Children's Appraisals of Maternal Involvement in Coping With Diabetes: Enhancing Our Understanding of Adherence, Metabolic Control, and Quality of Life Across Adolescence

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Objective To examine how children's appraisals of maternal involvement in coping with diabetes are associated with adherence, metabolic control, and quality of life across adolescence. **Methods** Children (N = 127, ages 10–15 years) with type 1 diabetes completed measures of adherence, quality of life, and appraisals of mothers' involvement in dealing with diabetes problems (i.e., mother appraised as uninvolved, controlling, or collaborative). Metabolic control was indexed through medical records. **Results** Regardless of age or sex of child, appraised maternal uninvolvement was associated with poorer adherence and quality of life, while appraised collaboration was associated with better adherence and metabolic control. There was evidence that the association between appraised collaboration and metabolic control was partially mediated by adherence. Appraised control was associated with poorer adherence among older, but not younger, children and with poorer quality of life among older females but not among older males or younger children of either sex. **Conclusions** Maintaining maternal involvement in diabetes care is important across ages 10 to 15, but the optimal form of this involvement may need to be adjusted to be consistent with the child's level of development. The present findings suggest that better adherence is seen across age when mothers are viewed as collaborating with, as opposed to controlling, their child when dealing with diabetes problems.

Diabetes is a source of stress for patients of all ages, but particularly so during adolescence, as the affected child faces normal developmental challenges while having to manage a serious illness. For children with diabetes, the transition into adolescence is frequently marked by declines in adherence, in metabolic control, and in psychosocial well-being (Anderson, Ho, Brackett, & Laffel, 1999; Jacobson et al., 1990; Kovacs, Obrosky, Goldston, & Drash, 1997; Northam, Anderson, Adler, Werther, & Warne, 1996; Wysocki, 1993; Wysocki et al., 1996). Understanding factors that contribute to such declines is important because patterns of nonadherence that emerge during adolescence are often maintained over time (Bryden et al., 2001; Kovacs, Goldston, Obrosky, & Iyenger, 1992), and consistently poor metabolic control has serious consequences for the child's long-term health (Diabetes Control and Complications Trial [DCCT], 1994).

A key factor in understanding poor diabetes management during this developmental transition is that adolescents begin to assume primary responsibility for managing their diabetes, and the important role parents had previously played in maintaining the medical regimen is altered (Anderson, Auslander, Jung, Miller, &

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Santiago, 1990; Anderson, Ho, Brackett, Finkelstein, & Laffel, 1997; Palmer et al., 2004; Wysocki et al., 1996). Decreased parental responsibility for diabetes care that occurs during adolescence is associated with poorer adherence and poorer metabolic control (Anderson et al., 1990, 1997, 2002; Wysocki et al., 1996), and interventions that maintain parental involvement minimize these declines (Anderson et al., 1999; Laffel, Vangsness, et al., 2003). However, the optimal form of parental involvement in diabetes care remains unclear and may need to be adjusted to the developmental level of the child, thus nurturing his or her autonomy and independence (Grotevant & Cooper, 1998; Steinberg & Silverberg, 1986). The present study examined how children's appraisals of the form of parental involvement in diabetes management were associated with the primary treatment goals for adolescents with diabetes—enhancing adherence to promote metabolic control while maximizing quality of life.

The manner in which parental involvement is appraised by the developing child is likely to determine whether parents' efforts have positive or negative consequences. The same parental behavior can be appraised quite differently across children. For example, when a parent helps the child determine the appropriate insulin dose, the child could appraise the parent as being supportive of his or her diabetes-management efforts, as a collaborative partner in managing diabetes, or as intrusively controlling his or her behavior. Similarly, when a parent allows the child to determine the insulin dose, the child could appraise the parent as being uninvolved in diabetes management or as expressing confidence in his or her diabetes-management skills. The factors contributing to these varied appraisals are undoubtedly quite complex (e.g., parenting style, parent/child personality traits, family environment, developmental factors), but the appraisal itself is likely to influence adjustment (La Greca & Bearman, 2002). In the present study, we examined three forms of appraisals of mothers—as uninvolved, controlling, or collaborative—that we believed would be particularly important for diabetes management and quality of life across early to middle adolescence.[1]

As children begin to assume independent responsibility for diabetes management during adolescence, it is critical that they continue to appraise parents as involved in their efforts to cope with the inevitable problems surrounding the management tasks. A broad literature reveals that children who appraise parents as uninvolved in their daily lives display poorer outcomes across a variety of domains (e.g., poor school achievement, delinquency, substance abuse, psychosocial maladjustment) compared with those who do not (Grolnick, Kurowski, Dunlap, & Hevey, 2000; Steinberg, Lamborn, Darling, Mounts, & Dornbusch, 1994), and these adverse effects continue across adolescence (Steinberg et al., 1994). Such negative outcomes may occur because appraising parents as uninvolved undermines children's efficacy and motivational resources (Deci & Ryan, 1987; Leung & Kwan, 1998; Steinberg et al., 1994) that can also impair diabetes management (Ott, Greening, Palardy, Holdreby, & DeBell, 2000; Williams, Freedman, & Deci, 1998). In the present study, we hypothesized that appraised uninvolvement would be associated with poorer quality of life, poorer adherence, and poorer metabolic control for children of all ages.

However, appraising parents as controlling (i.e., overly or intrusively involved in aspects of diabetes management) is likely to become detrimental as children move through adolescence (Anderson & Coyne, 1991; Holmbeck et al., 2002) because such appraisals conflict with the adolescent's developing autonomy. When an adolescent experiences parental behavior as inconsistent with autonomy, he or she may infer a message of incompetence (Pomerantz & Eaton, 2000). This could undermine adherence in a variety of ways, such as reducing self-efficacy and autonomous motivation for managing diabetes (Ott et al., 2000; Williams et al., 1998) or increasing parent–child conflict (Anderson et al., 2002). In the present study, we expected appraised parental control to interact with child age to predict quality of life, adherence, and metabolic control.

In contrast to the detrimental aspects of appraised parental uninvolvement and control, appraising parents as collaborators in resolving diabetes-related problems is more likely to be successful across adolescence. Collaboration involves negotiation and joint decision making and problem solving (Berg, Meegan, & Deviney, 1998; Berg et al., 2004; Rogoff, 1993) and presumably allows parents to remain involved in their child's diabetes-management activities while nurturing his or her autonomy and independent diabetes-management skills. When they appraise parents as collaborators, adolescents may be more likely to disclose and solicit help with diabetes-management problems. Such collaborations could enhance the level of adherence and quality of diabetes management during adolescence by optimizing the child's self-management decisions, compensating for his or her lack of skill, and/or providing a scaffold to more expert levels of performance. Appraised collaboration could be a key ingredient in the success of a recent

[1]Appraised maternal support was also measured but was not analyzed due to the ipsative nature of the appraised maternal involvement categories (see Methods).

intervention that promotes parent–adolescent teamwork in managing diabetes (Anderson et al., 1999; Laffel, Vangsness, et al., 2003).

The present study examined whether children's appraisals of the form of maternal involvement in dealing with diabetes problems (i.e., mother appraised as uninvolved, controlling, or collaborative) were associated with quality of life, adherence, and metabolic control across ages 10 to 15 years. We also examined directly whether adherence mediated associations between appraised maternal involvement and metabolic control. Data reviewed above suggest that appraised maternal involvement is likely to be associated with metabolic control via a behavioral adherence pathway, but these appraisals could also have more direct associations with glucose metabolism. We hypothesized that (a) appraised maternal *uninvolvement* would be associated with poorer outcomes regardless of child age (i.e., poorer adherence, metabolic control, and quality of life); (b) appraised maternal *control* would be associated with poorer outcomes for older children; (c) appraised maternal *collaboration* would be associated with better outcomes regardless of age; and (d) the associations of appraised involvement with metabolic control would be mediated through adherence.[2]

Method

Participants

Participants included 127 children (66 males, 61 females) between 10 and 15 years of age and their mothers. This age range was chosen because it captures a key period of autonomy development (Steinberg & Silverberg, 1986), when children display declines in diabetes management (Anderson et al., 1997, 1999; Jacobson et al., 1990). Mothers were recruited because they are the primary caregiver for children with diabetes (Seiffge-Krenke, 2002). Children had been diagnosed with type 1 diabetes for at least 1 year. Mother–child dyads were recruited during routine visits to outpatient diabetes clinics at a local children's hospital (69%), by mailings to clinic patients (22%), and during registration at diabetes camps (8%). This sample represents 68% of eligible participants who expressed interest; reasons for nonparticipation included time, distance, and transportation problems. Individuals who did not complete the study gave permission to access medical records. The study sample did not differ from nonparticipants on illness duration, age, or metabolic control, ts < 1.69, ps > .09, suggesting that it was representative of the larger population from which it was drawn.

Medical-record review indicated that all participants were prescribed a combination of fast-acting and intermediate insulin, which most participants (92%) took on a schedule of multiple daily injections (MDIs) of three or more per day (M = 3.29, SD = 0.61); 73% of those on MDI were specifically advised to alter the dose or number of injections to accommodate exercise, diet, or blood glucose fluctuations. Five percent of participants were on continuous subcutaneous insulin infusion (i.e., insulin pump), and 3% were on a fixed regimen of one or two insulin injections per day. Mothers reported that participants took an average of 3.52 (SD = 1.03) insulin injections and 4.66 (SD = 1.17) blood glucose tests per day. Most mothers were white (97%) and married (86%) and had at least some college education (88%). Average Hollingshead index (4.17) indicated a medium business and minor professional class sample. See Table I for additional sample descriptions.

Procedure

All study procedures were approved by the institutional review board at the University of Utah. After providing informed consent/assent, mothers and children were scheduled for a 2-hour laboratory session and were given separate questionnaire packets to be completed individually just prior to the session. Participants returned the questionnaires during the session, and individual structured interviews were conducted with them by trained research assistants. Participants were then fully debriefed and paid $20 each. The measures described below are a subset of a larger protocol (see Berg et al., 2004, and Palmer et al., 2004, for additional details).

Measures

Demographic and Illness Information

Mothers provided information on demographics (age, pubertal status, sex, number of children, ethnicity, income, education, marital status, and religious affiliation) and illness (duration, treatment regimen, and age at diagnosis). An index of regimen intensity was developed

[2]The larger data set included measures of the child's puberty and psychological autonomy (Palmer et al., 2004). These alternative developmental markers were examined as moderators of the association between appraised involvement and outcomes. Appraised involvement variables did not interact with puberty in any analysis, and interactions between appraised involvement and autonomy became nonsignificant when age was simultaneously included in the analysis (age effects remain when both developmental markers were included). Thus, in the present sample, age appears to be the best marker of the factors that moderate the relationship between appraised maternal involvement and outcomes.

Table I. Means, Standard Deviations (SD), and Correlations Among Primary Study Variables

Primary Variables	2	3	4	5	6	7	8	9	10	11	12	Mean (SD)
1. Age (years)	.02	.50**	.10	−.65**	.14	−.19*	−.02	−.00	.03	−.06	.02	12.78 (1.72)
2. Illness Duration (years)		−.86**	−.14	.02	.18+	.04	−.21*	.08	−.20*	−.21*	.25*	4.47 (2.86)
3. Age at Diagnosis (years)			.17+	−.35**	−.08	−.13	.17+	−.07	.19*	.15	−.20+	8.31 (3.31)
4. Regimen Intensity				−.08	.02	.04	.18+	.10	.19*	−.04	.09	−0.03 (1.57)
5. Maternal Responsibility					−.16+	.17+	.10	.12	−.19*	.01	−.10	1.46 (2.64)
6. Appraised Uninvolvement (%)						−.15	−.60**	.00	−.18+	−.27**	.21*	41 (29)
7. Appraised Control (%)[a]							−.06	.00	−.06	−.12	.08	7 (14)
8. Appraised Collaboration (%)[a]								.01	.13	.23*	−.25*	20 (22)
9. Diabetes Negative Quality of Life									−.37**	−.26**	.22*	61.06 (16.95)
10. Diabetes Life Satisfaction										.43**	−.15	26.25 (4.66)
11. Adherence (Child Report)											−.35**	3.62 (0.62)
12. Post-HbA1c (%; n = 95)												8.91 (1.47)

[a]Means and standard deviations for appraised collaboration and control are based on raw scores, while correlations are based on log-transformed scores.
$^{**}p < .001$; $^{*}p < .05$; $+p < .10$.

by summing standardized scores for mother reports of the number of insulin injections and blood glucose tests conducted per day (injections and tests were correlated, $r = .25$, $p < .005$).[3]

Appraised Maternal Involvement in Coping With Diabetes Stress

Following Berg's structured interview for assessing dyadic coping (Berg et al., 1998, 2004), children were asked to detail the two most stressful diabetes-related events experienced in the past week. The primary problems children described included dealing with extreme blood glucose levels, settings away from home, and mismanagement episodes (Beveridge et al., 2003). To capture appraisals of maternal involvement in coping with such problems, children were asked to describe three things they thought, did, or felt to deal with each event and to assign each coping strategy to one of four categories that applied to their mother: uninvolved, collaborative (mother and child worked together as a team or negotiated), controlling (mother told the child what to do or was too involved), or supportive (mother helped out, gave advice, listened). Scores on each form of appraised maternal involvement were obtained by computing the percentage of strategies assigned to each category (i.e., scores on each strategy could range from 0 to 100%). Given the ipsative nature of the appraised maternal involvement scores (i.e., they sum to 1), appraised *support* was not analyzed, to eliminate dependencies. Appraised support is likely to be important for children with diabetes but was excluded because it has been studied extensively in the past and we did not have reason to hypothesize age-related effects.

Maternal Responsibility for Diabetes Tasks

In past research, maternal involvement has commonly been measured as mothers' level of responsibility for performing diabetes care tasks. Maternal responsibility was measured in the present study using the responsibility items from the Diabetes Responsibility and Conflict Scale (Rubin, Young-Hyman, & Peyrot, 1989) to determine whether appraised maternal involvement was associated with adjustment independent of this more traditional measure. Mothers and children reported who was responsible for completing various diabetes-management tasks (e.g., giving insulin) on a scale of 1 (child does it alone) to 3 (mother and child share equally) to 5 (mother does it alone).[4] This scale is sensitive to declines in maternal involvement during adolescence (Rubin et al., 1989) and displays good reliability (Cronbach's alpha = .89 for both mother and child in the present study). Mother and child reports were highly correlated, $r = .72$, $p < .001$, and analyses conducted on each report separately yielded identical results. Mother and child scores were thus averaged to index maternal responsibility.

[3]The validity of the regimen intensity index was explored by comparing mother reports of the regimen with physician prescriptions extracted from medical records. Mother reports of the number of insulin injections matched those prescribed by physicians in 95% of cases. Analyses that covaried the physician-prescribed regimen (i.e., number of injections, fixed vs. flexible schedule) did not alter the pattern of results. These analyses are not reported below due to missing data on the prescribed regimen.

[4]The maternal responsibility scale consisted of 24 items, while the child scale consisted of 25 items due to an error in material preparation.

Adherence

Mother and child individually completed the Self-Care Inventory (La Greca, Follansbee, & Skyler, 1990) to index adherence during the past month. This questionnaire lists 14 diabetes-management items to be answered on a scale of 1 (never did it) to 5 (always did as recommended without fail), if the item was relevant to the child's regimen. Average ratings across relevant items were computed for each participant. The scale has good internal consistency (Cronbach alphas >.72 for child and parent report in the present study) and correlates well with more time intensive interview methods for measuring adherence (Greco et al., 1990). Validity of this index was evident as mother and child reports of adherence converged, $r = .54$, $p < .001$, and were associated with subsequent level of glycosylated hemoglobin (HbA_{1c}), $r = -.26$ and $-.35$, respectively; ps $< .05$. We did not combine mother and child reports, however, because these were differentially associated with each other as a function of maternal responsibility; that is, mother and child reports converged as maternal responsibility increased, $t(123) = -1.75$, $p < .08$. Presumably, this reflected mothers having more knowledge about the child's adherence when they were more involved in the diabetes regimen. When both mother and child reports of adherence were included in regression analyses predicting HbA_{1c} level, child reports continued to predict HbA_{1c}, $t(92) = -2.79$, $p < .01$, while mother reports did not, $t(92) = -1.31$, $p > .19$. Such findings suggest that mother-reported adherence did not provide unique information beyond that present in child-reported adherence. Thus, child reports of adherence were utilized in the primary analyses (see Holmbeck, Li, Schurman, Friedman, & Coakley, 2002, for an excellent discussion of how to analyze multisource data).

Diabetes Quality of Life

Children completed the Diabetes Quality of Life for Youth scale (Ingersoll & Marrero, 1991) to index the psychosocial impact of diabetes. Three subscales assess: (a) diabetes life satisfaction (17 items), (b) negative disease impact (23 items), and (c) disease-related worries (11 items), with each item answered on a 5-point Likert scale. The three subscales were significantly correlated in the present sample, rs $> |.26|$ and ps $< .005$. A varimax-rotated factor analysis on the subscale scores revealed two factors (92% variance), with the *worries* and *impact* scores loading on factor 1 and the *satisfaction* score loading on factor 2. To reduce the number of analyses, the scales for worries and impact were combined using factor-weighted scores to generate a negative quality of life index that was analyzed separately from diabetes life satisfaction. Internal consistency for each scale was high (alphas > .85).

Glycosylated Hemoglobin

Metabolic control was indexed via HbA_{1c} levels obtained from medical records. HbA_{1c} represents the average blood glucose levels present over the preceding 3 to 4 months and is linearly related to the development of severe microvascular complications (DCCT, 1994). Medical management of diabetes aims to keep HbA_{1c} as close to the normal range as possible, with lower levels reflecting better metabolic control. On average, 2.61 (SD = .87) HbA_{1c} measures were recorded in medical records per year, or one measure approximately every 4.6 months. The first HbA_{1c} value recorded at least 4 months after the laboratory session was analyzed to ensure that we had an index of subsequent metabolic control that could not inadvertently have influenced participants' questionnaire responses. Such data were available on 95 participants.

Results

Due to skewed data, scores for appraised maternal control and collaboration were logarithmically transformed to approximate normal distributions. With these transformations, assumptions underlying regression analysis were met for all appraised involvement variables (i.e., the residuals were normally distributed and unrelated to the predicted values). Although there were two outliers on the transformed scores, analyses conducted with and without these univariate outliers yielded identical results. Analyses reported below are based on the full sample, with the exception of HbA_{1c} analyses, which are based on the 95 subjects who had data. Those with HbA_{1c} data had marginally higher appraised maternal control than those without, $M = 8.5\%$ vs. 4.3%, $t(123) = -1.91$, $p < .06$, but did not differ on any other variables, ps $> .10$.

Means and zero-order correlations among the primary study variables are displayed in Table I. Appraised maternal *uninvolvement* tended to be higher among children who had longer illness durations and lower maternal responsibility and was associated with poorer adherence and metabolic control. Appraised maternal *collaboration* tended to occur among children with shorter illness durations, who had been diagnosed at an older age, and who were on more intense regimens; collaboration was associated with better adherence and metabolic control. Appraised maternal *control* decreased with age and with lower maternal responsibility, but was unrelated to the primary outcome variables when child age was not considered.

Correlations presented in Table I also provide information as to whether demographic or illness variables predicted the primary outcome variables: (a) illness duration was associated with poorer adjustment on most outcome variables; (b) maternal responsibility and age at diagnosis were associated with lower diabetes life satisfaction; and (c) age at diagnosis was marginally associated with HbA_{1c}. These correlations could reflect the burden of managing diabetes for the mother or child, a construct that could simultaneously influence appraised involvement. To rule out this possibility, we covaried duration, regimen intensity, and maternal responsibility in all regression analyses reported below. Age at diagnosis was not included as a covariate due to multicollinearity (i.e., child age, illness duration, and age at diagnosis are linear combinations of each other and cannot be simultaneously included in a regression) (Johnson & Meltzer, 2002). Duration was chosen as the covariate rather than age at diagnosis because it was more strongly correlated with all outcome variables.

Age Differences in Associations Between Appraised Maternal Involvement and Outcome Variables

Hierarchical regression analyses were conducted to determine whether different forms of appraised maternal involvement predicted the primary outcome variables (adherence, HbA_{1c}, quality of life) after covarying relevant variables and whether these associations differed across child age. Initial analyses suggested that there may be sex differences in the associations between appraised involvement and adjustment. Sex and its interactions with age and appraised involvement were thus included in all regressions. Illness duration, regimen intensity, and maternal diabetes responsibility were entered on Step 1; sex, age, and appraised maternal involvement were centered on their mean (Aiken & West, 1991) and entered on Step 2; all two-way interactions (or cross-products) between sex, age, and appraised maternal involvement were entered on Step 3; and the three-way interaction between sex, age, and appraised involvement was entered on Step 4. Because the focus of the current study was on appraised maternal involvement, only main and interactive effects involving the appraised involvement variables are reported. All two-tailed tests that were significant at $p < .05$ are reported below; one-tailed effects that were significant at $p < .05$ are noted only if they were predicted a priori.

After covariates were included in the model, appraised maternal uninvolvement predicted poorer adherence, $\beta = -7.23$, $\Delta R^2 = .05$, $t(109) = -2.52$, $p < .05$, and lower diabetes life satisfaction, $\beta = -2.84$, $\Delta R^2 = .03$, $t(109) = -1.95$, $p = .054$. Appraised uninvolvement, however, did not exert main effects on other outcomes, ts < |1.37|, ps > .17, or interact with age or sex in any analysis, ts < |0.97|, ps > .34. Thus, appraised maternal uninvolvement was associated with poorer adherence and poorer diabetes life satisfaction regardless of child age or sex.

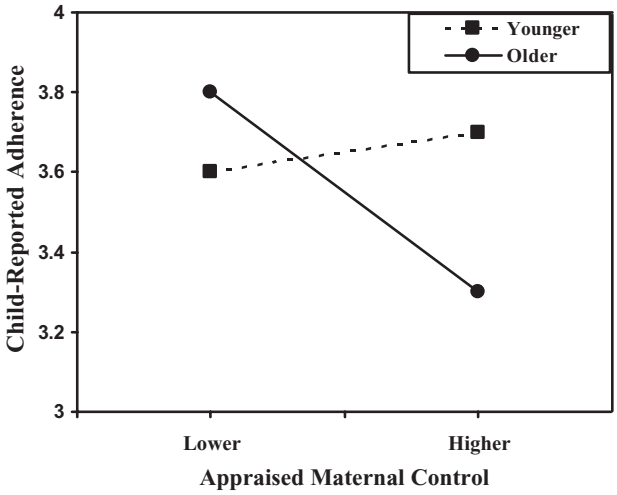

Figure 1. Predicted means for the Age × Appraised Maternal Control interaction predicting adherence.

Appraised maternal control exerted no main effects after covariates were included in the model, ts < |1.28|, ps > .20. As hypothesized, however, appraised maternal control interacted with age to predict adherence, $\beta = -1.76$, $\Delta R^2 = .03$, $t(106) = -2.02$, $p < .05$, diabetes life satisfaction, $\beta = -1.00$, $\Delta R^2 = .04$, $t(106) = -2.25$, $p < .05$, and negative quality of life, $\beta = 5.89$, $\Delta R^2 = .10$, $t(105) = 3.75$, $p < .001$. Appraised control did not interact with age to predict HbA_{1c}, $t(81) = 1.18$, $p > .24$. Predicted values for significant interactions were computed from the regression equations by substituting scores one standard deviation above and below the mean for age and appraised maternal control (Aiken & West, 1991). As displayed in Figure 1, the differential slopes of the plotted regression lines reveal that appraised maternal control was associated with poorer adherence among older, but not younger, children. The interactions between appraised control and age were further moderated by sex (i.e., Age × Appraised Control × Sex was significant) for both diabetes life satisfaction, $\beta = -1.74$, $\Delta R^2 = .03$, $t(105) = -1.99$, $p < .05$, and negative quality of life, $\beta = 6.64$, $\Delta R^2 = .03$, $t(104) = 2.15$, $p < .05$. As displayed in Figure 2, appraised maternal control was associated more strongly with high negative quality of life and low diabetes life satisfaction among older females than among older males or

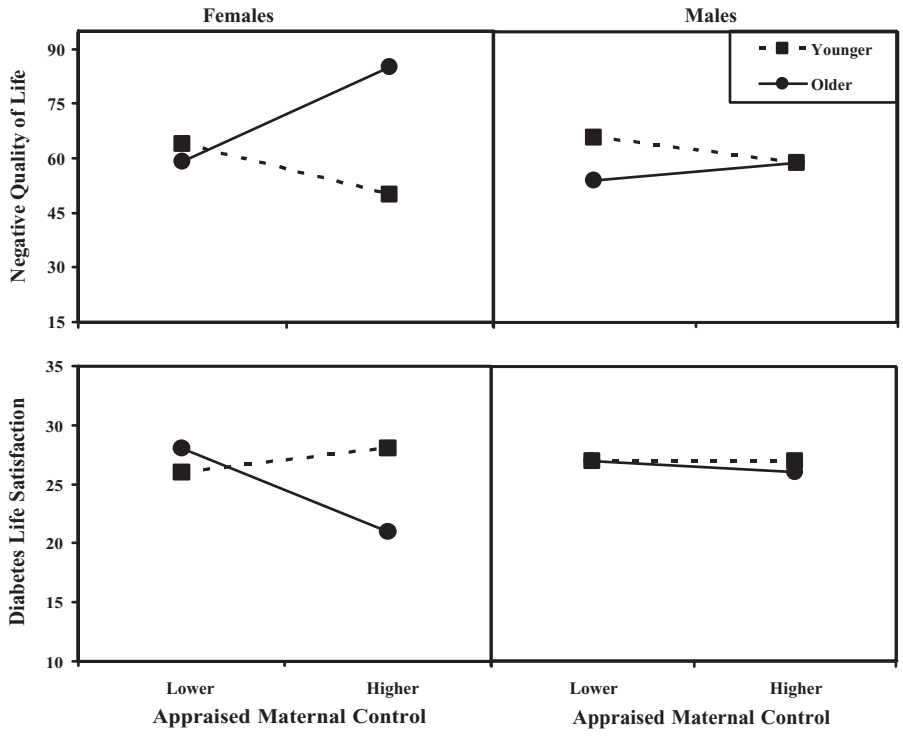

Figure 2. Predicted means for the Age × Sex × Appraised Maternal Control interactions predicting negative quality of life (top) and diabetes life satisfaction (bottom).

younger children of either sex. As predicted, then, appraised maternal control was associated with poorer adherence for older children of both sexes, but was associated with poorer quality of life primarily among older females.

After covariates were included in the model, regression analyses revealed that appraised maternal collaboration predicted better adherence, $\beta = 25.76$, $R^2 = .04$, $t(109) = 2.31$, $p < .05$, and HbA_{1c}, $\beta = -3.99$, $R^2 = .04$, $t(84) = -1.88$, $p < .05$ (one-tailed). Appraised collaboration was not related to either quality of life score, ts = .02 to .89, ps > .37, and did not interact with age or sex in any analysis, ts = –.75 to 1.66, ps > .10. Thus, regardless of age, children who appraised mothers as collaborators in coping with diabetes displayed better management without showing impaired quality of life.[5]

Adherence as a Mediator of the Association Between Appraised Collaboration and Glycosylated Hemoglobin

The final analyses examined whether the association that was found between appraised maternal collaboration and HbA_{1c} level was mediated through adherence. To support mediation, four conditions must be met: (1) The predictor (i.e., appraised maternal collaboration) must be associated with the mediator (adherence); (2) the predictor must be associated with the outcome (HbA_{1c}); (3) the mediator must be associated with the outcome; and (4) the strength of the association between the predictor and the outcome must be eliminated or reduced after statistically controlling the mediator (Holmbeck, 1997; Judd & Kenny, 1981). These conditions were evaluated by conducting the above regressions on the subset of subjects who had HbA_{1c} data. Conditions 1 and 2 were supported as appraised collaboration predicted adherence, $t(84) = 2.23$, $p < .05$, and HbA_{1c}, $t(84) = -1.88$, $p < .05$ (one-tailed). Condition 3 was supported by a main effect of adherence on HbA_{1c}, $t(84) = -3.11$, $p < .005$. Condition 4 was examined via additional regressions and the Sobel significance test (Sobel, 1988),

[5]Unlike analyses of child-reported adherence, appraised involvement was not associated with mother-reported adherence in any analysis. Additional analyses were conducted to determine whether shared variance across child and mother reports, as opposed to unique variance associated with either child or mother reports, best accounted for the data (Holmbeck et al., 2002). First, we covaried mother-reported adherence in all regressions that had child-reported adherence as the criterion variable. All significant predictions of child-reported adherence remained when mother-reported adherence was statistically controlled. Second, to ensure that child-reported adherence did not have different associations with HbA1c as a function of mother-reported adherence, we determined that mother and child reports of adherence did not interact to predict HbA1c, $t(91) = 0.23$, $p > .82$. Overall, these data suggest that mother-reported adherence did not provide unique information beyond shared variance with child, and that the unique information provided by child-reported adherence best accounts for the current findings.

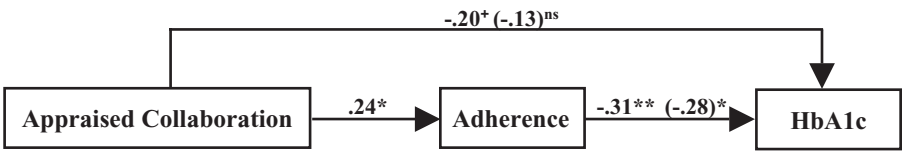

Figure 3. Values on paths are standardized regression coefficients. Coefficients outside the parentheses are zero-order coefficients, while those inside parentheses are partial regression coefficients from equations that include the other variable in the model. $^{**}p < 0.1$; $^{*}p < .05$; $p = .06$; $_{ns}$nonsignificant $p > .10$

which tests for a drop in the total effect of the predictor on the outcome after controlling the mediator. As displayed in Figure 3, there was partial evidence of mediation. When adherence was controlled, the strength of the association between appraised collaboration and HbA_{1c} was marginally reduced, Sobel $z = -1.72$, $p < .09$; in fact, the association became nonsignificant.

Discussion

Results suggest that optimal diabetes care across adolescence is more likely when children appraise mothers as collaboratively involved in dealing with problems surrounding diabetes management. Consistent with research examining parental responsibility for performing diabetes care tasks (Anderson et al., 1990, 1997; Wysocki et al., 1996), appraising mothers as uninvolved in coping with diabetes stress was associated with reduced satisfaction with and adherence to the diabetes regimen regardless of child age. This does not imply, however, that simply maintaining maternal involvement during adolescence will promote better adjustment. Children's appraisals of maternal involvement revealed that collaboration was associated with better outcomes across age, while intrusive or controlling involvement was associated with adverse outcomes for older children. Importantly, appraised involvement was associated with outcomes independent of measures regarding parent–child division of responsibility for diabetes care, suggesting that appraised involvement is different from this more traditional measure of parental involvement. Thus, interventions that promote maternal involvement must be sensitive to how this involvement is likely to be experienced by the developing child.

Although appraised maternal control was not common and decreased with age, its occurrence was associated with poorer adherence for older children. These age differences may occur for several reasons. When parents are appraised as being intrusively involved, older children are more likely to infer a message of incompetence (Pomerantz & Eaton, 2000). This may undermine adherence by reducing self-efficacy and autonomous motivation for managing diabetes (Ott et al., 2000; Williams et al., 1998), minimizing children's opportunities to learn from their mistakes (Wysocki et al., 1996), increasing parent–child conflict (Anderson et al., 2002), or pushing children toward an extreme reliance on peers (Fuligni & Eccles, 1993). Examining these underlying mechanisms was beyond the scope of the present study but is now occurring in a follow-up study.

The finding that appraised maternal control was associated with reduced quality of life primarily among older girls is important, particularly in light of girls' vulnerability to declines in psychosocial well-being during adolescence (e.g., Nolen-Hoeksema & Girgus, 1994). This finding may relate to sex differences in self-evaluations during adolescence. Pomerantz and Ruble (1998) have argued that compared with boys, adolescent girls are more demanding of themselves, take greater responsibility for failure, and feel that their self-worth is more contingent on pleasing others. Older girls' appraisals of mothers as controlling could thus be more damaging to self-esteem and quality of life than similar appraisals among boys. Future research to replicate and understand these sex differences will be important, as there is reason to believe that impaired psychosocial adjustment (e.g., symptoms of depression) mediates poor adherence and/or metabolic control among adolescent girls (Korbel, 2003; La Greca et al., 1995).

The adverse aspects of appraised maternal uninvolvement and control, evidenced for adherence and diabetes satisfaction, did not extend to metabolic control. This may be because HbA_{1c} can be affected by many variables (such as acute infections and hormonal changes of puberty), only a subset of which are likely to be altered by appraised maternal involvement. The data may also reflect more complex issues regarding the causes and consequences of these forms of appraised involvement. A mother may be uninvolved because her child has the maturity to make adaptive diabetes care decisions or for reasons unrelated to her child's abilities, such as hassles and stress (Palmer et al., 2004). These differing causes of maternal uninvolvement have different metabolic consequences; studies indexing developmental readiness—for instance, in terms of autonomy levels and

cognitive maturity—find that "premature" uninvolvement is more strongly associated with poor metabolic control (Palmer et al., 2004; Wysocki et al., 1996). Similarly, mothers may be appraised as controlling because they are making every effort to ensure that their child's diabetes is well managed. This could undermine the child's motivation to adhere, but simultaneously it could promote better metabolic control so long as the mother's diligence is sustained. Additional longitudinal research will be necessary to understand the associations of appraised maternal uninvolvement and control with metabolic processes.

Appraising mothers as collaborators in coping with diabetes stress was associated with better adherence and metabolic control for boys and girls of all ages, with evidence that the association between collaboration and metabolic control may be mediated by adherence. Furthermore, collaboration was unrelated to diabetes quality of life and to child age. Appraised collaboration appears to capture how mothers can remain involved across adolescence to promote adherence without impairing quality of life. This is noteworthy because some forms of maternal involvement in diabetes care are hypothesized to increase parent–child conflict (Anderson & Coyne, 1991), which is an important component of poor quality of life (Laffel, Connell, et al., 2003). These results are consistent with findings that interventions promoting mother–child teamwork maintain maternal involvement and sustain diabetes management without increasing dyadic conflict (Anderson et al., 2002; Laffel, Vangsness, et al., 2003). Teamwork intervention research has not examined children's appraisals of parental behavior, but our data suggest that such appraisals may be an important aspect of the intervention's success.

Appraised collaborative involvement may be beneficial to adherence in numerous ways. It is notable that appraised collaboration was unrelated to mothers' level of responsibility for performing diabetes care tasks. Thus, children can be independently responsible for performing diabetes-management tasks while simultaneously viewing their mothers as active collaborators in managing problems surrounding those tasks. Mothers who are viewed as collaborators in solving diabetes problems may be more aware of the quality of their child's diabetes-management efforts, putting them in a position to detect and address problems early and to titrate their involvement in a developmentally sensitive manner. Appraised collaboration may also promote the child's sense of efficacy and help to regulate negative emotions (Berg et al., 2004), which are important for diabetes management.

There were several limitations to this study that will be important to address in future research. First, the cross-sectional, correlational design prevents us from disentangling what are undoubtedly bidirectional associations between appraised maternal involvement and adjustment. For example, appraised maternal control may not only contribute to subsequent problems in diabetes management, but also occur in reaction to children's difficulties in managing diabetes (cf. Holmbeck et al., 2002; Pomerantz & Eaton, 2000). Such transactional processes can be evaluated only with longitudinal research. Second, the appraised maternal involvement measure contained elements not only of children's appraisals, but also of mother's actual behaviors. This is an important issue to clarify, as clinical implications could differ if the primary influence involved mothers' behaviors (e.g., parent training), children's appraisals (e.g., cognitive restructuring), or features of both (e.g., parent–child teamwork). Third, we did not examine aspects of fathers' involvement. Although mothers remain the primary caregivers of children with diabetes, fathers play a unique role in child development (Holmbeck et al., 2002; Seiffge-Krenke, 2002), so the present results may not extend to father–child diabetes-management processes. More generally, the exclusive focus on the mother–child dyad ignores the influence that other individuals or systems may have on the dyadic process of adolescent diabetes management. It may be useful, for example, to examine collaborative appraisals of health care providers, peers, and/or siblings, although one should note that the methodological challenges of examining these more complex systems are compounded as additional elements in the system are explored. Finally, our findings are based on a homogeneous sample of children with diabetes who were on fairly intense regimens. Although regimen intensity was controlled in our analyses, findings may not generalize to populations that have different treatment experiences, differing norms for adolescent development and parent–child relationships, or other pediatric conditions.

Despite such limitations, the present findings enhance our understanding of diabetes management during the transition into adolescence by pointing to the importance of how maternal involvement is appraised by the developing child. Our data suggest that optimal diabetes care across ages 10 to 15 includes an involved mother, but in such a way that children identify her as a collaborator rather than a director (or controller) when problems arise during diabetes management. If supported by future research, such collaborative involvement may be an important avenue for intervention as mothers and

adolescents negotiate different forms of involvement during the transition to adolescence. Identifying optimal forms of mother–child interaction across adolescence is crucial to assist adolescents in diabetes management, given that patterns of adherence laid down during adolescence are often maintained into adulthood.

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