

VU Research Portal

Explaining the adjustment of adolescents with type 1 diabetes: Role of diabetes-specific and psychosocial factors

Malik, J.A.; Koot, H.M.

published in

Diabetes Care
2009

DOI (link to publisher)

[10.2337/dc08-1306](https://doi.org/10.2337/dc08-1306)

document version

Publisher's PDF, also known as Version of record

[Link to publication in VU Research Portal](#)

citation for published version (APA)

Malik, J. A., & Koot, H. M. (2009). Explaining the adjustment of adolescents with type 1 diabetes: Role of diabetes-specific and psychosocial factors. *Diabetes Care*, 32(5), 774-779. <https://doi.org/10.2337/dc08-1306>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

E-mail address:

vuresearchportal.ub@vu.nl

Explaining the Adjustment of Adolescents With Type 1 Diabetes

Role of diabetes-specific and psychosocial factors

JAMIL A. MALIK, MSc
HANS M. KOOT, PhD

OBJECTIVE — The aim of this study was to explain adjustment (diabetes-related quality of life, general well-being, and psychopathology) in adolescents with type 1 diabetes by testing the direct, mediating, and moderating effects of diabetes-specific and psychosocial factors, using an adapted version of the Disability-Stress-Coping model of Wallander and Varni.

RESEARCH DESIGN AND METHODS — A total of 437 adolescents (54.5% girls; age range 11–19 years) with type 1 diabetes (mean \pm SD diabetes duration 6.13 ± 3.78 years) were recruited from 25 hospitals in the Netherlands. Questionnaires were completed by the adolescents and their family members. Metabolic control was assessed by measuring A1C in all participants in one laboratory.

RESULTS — Diabetes stress mediated between A1C and adjustment, after controlling for protective factors, and explained an additional 16% variance in quality of life and a 15% variance in general well-being, whereas a 19% additional variance in psychopathology was explained by both diabetes-related and general stress. No moderating effects were identified after controlling for the main effects of all risk and protective factors in the model.

CONCLUSIONS — Both diabetes-related and general stress are critical predictors of the adjustment of adolescents with type 1 diabetes. Protective factors such as self-worth and social support may mediate the effects of generic stress and thus should be encouraged. Diabetes-related stress has the potential to displace the effects of protective factors and thus may play a critical role in the development of maladjustment in adolescents with type 1 diabetes.

Diabetes Care 32:774–779, 2009

In the past two decades, considerable progress has been made in understanding various aspects of the psychosocial adjustment of patients with type 1 diabetes. Although negative attitudes, coping difficulties, and psychological problems such as depression, anxiety, and eating disorders are commonly reported as correlates of diabetes, little effort has been made to understand these outcomes in adolescents. The present study was designed to explore the adjustment of adolescents with type 1 diabetes by testing the direct, mediating, and moderating effects of diabetes-specific and psychosocial factors, using the Disability-Stress-

Coping model of Wallander and Varni (1). More specifically, the aim of the study was to differentiate the roles of diabetes-related stress, general stress, and resistance factors in the adjustment of adolescents. The model proposed by Wallander and Varni allows the identification of modifiable risk and protective factors in patients' adjustment by testing specified pathways (1) with a clear description of the role of disease-related and psychosocial factors. It was adapted for the present study to predict the adjustment of adolescents with type 1 diabetes.

Earlier studies have shown a weak association between disease parameters and

psychosocial adjustment (1). In adolescents with type 1 diabetes, contradictory associations have been reported between A1C and certain aspects of adjustment, including diabetes-related quality of life and general well-being. Although recent studies have also suggested an association between A1C and psychological distress (2), which may cause diminished psychosocial adjustment, the factors involved in this association have not been identified. In the present study, we hypothesized that the relationship between A1C and certain components of adolescents' adjustment (i.e., diabetes quality of life, general well-being, and psychopathology) is mediated by risk factors including diabetes-related and general stress and is moderated by protective factors including global self-worth, general social support, and tangible support. More specifically, we hypothesized that diabetes-related stress fully mediates between A1C and diabetes quality of life, whereas it partially mediates between A1C and the two other generic aspects of adjustment (i.e., general well-being and psychopathology). We also hypothesized that general stress fully mediates the relationship between A1C and general well-being and between A1C and psychopathology, whereas it partially mediates the relationship between A1C and diabetes quality of life.

As delineated by the model and as earlier studies have suggested, we might also expect to find the effects of protective factors (i.e., global self-worth, social support, and disease-specific, tangible support). Because both global self-worth and social support were found to be positively associated with adjustment in earlier research (3) and a negative association of these factors has been reported with distress (4), it can be suggested that global self-worth and social support decrease stress, which may further increase the likelihood of positive adjustment in adolescents with type 1 diabetes. However, studies addressing these relations did not account for the stress experienced. It may be that during adolescence, when young individuals are expected to play an increased role in self-care and daily stress

From the Department of Developmental Psychology, VU University, Amsterdam, the Netherlands.

Corresponding author: Jamil A. Malik, ja.malik@psy.vu.nl.

Received 15 July 2008 and accepted 18 January 2009.

Published ahead of print at <http://care.diabetesjournals.org> on 5 February 2009. DOI: 10.2337/dc08-1306.

© 2009 by the American Diabetes Association. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. See <http://creativecommons.org/licenses/by-nc-nd/3.0/> for details.

The costs of publication of this article were defrayed in part by the payment of page charges. This article must therefore be hereby marked "advertisement" in accordance with 18 U.S.C. Section 1734 solely to indicate this fact.

increases, protection conferred by personal strength or social support is mitigated by disease-related and general stress. Therefore, we expected that part of the protective effects of self-worth and support worked by reducing the effects of stress. We expected diabetes-related stress to fully mediate the relation between protective factors and diabetes-specific aspects of adjustment and partially mediate the relation between protective factors and generic aspects of adjustment. In contrast, we expected general stress to partially mediate the relation between protective factors and diabetes-specific aspects of adjustment and to fully mediate the effects of protective factors on generic aspects of adjustment.

A contrasting line of reasoning suggests that protective effects may still be evident in adolescence but only when stress is not too high; in other words, protective factors might moderate the influence of stress. To our knowledge, no study has investigated the moderating role of self-worth and support in the relation between diabetes-related and general stress and the adjustment of adolescents with type 1 diabetes. In the present study we expected moderating effects from intrapersonal and socioecological factors on the relationship between diabetes-related and general stress and components of adolescents' adjustment (i.e., diabetes quality of life, general well-being, and mental health). Specifically, we were interested in the role of social support as a buffer against the influence of stress on adjustment. Earlier research demonstrated that both family and friends are important sources of support for adolescents as they live with and manage their diabetes. Some studies reported that the family may be very helpful in coping with the everyday management and demands of diabetes (5,6), whereas other studies indicated that effective diabetes-specific support (i.e., tangible support) is provided mainly by parents but social/emotional support is provided mainly by friends (7). In accordance with results from studies indicating the effects of demographic variables on the adjustment of adolescents with type 1 diabetes (8,9), we also expected sex, age, and duration of disease to be influential factors. However, because adjustment differences due to demographic characteristics were not the primary focus of this study, these factors were controlled for in the present analysis.

Table 1—Demographic and disease characteristics and study variables

	Valid n	Boys	Girls	Total sample
Sex (%)	437	199 (45.5)	238 (54.5)	—
Age (years)	437	14.8 ± 1.9	14.7 ± 1.8	14.7 ± 1.9
Age at diabetes onset (years)	412	8.5 ± 4.2	8.6 ± 3.7	8.6 ± 3.9
Diabetes duration (years)	412	6.2 ± 3.8	6.1 ± 3.7	6.1 ± 3.8
SES mother	428	2.7 ± 2.3	2.7 ± 2.1	2.7 ± 2.2
SES father	407	4.6 ± 2.3	4.3 ± 2.3	4.5 ± 2.3
Two-parent family (%)	382	171 (44.8)	211 (55.2)	—
Single-parent family (%)	49	24 (49)	25 (51)	—
Injection (%)	408	184 (45.1)	224 (54.9)	—
Pump (%)	22	9 (40.9)	13 (59.1)	—
A1C	430	8.9 ± 1.5	8.9 ± 1.6	8.9 ± 1.5
Quality of life	392	202.1 ± 23.6	206.7 ± 21.5	204.2 ± 22.7
General well-being	432	26.4 ± 4.8	23.4 ± 5.1	24.8 ± 5.2
Psychopathology	402	34.0 ± 19.7	35.9 ± 19.7	34.0 ± 19.7
Diabetes-related stress	426	39.5 ± 11.8	45.1 ± 13.0	42.6 ± 12.8
General stress	372	3.8 ± 2.9	3.9 ± 2.9	3.9 ± 2.9
Global self-worth	431	3.5 ± 0.5	3.2 ± 0.6	3.3 ± 0.5
Social support	431	3.4 ± 0.3	3.5 ± 0.3	3.5 ± 0.3
Tangible support	354	560.4 ± 243.2	625.6 ± 255.8	595.9 ± 251.9

Data are means ± SD or mean (%). SES, socioeconomic status.

RESEARCH DESIGN AND METHODS

The study sample was drawn from 890 adolescents with type 1 diabetes who are seen at 1 of the 25 hospitals in the southwestern area of the Netherlands that offer diabetes care for adolescents. Adolescents aged 11–19 years old with type 1 diabetes, who were receiving daily insulin injections or using an insulin pump, were included. Of the 550 adolescents invited to participate, 21 were excluded owing to one of several reasons (disability, cystic fibrosis, insufficient command of the Dutch language, or duration of diabetes <1 year). Of the 529 adolescents who fulfilled the criteria (age range 11–19 years and Dutch language competence), 437 (83%) participated in the study. Of the 92 nonresponders, 45 never replied to the first letter, 27 could not be reached by telephone, and 20 were unreachable after telephone contact because of a change of address. Nonresponders did not differ significantly from responders in sex or age. Sample characteristics are presented in Table 1. After informed consent was obtained from the adolescents and their parents, questionnaires were completed by the adolescents during a routine outpatient visit in the presence of a research nurse. Questionnaires for family members were sent and returned by mail. Metabolic control was assessed by measuring A1C of all participants in one laboratory; mean A1C was not significantly different for adolescents

using a pump (5.3%) versus using injection (94.7%) (means ± SD 8.3 ± 1.23 vs. 8.6 ± 1.5).

Measurements

In addition to demographic characteristics and A1C, data were collected on adjustment and risk and protective factors from adolescents, parents, and health care workers, using the following measures.

Adjustment. Three aspects of adjustment were assessed: diabetes-related quality of life, general well-being, and psychopathology. A 51-item self-report questionnaire (Modified Diabetes Quality of Life for Youths) was used to measure diabetes quality of life (10). The questionnaire assesses Impact of Diabetes (23 items, $\alpha = 0.85$), Worries (11 items, $\alpha = 0.82$), and Satisfaction with Life (17 items, $\alpha = 0.85$). A composite scale score ($\alpha = 0.92$ for the present sample) was computed by summing the three subscale scores (Impact and Worries scales reversed) into a diabetes quality-of-life score (with higher scores indicating better quality of life). General well-being was measured with the 12-item Well-Being Questionnaire (11), which includes three subscales: Positive well-being (four items), Negative well-being (four items), and Energy (four items), summed into a total General well-being score ($\alpha = 0.79$). Psychopathology was measured by the Child Behavior Checklist/4–18 and Youth Self Report. Each contains 120

items on behavioral/emotional problems, to be scored on a 3-point Likert scale by parents and youth themselves, respectively. The Dutch versions of the questionnaires have a similar factor structure, and cross-national correlations ranged from 0.82 to 0.99 for the Child Behavior Checklist/4–18 and from 0.77 to 1.00 for the Youth Self Report (12). Standardized Z scores of all subscales from both questionnaires were added into a total psychopathology score ($\alpha = 0.88$).

Risk factors. Diabetes-related stress and general stress were used as risk factors in the present study. Diabetes-related stress was calculated by adding items from the Diabetes Fear of Injecting and Self-testing Questionnaire (D-FISQ) and complaints due to hypoglycemias and hyperglycemias. The D-FISQ is a 30-item self-report questionnaire consisting of the two subscales: Fear of Self-Injecting ($\alpha = 0.94$) and Fear of Self-Testing ($\alpha = 0.90$); ($\alpha = 0.57$ for the total score). The measures are related to adherence to diabetes care in pediatric type 1 diabetic patients (13). Complaints due to hypoglycemia and hyperglycemia were measured on a 20-item scale ($\alpha = 0.88$). General stress was reported by parents on a 5-item (parents, school/work, friends, and siblings) generic measure. Responses were rated on a 4-point Likert scale and rated as no stress/tension, a little stress/tension, moderate stress/tension, and a lot of stress/tension.

Protective factors. Protective factors included intrapersonal factors, (i.e., global self-worth), and socioenvironmental factors (i.e., social support and tangible support). Global self-worth was measured by the 6-item global self-worth subscale ($\alpha = 0.77$) of the Self-Perception Profile for Adolescents (14). Social support was assessed by the 24-item Social Support Scale for Children, which taps adolescents' perceived social support from four sources (classmates, friends, parents, and teachers, with six items in each subscale), from which a total score ($\alpha = 0.84$) combining all four subscales was computed. Tangible support from parents and friends was measured on the Modified Diabetes Specific Support Questionnaire (MDSSQ), using the 70-item MDSSQ-Family ($\alpha = 0.82$) and the 54-item MDSSQ-Friends ($\alpha = 0.82$), respectively. The MDSSQs are structured questionnaires about the frequency of supportive behaviors regarding insulin administration, blood glucose testing, following a meal plan, exercising regularly, and "feeling good" about diabetes. The adolescent

rates the supportiveness of each behavior, which is multiplied by the frequency score of the respective behaviors. Scores from similar categories of tangible support from parents and friends were combined to compute a tangible support score ($\alpha = 0.87$).

Statistical analyses

Pearson correlations between all variables in the study were computed for a preliminary analysis, followed by multiple linear regressions with each of the adjustment measures as outcomes and the risk and protective factors as predictors to test the main, mediation, and moderation hypotheses. Sobel statistics were used for further verification of all significant mediational effects that appeared from the regression analyses, according to the criteria defined by Baron and Kenny (15). Only significant mediations are addressed in the present study.

RESULTS— As expected, risk factors were positively related to psychopathology and negatively related to diabetes quality of life and general well-being. Correlations were inverted for protective factors, except tangible support, which correlated positively with psychopathology (i.e., $r = 0.16$, $P = 0.05$, and $r = 0.17$, $P = 0.05$) for girls and boys, respectively. Of the demographic and disease characteristics, age was correlated only with tangible support ($r = -0.20$ for girls and $r = -0.27$ for boys), and duration of diabetes correlated positively with A1C for boys (for correlations, see supplementary Table A1, available in an online appendix at <http://care.diabetesjournals.org/cgi/content/full/dc08-1306/DC1>). To account for the influence of these characteristics, they were controlled in further analyses.

In a series of stepwise multiple regressions, the mediational role of general stress and diabetes-related stress in the relation between A1C and adolescents' adjustment was tested in cases that met the criteria for mediation described by Baron and Kenny (15). Contrary to our hypothesis, general stress appeared to have no association with A1C and did not mediate the relationship between A1C and adjustment (for a summary of the mediation analysis, see supplementary Table A2, available in the online appendix).

After controlling for sex, age, and diabetes duration in a first block, A1C was added in the second block and explained a 3.8% variance in diabetes quality of life

($\beta = -0.18$, $P < 0.01$); 1% in general well-being ($\beta = -0.14$, $P < 0.01$); and 3.9% in psychopathology ($\beta = 0.17$, $P < 0.01$). To investigate the mediation of the association between A1C and adjustment, both diabetes-related and general stress were added in the third step (block 4). Diabetes-related stress fully mediated the relationship between A1C and two aspects of adjustment (i.e., diabetes quality of life and general well-being) ($P < 0.01$ by Sobel test) and partially mediated the relationship between A1C and psychopathology ($P < 0.05$ by Sobel test). Mediation of diabetes-related stress accounted for an overall 43.3% of the variance in diabetes quality of life, 39.4% of the variance in general well-being, and 41.1% of the additional variance in psychopathology.

Next, protective factors (i.e., global self-worth, tangible support, and general social support) were tested for their potential role in explaining adjustment. Analyses were rerun by controlling for sex, age, and diabetes duration in the first block and for A1C in the second block. Protective factors were inserted in the third block (model 4). Results indicated that global self-worth ($\beta = 0.43$, $P < 0.01$) and general social support ($\beta = 0.25$, $P < 0.01$) accounted for an increase of 25.7% variance explained in diabetes quality of life; global self-worth ($\beta = 0.45$, $P < 0.01$) and general social support ($\beta = 0.16$, $P < 0.01$) accounted for an increase of 32.6% variance explained in general well-being; and global self-worth ($\beta = -0.40$, $P < 0.01$), general social support ($\beta = -0.21$, $P < 0.01$), and tangible support ($\beta = 0.18$, $P < 0.01$) accounted for an increase of 28.5% variance explained in psychopathology.

To investigate the unique association of risk factors with outcomes after controlling for protective factors, diabetes-related and general stress were added in the fourth block (model 5). Results indicated that even after controlling for protective factors, diabetes-related stress ($\beta = -0.46$, $P < 0.01$) accounted for a 16% additional variance explained in diabetes quality of life and a 15% additional variance explained in general well-being. A substantial decrease in the regression coefficients of the two protective factors also indicated partial mediation by diabetes-related stress ($P < 0.01$ by Sobel test) on the relationship of self-worth and quality of life, as well as between general social support and quality of life. For general well-being, diabetes-related stress partially mediated ($P < 0.01$ by Sobel

Table 2—Results of mediation analysis

Dependent variable	Predictors	β Model 1	β Model 2	β Model 3	β Model 4	β Model 5
Diabetes quality of life						
Block 1	Sex	0.092	0.083	-0.064	0.028	-0.045
	Age	0.003	-0.001	0.059	-0.022	0.045
	Diabetes duration	0.003	0.027	-0.025	0.053	0.012
Block 2	A1C		-0.181*	-0.074	-0.136*	-0.072
Block 3	Global self-worth				0.427*	0.266*
	General social support				0.245*	0.163*
	Tangible support				-0.086	0.017
Block 4	Diabetes stress			-0.602*		-0.459*
	General stress			-0.14*		-0.062
R^2		0.10	0.114	0.433	0.371	0.533
General well-being						
Block 1	Sex	0.296*	0.291*	0.159*	0.199*	0.129*
	Age	0.03	0.025	0.08	0.02	0.091†
	Diabetes duration	0.067	0.089	0.026	0.123†	0.066
Block 2	A1C		-0.141*	-0.042	-0.072	-0.004
Block 3	Global self-worth				0.451*	0.306*
	General social support				0.148*	0.069
	Tangible support				0.002	0.097†
Block 4	Diabetes stress			-0.539*		-0.458*
	General stress			-0.054		-0.006
R^2		0.013	0.050	0.394	0.376	0.535
Psychopathology						
Block 1	Sex	-0.069	-0.063	0.052	-0.048	0.013
	Age	-0.048	-0.042	-0.065	0.013	-0.034
	Diabetes duration	-0.01	-0.038	-0.01	-0.084	-0.054
Block 2	A1C		0.173*	0.099†	0.141*	0.090†
Block 3	Global self-worth				-0.398*	-0.210*
	General social support				-0.207*	-0.124*
	Tangible support				0.175*	0.061
Block 4	Diabetes stress			0.440*		0.385*
	General stress			0.386*		0.261*
R^2		0.027	0.066	0.448	0.345	0.557

All β values are standardized regression coefficients. β Model 1: controlled variables (sex, age, and diabetes duration). β Model 2: effect of A1C controlling for variables in model 1. β Model 3: Effect of risk factors controlling for variables in models 1 and 2. β Model 4: effect of protective factors controlling for variables in models 1 and 2. β Model 5: effect of risk factors controlling for variables in models 1, 2, and 4. Difference of R^2 between any two models presents unique effect of variables included in later model. *Regression coefficient significant at 0.01. †Regression coefficient significant at 0.05.

test) the relationship between global self-worth and well-being with a substantial decrease in the regression coefficient and fully mediated ($P < 0.01$ by Sobel test) the relationship between general social support and well-being as the regression coefficient of general social support became insignificant (Table 2) after risk factors were included in the equation. Both diabetes-related ($\beta = 0.39$, $P < 0.01$) and general stress ($\beta = 0.26$, $P < 0.01$) significantly predicted psychopathology (i.e., $\Delta R^2 = 0.19$, $P < 0.01$) even after controlling for protective factors. In addition, both risk factors partially mediated the association between global self-worth and psychopathology as well the relationship between tangible support and psychopathology ($P < 0.01$ by Sobel test). Diabetes-related stress fully medi-

ated the association between tangible support and psychopathology ($P < 0.01$ by Sobel test). No conclusion can be drawn for mediation by general stress, since it had no significant relationship with tangible support in the initial regression analysis.

Finally, we tested the potential moderation of the relation between stressors and adolescents' adjustment by protective factors. Centered interaction terms were computed between three protective and two risk factors. Multiple regression analyses were conducted for all three outcome adjustment factors by controlling for demographic factors and diabetes duration in the first block, A1C in the second block, protective factors in the third block, and risk factors in the fourth block, and adding all six interactions between

two risk factors and three protective factors in the fifth block. None of the interaction terms significantly predicted any aspect of adjustment over and above the statistical main effects of risk and protective factors.

CONCLUSIONS— In this study we investigated the role of diabetes-specific and psychosocial factors in the adjustment of adolescents with type 1 diabetes, using an adapted version of the Disability-Stress-Coping model of Wallander and Varni. The results of the present study are consistent with those of studies reporting the negative effects of A1C on adjustment of adolescents (16,17). As expected, the level of A1C emerged as a significant predictor of diabetes-related quality of life and of general well-being and psychopa-

thology. However, the amount of variance in adjustment explained by A1C was small, which is in line with the tenet of Wallander and Varni (1) that although some physiological parameters of a disease or disability may affect adjustment, on the whole, these are not the most important factors influencing adjustment.

Diabetes-related stress, on the other hand, fully mediated the relationship between A1C and diabetes quality of life and well-being. Contrary to our hypothesis, general stress did not mediate the relationship between A1C and adjustment, despite its strong associations with all aspects of adjustment. Diabetes-related stress had strong effects on all three aspects of adjustment, whereas general stress independently predicted quality of life and psychopathology. The partial mediating effect of diabetes-related stress on the relationship of A1C and psychopathology compared with full mediation on the relationship of A1C and diabetes-related quality of life confirmed our hypothesis that diabetes-related stress is important in explaining diabetes-related aspects of adjustment compared with generic aspects of adjustment. Our findings are in line with the work of Wallander and Varni (1), who found that perceived disease-related stress was associated with higher negative affectivity and behavior problems in patients with cancer even after controlling for demographic and medical variables. The strong effects of diabetes-related stress could be explained by several factors, including the emotional trauma of the diagnosis of a life-threatening disease, burdens related to disease management, and disease-related fears.

The hypothesis of emotional trauma may be ill-founded; a recent study showed no effect from receiving a type 2 diabetes diagnosis on psychological well-being and perceived health status (18). In the case of a type 1 diabetes diagnosis, however, adverse effects can be expected after diagnosis because of the extra burden of blood testing and external insulin administration. Evidence for this conclusion comes from a recent study showing that outpatients with long-standing high A1C selected from seven hospitals perceived self-care behaviors to be burdensome (19). Furthermore, fear of self-injecting and fear of self-testing are also associated with poor general well-being and psychological comorbidities (20).

As expected, a significant amount of variance in all three aspects of adjustment

was explained by protective factors. These factors were controlled for to see the unique effect of risk factors on adjustment and also the potential mediation by risk factors of the relationship between protective factors and adjustment. Although general stress became insignificant in explaining adjustment (except psychopathology) when protective factors were controlled for, diabetes-related stress still emerged as a considerable predictor and mediated the relationship between protective factors and all three aspects of adjustment, at least in part. These results indicated that there may be a reciprocal relationship between protective factors and stress (i.e., protective factors might reduce level of stress, but stress might reduce level of self-worth and social support). These findings support the literature stating that factors such as commitment, help, support, and the open expression of feelings facilitate a child's adjustment to newly diagnosed diseases such as cancer and to biomedical treatment (1).

Diabetes-related stress appeared to have strong effects on diabetes quality of life and on general well-being. It fully mediated the relationship between global self-worth and general well-being and partially mediated the relationship between general social support and general well-being. The findings are in line with earlier research projecting a significant association of diabetes-related stress with general well-being in the Dutch population (21). The relationship between both protective factors in this study and diabetes quality of life was also partially mediated by diabetes-related stress, supporting earlier work showing a negative relationship between diabetes-related stress of self-management and diabetes-related quality of life (22). Psychopathology is the only aspect of adjustment significantly explained by both diabetes-related and general stress, even after controlling for protective factors. This finding suggests that both risk factors play a critical role in the development of psychopathology in adolescents with type 1 diabetes. Our results support findings reported by Wallander and Varni (1) suggesting that both disease-specific and generic perceived stress are associated with maladjustment.

Contrary to our hypothesis, no relation was found between tangible support and diabetes-related aspects of adjustment, whereas tangible support was positively related to psychopathology. This

relation was fully mediated by diabetes-related stress. Apparently, perhaps instead of alleviating the burden of diabetes care and self-care behaviors experienced by adolescents (19), tangible support adds to this burden, possibly increasing the chances of development of psychopathology. Given the cross-sectional nature of this study, it is also possible that tangible support was invoked by less than optimal adolescent self-care behavior related to some types of psychopathology.

In the present study we hypothesized that both intrapersonal and interpersonal factors would moderate the effects of diabetes-related psychosocial stress on the adjustment of adolescents. As suggested in earlier research (23), risk factors such as psychosocial and disease-specific stressors are inversely related to child adjustment, whereas the perception of self-worth and social support can help adolescents (24) even in the presence of stressors. In other words, a moderating role of global self-worth and support would indicate resilience in adolescents with type 1 diabetes. After controlling for the effects of risk and protective factors presented in the model, we did not find any moderating effect of global self-worth, general social support, and tangible support on the influence of diabetes-related and general stress on any aspect of child adjustment. These results confirm the results of a study by Varni and Katz (25), who found no moderating effect of social support in children with newly diagnosed cancer.

Application and limitations

A general conclusion can be drawn from this study that diabetes-related stress is critical in explaining both diabetes-specific and generic aspects of adjustment and thus should be addressed properly in treatment regimens. General stress, on the other hand, mainly affects generic aspects of adjustment, as most of the effects of general stress are removed by protective factors. This result suggests that it is valuable to promote the protective factors of adjustment, assess adolescents' burden of disease-related stress, and assist them in developing ways to cope with it.

This study has some limitations. First, although structured, reliable, and validated measures were used in the present study, for the current sample the low reliability of the D-FISQ limits the generalization of findings. Second, the study was cross-sectional, limiting conclusions regarding causality; a longitudinal design is

required to understand the true causal nature of the relationship between risk and protective factors and adjustment. Third, generalization of the results requires caution as the sample may not be truly representative of the population of adolescents with type 1 diabetes, although the sample size was substantial and participants were recruited from a wide range of diabetes care facilities. Finally, some aspects of the tested model might profit from a different operationalization. For example, daily hassles could be a better indicator of general stress than the index of events used in the present study. Despite this shortcoming, general stress appeared to play a significant role, in addition to diabetes-related stress, in the explanation of the adjustment of adolescents with type 1 diabetes.

Acknowledgments—No potential conflicts of interest relevant to this article were reported.

Parts of this study were presented orally at the 13th scientific meeting of the PSAD (PsychoSocial Aspects of Diabetes) Study Group, Cagliari, Sardinia, 11–13 April 2008, sponsored by a junior research travel award (to J.A.M.).

References

- Wallander JL, Varni JW. Effects of pediatric chronic physical disorders on child and family adjustment. *J Child Psychol Psychiatry* 1998;39:29–46
- Laffel LM, Connell A, Vangness L, Goebel-Fabbi A, Mansfield A, Anderson BJ. General quality of life in youth with type 1 diabetes: relationship to patient management and diabetes-specific family conflict. *Diabetes Care* 2003;26:3067–3073
- Edgar KA, Skinner TC. Illness representations and coping as predictors of emotional well-being in adolescents with type 1 diabetes. *J Pediatr Psychol* 2003;28:485–493
- Skinner TC, John M, Hampson SE. Social support and personal models of diabetes as predictors of self-care and well-being: a longitudinal study of adolescents with diabetes. *J Pediatr Psychol* 2000;25:257–267
- Graue M, Wentzel-Larsen T, Hanestad BR, Sovik O. Health-related quality of life and metabolic control in adolescents with diabetes: the role of parental care, control, and involvement. *J Pediatr Nurs* 2005;20:373–382
- Grey M, Davidson M, Boland EA, Tamborlane WV. Clinical and psychosocial factors associated with achievement of treatment goals in adolescents with diabetes mellitus. *J Adolesc Health* 2001;28:377–385
- La Greca AM, Auslander WF, Greco P, Spetter D, Fisher EB Jr, Santiago JV. I get by with a little help from my family and friends: adolescents' support for diabetes care. *J Pediatr Psychol* 1995;20:449–476
- Graue M, Wentzel-Larsen T, Hanestad BR, Batsvik B, Sovik O. Measuring self-reported, health-related, quality of life in adolescents with type 1 diabetes using both generic and disease-specific instruments. *Acta Paediatr* 2003;92:1190–1196
- Pouwer F, Snoek FJ. Association between symptoms of depression and glycaemic control may be unstable across gender. *Diabet Med* 2001;18:595–598
- Ingersoll GM, Marrero DG. A modified quality-of-life measure for youths: psychometric properties. *Diabetes Educ* 1991;17:114–118
- Pouwer F, van der Ploeg HM, Ader HJ, Heine RJ, Snoek FJ. The 12-item well-being questionnaire: an evaluation of its validity and reliability in Dutch people with diabetes. *Diabetes Care* 1999;22:2004–2010
- Verhulst FC, Van der Ende J, Koot HM, Handleiding voor de YSR. Rotterdam, Afdeling Kinder-en Jeugdpsychiatrie, Sophia Kinderziekenhuis/Academisch Ziekenhuis Rotterdam/Erasmus Universiteit Rotterdam, 1997
- Simmons JH, McFann KK, Brown AC, Rewers A, Follansbee D, Temple-Trujillo RE, Klingensmith GJ. Reliability of the diabetes fear of injecting and self-testing questionnaire in pediatric patients with type 1 diabetes. *Diabetes Care* 2007;30:987–988
- Wichstrom L. Harter's Self-Perception Profile for Adolescents: reliability, validity, and evaluation of the question format. *J Pers Assess* 1995;65:100–116
- Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol* 1986;51:1173–1182
- Lustman PJ, Anderson RJ, Freedland KE, de Groot M, Carney RM, Clouse RE. Depression and poor glycemic control: a meta-analytic review of the literature. *Diabetes Care* 2000;23:934–942
- Pouwer F, Snoek FJ, van der Ploeg HM, Ader HJ, Heine RJ. Monitoring of psychological well-being in outpatients with diabetes: effects on mood, HbA_{1c}, and the patient's evaluation of the quality of diabetes care: a randomized controlled trial. *Diabetes Care* 2001;24:1929–1935
- Adriaanse MC, Snoek FJ, Dekker JM, Spijkerman AM, Nijpels G, Twisk JW, van der Ploeg HM, Heine RJ. No substantial psychological impact of the diagnosis of type 2 diabetes following targeted population screening: the Hoorn Screening Study. *Diabet Med* 2004;21:992–998
- van der Ven NC, Lubach CH, Hogenelst MH, van Iperen A, Tromp-Wever AM, Vriend A, van der Ploeg HM, Heine RJ, Snoek FJ. Cognitive behavioural group training (CBGT) for patients with type 1 diabetes in persistent poor glycaemic control: who do we reach? *Patient Educ Couns* 2005;56:313–322
- Mollema ED, Snoek FJ, Ader HJ, Heine RJ, van der Ploeg HM. Insulin-treated diabetes patients with fear of self-injecting or fear of self-testing: psychological comorbidity and general well-being. *J Psychosom Res* 2001;51:665–672
- Snoek FJ, Pouwer F, Welch GW, Polonsky WH. Diabetes-related emotional distress in Dutch and U.S. diabetic patients: cross-cultural validity of the problem areas in diabetes scale. *Diabetes Care* 2000;23:1305–1309
- Franciosi M, Pellegrini F, De Berardis G, Belfiglio M, Cavaliere D, Di Nardo B, Greenfield S, Kaplan SH, Sacco M, Tognoni G, Valentini M, Nicolucci A. The impact of blood glucose self-monitoring on metabolic control and quality of life in type 2 diabetic patients: an urgent need for better educational strategies. *Diabetes Care* 2001;24:1870–1877
- Wrigley M, Mayou R. Psychosocial factors and admission for poor glycaemic control: a study of psychological and social factors in poorly controlled insulin dependent diabetic patients. *J Psychosom Res* 1991;35:335–343
- Delamater AM. Psychological care of children and adolescents with diabetes. *Pediatr Diabetes* 2007;8:340–348
- Varni JW, Katz E. Stress, social support and negative affectivity in children with newly diagnosed cancer: a prospective transactional analysis. *Psychooncology* 1997;6:267–278