The Interrelationships Among Paternal and Maternal Parenting Stress, Metabolic Control, and Depressive Symptoms in Adolescents With Type 1 Diabetes Mellitus*

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Objective To examine the relationship between paternal and maternal parenting stress, metabolic control, and depressive symptoms in adolescents with type 1 diabetes mellitus (T1DM). **Methods** 151 adolescents with T1DM (mean age 14.9 ± 1.7 years) and a comparison group ($n = 122$) reported their depressive symptoms and behavior problems. Mothers (T1DM $n = 126$; comparison group $n = 106$) and fathers (T1DM $n = 103$; comparison group $n = 55$) each reported parenting stress. Metabolic control was assessed by the glycosylated hemoglobin (HbA1c) values obtained from the medical records. **Results** Fathers of adolescents with T1DM reported significantly more parenting stress than fathers of the comparison group. Parenting stress was associated with depressive symptoms only in adolescents with T1DM. Parenting stress in fathers explained 25% of the variance in depressive symptoms in adolescents with T1DM and 18% of the variance in HbA1c. In mothers, this was 22% and 19%, respectively. **Conclusion** The combination of blood glucose control and depressive symptoms in adolescents with T1DM was found to be associated with both paternal and maternal parenting stress.

Key words adolescent; behavior problems; depression; parenting stress; type 1 diabetes mellitus.

Type 1 diabetes (T1DM) is a chronic illness in which both adolescents and parents are responsible for disease management and cope with multiple illness-specific daily tasks. The demanding aspects of this disease make both adolescents and their parents more vulnerable to stress. Higher levels of parenting stress were found to be associated with diabetes (Streisand et al., 2008; Streisand, Swift, Wickmark, Chen, & Holmes, 2005; Wysocki, Huxtable, Linscheid, & Wayne, 1989). Specifically, the level of parenting stress was found to be higher in families dealing with diabetes compared with families affected by severe diseases with fewer daily treatment demands, such as cystic fibrosis and cancer (Hullmann et al., 2010).

Stress in parents of children with T1DM is multifaceted and related to different aspects of the child's functioning. Higher levels of parenting stress are associated with increased rates of internalizing problems (Lewin et al., 2005) and depressive symptoms (Mullins et al., 2004) in the child. Studies suggest that problems like parental anxiety or depression have a direct or indirect (e.g., through parental involvement) negative impact on both metabolic control and psychosocial adjustment of adolescents with T1DM (Eckshtain, Ellis, Kolmodin, & Naar-King, 2010;

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Jaser & Grey, 2010). These data suggest that parenting stress is related to both physiological and psychological functioning of adolescents with T1DM. As both deterioration in metabolic control (Bryden, Dunger, Mayou, Peveler, & Neil, 2003) and increased emotional problems (Hesketh, Wake, & Cameron, 2004; Nardi et al., 2008), especially depression (Hood et al., 2006; Lawrence et al., 2006; Lin et al., 2004; Northam, Matthews, Anderson, Cameron, & Werher, 2005) are observed in many adolescents with T1DM, the association between parenting stress and the physical and emotional functioning of children with TIDM needs to be studied.

For a conceptual framework tying together parenting stress and functioning of adolescents, a transactional perspective is taken. From this perspective, parent and child functioning is seen as influencing each other in a reciprocal way (Cameron, Northam, Ambler, & Daneman, 2007; Chaney et al., 1997). Parents who experience a lot of parenting or diabetes-related stress may have difficulties in maintaining an optimal level of control concerning their children's disease management or, more generally, disciplining their children in daily life. Their children may feel that they are being overly controlled by their parents or, on the other hand, overwhelmed with responsibility for their disease management, in response to their parents' feelings and behavior. As a result, adolescents may develop behavior or emotional problems or difficulties in disease management. On the other hand, parents may experience stress in response to their children's behavior and emotional problems or metabolic functioning. Indeed, increased behavior problems in children with diabetes have been associated with higher levels of parenting stress, especially in mothers (DeVet & Ireys, 1998; Hilliard et al., 2010; Lewin et al., 2005; Mitchell et al., 2009; Mullins et al., 2004). However, the specific processes affecting parents and children in these families have been difficult to disentangle. In healthy adolescents, aggressive and rule-breaking behaviors were related to changes in overreactivity and warmth in the parents and vice versa (De Haan, Prinzie, & Deković, 2012). For families in which adolescents with T1DM experience specific problems like depressive symptoms or difficulties with metabolic control, parenting stress may play an important role in the children's physical and emotional functioning.

Although it is well known that fathers play an important role in the emotional and psychological development of their children (Lamb, 2004), their role in general is still underexposed in both research and clinical practice (Dashiff, Morrison, & Rowe, 2008). Differences in parenting stress among fathers and mothers, as well as different interrelationships with functioning of their children based on the parents' different role within the family, may exist. Fathers seem to be less involved and have less responsibility in their child's diabetes management compared with mothers (Dashiff, 2003; Seiffge-Krenke, 2002). In addition, fathers' monitoring efforts are likely to be low compared with mothers (Berg et al., 2008; Waizenhofer, Buchanan, & Jackson-Newsom, 2004). Therefore, fathers may experience less parenting stress regarding child disease characteristics (Mitchell et al., 2009; Streisand et al., 2008). However, more paternal involvement with disease management was associated with less impact of the disease on the family and better family functioning (Gavin & Wysocki, 2006; Wysocki & Gavin, 2004). For effective diabetes management, a positive father–child relationship before adolescence seems necessary (Berg et al., 2008). These different roles and responsibilities of mothers and fathers in the medical and psychological aspects of disease emphasize the need to study parenting stress of both parents separately (Dashiff et al., 2008; Haugstvedt, Wentzel-Larsen, Rokne, & Graue, 2011; Streisand et al., 2008).

In the present study, we examined whether mothers and fathers of adolescents with T1DM experience more stress than fathers and mothers of healthy peers, as the literature suggests that parents of children with T1DM are likely to report more parenting stress than parents of children without a chronic illness (Hauenstein, Marvin, Snyder, & Clarke, 1989; Wysocki et al., 1989). Next, we examined whether maternal and paternal parenting stress and diabetes-specific stress are associated with emotional problems and metabolic control in adolescents with T1DM. Because the role of mothers and fathers differs in families, we expected to find different associations between parenting stress and emotional and metabolic functioning of the adolescents for mothers and fathers. In addition, we controlled for adolescent age in these analyses, as it has been found that during adolescence, the parent–child relationship changes and parental responsibility of diabetes management decreases with increasing adolescent age (Palmer et al., 2004, 2009). As children age and become more independent in diabetes management, the overlap in experienced stress by parents and adolescents lessens (Beveridge, Berg, Wiebe, & Palmer, 2006). It was hypothesized that mothers would experience more parenting stress than fathers, especially concerning diabetes-related stress. Because functioning of parents and children is viewed from a transactional perspective, it was also hypothesized that parents would report more parenting stress when the adolescent is at risk for depression. Considering the health risk of poor metabolic control for acute complications (hypoglycemia and hyperglycemia/diabetic ketoacidosis) and for long-term microvascular and macrovascular complications (e.g., nephropathy,

hypertension, cardiovascular diseases) (Silverstein et al., 2005), we hypothesized that parenting stress would be associated with metabolic control. More specifically, we expected that parents of adolescents with poorly controlled diabetes would report more parenting stress because of daily stress concerning acute health issues (hypo- and hyperglycemia), as well as chronic concerns about long-term complications.

Method

Participants

Adolescents with T1DM and their parents were recruited from nine hospitals in The Netherlands. Adolescents were eligible to participate if they were aged between 12 and 18 years, were in secondary school, had diabetes for at least 6 months, and did not have comorbid medical or psychiatric conditions ($n = 302$). In the current study, 151 adolescents with T1DM (65 male and 86 female) and at least one of their parents (126 mothers and 103 fathers) participated. The available data of the nonparticipating adolescents with T1DM showed no significant differences from the study group in mean age or in glycosylated hemoglobin (HbA1c).

The comparison group was matched for school level, age, and gender to the group of adolescents with T1DM and was recruited from five secondary schools in the same geographic regions where the adolescents with T1DM lived in The Netherlands. The comparison group comprised 122 adolescents without T1DM or another medical or psychiatric condition (50 male and 72 female); 106 of their mothers and 55 of their fathers also participated.

Descriptive characteristics of all adolescents included in the study are shown in Table I. Medical information (most recent HbA1c), duration of the disease, treatment regimen) was recorded from the hospital charts. All adolescents were of Caucasian ethnicity.

Table I. *Group Characteristics**

Variable	Comparison group ($n = 122$)	T1DM ($n = 151$)
Mean age (SD)	14.62 (1.66)	14.89 (1.71)
Range	12–18	12–18
Gender		
Male	50 (41%)	65 (43%)
Female	72 (59%)	86 (57%)
Family constellation		
Intact family	88%	87%
Single parent	12%	13%
School level		
Lower	51 (41.8%)	42 (27.8%)
Vocational	12 (9.8%)	19 (12.6%)
Higher	27 (22.1%)	46 (30.5%)
Pre-university	32 (26.2%)	40 (26.5%)
Unknown		4 (2.6%)
Treatment		
Multiple daily injections		71 (47%)
Pump		80 (53%)
Mean HbA1c (SD)		8.3 (1.46)
Range		5.1–13.0
Mean age at diagnosis (SD)		9.43 (3.82)
Range		0–18
Mean years T1DM (SD)		5.74 (3.92)
Range		0–15
Mean CDI (SD)	7.32 (5.32)	6.59 (5.98)
Range	0–24	0–32
CDI at risk for depression, *n* (%)	18 (14.8)	18 (12.4)
Mean YSR total behavior problems (SD)	48.11 (9.07)	49.76 (11.15)
Range	26–71	28–95
Mean YSR internalizing behavior problems (SD)	47.72 (10.44)	49.36 (11.32)
Range	27–73	27–96
Mean YSR externalizing behavior problems (SD)	48.05 (8.21)	48.39 (10.09)
Range	29–64	29–100

*Group differences are not significant.

Measures

Parenting Stress

The Parenting Stress Index (PSI) short version (Dutch version: The Nijmeegse Parenting Stress Index Short index; NOSI-K) was used to measure parenting stress (Brock, Vermulst, Gerris, & Abidin, 1992) in both mothers and fathers. The self-report questionnaire consists of 25 items, rated from 1 (strongly disagree) to 6 (strongly agree). A total parenting stress score was computed as the sum of the items, with higher scores indicating more parenting stress. The range of possible scores varies between 25 and 150. Reliability ($\alpha = 0.93$) and validity of the questionnaire have been shown to be good (Brock et al., 1992).

For the parents of adolescents with T1DM, five questions concerning diabetes-related stress were added to the PSI: (1) stress related to diabetes-specific medical interventions, (2) diabetes-related disturbances in normal family life, (3) diabetes-related physical and emotional problems in the child that require extra attention, (4) diabetes-related restrictions in the social life of the child, and (5) worries about future health of the child. These questions were constructed by the Hvidore Study Group on Childhood Diabetes (Hoey et al., 2006) and were rated from 1 (substantial burden) to 5 (no burden). The diabetes-related parenting stress questionnaire showed good reliability in our sample (mothers' $\alpha = 0.79$; fathers' $\alpha = 0.84$).

Adolescent Depressive Symptoms

Self-reported depressive symptoms were measured using the Children's Depression Inventory (CDI; Kovacs, 1992). The questions refer to cognitive, affective, and behavioral depressive symptoms for children and adolescents aged 7–17 years. The questionnaire consists of 27 items answered on a 3-point Likert-type scale from 0 (absence of symptom) to 2 (clear symptom). Total scores range from 0 to 54. The overall scale indicates the extent of depressive feelings with a mean (SD) of 7.69 (4.9) for boys and 10.46 (6.5) for girls in the normative groups. Higher scores reflect more depressive feelings. A cutoff score of 13 was used to indicate that the adolescent is at risk for clinical depression (Kovacs, 1992; Timbremont & Braet, 2002). Psychometric characteristics of the CDI are sufficient (Evers, Vliet-Mulder, & Groot, 2000).

Adolescent Behavior Problems

The Youth Self-Report (YSR) measures self-reported behavior problems and competencies of adolescents aged 11–18 years (Achenbach & Rescorla, 2001). The questionnaire consists of 113 items answered on a 3-point Likert-type scale from 0 (absence of symptom) to 2 (clear symptom). The overall score indicates the extent of behavior problems. The YSR is divided into two broadband dimensions that reflect internalizing (anxious/depressed and withdrawn/depressed) and externalizing (rule-breaking and aggressive) behaviors. Psychometric characteristics are good for both scales (Evers et al., 2000).

Metabolic Control

Metabolic control was assessed by the HbA1c values obtained from the medical records. HbA1c is the medical standard for evaluating the level of diabetes control and reflects average blood glucose levels during the past 2–3 months. Higher HbA1c values represent poorer metabolic control. The level of metabolic control of adolescents with T1DM can be considered optimal (HbA1c $< 7.5\%$), suboptimal (HbA1c 7.5–9.0%), or poor (HbA1c $> 9.0\%$) (Rewers et al., 2009). Most recent HbA1c measures, reported 1 week before or after questionnaire completion, were used. HbA1c was analyzed with similar assays, using gas chromatography, in the different hospitals.

Procedure

The study was approved by the medical ethical committees of the Catharina Hospital in Eindhoven and the local committees of all participating hospitals. It is part of a larger study studying the self-perception of psychological functioning of adolescents with type 1 diabetes (Maas-van Schaaijk, Odink, Ultee, & van Baar, 2011). Adolescents with T1DM and their parents were contacted by telephone to participate. Next, adolescents with T1DM and their parents were both sent a letter in which they were separately informed of the study. After both adolescents and their parents agreed to participate and had completed an informed consent form, an appointment for the adolescents and their parent(s) was made. The adolescents answered the questionnaires when they visited the diabetes team, or in their homes. Their parents were sent questionnaires by mail. Schools were approached for cooperation in the same period for the comparison group, and adolescents without T1DM or any other chronic illness and their parents were invited to participate. For the comparison group, the questionnaires were sent to the adolescents and their parents at home.

Adolescents who answered the critical item on the CDI concerning suicidal thoughts as positive, or who scored above the clinical range for depression on both YSR and CDI, were approached to verify whether they received psychological treatment and to offer it when necessary.

Data Analysis

Potential differences in descriptive group characteristics were analyzed using χ^2 or *t*-tests. Group differences in parenting stress were analyzed using univariate analyses of variance. Pearson product correlations were used to determine the relationship between parenting stress of mothers and parenting stress of fathers. Pearson product correlations were also used to evaluate the bivariate relationships between parenting stress on one hand and child demographics (age, gender, school level, and marital status), children's disease characteristics (metabolic control, treatment form, illness duration, and age of diagnosis), and psychological and behavioral measures of the adolescents on the other hand. Hierarchical regression analyses were used to evaluate the association of parenting stress (PSI) of the mothers and fathers with physical functioning as reflected in the HbA1c of the adolescents, and the association of parenting stress with depressive symptoms (CDI) of the adolescents with T1DM.

Results

Descriptive characteristics of the adolescents are shown in Table I. Adolescents varied in age from 12 to 18 years, with a mean age of approximately 15 years. The group of adolescents with T1DM did not differ from the comparison group on age, gender, and education level, as expected in view of the matching procedure.

Group Differences Between Adolescents With T1DM and the Comparison Group

Fathers of adolescents with T1DM reported significantly more parenting stress than fathers of the comparison group [T1DM fathers mean = 49.64, $SD = 26.34$, 95% CI 45.16–54.12; comparison fathers mean = 40.65, $SD = 14.87$, 95% CI 34.52–46.79; $F(1,158) = 5.46$, $p = .021$; $\eta^2 = 0.034$]. Although mothers of adolescents with T1DM reported more parenting stress than mothers of the comparison group, this difference was not significant [T1DM mothers mean = 44.87, $SD = 20.68$, 95% CI 41.39–48.34; comparison mothers mean = 40.17, $SD = 18.69$, 95% CI 36.38–43.96; $F(1,232) = 3.24$, $p = .073$; $\eta^2 = 0.014$]. Strong correlations were found for general parenting stress between mothers and fathers (T1DM group $r = 0.74$; comparison group $r = 0.67$).

In terms of number of depressive symptoms on the CDI, the adolescents with T1DM did not differ from the comparison group [$F(1,265) = 1.100$, $p = .295$; $\eta^2 = 0.004$]. The number of adolescents identified as being at risk for a clinical depression was 18 (12.4% of 145 with complete data) in the group with T1DM and 18 in the comparison group (14.8% of 122 with complete data), which did not significantly differ (χ^2 (1, 270) = 0.197, $p = .66$).

In terms of the number of internalizing (INT), externalizing (EXT), and total (TOT) behavior problems, the adolescents with T1DM also did not differ from the comparison group [$F(3,242) = 1.095$, $p = .352$, $\eta^2 = 0.013$].

Adolescents With T1DM and Their Mothers and Fathers

Strong correlations were found for diabetes-specific parenting stress between mothers and fathers ($r = 0.54$). Paired sample *t*-tests showed that fathers and mothers of adolescents with T1DM do not differ in general parenting stress [fathers mean = 46.65, $SD = 22.66$; mothers mean = 45.04, $SD = 20.93$; 95% CI difference −1.64 to 4.84, $t(92) = 0.98$, $p = .33$] or in diabetes specific parenting stress [fathers mean = 14.19, $SD = 3.35$; mothers mean = 14.37, $SD = 3.05$; 95% CI difference −0.43 to 0.80, $t(96) = 0.60$, $p = .55$).

Adolescent age was not associated with general and diabetes-specific stress for either fathers or mothers. In the adolescents with T1DM, metabolic control was significantly associated only with externalizing behavior problems ($r = 0.19$) and total behavior problems ($r = 0.20$).

Fathers of adolescents with T1DM at risk for depression ($n = 10$) reported significantly more parenting stress (mean = 75.20, $SD = 29.94$, 95% CI 59.49–90.92) compared with fathers of adolescents not at risk for depression [mean = 46.63, $SD = 24.50$, 95% CI 41.42–51.84; $F(1,101) = 11.73$, $p = .001$; $\eta^2 = 0.106$]. Fathers of adolescents at risk for depression also reported more diabetes-related parenting stress (mean = 11.30, $SD = 3.65$, 95% CI 9.16–13.44) compared with fathers of adolescents not at risk for depression [mean = 14.32, $SD = 3.39$, 95% CI 13.61–15.03; $F(1,101) = 7.04$, $p = .009$; $\eta^2 = 0.066$].

Mothers of adolescents with T1DM at risk for depression ($n = 14$) also reported more general parenting stress (mean = 60.43, $SD = 28.28$, 95% CI 50.13–70.73) than mothers of adolescents not at risk for depression [mean = 42.57, $SD = 18.12$, 95% CI 38.89–46.27; $F(1,123) = 10.43$, $p = .002$; $\eta^2 = 0.079$]. In addition, mothers of adolescents with T1DM at risk for depression reported more diabetes-related parenting stress (mean = 12.46, $SD = 2.33$, 85% CI 10.75–14.17) compared with mothers of adolescents not at risk [mean = 14.54, $SD = 3.19$, 95% CI 13.95–15.12; $F(1,125) = 5.16$, $p = .025$; $\eta^2 = 0.040$].

Fathers and mothers of adolescents with poorly controlled diabetes (HbA1c > 9.0; $n = 36$), suboptimally controlled diabetes (7.5–9.0%; $n = 69$), and optimally controlled diabetes (HbA1c < 7.5%; $n = 41$) were compared. Mothers of adolescents with poorly controlled diabetes reported significantly more general parenting stress (mean = 58.77, $SD = 29.72$, 95% CI 50.88–66.66) than mothers of adolescents with suboptimally controlled diabetes (mean = 40.81, $SD = 17.43$, 95% CI 35.70–45.92) and mothers of adolescents with optimally controlled diabetes [mean = 43.14, $SD = 16.37$, 95% CI 36.43–49.85; $F(4,240) = 7.43$, $p = .001$, $\eta^2 = 0.109$]. No significant differences in diabetes-related parenting stress were found between the mothers of poorly controlled (mean = 13.77, $SD = 3.42$, 95% CI 12.49–15.05), suboptimally controlled (mean = 14.39, $SD = 3.51$, 95% CI 13.56–15.21), and optimally controlled adolescents [mean = 14.50, $SD = 2.74$, 95% CI 13.42–15.59; $F(4,240) = 0.43$, $p = .654$, $\eta^2 = 0.007$].

No significant differences were found in general parenting stress for fathers of adolescents with poorly controlled diabetes (mean = 58.74, $SD = 30.49$, 95% CI 47.57–69.91), suboptimally controlled diabetes (mean = 48.13, $SD = 25.72$, 95% CI 41.38–54.89), and optimally controlled diabetes [mean = 45.86, $SD = 16.82$, 95% CI 36.82–54.90; $F(4,192) = 0.175$, $p = .180$, $\eta^2 = 0.035$]. In addition, no significant differences were found in diabetes-related stress of fathers of poorly controlled (mean = 13.42, $SD = 3.27$, 95% CI 11.83–15.02), suboptimally controlled (mean = 14.10, $SD = 3.75$, 95% CI 13.13–15.06), and optimally controlled adolescents

(mean = 14.52, $SD = 3.16$, 95% CI 13.23–15.81; $F(4,192) = 0.56$, $p = .571$, $\eta^2 = 0.011$).

Parenting Stress and Physical and Emotional Functioning of Adolescents

Pearson correlation coefficients showed small-to-moderate associations between parenting stress and behavior problems and depressive symptoms for both groups and for both parents (see Table II). For diabetes-related characteristics, only HbA1c was found to correlate significantly with maternal parenting stress.

Separate hierarchical multiple regression models were generated to examine the association between parenting stress in mothers and fathers of adolescents with T1DM and the adolescents' HbA1c. Both models were conducted in steps, controlling for lower-order demographic and disease-related characteristics in Step 1 (i.e., age, gender, age at diagnosis, years DM, and treatment form), psychological and behavioral characteristics in Step 2, and maternal or paternal parenting stress in Step 3. Only independent variables with significant ($p \leq .05$) associations with the dependent variable were used. Results are presented in Table III. For the association between Hba1c and paternal stress, the first step was significant [$R^2 = 0.15$, $F(4,95) = 4.06$, $p = .005$]. The change in Step 2, where the total score of behavior problems was added to the model, was also significant [$R^2 = 0.18$, $F(5,95) = 3.84$, $p = .003$]. Finally, paternal parenting stress was added, with the full adjusted model explaining 18% of the variance in HbA1c [$R^2 = 0.23$, $F(6,95) = 4.51$, $p < .001$]. The relationship of maternal parenting stress and HbA1c also remained after controlling for the variables entered in Step 1 [$R^2 = 0.15$, $F(4,118) = 5.08$, $p = .001$] and Step 2 [$R^2 = 0.18$, $F(5,118) = 4.82$, $p < .001$], with the full adjusted model explaining 19% of the variance in HbA1c [$R^2 = 0.22$, $F(6,118) = 5.53$, $p < .001$].

Separate hierarchical multiple regression models also were generated to examine the association between parental parenting stress and depressive symptoms in adolescents with T1DM. Both models were analyzed in two steps, controlling for lower-order demographic and disease-related characteristics in Step 1 (i.e., age, gender, HbA1c, age at diagnosis, years DM, and treatment form) and entering maternal or paternal parenting stress in Step 2 (see Table IV). Only independent variables with significant ($p \leq .05$) associations with the dependent variable were used. For the association between depressive symptoms in the adolescent and paternal stress, the first step was not significant [$R^2 = 0.04$, $F(6,86) = 0.54$, $p = .78$]. When paternal parenting stress was added to the model in Step 2, it significantly explained 24.8% of the variance in depressive symptoms as experienced by the adolescents [$R^2 = 0.29$, $F(1,85) = 29.54$, $p < .001$]. Maternal parenting stress was also significantly related to depressive symptoms

Table II. *Pearson's Correlations Between Parental Stress and Characteristics of Adolescents and Their Behavioral and Emotional Problems*

	Comparison group		T1DM	
	Fathers ($n = 55$)	Mothers ($n = 106$)	Fathers ($n = 103$)	Mothers ($n = 126$)
Age	−0.064	0.079	−0.040	0.063
Gender	−0.044	0.017	0.000	−0.021
Treatment form	–	–	−0.184	−0.092
Years since DM diagnosed	–	–	−0.153	0.099
HbA1c	–	–	0.180	0.249*
YSR total	0.278**	0.313*	0.331*	0.293*
YSR internalizing	0.256	0.316*	0.314*	0.280*
YSR externalizing	0.244	0.258**	0.331*	0.293*
CDI total score	0.250	0.276*	0.500*	0.493*

*$p < .01$ level; **$p < .05$ level.

Table III. *Parenting Stress and Glycemic Control Regression Analysis*

	Fathers				Mothers			
Variables	*B*	*t*	*p*	R^2 change	*B*	*T*	*p*	R^2 change
Step 1				.15*				.15*
Age	0.06	0.64	0.52		0.05	0.58	0.57	
Gender	0.20	2.17	0.03		0.20	2.35	0.20	
Years DM	0.28	2.89	0.01		0.22	2.59	0.01	
Treatment	0.23	2.42	0.02		0.21	2.48	0.02	
Step 2				0.03				0.03
YSR tot	0.05	0.48	0.63		0.08	0.90	0.37	
Step 3				.06*				.05*
PSI	0.27	2.58	0.01		0.24	2.76	0.01	

*$p < .05$.

Table IV. *Parenting Stress and Depressive Symptoms Regression Analysis*

	Fathers				Mothers			
Variables	*B*	*t*	*p*	R^2 change	*B*	*t*	*p*	R^2 change
Step 1				.04				.04
Age	−0.01	−0.06	0.96		−0.08	−0.58	0.57	
Gender	−0.04	−0.38	0.70		−0.03	−0.33	0.74	
HbA1c	−0.03	−0.32	0.75		−0.01	−0.09	0.93	
Years DM	0.25	0.89	0.38		0.21	0.80	0.42	
Age at diagnoses	0.13	0.44	0.66		0.22	0.83	0.41	
Treatment	0.10	1.05	0.30		0.05	0.59	0.56	
Step 2				.25*				.22*
PSI	0.54	5.44	0.00		0.49	5.59	0.00	

*$p < .05$.

after controlling for the variables entered in Step 1 [$R^2 = 0.04$, $F(6,109) = 0.69$, $p = .66$], with the full adjusted model explaining 21.6% of the variance in depressive symptoms in the adolescents [$R^2 = 0.25$, $F(1,108) = 31.24$, $p < .001$].

Discussion

Fathers of adolescents with T1DM showed more parenting stress than fathers of adolescents without a chronic disease, which supports our hypothesis. Although depressive symptoms in adolescents with T1DM were not clinically elevated in our study, the relation between depressive symptoms and parenting stress was different for parents of adolescents with and without T1DM. Although parents of adolescents with T1DM reported significantly more parenting stress when the adolescent experienced more depressive symptoms, no such relationship was found between parenting stress and depressive symptoms in the comparison group. In parents of the comparison group, parenting stress was related to aggressive behavior of the adolescents.

In the adolescents with T1DM, general parenting stress demonstrated a stronger relationship with depressive symptoms than diabetes-related parenting stress. Parents of adolescents with T1DM who were seriously at risk for depression reported significantly more general parenting stress with large effect sizes, and significantly more diabetes-related parenting stress with moderate effect sizes, compared with parents of adolescents with T1DM who were not at risk for depression. Examination of the association between parenting stress and disease control in diabetes showed the greatest parental stress, with a large variation, in the parents of the poorly controlled group. Mothers of poorly controlled adolescents experienced significantly more general, but not diabetes-specific, parenting stress. However, these mothers may also experience stress because they feel the need to improve disease management and to monitor their children more closely to do so, which was not addressed in our measurement of diabetes-specific stress. Future studies might use improved measures of diabetes-related parental stress to understand better these specific concerns related to disease management.

An especially important finding was that parenting stress in fathers and mothers of adolescents with T1DM was related to adolescent emotional functioning and, to a lesser degree, to physical functioning. Specifically, 25% of the variance in self-reported depressive symptoms was explained by general parenting stress of their fathers; 22% of the variance was explained by maternal parenting stress. Parenting stress was also related to physical functioning in the adolescents with T1DM, especially in fathers. Parenting stress in fathers explained 18% of the variance in HbA1c, and parenting stress in the mothers accounted for 19% of the variance in HbA1c. Another important finding of this study was that parents, particularly fathers, of adolescents with T1DM were worried when their child was experiencing depressive feelings, and to a lesser degree when the metabolic control of the adolescent was worrisome. Parental worries mostly concerned general parenting issues, and not diabetes-related parenting issues, which may be associated with the transition in responsibility in this developmental phase. Because parents become less responsible for their child's disease management during adolescence, they often are not faced with direct disease outcomes like the actual blood glucose level. However, when interacting with their child, they may frequently be confronted with the child's negative mood. This suggests that everyday stressors play a bigger role for parents than the possibility of future problems, such as the physical

complications that may result from diabetes. Even if these daily stressors of the adolescents' functioning and behavior could reflect physical problems, it appears that parents focus on the behavioral consequences and not on possible physical functioning.

This study indicates that the combination of diabetes and depressive symptoms in adolescents is associated with parenting stress. Surprisingly, this finding was independent of the age and gender of the adolescents. These findings are important for family assessment and treatment, as detailed information about parenting stress for both fathers and mothers can identify risk factors for the psychological well-being of the adolescent. Paternal stress may influence family functioning by affecting mother and child adjustment. In addition, child behavior may be more related to paternal parenting stress than maternal parenting stress (McBride, Schoppe, & Rane, 2002). Most of the time, however, health care professionals tend to focus on mothers of children with T1DM because mothers seem to take more responsibility in diabetes management tasks than fathers (Mitchell et al., 2009). Because paternal parenting stress was associated with psychological functioning of the adolescents, the results of this study emphasize the necessity to involve fathers in the treatment of adolescents with diabetes and to determine ways to keep fathers engaged in clinical practice. The involvement of fathers in parenting their adolescents with T1DM was also reflected by the large number of fathers who participated in this study. It is possible that paternal involvement in the treatment can be improved by explicitly inviting fathers to treatment appointments and by being flexible in scheduling appointments (e.g., in the evening).

The association between fathers' emotional functioning and the behavior and psychological well-being of their children needs further attention in research, especially during adolescence. Further, our results indicate that discussing the adolescents' psychological health with both parents instead of focusing on the physical health of their child is important for psychological well-being of both the adolescent and his or her parents.

In our study, the adolescents with T1DM did not differ in reported depressive symptoms and behavior problems from the comparison group. This finding is in contrast with studies reporting higher rates of depression in adolescents with T1DM (Hassan, Loar, Anderson, & Heptulla, 2006; Hood et al., 2006; Lawrence et al., 2006). In a recent meta-analysis, Reynolds and Helgeson (2011) found that children with diabetes experienced somewhat elevated levels of depression, anxiety, and psychological distress. However, the differences between children with diabetes and comparison groups were smaller in more recent studies, possibly because of substantial technological changes in diabetes management and new clinical standards during the past 15 years. Another study among Dutch adolescents with T1DM did not reveal an elevated level of the prevalence of depression (de Wit et al., 2007).

Although the current study has clarified several facets of the relation between parenting stress in both parents and depressive symptoms in adolescents with T1DM, several limitations must be considered. A technical point is that different HbA1c values were determined in the laboratories of all participating hospitals, instead of one laboratory only. Although a similar method was used to determine HbA1c values across participants, small differences cannot be excluded. In The Netherlands, however, these assays are considered to result in comparable values. Another limitation is that although we studied a relatively large group of adolescents with T1DM and their mothers and fathers, many eligible patients refused to participate. However, a participation rate of 50% is comparable with other studies (Frøisland et al., 2012; Lawrence et al., 2006; Lin et al., 2004). Nevertheless, our study may have been biased in that our results reflect data of relatively well-functioning adolescents and parents. Although we had no reason to believe that a specific subgroup participated in this study, we could not examine this possibility in detail. Furthermore, parental psychopathology, such as anxiety and depression, was not assessed, even though several studies have shown that parental psychological functioning may be associated with parenting stress (Lewin et al., 2005; Mullins et al., 2004) and physical and emotional functioning of adolescents (Eckshtain et al., 2010; Wiebe et al., 2011). Another limitation is that all families were Caucasian, which represents the majority of the Dutch population; yet, these results cannot be generalized to families with another background. Finally, longitudinal studies, which follow paternal and maternal parenting stress in relation to emotional and physical functioning of adolescents with T1DM across time, are necessary to evaluate causal relationships.

In conclusion, our findings show that parenting stress of both mothers and fathers is related to depressive symptoms, as well as to metabolic control in adolescents with T1DM. Treatment guidelines for adolescents with T1DM and future longitudinal studies should address both their mothers' and fathers' parenting stress.

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