Comparison of Adolescents with and without Diabetes on Indices of Psychosocial Functioning for Three Years

Vicki S. Helgeson,[1] PhD, Pamela R. Snyder,[1] MA, Oscar Escobar,[2] MD, Linda Siminerio,[3] PhD, and Dorothy Becker,[3] MBBCH

[1]Carnegie Mellon University, [2]Children's Hospital of Pittsburgh, and [3]University of Pittsburgh Medical Center

Objective   To determine whether diabetes is associated with psychosocial difficulties over the transition to adolescence.   **Methods**   We compared adolescents with diabetes ($n = 132$) with a healthy comparison group ($n = 131$) on indices of psychosocial functioning for 3 years. We interviewed both groups annually and had one parent complete a questionnaire.   **Results**   There were no group differences in depressive symptoms, anxiety, anger, or behavioral problems. However, adolescents with diabetes showed greater declines in social acceptance compared with healthy adolescents, and a greater rise in disturbed eating behavior. Over time, depressive symptoms and anxiety increased and self-worth decreased for females but not males; however, these differences were not qualified by group   **Conclusions**   Diabetes is not associated with indicators of psychological distress from early to middle adolescence, but may be associated with the emergence of social difficulties and eating disturbances. Gender differences in psychological distress emerged, replicating past research.

Key words   adolescence; case control study; diabetes.

Type 1 diabetes is one of the most common chronic diseases among children and adolescents. A large amount of self-control is required to manage the disease. Type 1 diabetes requires keeping track of food intake, monitoring blood glucose, administering insulin, engaging in physical exercise, and adjusting insulin levels. When diabetes is not managed effectively, there is the potential for serious health consequences in both the short-term (e.g., coma) and long-term (e.g., blindness, kidney disease, circulatory problems).

Not surprisingly, adolescents have worse metabolic control than younger children and adults. This is partly due to the decrease in insulin sensitivity associated with puberty (Amiel, Sherwin, Simonson, Lauritano, & Tamborlane, 1986) and partly due to adolescents engaging in poorer self-care behavior (Anderson, Ho, Brackett, Finkelstein, & Laffel, 1997). Taking care of diabetes can interfere with the goals of adolescents to establish a sense of independence from parents and to establish a peer group (Holmbeck et al., 2000). Given the normative challenges that healthy adolescents face and the problems in self-care and

metabolic control that occur among adolescents with diabetes, diabetes may be associated with psychosocial difficulties among adolescents. The primary purpose of this study is to determine whether young adolescents with diabetes differ from healthy adolescents on a variety of domains of psychosocial functioning.

There are several reviews of the literature that indicate diabetes is associated with *some* psychosocial difficulties during childhood and adolescence (Delameter, 2000; Wysocki, Greco, & Buckloh, 2003). This conclusion is largely derived from a contradictory set of findings. Two key studies of older adolescents noted an increased risk of psychiatric problems among those with diabetes (Blanz, Rensch-Riedmann, Fritz-Sigmund, & Schmidt, 1993; Kovacs, Obrosky, Goldston, & Bonar, 1997). However, studies of children and younger adolescents are less clear. Some case-control studies have shown that diabetes is not associated with psychosocial difficulties (e.g., Frank et al., 1998; Hamlett, Pellegrini, & Katz, 1992); one study showed that children with diabetes had more behavioral problems than a comparison group

(Overstreet et al., 1995), and another study showed that children with diabetes had more depression, dependency, and withdrawn behavior than same-sex friends but the differences were not stable across the 3 years of the study (Grey, Lipman, Cameron, & Thurber, 1995).

There are several reasons that it is difficult to draw conclusions from the previous literature. First, the number of studies conducted in the area is small; second, their designs are varied. Most importantly, however, for the purpose of this study is that previous research on children and adolescents has examined heterogeneous age ranges: ages 1–17 (Frank et al., 1998), ages 6.5–14 (Hamlett et al., 1992), ages 8–14 (Grey, Lipman, Cameron, & Thurber, 1995), and ages 8–16 (Overstreet et al., 1995). We argue that early adolescence might be the time during which those with diabetes begin to experience more psychosocial difficulties compared with healthy peers. Because previous case-control studies have tended to group young adolescents with both children and older adolescents, it is difficult to determine whether young adolescents with diabetes are at risk for psychosocial problems. It is possible that group differences appear or even emerge during adolescence, but the inclusion of children in previous studies has obscured this effect.

In the present study, we enrolled children who were in early adolescence, ages 10.7–14.2 years (a 3.5-year window), and in the 5th, 6th, or 7th grades at the start of the study. We followed these adolescents over 2 years with three waves of data collection so that we could determine whether group differences in psychosocial functioning emerged at baseline, persisted over time, or emerged with time. Few of the previous case-control studies have employed a longitudinal design. One noteworthy exception found that group differences were not stable over the course of the 3 years (Grey et al., 1995).

We enrolled participants in the study during early adolescence because this is a transition period characterized by significant biological, psychological, and social changes (Holmbeck, Friedman, Abad, & Jandasek, 2006). Each of these areas of change may be made more difficult by diabetes. The hormonal changes associated with puberty make it more difficult to maintain optimal blood glucose control (Goran & Gower, 2001). The body image changes that accompany adolescence are compounded by further changes associated with managing diabetes, including insulin-related weight gain (Diabetes Control and Complications Trials [DCCT] Research Group, 1988).

A critical task of adolescence is the development of a sense of autonomy and independence (Collins, Gleason, & Sesma, 1997), a task that may be viewed as more difficult by adolescents with diabetes who feel that their lives are dictated by their treatment regimen. Independence from parents in particular may be made more difficult as parents are often intimately involved in helping the adolescent take care of diabetes. In fact, too much autonomy has been shown to be related to poor health outcomes among adolescents with diabetes (Anderson et al., 1997; Wysocki et al., 1996).

Another important task of adolescence is establishing connections to a peer group (Collins et al., 1997)—a group that sets norms and to which one is expected to conform. Diabetes and its accompanying self-care behaviors set adolescents apart from their peers. The greater complexity in cognition afforded by adolescence (Holmbeck, Friedman et al., 2006) may facilitate thinking about the consequences of health behaviors and the future, but does not necessarily translate into better diabetes care. Adolescents may choose to ignore their treatment regimen if adherence interferes with social goals. The increase in extracurricular activities that accompanies adolescence may make it more difficult to execute all the self-care behaviors required to manage the disease. Thus, if there is ever a point during which children with diabetes begin to have psychosocial difficulties, early adolescence would seem to be a period worthy of investigation. It is at this time that self-care behavior declines and metabolic control deteriorates.

We compared children with diabetes with healthy children on a wide array of indices of psychosocial functioning. Previous studies that have evaluated psychopathology show that those with diabetes tend *not* to have more problems (e.g., Frank et al., 1998), but studies that have employed a broader array of measures of psychosocial functioning have been more likely to find group differences (e.g., Hauser et al., 1992). Although diabetes may not be associated with psychopathology, it may be associated with less severe disturbances in psychosocial functioning that could have important consequences.

In the present study, we compared children with diabetes with a healthy comparison group on measures of psychological distress, competence, disturbed eating behavior, and behavioral problems. These are the most commonly assessed domains of psychological functioning evaluated by previous research, although typically not all in a single study. The three measures of psychological distress that we employed are depressive symptoms, anxiety, and anger. Although it is not clear whether youth with diabetes have more depressive symptoms than their healthy peers, depressive symptoms has been linked to poor metabolic control and emergency room visits in

youth with diabetes (Lawrence et al., 2006). Anxiety has been examined in previous research but the measure used often has overlapped with depressive symptoms; thus, we examine a measure of anxiety that has been empirically distinguished from depressive symptoms (Stark & Laurent, 2001). Anger is an emotion that has been rarely investigated in youth with diabetes. These youth could respond to the restrictiveness of their disease with anger as they observe peers gaining freedoms at this time in their lives. Overall, we used measures that are standard for the field with excellent psychometric properties. To provide a more comprehensive evaluation of children with diabetes compared with healthy children, parents completed some measures and children completed others.

A methodological concern with some of the early studies is that the sample sizes of children with diabetes were notably small, which might have limited the power to detect significant differences. We employ a fairly large sample of 132 adolescents with diabetes, which provides us with the power to detect smaller differences and the ability to evaluate an important demographic variable—gender—that could be associated with outcomes during adolescence and could moderate the relation of health status to outcomes.

To our knowledge, none of the previous case-control studies examined gender differences in outcomes. Gender is an important issue to address during adolescence for three reasons. First, adolescence is a time of gender intensification, in which gender roles become salient to boys and girls (Crouter, Manke, & McHale, 1995; Hill & Lynch, 1983). Second, adolescence is a time when gender differences in mental health appear. Women have twice the rate of depression than men, and this difference first appears during adolescence (Wichstrom, 1999). In addition, body image declines for girls during adolescence (Allgood-Merten, Lewinsohn, & Hops, 1990). Third, some studies show gender differences in adjustment to diabetes during adolescence (Kovacs et al., 1990; La Greca, Swales, Klemp, Madigan, & Skyler, 1995). It is not clear, however, whether these gender differences are different from the gender differences in mental health that emerge among healthy youth during adolescence. Thus, we examine the effect of health status (diabetes vs. healthy), gender, and the interaction between health status and gender on psychosocial functioning with three waves of data collected over 2 years.

In sum, we compare young adolescents with diabetes with a healthy comparison group on a wide array of indices of psychosocial functioning. The findings from this study will make a significant contribution to the literature for four reasons: (a) we examine a distinct age group, young adolescents, and a group for whom one might expect problems to appear, compared with healthy peers; (b) we employ a wide range of outcome measures, some of which are reported by adolescents and others by parents; (c) we have a fairly large sample size enabling us to examine whether gender moderates any of the group differences; and (d) we follow adolescents for 2 years with three waves of data collection. By examining these variables over time, we have the opportunity to examine whether group differences emerge over time, persist over time, or recede over time (Holmbeck, Bruno, & Jandasek, 2006).

The previous literature leads us to expect few differences between adolescents with and without diabetes in psychosocial functioning. On only one outcome—disturbed eating behavior—is there sufficient literature to justify a prediction that those with diabetes will have more problems (Colton, Rydall, Olmsted, Rodin, & Daneman, 2004; Jones, Lawson, Daneman, Olmstead, & Rodin, 2000; Nielsen, 2002). For the other outcomes, the literature is contradictory, providing a major impetus for the study. If group differences appear, we expect those with diabetes to have more problems than those without diabetes. We also expect group differences to emerge or increase with time, as children reach the peak of early adolescence.

Method
Recruitment

Adolescents with Diabetes
Adolescents with diabetes were recruited from a local Children's Hospital. Letters of invitation ($n = 307$) were sent to all adolescents with Type 1 diabetes who were ~11–13 years of age. Of these, 20 families returned postcards refusing contact about the study. Of the remaining 287 families, we reached 261 and determined that 171 were eligible. Eligibility requirements included: adolescent attending Children's Hospital; in 5th, 6th, or 7th grade; diagnosed with Type 1 diabetes for at least 1 year prior to enrollment; and no other major chronic illness (e.g., cancer, rheumatoid arthritis). Of eligible families, 132 (77%) agreed and 39 refused.

Healthy Comparison Group
Healthy adolescents were recruited from two sources: three health fairs at area malls ($n = 70$) and from a local pediatric physician network ($n = 61$). The physician network selected all families from their database in

geographic areas that were comparable with where the diabetes group was located, and within our age range. They divided that total number by the number of letters requested, and, using the quotient (*n*), sent letters to every *n*-th family. Of the 156 letters sent, 33 people returned postcards refusing contact about the study without us being able to determine eligibility. Eligibility requirements included being in grades 5, 6, or 7 and having no major chronic illness. Of the remaining 123 families, we reached 112 by phone and determined that 93 were eligible. Of those, 61 (66%) agreed to be in the study.

Procedure

The study was approved by the Institutional Review Boards of the involved institutions. Parental consent and child assent were obtained in person at the time of the initial interview Time 1 (T1). Adolescents with diabetes (*n* = 132; 70 girls, 62 boys) were interviewed in the General Clinical Research Center immediately before or after their regular clinic appointment. Healthy adolescents (*n* = 131; 67 girls, 64 boys) were interviewed in their homes. For both groups, one parent completed a questionnaire in a private room (diabetes: *n* = 129; healthy: *n* = 130). In the majority of cases, the parent was the mother (92% for both groups). Adolescents' ages ranged from 10.70 to 14.21 years, with a mean of 12.08 (*SD* = 0.73). The majority of participants were White (93% diabetes; 91% healthy). Household structure was the same for both groups with nearly three-quarters living with their biological mother and father (74% diabetes; 73% healthy). Adolescents with diabetes had the illness between 1 and 13 years, with an average of 4.91 (*SD* = 2.98) years. Their average HbA1c was 8.04 (*SD* = 1.31).

We interviewed adolescents 1 year later at Time 2 (T2) and another year later at Time 3 (T3). Of the adolescents with diabetes, we retained the vast majority of the sample at T2 (96%, *n* = 127) and T3 (95%; *n* = 126). The majority of parents completed questionnaires at T2 (94%) and at T3 (90%). Of the healthy adolescents, we interviewed 98% (*n* = 129) at T2 and 98% (*n* = 129) at T3. The majority of parents completed questionnaires at T2 (97%) and T3 (96%).

All adolescent interviews were conducted aloud, with the exception of the depression scale and the eating disturbance items which were completed by the child in private due to their sensitive nature. Response cards were provided for standardized scales administered orally.

Measures

With the exception of the background variables (and unless noted), all other measures were administered at all three times of assessment.

Background

Parents provided demographic information, including age, race, household structure, parent education, and parent occupation on the T1 parent questionnaire. From education and occupation information, we computed the four-factor Hollingshead index to measure social status (Hollingshead, 1975). We calculated body mass index (BMI) from height and weight measured at the clinic for children with diabetes and by stadiometer and digital scale at families' homes for healthy children.

Tanner Stage

At T1, parents completed the parent version of Carskadon and Acebo's (1993) self-report of pubertal status. The authors showed that parent ratings were strongly correlated with child and pediatrician ratings of Tanner stages. There were missing data on this measure for four healthy adolescents and five adolescents with diabetes because parents did not complete that portion of the questionnaire. For the adolescents with diabetes, we substituted the physician rating of Tanner stage. Physician ratings were highly correlated with parent report; Spearman's rho = .71, *p* < .001. The internal consistencies of the self-report scale were good (diabetic girls, .73; healthy girls, .77; diabetic boys, .74; healthy boys, .86).

Psychological Distress

We used the abbreviated form of the Children's Depression Inventory (CDI) to assess depressive symptoms (Kovacs, 2001). Internal consistency is high, as is test–retest reliability. Alphas were .73 at T1, .70 at T2, and .78 at T3. We measured anxiety with the 7-item scale that Stark and Laurent (2001) developed in response to concerns about the inability to distinguish depressive symptoms and anxiety in children. These were the seven items from the Revised Children's Manifest Anxiety Scale that were found to reflect anxiety uniquely. The authors provided convergent and discriminate validity for their measure. To increase variability in the scale and make the response format consistent with other items, we changed the true/false format to 3-point scales (not at all true, sort of true, very true of me). The internal consistencies in the present study were .68 at T1, .72 at T2, and .72 at T3, which are comparable with the alphas reported by Stark and Laurent (2001). Consistent with the authors' intent,

we found much lower correlations between this measure of anxiety and depressive symptoms (rs ranged from .40 to .43) than is commonly found in the literature. We used the 3-item anger subscale of the Differential Emotions Scale (Izard, Libero, Putman, & Haynes, 1993). Test–retest reliability is high, and validity with comparable scales has been reported. To be consistent with other scales, we changed the response format to a 3-point scale. The internal consistency was .76 at both T1 and T2 and .77 at T3, which is slightly lower than the .85 the authors reported. Because the three scales were only modestly related (rs ranged from .22 to .51), we examined them separately.

Competence

We administered two subscales from the Self-Perception Profile for Children (Harter, 1985) to assess children's judgments of their competence: social acceptance and global self-worth. The internal consistencies for the two subscales were adequate (social acceptance .76, .67, and .68; global self-worth .75, .75, and .68, at T1, T2, T3, respectively).

Disturbed Eating Behavior

The Eating Disorder Inventory (EDI; Garner, 1991) is a valid and reliable self-report instrument that was designed to identify the presence of various attitudes and behaviors associated with eating disorders. We used two subscales: drive for thinness (preoccupation with weight) and bulimia (episodes of uncontrollable eating or bingeing). Three items from the drive for thinness scale were removed because they are biased by the presence of diabetes (Steel, Young, Lloyd, & Macintyre, 1989). Their inclusion in previous research has artificially inflated the presence of eating disturbances among people with diabetes. Internal consistencies were good in the present study (bulimia .75 at T1, .77 at T2, and .74 at T3; drive for thinness .87 at T1, .85 at T2, and .89 at T3).

Behavioral Problems

Parents completed the Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 1992), which assesses an array of emotional and behavioral problems and has excellent reliability and validity. Parents completed the full BASC, which includes 11 individual scales and 4 composite indices. To reduce the number of analyses, we focused on the four composite indices. The externalizing composite index includes hyperactivity, aggression, and conduct problems. The internalizing composite index consists of anxiety, depression, and somatization. The behavioral symptoms index can be considered an overall index of problem behavior and consists of hyperactivity, aggression, anxiety, depression, atypicality, and attention problems. Finally, the adaptive skills index consists of social skills and leadership. All of these indices are converted to T scores. The internal consistencies of all indices were high (alphas ranged from .89 to .94 across the three waves of assessment).

The BASC also includes a self-report scale for children. Adolescents completed the one portion of the BASC that is not reflected in the parent questionnaire, the three scales that reflect school maladjustment (attitudes toward school, attitude toward teachers, sensation seeking). To reduce the number of analyses, we only examined the school maladjustment index. Internal consistencies were adequate (alphas ranged from .71 to .86 across three waves).

Results
Overview of Analysis

Potential Covariates

Before comparing adolescents with diabetes with our group of healthy adolescents, we examined whether there were group differences on background and demographic variables at T1. There were no group differences on gender, age, race or ethnicity, or household structure. We also examined the racial composition and size of the communities from which the participants were drawn and found no group differences. However, there were group differences on BMI, $F(1, 261) = 6.99$, $p < .01$, such that adolescents with diabetes had a higher BMI ($M = 22.05$; $SD = 4.36$) than healthy adolescents ($M = 20.63$, $SD = 4.37$). There also was a group difference in Tanner stage, $F(1, 257) = 8.79$, $p < .01$, such that adolescents with diabetes had a higher Tanner stage ($M = 2.77$, $SD = 0.99$) than healthy adolescents ($M = 2.39$, $SD = 1.11$). There was a group difference on social status, $F(1, 261) = 8.66$, $p < .01$, such that adolescents with diabetes were from lower status families ($M = 41.97$, $SD = 11.05$) than healthy adolescents ($M = 46.40$, $SD = 13.31$). Thus, we controlled for BMI, Tanner stage, and social status in all analyses.

Longitudinal Growth Modeling

We analyzed the data by using the statistical procedure referred to as longitudinal growth modeling or multilevel modeling (Singer & Willett, 2003). Longitudinal growth modeling has a number of advantages over ordinary least squares regression. One advantage is that if an individual misses a wave, the data from his/her other waves are included in the analysis. Another reason that we chose

multilevel modeling is that our variables are correlated across time. Ordinary least squares regression assumes that this autocorrelation is zero. With multilevel modeling, we can examine two sources of change. First, we can examine changes over time within an individual, such as whether depressive symptoms increase or decrease over time (referred to as the Level 1 model). Second, we can examine whether individual difference characteristics (i.e., group, gender) influence these trajectories of change over time, such as whether the change in depressive symptoms over time is larger for adolescents with diabetes than healthy adolescents (referred to as the Level 2 model). The strengths of growth curve modeling for pediatric psychology are discussed in depth by DeLucia and Pitts (2006) in the Special Issue on ''Longitudinal Research in Pediatric Psychology'' in the *Journal of Pediatric Psychology*.

As suggested by Singer and Willett (2003), we began the analysis on all outcome variables by fitting the unconditional means model. The model tests whether or not there is variation in the outcome (e.g., depression) that is worth exploring. This was the case for all of our outcome variables. Thus, we proceeded to the unconditional growth model in which we add time to the Level 1 model. This model tests whether there is significant variability in the outcome across time. It also provides a baseline for comparing the subsequent models that we fit to the data. The subsequent models consisted of adding gender, group, and the interaction between gender and group to both equations in the Level 2 model to predict the overall level of the outcome variable and the annual rate of change in the outcome variable. We also added the three covariates to adjust for their effects on the overall level of the outcome variable. For exploratory purposes (as we had no hypotheses), we also examined the interaction of the three covariates with the growth parameter (time). Pubertal status never interacted with the slope for time; social status and BMI interacted with the slope for time on only one occasion but not the same occasion. Therefore, we did not retain these parameters in our model. Consistent with Singer and Willett's (2003) recommendations, we dropped nonsignificant terms (with the exception of the three covariates) from the final model. Table I displays the final model for each outcome variable. The table displays the unstandardized betas for each parameter; standard errors are in parentheses. The chi-square statistic comparing the final model with the unconditional growth model is shown at the bottom of the table. In all cases, the chi-square is significant, suggesting that we have significantly improved model fit

Table I. Final MultiLevel Models: Parameters (Unstandardized Betas) and Standard Errors

		Depression	Anxiety	Self-worth	Social acceptance	Drive for thinness	Internalizing problems	Externalizing problems	Adaptive skills	School maladjustment
Initial status π_{0i}	Intercept	1.16*** (.02)	1.65*** (.03)	3.44*** (.05)	3.30*** (.05)	2.07*** (.09)	53.88*** (.92)	49.70*** (.94)	51.36*** (.89)	45.57*** (.72)
	Gender	−0.04 (.03)	−0.02 (.05)	0.09+ (.06)	–	−0.30* (.12)	−2.86* (1.35)	5.16*** (1.44)	3.99** (1.19)	5.50*** (1.06)
	Group	–	–	0.07 (.05)	0.05 (.07)	−0.10 (.11)	–	–	0.76 (.97)	–
	Gender × Group	–	–	–	–	–	–	–	−4.48* (1.88)	–
	Puberty	0.01 (.01)	0.03 (.02)	−0.02 (.03)	−0.04 (.03)	0.09+ (.05)	1.36* (.68)	2.99*** (.73)	−0.99* (.57)	1.60* (.53)
	Social status	0.00 (.00)	0.00* (.00)	0.00 (.00)	0.00 (.00)	−0.00 (.00)	−0.11* (.05)	−0.11* (.05)	0.08* (.04)	−0.09* (.04)
	BMI	0.01* (.00)	0.01 (.01)	−0.01* (.01)	−0.01* (.01)	−0.06*** (.01)	0.07 (.14)	−0.30* (.15)	0.00 (.12)	−0.25* (.11)
Rate of change π_{1i}	Intercept (time)	0.03* (.01)	−0.02 (.02)	−0.11*** (.03)	0.02 (.02)	−0.20*** (.06)	−1.47*** (.23)	−0.95*** (.23)	−0.82** (.04)	1.28*** (.25)
	Gender	−0.04* (.02)	−0.06* (.03)	−0.06* (.03)	−0.08* (.03)	0.12* (.06)	–	–	0.73+ (.43)	–
	Group	–	–	–	–	–	–	–	–	–
df, χ^2		5, 26.00***	5, 26.37***	7, 30.47***	5, 20.59***	7, 212.1***	5, 28.12***	4, 21.53***	7, 21.90**	4, 31.50***

+p < .10, *p < .05, **p < .01, ***p < .001.

Table II. Unadjusted Scale Means for Males and Females with and without Diabetes over Time

	Time 1				Time 2				Time 3			
	Diabetes		Healthy		Diabetes		Healthy		Diabetes		Healthy	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Depressive symptoms	1.11	1.19	1.13	1.17	1.12	1.17	1.09	1.20	1.09	1.22	1.08	1.24
Anxiety	1.64	1.66	1.63	1.72	1.48	1.57	1.55	1.66	1.46	1.70	1.53	1.63
Anger	1.79	1.75	1.68	1.83	1.94	1.98	1.94	2.05	1.97	2.04	1.98	2.08
Self-worth	3.65	3.48	3.55	3.54	3.46	3.25	3.46	3.20	3.41	3.20	3.52	3.29
Social competence	3.38	3.33	3.43	3.28	3.27	3.14	3.35	3.19	3.27	3.22	3.49	3.29
Drive for thinness	1.58	2.12	1.61	2.12	1.67	2.27	1.52	1.92	1.43	2.40	1.30	2.14
Bulimia	1.66	1.66	1.63	1.75	1.73	1.68	1.55	1.70	1.57	1.63	1.45	1.70
Behavioral Symptom Index	53.80	52.42	51.57	52.60	50.30	50.33	48.92	50.26	48.70	49.03	48.36	49.33
Externalizing problems	54.00	50.84	53.06	51.17	51.93	50.40	51.82	50.60	50.56	48.12	51.85	50.49
Internalizing problems	52.82	55.32	48.68	54.03	49.77	53.03	45.87	52.21	48.84	52.14	46.34	51.76
Adaptive skills	47.68	52.19	49.84	51.48	46.33	50.86	49.44	48.24	47.61	52.10	49.44	48.48
School maladjustment	49.76	45.40	50.06	45.51	53.07	48.62	51.46	49.52	52.80	48.05	51.69	48.63

with the addition of these parameters. The unadjusted means for males and females in both groups at T1, T2, and T3 are shown in Table II.

We evaluated the intraclass correlation coefficient in the unconditional means model for each outcome variable, which represents the autocorrelation (average correlation) between any pair of residuals on two occasions (T1 and T2, T2 and T3, T1 and T3). When this number was relatively high (over 50%), we reran the models using the autoregressive covariance matrix rather than the unstructured covariance matrix. The final parameters and their significance levels were the same as those reported using the unstructured covariance matrix. Thus, we present the unstructured covariance matrix in this article. We also reran the analyses using age rather than time as the growth parameter. The significant parameters reported below remained significant when age was substituted for time, and no new significant parameters emerged.

We only report effects that are statisically significant at $p < .05$. Marginal effects ($p < .10$) are only reported in the context of explaining significant gender/group by time interactions.

Psychological Distress

Depressive Symptoms

There were no group effects for depressive symptoms. The final model revealed an effect for time and a gender by time interaction, indicating that the gender difference in depressive symptoms changed across time (Table I). The approach that we adopted to interpret interactions is the one recommended by Singer and Willett (2003), recomputing the model by recentering time. This enables us to dissect the interaction and examine the gender
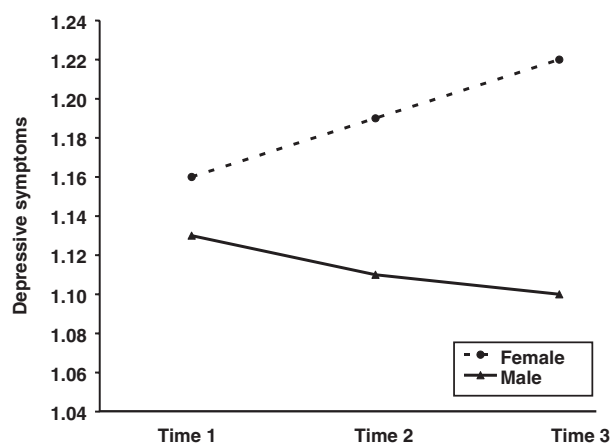
Figure 1. Changes in depressive symptoms over time for females and males.

difference at each wave of assessment. That is, recentering the predictor variable improves the interpretability of intercepts. In the original model tested (shown in Table I), time is coded as 0, 1, and 2, such that the first wave of data collection is scored as 0. In this model, the effect for gender ($\beta = -.04$, n.s.) represents the gender difference at T1. When we recentered time so that the second wave of data collection is scored as 0 (i.e., -1, 0, 1), an effect for gender emerges ($\beta = -.08$, $p < .01$). This effect indicates that there is a gender difference at T2. When we recentered time so that the third wave of data collection is scored as 0 (-2, -1, 0), an even larger effect for gender appeared ($\beta = -.12$, $p < .001$). This represents the T3 gender difference. In sum, there was no gender difference in depressive symptoms at T1 but a gender difference at T2 and T3, as depicted in Fig. 1. A gender difference in depressive symptoms (female more)

emerged over time. These findings held across diabetes and healthy groups.

Anxiety

There were no group effects on anxiety. The final model revealed a gender by time interaction. Using the same recentering approach, we determined that there was no gender difference in anxiety at T1, a marginal gender difference at T2 ($\beta = -.08$, $p = .09$), and a significant gender difference at T3 ($\beta = -.13$, $p < .05$). A gender difference (female greater than male) emerged over time and was unaffected by group. Here, anxiety remained the same over time for females but decreased over time for males.

Anger

There were no effects of group or gender. The only significant predictor of anger was time ($\beta = .13$, $p < .001$). Anger increased over time (T1 = 1.77; T2 = 1.98; T3 = 2.01).

Competence

Self-Worth

The final model revealed an effect for time, indicating an overall decline in self-worth over time, but also a gender by time interaction. The gender difference in self-worth was marginal at T1, significant at T2 ($\beta = .16$, $p < .01$), and significant at T3 ($\beta = .23$, $p < .001$), such that the rate of decline was larger among girls than boys.

Social Acceptance

The final model revealed a group by time interaction. There was no group difference at T1 or T2 but a marginally significant group difference at T3 ($\beta = -.10$, $p = .08$). Thus, the time slopes are significantly different for diabetes and healthy (i.e., the group by time interaction), but the follow-up tests to interpret the interaction revealed that the group difference was not large enough to reach statistical significance at any given time point. The interaction is depicted in Fig. 2. Social acceptance remains the same over time for the healthy group but declined over time for those with diabetes.
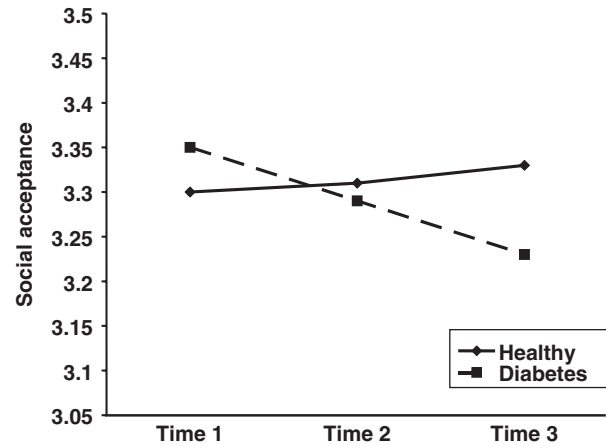
Eating Disturbances

Bulimia

None of the parameters were significant in the final model.

Drive for Thinness

In the final model, there was an overall effect for gender, a gender by time interaction, and a group by time interaction. The gender difference in drive for thinness

Figure 2. Changes in social acceptance over time for healthy adolescents and adolescents with diabetes.
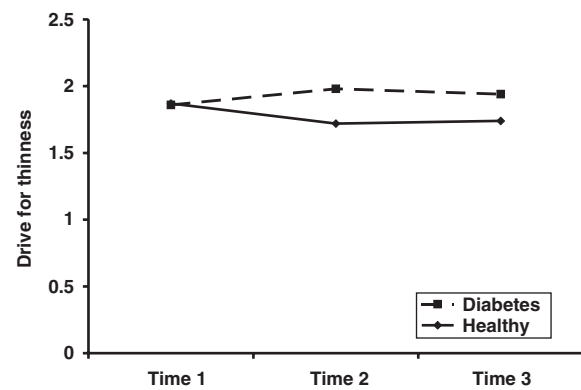
Figure 3. Changes in drive for thinness over time for healthy adolescents and adolescents with diabetes.

(females more than males) increased in size with each wave of assessment (T1 = −.31, $p < .05$; T2 = −.50, $p < .001$; T3 = −.70, $p < .001$). The group by time interaction revealed an increase in drive for thinness for adolescents with diabetes over time and a decrease for healthy adolescents, when averaging across males and females. These findings are shown in Fig. 3.

BASC Summary Indices

Behavioral Symptoms Index

Only the effect of time was significant in the final model ($\beta = -1.86$, $p < .001$), indicating a decline in behavioral symptoms over time.

Internalizing Problems

The final model revealed effects for time and gender, such that internalizing symptoms declined over time and were higher in females than in males. There were no effects for group.

Externalizing Problems

The final model revealed effects for time and gender, indicating externalizing problems declined with time and that males have more externalizing problems than females. There were no effects involving group.

Adaptive Skills

The final model revealed effects for time (decline) and gender as well as a gender by group interaction. Averaging across time, females had higher adaptive skills than males in both groups but the difference was larger among those with diabetes (females, $M = 52.32$; males, $M = 47.24$) than the comparison group (females, $M = 49.47$; males, $M = 48.80$), largely due to the high adaptive skills of females with diabetes.

School Maladjustment

The final model revealed effects for time (increase) and gender (boys higher than girls). There were no effects for group.

Discussion

Recently, Donnellan, Trzesniewski, and Robins (2006) suggested that future adolescent research should employ multilevel models to understand normative patterns of change as well as individual differences in the trajectories of those changes. This study meets this request. The overall goal of this study was to compare young adolescents with diabetes with healthy adolescents on a wide array of indices of psychosocial functioning over several years. Although previous case-control studies exist, findings have been mixed—possibly due to wide age ranges studied, small sample sizes, and at times a limited battery of assessment tools. We examined a wide array of indices of psychosocial functioning, some from the adolescent's perspective and some from the parent's perspective. We focused on a narrow age range, early adolescence, within which one might expect diabetes to pose difficulties. We also used a larger sample than has been employed in much previous research. We employed a longitudinal design and collected three waves of data over 2 years, with an excellent retention rate. In general, our results showed few group differences, suggesting that diabetes is not associated with *major* psychosocial difficulties. However, two noteworthy group differences emerged with time.

First, there was some evidence for an emergence of greater difficulties in social competence among those with diabetes. The establishment of a peer group is a major task of adolescence—and a task that might be made more difficult by diabetes. Studies of children with diabetes rarely focus on peers. One study showed no difference in support from friends between adolescents with and without diabetes (Helgeson, Reynolds, Shestak, & Wei, 2006), whereas another study suggested that adolescents with diabetes had some peer difficulties (Wallander, Varni, Babani, Banis, & Wilcox, 1988) at least according to parent report. The size of the group difference in the present study was small and only emerged with time. However, a larger effect may appear with age as peers take on increasing importance. Peers may have direct and indirect effects on self-care behavior. If adolescents with diabetes feel as if they do not fit in with peers, they may be vulnerable to social pressures to engage in behaviors that conflict with diabetes. Although older adolescents with diabetes have better problem-solving skills with respect to self-care behavior compared with younger children, they have been shown to be less likely to choose the correct self-care behavior in the face of peer pressure (Thomas, 1997). We do not want to overstate our finding. At no time of assessment did the group difference reach statistical significance. It was the slopes over time that significantly differed between the two groups but even this effect size was quite small ($\eta^2 = .02$), leading us to suggest that future research should further investigate how the peer relationships of children with diabetes change over time.

Second, on one of the two indicators of disturbed eating behavior—drive for thinness—there was evidence of greater difficulties for those with diabetes compared with healthy peers. Drive for thinness increased over time among those with diabetes, but decreased over time among the comparison group. These findings are consistent with previous research that shows eating disturbances and disturbed eating behavior are higher among adolescent girls with than without diabetes (Colton et al., 2004; Jones et al., 2000; Nielsen, 2002). Because eating disorders are much more common among girls than boys, little research has investigated this issue among boys with diabetes. These findings suggest that there may be cause for concern among both girls and boys. Given that insulin is associated with weight gain (DCCT Research Group, 1988), it is not a surprise that boys and girls with diabetes may be sensitive to changes in body size. Although the effect size for the differential slopes between the two groups was small ($\eta^2 = .03$), even small differences could have a large impact on the physical health of adolescents with diabetes over time. Disordered eating behavior has been associated with hypoglycemic episodes,

ketoacidosis, poor metabolic control, and diabetic retinopathy (Jones et al., 2000; Rydall, Rodin, Olmsted, Devenyi, & Daneman, 1997).

Many of the gender differences in psychosocial outcomes that emerged in this study were consistent with previous research, and were consistent across children with and without diabetes. From the parents' perspective, boys had more externalizing problems than girls, girls had more internalizing problems than boys, and girls had more adaptive skills than boys. According to adolescents' own reports, boys had more difficulties with school than girls.

Other gender differences emerged over time, consistent with previous research on the transition through adolescence. A gender difference in depressive symptoms emerged (females greater than males), consistent with previous research that has identified ages 13–14 as the time when gender differences in depressive symptoms first appear (Wichstrom, 1999). Parallel findings emerged for anxiety. Our findings also replicated the decline in self-esteem that occurs during adolescence (Twenge & Campbell, 2001), confirming that the decline is larger among girls than boys. A gender difference in disturbed eating behavior emerged with time, and a gender difference in adaptive skills decreased over time (females greater than males in both).

Taken collectively, there are few differences between children with diabetes and healthy children over the early transition to adolescence in terms of psychosocial difficulties and behavioral problems. Possible exceptions include social acceptance, which appears to be declining at a higher rate among those with diabetes, and disturbed eating behavior, which appears to be increasing among adolescents with diabetes. The implications of these trends for diabetes outcomes, such as self-care behavior and metabolic control, should be examined. However, it may be that poor diabetes outcomes are driving these differences. Given the fact that diabetes and healthy groups did not differ on most indices of psychosocial functioning and that the differences that did appear are small, it is possible that a small group of adolescents with diabetes are responsible for the detection of an overall group effect on a couple of our measures. Across outcomes, there is a large overlap in the distributions of the two groups on psychosocial functioning over this period of adolescence. Yet, this does not mean that efforts should not be made to detect the subgroup of adolescents with diabetes who may be vulnerable to psychosocial problems. Clinicians who work with children with diabetes should explore areas of difficulty in peer relations. Extra efforts could be made also to ensure that adolescents with diabetes visit a dietician, educator, psychologist, or other health care professional, annually. The entire health care team should be vigilant for signs of disturbed eating behavior as they review dietary habits.

Before concluding, we must acknowledge the limitations of the study, including the fact that the majority of participants were White and middle-class and that children with diabetes were selected from a single clinic, all of which decrease the generalizability of our findings. We interviewed healthy adolescents at home and adolescents with diabetes in the hospital, because the distance from the hospital made it too costly to interview those with diabetes at home. To minimize the effect of the clinic on the interview, we interviewed adolescents with diabetes on a different floor from the clinic. Nonetheless, the interview setting is an inherent difference between the two groups. In addition, despite our having pursued two avenues to acquire a healthy comparison group, the comparison group was not fully matched to the diabetes group on demographic variables, leaving us to statistically control for these differences. One avenue for future research to pursue is Robert Noll's (e.g., Noll et al., 2001) methodology of matching each target child to a same age and sex classmate. This methodology has yet to be applied to diabetes.

Despite these limitations, there are a number of strengths of the current study, including the relatively large sample, the high retention rate, the administration of a wide array of standardized instruments, and the longitudinal design. As noted by Holmbeck, Bruno, et al. (2006), the use of longitudinal designs has historically been the exception rather than the rule in past research on child and pediatric psychology. Future research should continue to examine changes in psychosocial functioning among youth with diabetes over later adolescence and into young adulthood.

Acknowledgments

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