

# Maternal Trait Anxiety and Diabetes Control in Adolescents with Type 1 Diabetes

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**Objective** To examine the relationship of maternal trait anxiety with diabetes regulation among adolescents with type 1 diabetes. **Methods** Adolescents and their mothers completed surveys assessing trait anxiety, maternal involvement in diabetes care, adolescent management skills, autonomous motivations, mood state, and absenteeism due to diabetes. HbA<sub>1c</sub> readings, used to assess metabolic control, were obtained from medical records. **Results** Trait-anxious mothers reported taking more responsibility for diabetes management tasks and perceived their adolescents as having poorer management skills. Adolescents with high-anxious mothers reported stronger beliefs that their mothers had high control over their diabetes and their parents were over-protective. For younger adolescents, maternal trait anxiety was associated with higher HbA<sub>1c</sub> levels and greater absenteeism. For older adolescents, maternal trait anxiety was associated with lower autonomous motivations for diabetes care and lower positive affect. **Conclusions** Interventions for adolescents with diabetes may benefit from addressing these maternal anxiety dynamics in ways that improve diabetes control.

**Key words** adolescence; anxiety; diabetes; metabolic control; self-regulation.

The management of type 1 diabetes poses significant challenges for adolescents as it requires continual monitoring of blood glucose levels and strict adherence to insulin, diet, and exercise regimens. Parents, and particularly mothers, are actively involved in the management of their children's diabetes, taking considerable responsibility for diabetes care during the pre-adolescent years and then guiding the shift in responsibility to their children during adolescence (Anderson, Auslander, Jung, Miller, & Santiago, 1990; La Greca, Follansbee, & Skyler, 1990). Illness regulation styles of mothers may therefore play a key role in the management of their children's diabetes as well as in their children's development of skills for diabetes control. Personality dynamics critically shape illness regulation styles (Contrada & Coups, 2003) as well as parenting behaviors (Dix, 1991), and may therefore represent an important influence in the management of children's chronic conditions. In this study, we examined the role of maternal trait anxiety in the regulation of diabetes in adolescents.

Considerable research has established the role of trait anxiety in illness regulation processes (Cameron, 2003; Wiebe, Alderfer, Palmer, Lindsay, & Jarrett, 1994). Trait anxiety is associated with heightened vigilance in monitoring health threats (Cameron, 2003; Eysenck, 1997) as well as greater sensitivity in detecting symptoms and tendencies to attribute symptoms to illness or other threats (Cameron, Leventhal, & Love, 1998; Wiebe et al., 1994). Although research to date has focused on how trait anxiety influences the regulation of one's own illness experiences, its influences on regulation behavior involved in caring for a child with an illness condition remain unexplored. Transactional models of parenting (Dix, 1991; Dix, Gershoff, Meunier, & Miller, 2004; Pomerantz & Eaton, 2001) identify parental anxiety and other emotions as fundamental processes guiding parent-child interactions, particularly those aimed at achieving desired outcomes. Within the context of caring for an adolescent with diabetes, a parent's propensity to experience anxiety could instigate a cycle of "miscarried helping" (Anderson

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& Coyne, 1993), where well-intentioned efforts to maintain the child's health fail because they conflict with the child's developing needs for autonomy and independence. Maternal trait anxiety may motivate vigilance in monitoring the child's insulin, diet, and exercise behaviors as well as high or even excessive parental responsibility for diabetes management. It may also promote tendencies to notice the child's symptoms and attribute them to diabetic events, thereby encouraging sick role behavior such as staying home from school and social events as well as unnecessary use of medical care. Anxious mothers may also tend to develop negative appraisals of their children's competence in diabetes management (Dix, 1991).

These potential influences of trait anxiety on maternal involvement and protectiveness in diabetes care may not necessarily lead to better metabolic control. Maternal trait anxiety may foster not only high levels of behavioral involvement in diabetes management (participation in blood glucose monitoring, diet management, administration of injections, etc.), but also emotional over-involvement (over-protective behavior and exaggerated emotional responses). Although parents' behavioral involvement in diabetes care is associated with better metabolic control in children and adolescents (Anderson, et al., 1997; Gowers, Jones, Kiana, North, & Price, 1995; Wiebe et al., 2005), involvement that is experienced as excessive, controlling, or over-protective is associated with poorer adjustment among children with diabetes (Liakopoulou et al., 2001; Wiebe et al., 2005) and other pediatric conditions (Holmbeck et al., 2002; Power, Dahlquist, Thompson, & Warren, 2003). These effects may arise in part because high maternal involvement in diabetes care leads adolescents to infer that the mother controls diabetes management and, consequently, they fail to take the initiative to control their glucose levels. As adolescents must engage in diabetes care when they are away from their parents, this lack of initiative may impair metabolic regulation and increase diabetes complications such as ketoacidosis and infections. Maternal anxiety influences on metabolic control and diabetes complications may be particularly strong during early adolescence, when adolescents are adjusting to new levels of social independence.

Maternal trait anxiety, by motivating emotional over-involvement or over-protection, may impede the development of autonomous motivations for diabetes care as adolescents get older. Autonomous motivations represent desires to engage in behaviors in order to achieve personal goals rather than to address pressures from other individuals or environmental forces.

Autonomous motivations tend to be associated with greater adherence to health regimens and better health outcomes over the long term (Ryan, Plant, & O'Malley, 1995; Senecal, Nouwen, & White, 2000; Williams, Freedman, & Deci, 1998), and so the development of autonomous motivations may be critical for achieving long-term diabetes control. Anxious mothers, by maintaining high involvement and exhibiting overly protective reactions, may undermine their adolescents' development of autonomous motivations (Pomerantz & Eaton, 2000) and, in turn, their adherence to their diabetes regimen. Maternal trait anxiety may have the further consequence of contributing to negative mood in these adolescents, particularly as they get older and issues of autonomy and control increasingly represent a potential source of conflict.

In this study, we surveyed 13–18-year-old adolescents with diabetes and their mothers to assess associations of maternal trait anxiety with key aspects of diabetes regulation and well-being. Much research on parental involvement in diabetes care has focused on the 10–15-year age range as it tends to be the time when parental involvement changes most dramatically. Consequently, less is known about the role of parental dynamics in diabetes regulation during later adolescence, when the adolescent is expected to have increased responsibility for diabetes care. We therefore included 16–18-year-old adolescents in the sample in order to explore these dynamics. The younger age criterion was set at 13 years because of its significance as a time of transition to greater independence for New Zealand youth with diabetes: It is the time when they switch from primary to secondary school and their diabetes care shifts from a children's clinic to an adult clinic. Although parental involvement is still expected, it is anticipated that the adolescents will be transitioning to greater independence in diabetes care at this stage.

It was hypothesized that maternal trait anxiety would be associated with greater behavioral involvement of mothers in diabetes care and stronger beliefs of maternal control over diabetes management, as reported by both mothers and adolescents. In addition, maternal trait anxiety was hypothesized to be associated with maternal appraisals that adolescents had poorer management skills as well as adolescent appraisals of higher parental over-protectiveness. It was also hypothesized to be associated with lower autonomous motivations and adherence, poorer metabolic control, greater absenteeism due to diabetes, and more negative mood. The associations of maternal trait anxiety with these diabetes regulation variables were expected to be independent of other

psychological, demographic, and clinical characteristics such as adolescent trait anxiety, gender, and diabetes duration.

We also assessed whether associations of maternal trait anxiety with diabetes regulation differ across early-to-late adolescence. As younger adolescents and their mothers are in the process of adjusting to the adolescents' increased independence and their need to engage in more diabetes care away from home, it was predicted that associations of maternal trait anxiety with poorer metabolic control and greater diabetes-related absenteeism would be stronger for younger adolescents than for older adolescents. As maternal anxiety is expected to impede the development of autonomous motivations and, in turn, reduce adherence as adolescents take greater responsibility for their diabetes care, the associations of maternal anxiety with low autonomous motivations and poor adherence were expected to become stronger with older age. Finally, because challenges to independence in diabetes care may increasingly become a source of conflict as adolescents get older, it was predicted that correlations of maternal trait anxiety with negative mood would become stronger with age.

## Method

### Participants

The participants were adolescents attending the Auckland Diabetes Centre, which serves all adolescents and adults with diabetes in the Auckland region. Over a 9-month recruitment phase, all adolescents attending their regular, 3-monthly clinic visits who were between 13 and 18 years of age were invited to participate in the study. Of the 62 adolescents approached, 59 (95%) of them agreed to participate, 2 declined and 1 did not participate as the parents refused consent.

The mothers of 47 adolescents (80% of the adolescent sample) were also recruited for participation; the fathers of an additional two adolescents participated as the primary caregivers involved in diabetes management, but their data were excluded because of the study's focus on mother-child interactions. Of the 47 mothers, 36 (77%) were married, 7 (15%) were separated or divorced, and 4 (8%) were widowed or single; the average number of children was 2.58 ( $SD = 1.07$ ; range = 1–5). The mean age was 43.60 years ( $SD = 4.67$ ; range = 32–53). The majority were New Zealand European ( $n = 38$ ; 81%), with the rest identifying their ethnicity as Maori/Pacific Island ( $n = 4$ ), Indian ( $n = 2$ ), or other ( $n = 3$ ). Most women were employed ( $n = 41$ ; 87%) and had completed secondary school

( $n = 39$ ; 83%); 24 (51%) of the women had a tertiary qualification (e.g., a university degree). The median annual household income was NZ\$65,000 (range = NZ\$10,000 to >NZ\$125,000).

The analyses are based on data provided by the 47 mothers and their adolescents (26 females and 21 males). Most adolescents were New Zealand European ( $n = 39$ ; 83%); the rest identified with Maori/Pacific Island ( $n = 3$ ) or another ethnicity ( $n = 5$ ). The mean age was 15.90 years ( $SD = 1.12$ ; range = 13.17–17.92). They had been treated for diabetes for an average of 7.25 years ( $SD = 4.12$ , range = 1.00–14.58), and the average age at diagnosis was 8.65 years ( $SD = 4.04$ , range = 0.50–14.75). Comparisons of these 47 adolescents with the 12 adolescents whose mothers did not participate revealed no differences on any demographic, psychological, or clinical factors. All 47 mothers completed both questionnaires. All 47 adolescents included in the analyses completed the first questionnaire and 45 (96%) of them completed the second questionnaire.

### Procedure

This research project was approved by the Auckland Ethics Committee. Participants received an initial questionnaire during the adolescent's regular clinic visit, and they received a second questionnaire three months later, which coincided with the adolescent's next regular clinic visit and HbA1c assessment. Due to concerns about the acceptability of a lengthy questionnaire containing the entire battery of measures, each questionnaire contained a subset of the measures. Because of the theoretical focus on maternal trait anxiety as a stable factor that may predict diabetes regulation dynamics, trait anxiety was assessed in the first questionnaire and the diabetes regulation measures were distributed across the two questionnaires. The first questionnaire included measures of trait anxiety and maternal control over diabetes (both mother and adolescent versions); maternal distress, absenteeism, and demographic and family characteristics (mother version); and mood (adolescent version). The second questionnaires included measures of maternal involvement (adolescent and mother versions); autonomous motivation, adherence, and parental over-protectiveness (adolescent version); and maternal beliefs of child's management skills and absenteeism (mother version). Information about adolescent age, age at diagnosis, gender, and ethnicity were obtained from medical records.

Adolescents attending their clinic appointments were met by a researcher and given information about the study, and interested adolescents completed a consent form; adolescents under 16 years of age also received a parental consent form. Consenting participants received the first questionnaire (along with an addressed, postage-paid envelope) to complete at home, as well as a packet with the study information, questionnaire, consent form, and return envelope to give to their mothers. Participant information stressed the importance of confidentiality and of completing the measures in private and independently of the other party (mother or adolescent). Participants were called 2–3 days later and given any needed assistance with completion of the measures. All participants confirmed they completed their questionnaires privately. Participants who had not mailed back the questionnaire within 2 weeks of posting received reminder phone calls. The second questionnaires were sent to participants 3 months later. Participants were contacted 3–4 days after the mailing to ensure they had received the packets and to provide any needed assistance. Reminder calls were made to those who had not returned the questionnaires within 2 weeks. Participants received movie passes in appreciation of their participation.

### **Measures Completed by Mothers and Adolescents**

#### **Trait Anxiety**

The 20-item trait version of the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1974) was used to assess dispositional anxiety. This measure has well-established levels of reliability and validity (Watson & Clark, 1984). In this sample, Cronbach's  $\alpha = .86$  and  $.88$  for mothers and adolescents, respectively.

#### **Maternal Control Over Diabetes**

The personal control subscale of the Illness Perceptions Questionnaire-Revised (IPQ-R; Moss-Morris et al., 2002) was adapted to assess maternal control over diabetes as perceived by mothers and adolescents. For the measure completed by mothers, each of the six items (e.g., "What I do can determine whether my diabetes gets better or worse") was phrased to assess perceptions of control over their child's diabetes (e.g., "What I do can determine whether my child's diabetes gets better or worse"). For the measure completed by adolescents, the items were phrased to assess perceptions of their mothers' control over their diabetes (e.g., "What my mother does can determine whether my diabetes gets better or worse"). Items are rated from 1 (*strongly disagree*) to

5 (*strongly agree*), and the ratings are summed; for mothers,  $\alpha = .86$ ; for adolescents,  $\alpha = .76$ .

#### **Maternal Involvement in Diabetes**

The responsibility subscale of the Diabetes Responsibility and Conflict Scale (Rubin, Young-Hyman, & Peyrot, 1989) was used to assess perceived involvement in diabetes management (e.g., "Who gives injections?", "Who decides what to eat at meals and snacks?"). Items are rated on a scale ranging from 1 (*child does it alone*) to 3 (*mother and child share equally*) to 5 (*mother does it alone*), and the average rating is calculated. The measure has been found to have strong reliability and validity (Palmer et al., 2004; Rubin et al., 1989). One item, "Who remembers to make appointments with dentists or other doctors?" was omitted as it is not relevant within the New Zealand context (dental care is provided through schools and the diabetes clinic manages all medical care). The measure thus included 24 items (mothers:  $\alpha = .81$ ; adolescents:  $\alpha = .87$ ).

### **Measures Completed by Mothers Only**

#### **Demographic and Family Characteristics**

The first questionnaire for mothers included items assessing age, ethnicity, education, income, marital status, and number of children. To assess paternal involvement, mothers were asked, "How often is your child's (biological father/stepfather) involved in your child's diabetes care based on a typical week?" Responses ranged from 1 (*never*) to 6 (*multiple times a day*).

#### **Maternal Distress About Diabetes**

The emotional representation subscale of the Illness Perceptions Scale-Revised was completed by mothers to assess their distress about diabetes. The six items (e.g., "When I think about my child's diabetes I get upset") are rated from 1 (*strongly disagree*) to 5 (*strongly agree*)  $\alpha = .88$ . This measure has been demonstrated to have high reliability and construct validity (Moss-Morris et al., 2002).

#### **Maternal Beliefs of Child's Diabetes Management Skills**

Mothers' appraisals of their children's management skills were assessed with a 24-item scale developed by Wiebe, Berg, and Palmer (2005). Items were generated by asking 127 mothers to freely report the issues they consider when deciding whether their child is capable of assuming responsibility for independent diabetes management. This scale shows good reliability ( $\alpha = .87$ ) and correlates as expected with age and maternal involvement in prior



research (Wiebe, Berg, & Palmer, 2005). The items (e.g., “My child cannot yet adjust his/her own insulin”; “My child makes good choices about food”) are rated from 1 (*strongly disagree*) to 5 (*strongly agree*). Ratings are summed, after reverse-scoring as needed; higher scores reflect more positive beliefs ( $\alpha = .84$ ).

### Absenteeism

Mothers reported how many times in the past 3 months their child had: (a) missed school because of diabetes; and (b) missed social activities (e.g., sports, sleepovers) because of diabetes. Responses were coded as 0, 1, 2, 3, or 4 or more missed events.

### Measures Completed by Adolescents Only

#### Positive and Negative Mood

The state version of the Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988) was used to assess general mood. Participants rate the extent to which they experienced each of the 10 positive moods (e.g., enthusiastic, proud, and interested) and the 10 negative moods (e.g., angry, guilty, and upset) over the past 2 weeks, using a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*). Positive mood scores ( $\alpha = .80$ ) and negative mood scores ( $\alpha = .80$ ) are generated by summing the subscale item ratings. The PANAS demonstrates high reliability and validity in use with both adult and adolescent populations (Melvin & Molloy, 2000; Watson et al., 1988).

#### Parental Over-protectiveness

An adapted measure consisted of three items from the Diabetes Quality of Life (DQOL) measure for youth with diabetes (Diabetes Control and Complications Trial Research Group, 1988; Ingersoll & Marrero, 1991): “How often do you find that your parents are too protective of you?”, “How often do you feel that your parents worry too much about your diabetes?”, and “How often do you find that your parents act like diabetes is their disease, not yours?” Ratings ranged from *never* (1) to *always* (5) and were summed to generate scores ( $\alpha = .81$ ). Parental over-protectiveness is one facet of the DQOL impact subscale; the other facets involve the impact of diabetes on social activities and experiences of physical disability. Using the present data set, we confirmed that the 3-item parental over-protectiveness measure is distinctive from the other DQOL impact items by conducting a series of principal components analyses (with varimax rotation), each of which included the three parental over-protectiveness items and three of the other 20 subscale items (only three additional items

were used in an analysis in order to ensure sufficient power). In every analysis, the three parental over-protectiveness items loaded onto a common factor (loadings  $> .65$ ) while the other items loaded onto 1–2 separate factors.

#### Autonomous Motivation

The Treatment Self-Regulation Questionnaire (Williams et al., 1998) was used to assess autonomous motivations to engage in diabetes management. Items provided after the statements “I take my medications for diabetes and/or check my glucose because...” and “The reason I follow my diet and exercise regularly is that...” correspond to two subscales: autonomous regulation (8 items; e.g., “I personally believe that controlling my diabetes will improve my health”) and controlled regulation (11 items; e.g., “Other people would be mad at me if I didn’t”). Ratings range from 1 (*not at all true*) to 7 (*very true*). This measure was developed with adults (Williams et al., 1998), but appears relevant to adolescents. The scale requires a fifth grade reading level and was readily comprehended by the present sample. Further, similar items measuring autonomous motivation for other health behaviors (e.g., motivation to not smoke) are valid for adolescents in the current age range (Williams, Cox, Kouides, & Deci, 1999). To calculate scores, the average rating for the controlled regulation items ( $\alpha = .85$ ) is subtracted from the average rating for the autonomous regulation items ( $\alpha = .77$ ); higher scores thus reflect higher levels of relative autonomous motivations.

#### Adherence

Adherence was measured with the Self Care Inventory (Greco et al., 1990), a 14-item self-report measure that covers all aspects of the type 1 diabetes regimen (glucose monitoring, insulin administration, diet, and exercise). Participants rate the extent to which they followed their recommended regimen for diabetes care over the past month, where 1 = *never did it*; 2 = *sometimes followed recommendations, mostly not*; 3 = *followed recommendations about 50% of the time*; 4 = *usually did this as recommended, occasional lapses*; and 5 = *always did this as recommended without fail*. A *not applicable* response was also available. Ratings are averaged, with higher scores reflecting greater adherence ( $\alpha = .83$ ).

#### Assessment of Metabolic Control

HbA<sub>1c</sub> (glycosylated hemoglobin) was used to assess metabolic control. HbA<sub>1c</sub> is an indication of average blood glucose levels over the past 12–16 weeks and is

determined through analysis of hemoglobin in red blood cells (Drexler, 1987). Higher HbA<sub>1c</sub> levels represent higher blood glucose and thus poorer metabolic control. Adolescents have their HbA<sub>1c</sub> taken during each clinic visit, and readings for the visits 3 months prior to and 3 months following questionnaire completion were obtained from the medical records.

### Statistical Analyses

Tests of the normality of variable distributions revealed skewness only in absenteeism values (2.12, *SE* = .34). Logarithmic transformations of absenteeism values were therefore used in analyses. Pearson correlations were calculated to test hypotheses regarding zero-order associations of maternal trait anxiety with the diabetes regulation variables. To assess whether observed associations between maternal trait anxiety and diabetes regulation variables were independent of other personal and psychosocial factors, correlation and regression analyses assessed associations between maternal trait anxiety, adolescent trait anxiety, clinical factors, demographic characteristics, maternal diabetes distress, and diabetes regulation variables.

Multiple regression analyses were used to assess the moderating effects of adolescent age on the relationships between maternal trait anxiety and the diabetes regulation and mood variables: HbA<sub>1c</sub> levels, absenteeism, autonomous motivation, adherence, positive mood, and negative mood. These analyses included maternal trait anxiety (centered about the mean), age (centered about the mean), and a Maternal trait anxiety  $\times$  age interaction term. Preliminary regressions revealed that duration of diabetes, age at diagnosis, and the demographic or psychosocial characteristics of mothers and adolescents did not predict any of the dependent variables, with two exceptions: Number of children in the family was associated with lower autonomous motivations, and adolescent trait anxiety predicted lower positive mood and higher negative mood. These variables were therefore included as covariates in the analyses of the respective dependent measures. Regression analyses of the other dependent measures confirmed that number of children and adolescent trait anxiety were not significant predictors and their inclusion did not alter the significance of the Maternal trait anxiety  $\times$  age effects, and so they were not included in the final analyses of these measures. Assessments of the assumptions underlying regression analysis revealed normally distributed residuals, no problems of multicollinearity, and no

relationships between residuals and predicted values in any analyses.

## Results

### Correlations of Maternal Trait Anxiety and Adolescent Age with Diabetes Regulation Factors

Table I presents the correlations of maternal trait anxiety and adolescent age with the following sets of diabetes regulation variables: (a) mothers' reports of their beliefs about diabetes management; (b) adolescents' reports of their beliefs about diabetes management, adherence, and mood; and (c) metabolic control and absenteeism over the 3 months following the first questionnaire. With regard to mothers' beliefs about diabetes management, mothers with higher (vs. lower) trait anxiety tended to believe that they were more involved in their adolescents' diabetes management activities and that their adolescents had relatively poorer diabetes management skills. Mothers of older adolescents tended to report less involvement with diabetes management. With regard to adolescents' beliefs about diabetes management, maternal trait anxiety was positively correlated with

**Table I.** Correlations of Diabetes Regulation Factors with Maternal Trait Anxiety and Adolescent Age

Diabetes regulation variable	Score range	Mean (SD)	Maternal trait anxiety ( <i>r</i> )	Adolescent age ( <i>r</i> )
Mothers' reports				
Maternal diabetes involvement	1–5	2.10 (0.45)	.31*	-.42**
Maternal control of diabetes	6–30	20.07 (4.82)	-.03	-.04
Adolescent's management skills	24–120	94.59 (12.37)	-.32*	.21
Adolescents' reports				
Maternal diabetes involvement	1–5	1.91 (0.54)	.09	-.37**
Maternal control of diabetes	6–30	15.47 (4.28)	.40**	-.18
Parental over-protectiveness	3–15	9.41 (3.39)	.35**	.05
Autonomous motivation	-6 – +6	0.67 (0.82)	-.19	.22
Adherence	1–5	3.74 (0.68)	.07	-.14
Positive mood	10–50	33.44 (7.50)	-.25	-.06
Negative mood	10–50	20.53 (6.94)	.14	.20
Diabetes control				
HbA <sub>1c</sub>	4.70–14	8.30 (1.26)	.14	.14
Absenteeism	0–4	0.74 (1.37)	.42**	-.36*

\**p* < .05, \*\**p* < .01.

adolescents' beliefs of both maternal control of diabetes and parental over-protectiveness. Adolescent age was associated only with adolescents' reports of maternal involvement, with older adolescents tending to report less maternal involvement with diabetes care. In terms of diabetes control, maternal trait anxiety was associated with higher absenteeism rates over the subsequent 3 months and adolescent age was associated with lower absenteeism rates.

### **Independence of the Associations of Maternal Trait Anxiety with Diabetes Regulation Factors**

Additional analyses assessed whether the observed associations of maternal anxiety with the diabetes regulation variables were independent of other clinical and psychosocial factors. First, correlational analyses evaluated associations of maternal trait anxiety and the diabetes regulation variables with adolescent trait anxiety, gender, age, ethnicity (New Zealand European vs. other), diabetes duration, age at diagnosis, maternal age, number of children, and paternal involvement in diabetes care. Maternal trait anxiety was correlated only with adolescent trait anxiety ( $r = .30, p < .05$ ) and gender (boys tended to have more anxious mothers;  $r = .30, p < .05$ ), and neither of these two factors was correlated with any of the diabetes regulation variables. As further confirmation that the associations of maternal trait anxiety with the diabetes regulation variables are independent of adolescent trait anxiety and gender, multiple regression analyses assessed the independent associations of maternal trait anxiety, adolescent trait anxiety, and gender with: (a) maternal beliefs of their diabetes involvement; (b) maternal beliefs of adolescent diabetes management skills; (c) adolescent beliefs of maternal control over diabetes; and (d) parental over-protectiveness. These analyses revealed that maternal trait anxiety was significantly associated with these variables ( $t$ 's  $> 1.98, p$ 's  $< .05$ ) after controlling for adolescent trait anxiety and gender. Further regression analyses of the diabetes regulation variables included a Maternal trait anxiety  $\times$  gender interaction term to assess whether the maternal trait anxiety associations with diabetes regulation factors were different for boys and girls. Only the analysis of mothers' reports of their adolescents' management skills revealed a significant interaction ( $\beta = .42, t = 2.09, p < .05$ ), with low-anxious mothers of boys reporting higher management skills in relation to high-anxious mothers of boys and either low- or high-anxious mothers of girls. Otherwise, the associations of maternal trait anxiety with diabetes regulation variables were comparable for boys and girls.

### **Adolescent Age Differences in the Relationships of Maternal Trait Anxiety with Diabetes Regulation Factors**

The regression analysis of HbA<sub>1c</sub> revealed a significant Maternal trait anxiety  $\times$  age interaction effect indicating that, as predicted, age moderated the relationship of maternal trait anxiety with metabolic control (see Table II and Fig. 1)<sup>1</sup>. For younger adolescents, higher maternal trait anxiety was associated with higher HbA<sub>1c</sub> levels (poorer metabolic control). Older adolescents exhibited high HbA<sub>1c</sub> levels, as is typically observed in older adolescent samples, and these levels were high regardless of maternal trait anxiety. A significant Maternal trait anxiety  $\times$  age effect also emerged in the analysis of absenteeism due to diabetes (Table II). Corresponding with their relatively poorer metabolic control, younger adolescents with high-anxious mothers also had higher absenteeism rates compared with younger adolescents with low-anxious mothers and older adolescents (Fig. 1).

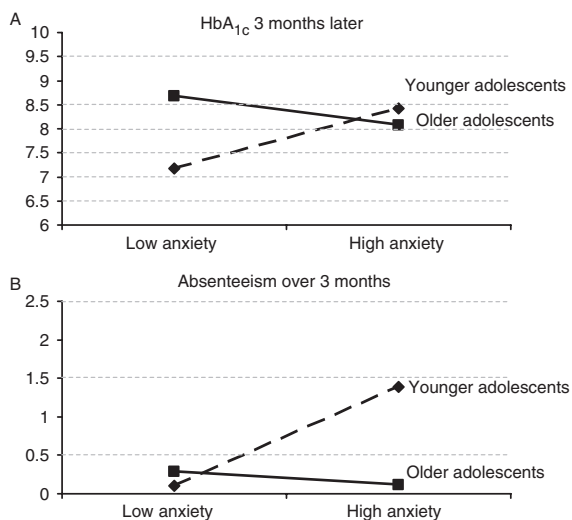
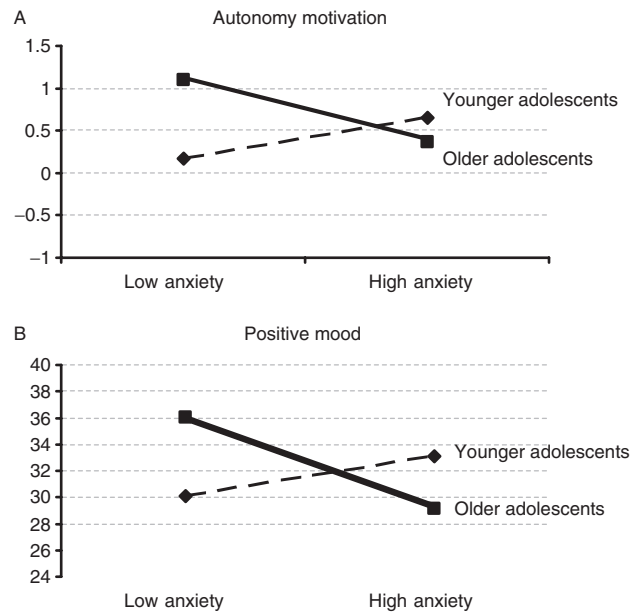
The regression analysis of autonomous motivations revealed a significant Maternal trait anxiety  $\times$  age interaction effect (Table II). As predicted, lower maternal trait anxiety was associated with higher autonomous motivation for older adolescents, but it was unrelated to autonomous motivations for younger adolescents (Fig. 2). The regression analysis of negative mood, which included adolescent trait anxiety as a covariate ( $\beta = .77, t = 6.67, p < .001$ ), revealed nonsignificant main and interaction effects of age and maternal trait anxiety ( $t$ 's  $< 1$ ). The regression analysis of adherence revealed the Maternal trait anxiety  $\times$  age interaction effect was not significant. For positive mood, the Maternal trait anxiety  $\times$  age interaction effect was significant (Table II). As predicted, higher maternal trait anxiety was associated with less positive mood for older adolescents, but not for younger adolescents (Fig. 2).

It is possible that the associations of maternal trait anxiety with poor metabolic control and absenteeism in younger adolescents were due to prior experience of poor

<sup>1</sup>As a supplementary analysis, we examined whether age moderates the relationship of maternal trait anxiety with HbA<sub>1c</sub> assessed at the time when the first questionnaire (containing the maternal trait anxiety measure) was completed. This analysis revealed a comparable set of findings, Model  $F = 3.79, p < .02, R^2 = .18$ , with a main effect of age ( $t = 2.19, p < .05$ ), a nonsignificant effect of maternal trait anxiety ( $t = 1.00, NS$ ), and a significant maternal trait anxiety  $\times$  age interaction ( $t = -2.66, p < .01$ ). Although these findings are limited by their retrospective nature, given that HbA<sub>1c</sub> reflects metabolic control over the prior 12–16 weeks, they nevertheless provide evidence for the stability of the relationships over time.

**Table II.** Regression Analyses Assessing Moderating Effects of Maternal Trait Anxiety on the Relationships between Adolescent Age and Diabetes Regulation Factors

Measure	<i>B</i>	<i>SE B</i>	<i>B</i>	<i>t</i>	Model <i>F</i>	Model <i>R</i> <sup>2</sup>
HbA <sub>1c</sub> 3 months later					3.11*	.19
Maternal trait anxiety	.02	.02	.13	0.92		
Age	.27	.16	.24	1.66		
Maternal trait anxiety × age	-.05	.02	-.38	-2.62**		
Absenteeism					9.72**	.42
Maternal trait anxiety	.01	.004	.32	2.53**		
Age	-.05	.030	-.22	-1.76		
Maternal trait anxiety × age	-.012	.004	-.40	-3.24**		
Autonomous motivation					4.69**	.32
Number of children in family	-.30	.10	-.40	-2.92**		
Maternal trait anxiety	-.01	.01	-.11	-0.78		
Age	.19	.10	.24	1.83		
Maternal trait anxiety × age	-.04	.01	-.40	-2.94**		
Positive mood					5.00**	.35
Adolescent trait anxiety	-.37	.11	-.46	-3.30**		
Maternal trait anxiety	-.12	.13	-.13	-0.94		
Age	.27	.97	.04	0.28		
Maternal trait anxiety × age	-.25	.11	-.31	-2.26**		

\**p* < .05 \*\**p* < .01.**Figure 1.** Maternal trait anxiety × age interaction effects on: (A) HbA<sub>1c</sub> levels taken 3 months following completion of first questionnaire; and (B) adolescent absenteeism over the 3 months following completion of the first questionnaire. The values were estimated by setting the high and low maternal trait anxiety values and the older and younger age values in the regression equation to 1 *SD* above and below the respective means.**Figure 2.** Maternal trait anxiety × age interaction effects on: (A) adolescent autonomous motivation; and (B) adolescent positive mood. The values were estimated by setting the high and low maternal trait anxiety values and the older and younger age values in the regression equation to 1 *SD* above and below the respective means.

diabetes control inducing greater distress in the mothers which, in turn, elevated trait anxiety scores. To explore this possibility, we assessed whether HbA<sub>1c</sub> readings obtained at the clinic visit 3 months prior to questionnaire completion were correlated with maternal distress about diabetes or maternal trait anxiety. Prior HbA<sub>1c</sub> readings were not correlated with maternal diabetes distress or maternal trait anxiety, either for the entire sample or for the sample of 24 mothers whose adolescents were below the median age ( $-.15 < r$ 's < .15; *ns*).

## Discussion

The findings reveal significant associations of maternal trait anxiety with key aspects of diabetes regulation in adolescents. Mothers with higher anxiety reported greater responsibility for performing diabetes management tasks (i.e., higher behavioral involvement), and perceived their adolescents as having poorer management skills. Interestingly, maternal trait anxiety was unrelated to mothers' beliefs of their control over diabetes and its symptoms. Maternal trait anxiety was associated with a contrasting pattern of diabetes regulation beliefs held by adolescents. Adolescents with high-anxious mothers were not more likely to perceive their mothers as being



behaviorally involved in diabetes care, but they tended to believe that their mothers had significant control over their diabetes and that their parents were overly protective in their diabetes care. Taken together, these findings suggest that anxious mothers tend to view themselves as relatively active in the diabetes management processes, and this involvement may be driven in part by their relatively low confidence in their adolescents' abilities to take responsibility for these activities. These maternal efforts and appraisals may lead adolescents to infer that their diabetes management depends on their mother's care, although they are also inclined to view their parents as overly protective and worried. These maternal anxiety-related dynamics did not appear to undermine treatment adherence, as reported by adolescents.

For younger adolescents, maternal trait anxiety was associated with higher HbA<sub>1c</sub> levels and greater absenteeism due to diabetes during the subsequent 3 months, as reported by mothers. Despite maternal reports of relatively high involvement with diabetes care, it appears that young adolescents with high-anxious mothers (vs. those with low-anxious mothers) may be less successful in managing their diabetes. Consistent with the concept of "miscarried helping" (Anderson & Coyne, 1993) where efforts to help may undermine adaptive outcomes, this relationship may be due to several factors. First, young adolescents with high-anxious mothers may feel relatively less able to engage in self-care activities on their own and they may take less initiative in making self-care decisions when away from home. Second, the high absenteeism rates for younger adolescents with high-anxious mothers may be driven in part by maternal propensities to detect symptoms experienced by their adolescents and attribute them to diabetes events. Mothers typically have greater authority over decisions to stay home from school or events during the younger adolescent years, and so these associations of maternal anxiety with absenteeism may diminish as adolescents get older. Third, trait-anxious mothers may have a propensity to develop fears of hypoglycemia, which may lead them to engage in diabetes management behaviors that tend to maintain blood glucose at a higher level in order to decrease the probability of hypoglycemia (Marrero, Guare, Vandagriff, & Fineburg, 1997). Finally, maternal trait anxiety may influence parent-child interactions in ways that elicit physiological processes that exacerbate glucose levels and diabetes symptoms (Gonder-Frederick, Cox, & Ritterband, 2002). Further research is needed to explore these potential effects.

High maternal anxiety was also associated with low autonomous motivation in late adolescence, suggesting that it inhibits the development of these motives during adolescence. Although older adolescents with high-anxious mothers did not exhibit relatively worse adherence or metabolic control than did older adolescents with low-anxious mothers, evidence that these motivations are linked with better health outcomes over time suggests that low autonomous motivations may have detrimental effects for these adolescents in the future. Further research is needed to determine whether older adolescents with high-anxious mothers tend to exhibit poorer adherence and metabolic control during the subsequent years of adulthood, and whether they exhibit delayed improvements in autonomous motivations during the adult years.

Maternal trait anxiety was also associated with lower levels of positive mood in older adolescents, although it was unrelated to negative mood in the adolescents. Given evidence that the PANAS positive affect subscale taps a depression/elation dimension whereas the negative affect subscale taps an anxiety/relief dimension (Carver, Sutton, & Scheier, 2000), it appears that maternal trait anxiety is associated with depressive mood rather than anxious mood in older adolescents with diabetes. Although it is not clear that this dysphoria is due to maternal anxiety influences on diabetes-related interactions per se, this pattern of findings contributes to a general picture in which older adolescents with high-anxious mothers are experiencing greater motivational and affective disturbances. Research using more detailed quality of life indices and assessments of mood in relation to daily mother-adolescent interactions could provide a more comprehensive understanding of these affective dynamics.

The findings that maternal trait anxiety is associated with high maternal involvement and over-protectiveness and, in younger adolescents, with poor metabolic control are consistent with evidence of a positive correlation between emotional over-involvement and HbA<sub>1c</sub> (Liakopoulou et al., 2001). In terms of implications for interventions targeting factors that disrupt diabetes regulation, screening for trait anxiety may be more feasible than screening for emotional over-involvement. Trait anxiety measures are easy to administer whereas emotional over-involvement is difficult to assess in clinic settings as it requires evaluations of speech patterns. Moreover, trait anxiety is a stable facet influencing parental dynamics whereas emotional over-involvement may be more transient and influenced by situational factors. Future research should evaluate the relationship

between trait anxiety and emotional over-involvement and identify those facets of trait anxiety that promote the observed effects.

The use of the maternal responsibility measure as an indicator of maternal involvement in diabetes care is limited in that it does not indicate the extent of intrusive or controlling involvement versus collaborating involvement. Wiebe and colleagues (2005) found that, among 10–15 year old children, appraisals of controlling involvement of their mothers in efforts to cope with diabetes-related problems (e.g., mismanagement episodes or extreme blood glucose levels) were associated with poorer adherence among older children and poorer quality of life among older girls. In contrast, collaborative involvement of mothers was associated with better adherence and metabolic control. These findings, together with the present findings on the associations of maternal trait anxiety with maternal control, autonomous motivations, and positive affect, suggest that maternal trait anxiety may be associated with controlling rather than collaborative involvement styles. If this relationship is observed in future research, then interventions designed to maintain parental involvement during adolescence could screen for maternal trait anxiety and give special attention in helping anxious mothers redirect their efforts from controlling to collaborative forms of involvement.

The present findings complement evidence regarding the relationship of maternal depression with diabetes management in adolescents, which suggests that maternal depression is associated with older children's appraisals that their mothers are less involved in helping them cope with diabetes management problems (Wiebe et al., 2004). The contrasting patterns of relationships of maternal depression and anxiety with diabetes management underscore the distinctive influences of these personality dynamics in caring for individuals with illness. Research guided by Dix's (1991; Dix et al., 2004) transactional model of affective processes in parenting can serve as a useful framework for further research on how these maternal dispositions influence the cognitive, expressive, and behavioral processes involved in parent-child interactions concerning diabetes.

Several study limitations must be noted. First, the sample was not sufficiently large to enable us to test path models of mediational relationships among variables. The findings can guide such assessments using larger samples. Second, although the sampling of consecutive cases at the primary diabetes clinic provided a reasonably representative sample of adolescents with diabetes in the region, the findings may not generalize to adolescents who

fail to attend diabetes visits or who live in different cultures. Third, the administration of some diabetes management measures three months after maternal trait anxiety was assessed may have led to attenuated or inflated estimates of their relationships with maternal trait anxiety. Although trait anxiety tends to be highly stable over time, some variations may occur over the course of several months. Finally, given the correlational nature of the findings, one cannot make inferences regarding the causal role of maternal trait anxiety on diabetes regulation processes. The dynamic relationships among these factors are such that the diabetes regulation variables may influence maternal anxiety. For example, high HbA1c levels, which are highly stable over time, may contribute to heightened anxiety in mothers over prolonged periods. Although the associations of maternal trait anxiety with HbA1c and other diabetes regulation variables were independent of current maternal distress about diabetes, further research is needed to delineate the potentially reciprocal relationships among these factors as well as whether the observed patterns are due to associations of maternal trait anxiety with other factors relating to mother-adolescent interactions and diabetes experiences.

To conclude, this study provides new evidence regarding the role of maternal trait anxiety in the regulation of adolescent diabetes. Further research identifying the anxiety dynamics involved in mothers' efforts to assist in diabetes management could inform the development of interventions tailored to address maternal anxiety influences in ways that improve diabetes care.

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