0005$, increasing the model's $R^2$ from .03 to .22, $F(2,51) = 8.68, p < .0006$; unexpectedly, higher mother stress was associated with better social competence (See Table 8). For behavior problems, a significant main effect was found for negative family behavior ($R^2 = .21$), $F(1,54) = 15.32, p < .0003$; as expected, higher negative
Figure 2
Model of Adjustment Relationships
Figure 3
Model of Adherence Relationships
Stress
Adolescent Characteristics
Maternal Stress
Adolescent Stress

Psychological Adjustment
Social Competence
Total Behavior Problems

Family Factors
Positive Family Behavior
Negative Family Behavior

Puberty
Tanner Stage
(Pubertal or Not Pubertal)

Adherence
Injection
Exercise
Diet Type
Testing/Eating Frequency
Calories Consumed
Concentrated Sweets
(each entered separately)

--- Expected Relationship
--- - Tested (but not necessarily expected) Relationship

Figure 4
Model of Metabolic Control Relationships
Table 8
Best Prediction Models for Adjustment: Social Competence and Behavior Problems

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>t</th>
<th>p&lt;</th>
<th>Adjusted R²</th>
<th>F(df)</th>
<th>p&lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social Competence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>49.27</td>
<td>30.60</td>
<td>.0001</td>
<td>.22</td>
<td>8.68 (2,51)</td>
<td>.0006</td>
</tr>
<tr>
<td>Positive Family Behavior</td>
<td>5.42</td>
<td>2.04</td>
<td>.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Stress</td>
<td>6.85</td>
<td>3.72</td>
<td>.0005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Behavior Problems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>51.43</td>
<td>52.19</td>
<td>.0001</td>
<td>.21</td>
<td>15.32 (1,54)</td>
<td>.0003</td>
</tr>
<tr>
<td>Negative Family Behavior</td>
<td>7.60</td>
<td>3.91</td>
<td>.0003</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
family behavior was associated with more behavior problems (See Table 8). No other predictors emerged.

**Adherence**

Each adherence measure was examined in a separate series of hierarchical regressions. Gender, age, disease duration, Tanner Stage, and SES, were entered initially. Family relation scores were entered next, followed by stress scores, and finally, adjustment scores (see Figure 3). Again, these scores were entered separately (i.e., from scores from other domains) and then simultaneously. Because it seemed likely that diabetes-specific family measures would be stronger predictors to adherence behaviors than general and diabetes-specific family measures combined, all series of regressions were also run with family relation scores computed with only diabetes-specific family measures (i.e., Diabetes Issues Checklist, Diabetes Family Behavior Checklist, Behavior Interaction Task for diabetes issues). However, as no other significant associations with these measures emerged, only results from regressions using the combined family relation scores are reported.

**Injection.** Both adjustment scores emerged as significant predictors of the Injection factor, (social competence, \( t(51) = 1.82, p < .07 \); behavior problems, \( t(51) = 1.81, p < .08 \)); however, the variance accounted for was small \( (R^2 = .08) \), \( F(2,51) = 3.21, p < .05 \). Better social competence and more behavior problems seemed to be associated with poorer injection adherence.
### Table 9
Best Prediction Models for Adherence Measures

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>t</th>
<th>p&lt;</th>
<th>R²</th>
<th>F(df)</th>
<th>p&lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Injection</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-1.53</td>
<td>-2.37</td>
<td>.02</td>
<td>.08</td>
<td>3.21 (2,51)</td>
<td>.05</td>
</tr>
<tr>
<td>Behavior Problems</td>
<td>.02</td>
<td>1.82</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Competence</td>
<td>.01</td>
<td>1.81</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Calories Consumed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-.72</td>
<td>-5.00</td>
<td>.0001</td>
<td>.05</td>
<td>3.80 (1,53)</td>
<td>.06</td>
</tr>
<tr>
<td>Negative Family Behavior</td>
<td>-.55</td>
<td>11.95</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exercise</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.59</td>
<td>.99</td>
<td>.33</td>
<td>.21</td>
<td>5.93 (3,51)</td>
<td>.002</td>
</tr>
<tr>
<td>Age</td>
<td>-.27</td>
<td>-2.99</td>
<td>.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Externalizing Behavior Problems</td>
<td>.05</td>
<td>2.72</td>
<td>.009</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Family Behavior</td>
<td>.47</td>
<td>1.95</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diet Type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.35</td>
<td>.98</td>
<td>.33</td>
<td>.06</td>
<td>4.33 (1,53)</td>
<td>.04</td>
</tr>
<tr>
<td>Age</td>
<td>-.20</td>
<td>-2.08</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Testing/Eating Frequency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-1.39</td>
<td>-1.49</td>
<td>.14</td>
<td>.06</td>
<td>4.12 (1,49)</td>
<td>.05</td>
</tr>
<tr>
<td>Age</td>
<td>.13</td>
<td>2.03</td>
<td>.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Concentrated Sweets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.20</td>
<td>-2.37</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-.56</td>
<td>-2.26</td>
<td>.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavior Problems</td>
<td>.03</td>
<td>2.05</td>
<td>.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Competence</td>
<td>.03</td>
<td>2.9</td>
<td>.005</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* In these regressions, boys = 1, girls = 2; for Tanner Stage, not pubertal = 1, pubertal = 2. For all adherence measures except Exercise, lower scores indicate greater adherence. For Exercise, higher scores indicate greater adherence.
Negative family behavior also emerged, separately, as a significant predictor ($R^2 = .05$), $F(1,52) = 3.93$, $p < .05$; more negative family behavior was associated with poorer injection adherence. Social competence contributed additional significant predictive power to the model, $t(51) = 1.77$, $p < .08$, increasing the model's $R^2$ to .09, $F(2,51) = 3.6$, $p < .03$; as before, better social competence was associated with poorer adherence.

When behavior problems and negative family behavior were both entered into the model, neither emerged as a significant predictor; this effect was due to the strong correlation between the two measures. Based on the previous finding of negative family behavior as a predictor of behavior problems, the model including behavior problems and social competence was retained as the best model (see Table 9).

**Calories Consumed.** Negative family behavior emerged as a significant predictor of Calories Consumed ($R^2 = .05$), $F(1,53) = 3.80$, $p < .06$; more negative family behavior was associated with undereating (see Table 9). No other predictors emerged.

**Exercise.** Age emerged as a significant predictor ($R^2 = .11$), $F(1,53) = 7.35$, $p < .009$; older adolescents were less compliant with exercise than younger adolescents (see Table 10). Behavior problems contributed additional significant predictive power as a main effect, $t(51) = 1.96$, $p < .06$, increasing the model's $R^2$ from .11 to .15, $F(2,52) = 5.80$, $p$
more behavior problems were associated with more exercise. Positive family relations also contributed significant predictive power, $t(51) = 1.86$, $p < .07$, further increasing the model's $R^2$ to .19, $F(3,51) = 5.2$, $p < .003$; greater positive family relations were associated with better exercise adherence. Because the behavior problems score consists of measures of internalizing behaviors and externalizing behaviors, it was unclear which was responsible for the significant effects. To investigate this issue, hierarchical analyses were rerun with internalizing behaviors and externalizing behaviors considered in separate analyses. Only externalizing behaviors offered significant predictive power, $t(52) = 2.3$, $p < .03$, increasing the model's $R^2$ to .17, $F(2,52) = 6.63$, $p < .003$; more externalizing behaviors were associated with more exercise. Positive family relations again contributed significant predictive power, $t(51) = 1.95$, $p < .06$, further increasing the model's $R^2$ to .21, $F(3,51) = 5.9$, $p < .002$ (see Table 9).

**Diet Type.** Only age emerged as a significant predictor of Diet Type ($R^2 = .06$), $F(1,53) = 4.33$, $p < .04$; unexpectedly, older adolescents were more compliant than younger adolescents (see Table 9). In an attempt to understand this finding, adolescents in the sample were divided into three groups by ages (i.e., 12-13, 14-15, and 16-17 years). The means of the two adherence measures which
Table 10
Means and Standard Deviation of Exercise, Diet Type, and Testing/Eating Frequency Adherence Scores by Age Group

<table>
<thead>
<tr>
<th>Adherence Measure</th>
<th>12-13 years (n=28)</th>
<th>14-15 years (n=15)</th>
<th>16-17 years (n=13)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exercise</strong></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Exercise Frequency</td>
<td>52.6 (22.7) [2.8]</td>
<td>64.8 (17.5) [2.1]</td>
<td>75.9 (14.7) [1.4]</td>
</tr>
<tr>
<td>Exercise Duration</td>
<td>.05 (.03) [27.72]</td>
<td>.07 (.04) [20.23]</td>
<td>.11 (.12) [19.28]</td>
</tr>
<tr>
<td>Exercise Type</td>
<td>.966 (.018) [.036]</td>
<td>.968 (.012) [.033]</td>
<td>.980 (.015) [.020]</td>
</tr>
<tr>
<td><strong>Diet Type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Calories:</td>
<td>13.5 (5.6) [46.5]</td>
<td>16.5 (6.3) [43.5]</td>
<td>7.2 (6.7) [52.8]</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Calories:</td>
<td>14.4 (5.2) [39.4]</td>
<td>7.5 (8.7) [42.5]</td>
<td>8.8 (6.6) [33.8]</td>
</tr>
<tr>
<td>Fat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Testing/Eating Frequency</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eating Frequency</td>
<td>22.0 (11.3) [4.7]</td>
<td>22.6 (11.4) [4.6]</td>
<td>25.5 (12.4) [4.5]</td>
</tr>
<tr>
<td>Glucose Testing Frequency [per day]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose Testing</td>
<td>52.4 (22.7) [1.9]</td>
<td>58.9 (25.5) [1.6]</td>
<td>71.5 (30.3) [1.1]</td>
</tr>
</tbody>
</table>

*Note.* Values in brackets provide the reader with an interpretation of each adherence measure using a familiar measurement scale.
make up Diet Type (i.e., percentage of calories from carbohydrates, percentage of calories from fat) were examined for each age group (see Table 10). Middle adolescents were the least compliant to low-fat, high-carbohydrate diets, while the oldest adolescents were the most compliant.

**Testing/Eating Frequency.** Age emerged as a significant predictor for Testing/Eating frequency \( (R^2 = .06) \), \( F(1,49) = 4.12, p < .05 \); older adolescents were less adherent than their younger counterparts. Tanner Stage contributed additional significant predictive power as a main effect, \( t(48) = -.52, p < .05 \), increasing the model's \( R^2 \) to .11, \( F(2,48) = 4.17, p < .02 \). Tanner Stage alone explained as much variance as age and Tanner Stage together \( (R^2 = .12) \), \( F(1,49) = .007 \). Tanner Stage was dichotomized as "pubertal" (i.e., Tanner Stages II, III, and IV) and "not pubertal" (i.e., Tanner Stages I and V). It appears that pubertal adolescents were more adherent than adolescents who were not pubertal. Further investigation reveals this inconsistent result to be due to the significant number of Tanner Stage V adolescents (i.e., 17 of 22) in the "not pubertal" group. These adolescents tended to be older (correlation of age and Tanner Stage, \( r = .71, p < .0001, n=52 \)), and, as previously stated, older adolescents were less adherent than younger adolescents (see Table 10). Because the effect of Tanner Stage was apparently actually due to age, the model in which
age was predictive of Testing/Eating Frequency was retained as the best model (see Table 9).

Concentrated Sweets. Gender emerged as a significant predictor of concentrated sweet consumption ($R^2 = .03$), $F(1,53) = 2.87, p < .10$; boys ate more concentrated sweets than girls. Both adjustment scores contributed additional significant predictive power as main effects (social competence, $t(51) = 2.91, p < .005$; behavior problems, $t(51) = 2.05, p < .05$); better social competence and more behavior problems seem to be associated with poorer adherence. The increase in $R^2$ with this model was from .05 to .19, $F(3,51) = 5.17, p < .003$ (See Table 9). Because the concentrated sweets factor was not normally distributed, hierarchical regressions were run on a transformation of the factor score as well, with similar results.

Diabetes Control

Each diabetes control measure (i.e., HbA1c, Triglycerides, Cholesterol) was examined in a separate series of hierarchical regressions. Gender, age, disease duration, Tanner Stage, and SES, were entered initially. Adherence factors were entered next, followed by family relation scores, stress scores, and adjustment scores. Finally, interaction effects for each adherence measure were tested. Again, psychosocial scores were entered separately (i.e., from scores from other domains) and then simultaneously. Due to sample size constraints, adherence factors were not tested simultaneously (see Figure 4).
**HbA1c.** Gender emerged as a significant predictor of HbA1c ($R^2 = .05$), $F(1, 51) = 3.91, p < .05$; girls had higher HbA1c levels than boys (see Table 11). The Testing/Eating Frequency factor contributed significant additional predictive power as a main effect, $t(50) = 2.77, p < .008$, increasing the model's $R^2$ from .05 to .16, $F(2, 50) = 6.05, p < .004$; poorer adherence was associated with higher HbA1c levels (see Table 12). No psychosocial factors added significant additional variance.

**Triglycerides.** Gender emerged as a significant predictor of triglycerides ($R^2 = .11$), $F(1, 44) = 6.36, p < .02$; girls had higher triglyceride levels than boys. The Injection factor contributed significant predictive power, but only when it was allowed to interact with gender (see Table 12). For boys, there was the expected relationship between injection adherence and triglycerides; greater adherence was associated with lower triglyceride levels, although this relationship was weak. For girls, the relationship was stronger, and in the opposite direction; greater adherence was associated with higher triglycerides (see Table 11 for Beta weights).

Further investigation of the characteristics of male and female adolescents seemed warranted in an attempt to explain this gender effect. These data are provided in Table 11. As previously stated, females had significantly
Table 11
Interpreting Gender x Adherence Interactions as Predictors of Triglycerides and Cholesterol: Characteristics by Gender

<table>
<thead>
<tr>
<th>Adolescent Characteristic</th>
<th>Males (n=32) M (SD)</th>
<th>Females (n=24) M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c (percentage)(^a)</td>
<td>9.1 (1.8)</td>
<td>10.0 (1.9)</td>
</tr>
<tr>
<td>Triglycerides (mg/dl)(^b)</td>
<td>60 (20)</td>
<td>86 (41)</td>
</tr>
<tr>
<td>Cholesterol (mg/dl)(^b)</td>
<td>162 (29)</td>
<td>188 (30)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>14.1 (1.6)</td>
<td>14.7 (1.8)</td>
</tr>
<tr>
<td>Disease Duration (years)</td>
<td>6.1 (3.5)</td>
<td>6.3 (3.7)</td>
</tr>
<tr>
<td>Weight Deviation from Ideal (kg)</td>
<td>4.3 (5.4)</td>
<td>4.2 (5.5)</td>
</tr>
<tr>
<td>Insulin Dose (units/kg/day)</td>
<td>.94 (.22)</td>
<td>1.02 (.29)</td>
</tr>
<tr>
<td>Tanner Stage (I-V)(^b)</td>
<td>3.1 (1.4)</td>
<td>4.0 (1.1)</td>
</tr>
<tr>
<td>Socioeconomic Status (I-V)</td>
<td>3.1 (1.2)</td>
<td>3.2 (1.0)</td>
</tr>
</tbody>
</table>

**Injection Factor**

- **Injection Regularity**: .74 (.59) / .55 (.35)
- **Injection Interval**: 1.31 (1.06) / 1.20 (1.02)
- **Injection-meal Timing**: .78 (.47) / .80 (.40)
- **Regularity of Injection-meal Timing**: 19.8 (19.5) / 20.5 (16.8)

**Exercise Factor**

- **Exercise Frequency**: 58.9 (21.9) / 64.0 (21.4)
- **Exercise Duration**: .06 (.08) / .07 (.05)
- **Exercise Type**: .967 (.017) / .973 (.015)
Table 11--continued

<table>
<thead>
<tr>
<th></th>
<th>Testing/Eating Frequency</th>
<th>Eating Frequency</th>
<th>Glucose Testing Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B = -15.58&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B = 13.82&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>22.5 (11.5)</td>
<td>23.6 (11.7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>59.9 (23.0)</td>
<td>56.2 (29.8)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* For Exercise factor scores, lower scores indicate poorer adherence. For all other adherence scores, lower scores indicate greater adherence.

<sup>a</sup> Differed significantly by gender, p < .07.

<sup>b</sup> Differed significantly by gender, p < .01.

<sup>c</sup> Beta weight for adherence factor for each gender, calculated using the appropriate regression equation from Table 12.
higher HbA1c levels than males; their triglyceride and cholesterol levels were also significantly higher. Females were older, had longer disease duration, and higher insulin dosages. However, these differences were not significant. Only Tanner Stage significantly differentiated between the two groups; girls were in higher Tanner Stages than boys.

In an attempt to investigate whether the interaction of gender with the Injection factor was the result of female adolescents' poorer metabolic control, the regression was rerun controlling for HbA1c levels. Gender continued to interact with the Injection factor, and HbA1c did not add significant predictive power to the model (see Table 13). Significant predictor of triglycerides, \( t(43) = -1.91, \ p < .06 \), increasing the \( R^2 \) of the initial model to .19 (see Table 13). Higher fat, lower carbohydrate diets appeared to be associated with lower triglycerides. The model was rerun with each of the Diet Type measures separately (fat consumption and carbohydrate consumption) in an attempt to ascertain which was responsible for the significant effects. Both measures offered approximately equal significant predictive power.

Both adherence factors (i.e., Injection and Diet Type) were not entered into the model simultaneously due to the limitations of sample size. However, it is expected that if both were entered together, more variance would be explained than was with each entered separately.
model, $t(41) = 2.17$, $p < .04$. The complete model’s $R^2$ was increased to .36, $F(4,39) = 6.98$, $p < .0002$. Again, however, the gender with Exercise interaction remained significant (see Table 13).

**Cholesterol.** Gender emerged as a significant predictor of triglycerides ($R^2 = .15$), $F(1,43) = 8.67$, $p < .005$; girls had higher cholesterol levels than boys. The Exercise factor contributed significant predictive power, but only when it was allowed to interact with gender (see Table 12). For girls, greater exercise (better adherence) was associated with lower cholesterol levels, while a slightly weaker relationship, in the reverse direction, was true for boys: greater exercise was associated with higher cholesterol (see Table 11 for Beta weights). As before, this model was rerun controlling for HbA1c. In this case, HbA1c did add significant predictive power to the initial model.

The Testing/Eating Frequency factor also contributed significant predictive power when it was allowed to interact with gender (see Table 12). For girls, better adherence was again associated with lower cholesterol levels, while, again, for boys, better adherence was associated with higher cholesterol (see Table 11 for Beta weights). Adolescent stress contributed significant additional predictive power to the model, $t(40) = -2.52$, $p < .02$, increasing the $R^2$ from .20 to .32, $F(4,40) = 6.13$, $p < .0006$; higher adolescent stress seemed to be associated with lower cholesterol levels.
When HbA1c was entered into the model, the $R^2$ for the complete model was increased to .39, $F(5,38) = 6.60, p < .0002$. The gender with Testing/Eating frequency interaction remained, as did the significant predictive power of adolescent stress (see Table 13).

As with the model for triglycerides, both adherence factors (i.e., Exercise and Testing/Eating Frequency) were not entered into the model for cholesterol simultaneously due to the limitations of sample size. However, it is expected that if both were entered together, more variance would be explained than was with each entered separately.
Table 12
Best Prediction Models for Hemoglobin A1c, Triglycerides, and Cholesterol Controlling for Gender

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>t</th>
<th>p&lt;</th>
<th>R²</th>
<th>F(df)</th>
<th>p&lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>7.59</td>
<td>10.07</td>
<td>.0001</td>
<td>.16</td>
<td>6.05 (2,50)</td>
<td>.004</td>
</tr>
<tr>
<td>Gender</td>
<td>1.06</td>
<td>2.15</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing/Eating Frequency</td>
<td>.87</td>
<td>2.77</td>
<td>.008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triglycerides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>40.28</td>
<td>3.12</td>
<td>.003</td>
<td>.24</td>
<td>4.93 (3,43)</td>
<td>.005</td>
</tr>
<tr>
<td>Gender</td>
<td>20.95</td>
<td>2.43</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injection</td>
<td>53.23</td>
<td>1.96</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Injection</td>
<td>-46.92</td>
<td>-2.39</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholesterol</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>123.88</td>
<td>9.77</td>
<td>.0001</td>
<td>.32</td>
<td>7.81 (3,41)</td>
<td>.0003</td>
</tr>
<tr>
<td>Gender</td>
<td>33.22</td>
<td>4.04</td>
<td>.0002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise</td>
<td>31.67</td>
<td>3.47</td>
<td>.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Exercise</td>
<td>-22.29</td>
<td>-3.54</td>
<td>.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>144.79</td>
<td>10.34</td>
<td>.0001</td>
<td>.32</td>
<td>6.13 (4,40)</td>
<td>.0006</td>
</tr>
<tr>
<td>Gender</td>
<td>21.62</td>
<td>2.35</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing/Eating Frequency</td>
<td>-44.98</td>
<td>-2.58</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adolescent Stress</td>
<td>-12.08</td>
<td>-2.52</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Testing Frequency/Eating Frequency</td>
<td>29.40</td>
<td>2.83</td>
<td>.007</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. In these regression, boys = 1, girls = 2.
For Injection and Testing/Eating Frequency, lower scores indicate greater adherence. For Exercise, higher scores indicate greater adherence.
Table 13
Best Prediction Models for Triglycerides, and Cholesterol Controlling for HbA1c and Gender

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Adjusted B</th>
<th>t</th>
<th>p&lt;</th>
<th>R²</th>
<th>F(df)</th>
<th>p&lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Triglycerides</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-14.68</td>
<td>-.55</td>
<td>.59</td>
<td>.19</td>
<td>4.46</td>
<td>(3,42)</td>
</tr>
<tr>
<td>Gender</td>
<td>16.92</td>
<td>1.91</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HbA1c</td>
<td>5.38</td>
<td>2.08</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet Type</td>
<td>-7.25</td>
<td>-1.91</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>12.66</td>
<td>.49</td>
<td>.63</td>
<td>.18</td>
<td>3.47</td>
<td>(4,41)</td>
</tr>
<tr>
<td>Gender</td>
<td>18.57</td>
<td>2.11</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HbA1c</td>
<td>3.26</td>
<td>1.26</td>
<td>.22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injection</td>
<td>41.64</td>
<td>1.48</td>
<td>.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Injection</td>
<td>-38.23</td>
<td>-1.86</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cholesterol</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>84.39</td>
<td>3.43</td>
<td>.001</td>
<td>.36</td>
<td>6.98</td>
<td>(4,39)</td>
</tr>
<tr>
<td>Gender</td>
<td>30.40</td>
<td>3.77</td>
<td>.0005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HbA1c</td>
<td>4.54</td>
<td>1.88</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise</td>
<td>29.98</td>
<td>3.26</td>
<td>.002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Exercise</td>
<td>-20.22</td>
<td>-3.08</td>
<td>.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>107.49</td>
<td>4.49</td>
<td>.0001</td>
<td>.39</td>
<td>6.60</td>
<td>(5,38)</td>
</tr>
<tr>
<td>Gender</td>
<td>21.09</td>
<td>2.36</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HbA1c</td>
<td>4.23</td>
<td>1.78</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing/Eating</td>
<td>-48.87</td>
<td>-2.92</td>
<td>.006</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adolescent Stress</td>
<td>-11.89</td>
<td>-2.55</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Testing</td>
<td>31.32</td>
<td>3.10</td>
<td>.004</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. In these regression, boys = 1, girls = 2.
For Diet Type, Injection and Testing/Eating Frequency, lower scores indicate greater adherence. For Exercise, higher scores indicate greater adherence.
DISCUSSION

This study examined the validity of a model of the interrelations among psychosocial variables, adherence, and metabolic control in adolescents with diabetes. Several investigators have studied the relationships among various psychosocial factors and health outcome measures in this population, but few have attempted to delineate a more comprehensive model of those relationships. This study used standardized questionnaire and behavioral measures from multiple respondents (i.e., adolescents, mothers, fathers) to assess psychosocial factors; 24-hour recall methodology, on multiple occasions with both adolescent and parent respondents, to assess adherence; and indices of both glucose and lipid metabolism (i.e., HbA1c, triglycerides, cholesterol) to assess diabetes control. A measure of pubertal development (i.e., Tanner Stage) was also included in an attempt to account for the physiological effects of puberty on metabolic control.

Results of this study support the reliability (i.e., internal consistency, interrater reliability, parent-parent or parent-child agreement) of measures for this sample. Only the Family Environment Scale (Moos & Moos, 1981) exhibited extremely poor internal consistency for subscale scores. Several other investigators have used this measure
to assess perceptions of family environment in relation to adherence or metabolic control (Anderson et al., 1981; Hauser et al., 1986; Hauser, Jacobson, Wertlieb, Brink et al., 1985; Hauser, Jacobson, Wertlieb, Wolfsdorf et al., 1985; Schafer et al., 1983). With the exception of Shouval et al. (1982), who reported poorer internal reliabilities for the FES subscales than were reported by Moos & Moos (1981; ranging from .4 to .8), the internal consistencies of subscales for this measure for the samples being studied have not been reported. Without such data it is difficult to ascertain the reliability, and therefore the validity, of the results of those studies.

Consistent with previous research (Brand et al., 1986; Chase & Jackson, 1981; Delameter, 1985; Dunn & Turtle, 1981; Johnson, 1980; Kurtz & Delameter, 1984), adolescents in this study did not differ significantly from the normal population in their report of adjustment, life stress, or communication and conflict with their parents. In contrast, behavioral interactions between adolescents and their parents were marked by more negative and less positive communication behaviors than exhibited by a normative, non-clinic sample. However, their problem-solving effectiveness and ability to resolve issues were not different from the norm (Prinz et al., 1979; Prinz & Kent, 1978).

Adolescents in this study were similar to other adolescents with diabetes in their report of family support for their treatment regimen (Glasgow et al., 1985; Schafer et
al., 1983; McCaul, Glasgow, & Schafer, 1987) and in their adherence behaviors (Johnson et al., 1986; Johnson, Freund, Silverstein, Hansen, & Malone, 1990). As in other studies (Allen et al., 1983; Bobrow et al., 1985; Jacobson, Hauser, Lavori et al., 1990; Jacobson, Hauser, Wolfsdorf et al., 1987; Johnson et al., 1986; Johnson, Freund, Silverstein, Hansen, & Malone, 1990), adherence for these adolescents was poorer than has been found in younger aged children.

Data from questionnaires and from behavioral interactions indicated that general issues (i.e., telephone calls, fighting with brothers and sisters, allowance, friends, drugs and alcohol) were subject to much more conflict than were diabetes-related issues (i.e., how much to exercise, recording testing results, how much to eat, when to give injections). This finding suggests that, at least in these families, diabetes has not become an overriding focus, and that common problems between adolescents and their parents are more salient than issues related to the disease. While this comparison has not previously been reported in the literature, this result is consistent with findings that adolescents with diabetes exhibit few differences from the general population.

On measures of adjustment and of life stress, mothers and fathers agreed more strongly with each other than either did with their child. Adolescents viewed themselves as demonstrating more social competence and fewer behavior problems than their parents reported. This tendency for
adolescents to acknowledge fewer problems than their parents was evident in their reports of family interactions as well. However, in terms of life stress, adolescents reported more daily hassles and major life stressors than did their parents. This is consistent with the literature which describes adolescence as a time when stressful life events may be increased (Coddington, 1972; Johnson, 1982, Newcomb, Huba, & Bentler, 1986).

On measures of parent-child interactions, mothers and adolescents agreed with each other more strongly than did fathers and adolescents. Mothers and adolescents were also viewed as engaging in more interactions, both in general and in relation to the diabetes treatment regimen, than were fathers and adolescents. This is consistent with the tendency for mothers, rather than fathers, to be the primary caregivers, and therefore, to be more involved in day-to-day interactions with their children. As previously mentioned, adolescents reported fewer conflicts with their parents than their parents reported.

The finding that mothers in this study showed the best agreement with other family members, while fathers tended to show the worst agreement is consistent with the general clinical child literature (Achenbach & Edelbrock, 1983; Herjanic & Reich, 1982; Orvaschel, Weissman, Padian, & Lowe, 1981). Also consistent with the literature was the tendency for mothers to report more problems than did fathers, and for parents, especially mothers, to report more problems.
than did their children (Jacob, Grounds, & Haley, 1982; Leon, Kendall, & Garber, 1980).

Attempts to delineate a model of the associations among psychosocial, adherence, and health outcome variables yielded some expected, consistent relationships. The model exploring associations between family factors and psychological adjustment found results consistent with previous research (Grey et al., 1980; Hauser et al., 1986). Positive family relations were associated with higher social competence, and negative family relations were associated with more behavior problems. The causal direction of these relationships is not clear. It may be that poor adolescent adjustment is the result of living in a difficult family situation; however, just as likely is the possibility that living with a poorly-adjusted adolescent may induce family conflict.

An unexpected finding was the positive relationship between maternal stress and adolescent social competence; higher maternal stress was associated with better social functioning. In this study, social competence was defined by the adolescents' involvement in social activities, sports, and jobs, as well as by their relationships with family and friends and their school performance. Maternal stress included a measure of daily hassles, as well as major life events. It may be that mothers of adolescents who are engaged in a high number of school, sports, and social activities, experience more daily stressors in terms of
responsibilities related to their youngsters' social lives (i.e., arranging transportation, attending sporting events, paying for special activities, sporting equipment, etc.). Increased maternal stress may, in fact, be a consequence of greater adolescent social competence. Alternatively, mothers who are employed, and/or who lead active lifestyles (and who are likely to experience significant daily hassles), may also be likely to have children who engage in a number of social and recreational activities. Increased adolescent social competence may therefore be associated with a busy maternal lifestyle.

Exploration of the models predicting adherence behaviors found some associations with psychosocial measures. Adolescent psychological adjustment was found to be associated with three measures of adherence to the treatment regimen: insulin injections, consumption of concentrated sweets, and exercise. For insulin injections and consumption of concentrated sweets, better social competence and greater behavior problems were associated with poorer adherence. This finding is somewhat consistent with that of Jacobson and colleagues (1987; 1990). However, in their study, measures of social competence and behavior problems were combined into a single measure of adjustment which was found to be positively associated with adherence; poorer adjustment was associated with poorer adherence. In this study, the finding that better social competence was associated with poorer adherence to insulin injections and
to higher consumption of concentrated sweets may be related to the need that adolescents have to fit in with their peers. Clinical experience suggests that some adolescents may feel that, in order to maintain a "popular" social status, they cannot let prescriptions for insulin injections and prohibitions against eating concentrated sweets interfere with their involvement in social activities. Also, adolescents who are active and socially involved may have more hectic schedules, possibly making it more difficult for them to take their insulin injections and eat at the same time every day.

Exercise was also associated with psychological adjustment; adolescents who exhibited more externalizing behavior problems tended to engage in more exercise. Intuitively it makes sense that adolescents with behavior problems which include hyperactivity are likely to be more active. Alternatively, it may be that adolescents who are more active by temperament are more likely to engage in behaviors that get them into trouble.

Family behavior was associated with two measures of adherence: exercise and calorie consumption. Adolescents who had positive family relations engaged in more exercise. It may be that families which are characterized by supportive, positive interactions strongly encourage their children to engage in sports or exercise activities, or even engage in those activities with them.
Negative family relations were associated with decreased calories consumed. Both previous research (Johnson et al., 1986; Johnson, Freund, Silverstein, Hansen, & Malone, 1990) and this study confirm that IDDM adolescents, as a whole, tend to eat fewer calories than ideal. It appears that adolescents from families marked by conflict and negative interactions tend to undereat even more than typical adolescents. It is interesting to speculate the reasons for this finding. Minuchin (1974), in addition to his work with psychosomatic families of children with diabetes, also worked with families of adolescents with anorexia nervosa, and described similarities between the two in terms of reactions to family conflict. He viewed the "symptoms", poor control or diabetes or severe undereating and weight loss of anorexia nervosa, as resulting from an inability to address and resolve family conflict. Although it is not clear from this study what mediated the observed relationship between family conflict and undereating in these IDDM adolescents, it suggests an area for further research.

Age was found to be associated with three measures of adherence in this study: exercise, testing and eating frequency, and diet type. Consistent with previous research, younger adolescents were more adherent than older adolescents in exercise and testing/eating frequency (Johnson et al., 1986; Johnson, Freund, Silverstein, Hansen, & Malone, 1990).
In this study, age appeared to have a curvilinear relationship with carbohydrate and fat consumption, with middle adolescents (aged 14-15) having the highest fat and lowest carbohydrate consumption and oldest adolescents (aged 16-17) having the lowest fat and highest carbohydrate consumption. It may be that peer influences and normal adolescent separation from parents during early and middle adolescence negatively influence adolescents' food choices. As the adolescent matures, he or she may be able to make more appropriate food choices, either independent of peers, or with peers who are also eating healthier diets.

In this study, gender was associated with only one adherence measure; boys consumed more concentrated sweets than did girls. This finding has not been previously reported and may be limited to this specific sample.

Diabetes specific family measures were not found to be better predictors of adherence than general and diabetes measures combined. It is possible that the diabetes-specific measures were not specific enough; it may be that adherence behaviors are best predicted by family support and/or conflict specific to that particular adherence behavior. For example, injection adherence may be associated only with family conflict or support around the issues of injection, and not associated with family behavior around other aspects of diabetes care (e.g., glucose testing, diet, or exercise.)
Models of diabetes control relationships found gender to be significantly associated with all measures of metabolic control. Consistent with the literature, adolescent girls were in poorer control than adolescent boys (Anderson et al., 1981; D'Antonio et al., 1989; Kaar et al., 1984; Johnson, Freund, Silverstein, Hansen, & Malone, 1990; Schafer et al., 1983 Simonds et al., 1981). D'Antonio and colleagues have suggested that genetic, hormonal, and/or life-style factors may play a role in these differences; the significance of these findings is the enhanced risk to females with IDDM to develop serious long-term complications from the disease. In this sample, significantly more girls than boys were found to be at the higher Tanner stages. With the exception of concentrated sweet consumption (girls were more adherent than boys), there were not significant gender-related differences in lifestyle behaviors such as exercise and eating. This suggests that hormonal factors may be influencing metabolic control. Although ratings of Tanner Stages used in this study as measures of pubertal development were not found to be related to indices of metabolic control, Tanner stage may not accurately reflect underlying hormonal change. In this study, data on Tanner Stages was collected at the clinic visit when possible; however, at times the information was obtained retrospectively through review of medical records. Different physicians made ratings on Tanner Stages for different adolescents; reliability was not assessed, and the
degree of standardization with which they rated adolescents' pubertal development is unknown. Future studies may benefit from a more standardized procedure for obtaining ratings of Tanner Stages and from better physiological indicators of pubertal development.

This study found few associations between measures of adherence and diabetes control. However, there were some consistencies in the associations that were found. Only the Testing/Eating Frequency measure was significantly related to HbA1c; better adherence with glucose testing and eating frequency was associated with lower HbA1c levels. This finding is consistent with work by Johnson and colleagues (Johnson et al., 1991) who, using Linear Structural Equation Model (e.g., LISREL) found that only the Testing/Eating Frequency measure exhibited a significant association to HbA1c in their longitudinal causal model. Schafer et al. (1983) also found a significant relationship between their adherence measure of number of daily glucose tests and HbA1.

Two significant associations were found between adherence behaviors and triglyceride levels. Lower fat, higher carbohydrate diets were associated with higher triglyceride levels, when controlling for gender and HbA1c levels. This is consistent with results reported by Johnson, Freund, Silverstein, Hansen, & Malone (1990) who found that, in poorly controlled patients, higher carbohydrate diets were associated with higher triglyceride levels. Adolescents in this study were generally in fair to
poor control. In these poorly controlled adolescents, who may be underinsulinized, higher triglyceride production by the liver from glucose and fructose would be the logical result of higher carbohydrate consumption. Research has documented increased triglycerides can result from high carbohydrate diets (Little, McGuire, & Derksen, 1979).

Injection adherence was also associated with triglyceride levels; this relationship was previously reported (Johnson, Freund, Silverstein, Hansen, & Malone, 1990; Johnson et al., 1991) However, in this study, the relationship appeared to differ depending on gender. For boys, greater injection adherence was significantly associated with lower triglyceride levels. The relationship was stronger for girls but in the reverse direction; greater injection adherence was associated with higher triglyceride levels. The physiological explanation for this difference is unclear. In general, as seen with the boys in this study, greater injection adherence is thought to result in lower triglyceride levels; the appropriate availability of insulin by injection is necessary to remove circulating triglycerides. Girls did not have significantly different insulin doses or injection adherence behaviors than boys. It may be that for girls, hormonal influences are effecting the action of insulin on circulating triglycerides. As previously mentioned, girls did differ from boys in their level of pubertal development. It seems that hormonal changes, which are associated with pubertal changes, and
which are likely to be gender-specific, are responsible for this differential relationship. It is clear from the literature that significant gender differences exist between indicators of diabetes control for adolescents with IDDM; the mechanisms by which these differences occur need to be more closely investigated.

In this study, significant associations were found between adherence behaviors and cholesterol levels. This is inconsistent with the findings of Johnson, Freund, Silverstein, Hansen, & Malone (1990) who found no significant associations to cholesterol. In their study, the age range of the sample was from 6-19 years, while in this study, the age range of the sample was from 12-18 years. These investigators also found no significant correlations between cholesterol and other measures of diabetes control (i.e., HbA1c, triglycerides); however, other studies have found significant relationships (D'Antonio et al., 1989; Strobl et al., 1985; Linn, Linn, Skyler, & Jensen, 1983). It seems likely that cholesterol-adherence relationships may be more readily described in age-homogenous samples. When effects have been observed in age-heterogenous samples, they may be due to powerful effects of hormones associated with growth and development.

Two adherence measures were significantly associated with cholesterol levels, and again, the association appeared to differ depending on gender. For girls, greater adherence to exercise (more exercise) and testing/eating frequency
were significantly associated with lower levels of cholesterol. For boys, the reverse was true; greater exercise and testing/eating frequency were associated with higher cholesterol levels. This finding is similar to that reported by Johnson, Freund, Silverstein, Hansen, & Malone (1990) who described a significant association between exercise and triglyceride levels which was dependent upon the youngster's initial level of metabolic control as well as on gender. For youngsters in poor control, the expected relationship was found; greater exercise was associated with lower triglyceride levels. For youngsters in good control, the reverse was true; greater exercise was associated with higher levels of triglycerides. These associations were stronger for girls than for boys.

Girls were in poorer control than boys in this study and in the Johnson, Freund, Silverstein, Hansen, & Malone (1990) study. In this study, a relationship between exercise and cholesterol, rather than between exercise and triglycerides, was found. However, a significant correlation between cholesterol and triglycerides was found for this sample, suggesting that a similar mechanism may explain the differential effect of exercise on cholesterol levels due to gender. Delineation of this mechanism is a goal for additional research.

As previously described, the Testing/Eating Frequency measure exhibited a similar association to cholesterol depending on gender. Girls who ate more frequently, and who
tested their blood glucose more frequently, had lower cholesterol levels. Boys had higher cholesterol levels when their frequency of eating and blood glucose testing was high. Again, one could speculate that either differences in pubertal level, hormonal effects specific to gender, or both are influential in the differential effects of adherence on metabolic control. It is notable that Testing/Eating Frequency was the only adherence factor to be significantly associated with both glycemic and lipid indices of diabetes control. This finding suggests that these adherence behaviors may be of particular importance in influencing metabolic control.

Adolescent stress was the only psychosocial measure to exhibit a direct relationship to a measure of diabetes control in this study. Unexpectedly, the association between adolescent stress and cholesterol was negative; higher adolescent stress was significantly related to lower levels of cholesterol. This finding is opposite from that reported by Chase & Jackson (1981). They found a significant correlation between cholesterol levels and a measure of major life events (r = .39, p < .01) in a sample of 15-18 year olds; significant correlations were not reported between these two measures for 6-11 or 2-14 year olds. In this study, the measure of adolescent stress included both major life events and daily hassles, and it appears from correlational data that adolescent daily hassles is what accounts for the observed relationship (i.e., the
correlation between adolescent quantity of hassles and cholesterol was \( r = -0.27, \ p < 0.08, \ n = 44; \) the correlation between total life events and cholesterol was not significant, \( r = 0.05, \ p < 0.73, \ n = 47). \) It may be that adolescents who report increased daily hassles are leading more active lifestyles which includes more exercise; adolescent hassles did significantly correlate with exercise adherence measures (\( r = 0.28). \) Decreased cholesterol levels are the logical result of increased exercise activity. In fact, in this study, exercise was a significant predictor of cholesterol levels.

It should be noted that in this study, only total cholesterol levels were obtained. In future studies, it would be useful to examine the relationships between HDL (i.e., high-density lipoprotein) and LDL (low-density lipoprotein) cholesterol, as LDL cholesterol has been found to be more strongly associated with heart disease.

Overall, this investigation provided some support for the proposed model of associations among psychosocial variables, adherence, and metabolic control. Family factors were found to be significantly associated with adolescent adjustment, and adolescent adjustment appeared to be related to parameters of metabolic control indirectly, through an association to specific adherence measures. Adolescent stress was found to be related to metabolic control directly, although in an unexpected direction. Physiological influences of puberty, as measured by Tanner
Stages, were not shown to have an association with indices of diabetes control. Several findings suggested by the literature were not replicated, and, in fact, some observed relationships were in the opposite direction from that expected.

There are several possible reasons for the lack of congruity of the findings of this study with those of other investigations. In contrast with much of the other research, this study used a homogenous sample of adolescents within a limited age range. In addition, participants in this sample had a duration of disease of at least two years. This is different from the work of many other investigators, several of whom have been studying the relationships between the aforementioned variables in newly-diagnosed children and adolescents (i.e., Jacobson and colleagues, Kovacs and colleagues). There are likely to be significant differences between the results of these researchers and this investigation based on both psychological and physiological differences between newly-diagnosed adolescents and those who have had the disease for some time. Adjustment to the diagnosis is a stressor in itself. Also, those who are newly-diagnosed may be producing endogenous insulin for months, sometimes years, after diagnosis, thus influencing any association one might find between psychosocial factors, adherence, and metabolic control.

Other differences include the use of different measures in various studies to assess constructs which are given the
same label by different investigators: adjustment, stress, adherence. This study used standardized, frequently-used questionnaires as well as behavioral data; the reliability of these measures in this sample was demonstrated. Only the Family Environment Scale failed to demonstrate adequate reliability. Adherence in this study was assessed as a multivariate construct, as has been supported in previous work by Johnson and colleagues (1986, 1990), and was supported in this study as well (i.e., the between-factors correlations were low, ranging from $r = -0.24$, $p < 0.07$ to $r = 0.21$, $p < 0.12$). Many other studies have conceptualized adherence as a univariate construct, and those which have not have frequently used measures of adherence with unproven validity and reliability. Measurement of metabolic control has also varied across study; this study used HbA1c, which is often considered "the" measure of diabetes control; measures of lipid metabolism were also included.

The results of this investigation suggest a model of associations among psychological adjustment, stress, family factors, adherence, and metabolic control. Several directions for future research can be identified. Attempts to replicate the findings of this study would be valuable, using better measures of general family functioning and of pubertal development. It would be useful to collect data at multiple points in time in an attempt to tease out the direction of observed associations.
The importance of including indices of lipid metabolism in these studies should be emphasized. In spite of the increased risk for heart disease in patients with diabetes, very few studies have investigated factors influencing triglyceride and cholesterol levels in adolescents with IDDM. Johnson, Freund, Silverstein, Hansen, & Malone (1990) did include these parameters; in their study, as in this one, adherence measures were better predictors to lipid indices of control than to HbA1c. In fact, in this study, adherence behaviors accounted for more variance in cholesterol levels than in other measures of metabolic control; if all adherence behaviors were entered together into the model, it is likely that even greater variance could be explained.

Finally, attempts to identify underlying mechanisms, including hormonal changes, that may be influencing adherence-control relationships differentially between boys and girls, and between good and poorly-controlled IDDM adolescents, need to be the focus of future research.
REFERENCES


Hanson, C.L., Henggeler, S.W., & Burghen, G.A. (1987a). Model of associations between psychosocial variables and health-outcome measures of adolescents with IDDM. Diabetes Care, 10, 752-758.


BIOGRAPHICAL SKETCH

Lynn Ann Reynolds was born on August 30, 1959, in Tawas City, Michigan. She graduated from Oscoda Area High School in June of 1977. Lynn attended Michigan State University from which she received a Bachelor of Science degree in physiology and psychology in June of 1981.

After graduation from college, Lynn was employed for three years by Alternative Services, Inc., a non-profit organization operating group homes for multiply-handicapped adolescents and adults. She worked first as a program aide, and then as an assistant home manager.

In September of 1984, Lynn entered the graduate program in Clinical and Health Psychology at the University of Florida. She received her Master of Science degree in December of 1987. Her area of concentration has been pediatric psychology. She plans to pursue a career combining clinical and research activities, with a focus on children with chronic illnesses and their families.
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Suzanne B. Johnson, Chair
Professor of Clinical and Health Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Hugh C. Davis
Professor of Clinical and Health Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Janet Silverstein
Associate Professor of Clinical and Health Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Stephen R. Boggs
Assistant Professor of Clinical and Health Psychology
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Constance L. Shehan
Associate Professor of Sociology

This dissertation was submitted to the Graduate Faculty of the College of Health Related Professions and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 1991

Dean, College of Health Related Professions

Dean, Graduate School