

## **Explaining the Adjustment of Adolescents with Type 1 Diabetes: The Role of Diabetes-Specific and Psychosocial Factors**

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*Objective:* This study aims 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 Wallander and Varni's Disability-Stress-Coping model.

*Method:* 437 adolescents (54.5% girls; age range 11-19 years) with type 1 diabetes (mean diabetes duration 6.13 years, SD=3.78), were recruited from 25 hospitals in the Netherlands. Questionnaires were completed by the adolescents and their family members. Metabolic control was assessed by measuring HbA1c in all participants in one lab.

*Results:* Diabetes stress mediated between HbA1c 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 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.

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 Wallander and Varni's Disability-Stress-Coping model (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 HbA1c and certain aspects of adjustment including diabetes-related quality of life and general well-being. Although recent studies have also suggested an association between HbA1c 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 HbA1c 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 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 HbA1c and diabetes quality of life while it partially mediates between HbA1c 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 HbA1c and general well-being, and between HbA1c and psychopathology, whereas it partially mediates the relationship between HbA1c 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). As 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 experienced stress. It might well be that during adolescence, when young people are expected to play an increased role in self-care and daily stress 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. By 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 would suggest 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 socio-ecological 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), while other studies indicated that effective diabetes-specific, (i.e., tangible support is mainly provided 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 gender, age, and duration of disease to be influential factors. However, since this was not the primary focus of this study these factors were controlled in the present analysis.

## **METHOD**

***Sample and procedure:*** The study sample was drawn from 890 adolescents with type 1 diabetes who visit one of the twenty-five hospitals in the south-western area of the Netherlands offering diabetes care for adolescents. Adolescents 11-19 years old with type 1 diabetes, who were on daily insulin injection or pump, were included. Out of the 550 invited adolescents, 21 were excluded due to one of several reasons (disability, cystic fibrosis, insufficient command of the Dutch language, duration of diabetes < 1 year). Of the 529 adolescents who fulfilled the criteria (age range 11-19 years, 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 due to a change of address. Nonresponders did not significantly differ from responders in sex or age. Sample characteristics are presented in Table 1. After obtaining informed consent 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 HbA1c of all participants in one lab; mean HbA1c was not significantly different for adolescents using pump (5.3%) versus using injection (94.7%) (means 8.3, SD=1.23 vs. 8.6, SD=1.5).

***Measurements:*** In addition to demographic characteristics and HbA1c, data was collected on adjustment and risk and protective factors from adolescents, parents, and healthcare 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,  $\alpha=.85$ ), Worries (11 items,  $\alpha=.82$ ), and Satisfaction with Life (17 items,  $\alpha=.85$ ). A composite scale score ( $\alpha=.92$  for the present sample) was computed by summing the three subscale scores (Impact and Worries scales reversed) into a diabetes QoL score (with higher scores indicating better quality of life). General well-being was measured with the 12-item Well-Being Questionnaire (WBQ12)(11), which includes three subscales: Positive well-being (4 items), Negative well-being (4 items), and Energy (4 items), summed into a total General well-being score ( $\alpha=.79$ ). Psychopathology was measured by the Child Behavior Checklist/4-18 (CBCL/4-18) and Youth Self Report (YSR). Each contains 120 items on behavioural/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 .82-.99 for the CBCL and from .77-1.00 for the YSR (12). Standardized Z-scores of all subscales from both questionnaires were added into a total psychopathology score ( $\alpha=.88$ ).

**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 hypoglycaemias and hyperglycaemias. The D-FISQ is a 30-item self-report questionnaire consisting of the two subscales Fear of Self-Injecting (FSI,  $\alpha=.94$ ) and Fear of Self-Testing (FST,  $\alpha=.90$ ) ( $\alpha=.57$  for the total score). The measures are related to adherence to diabetes care in pediatric type 1 diabetes patients (13). Complaints due to hypoglycaemia and hyperglycaemia were

measured on a 20-item scale ( $\alpha=.88$ ). 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 no stress/tension, a little, moderate, and a lot of stress/tension.

**Protective Factors:** Protective factors included intrapersonal factors, (i.e., global self-worth), and socio-environmental factors, (i.e., social support and tangible support). Global self-worth was measured by the 6-item global self-worth subscale ( $\alpha=.77$ ) of the Self-Perception Profile for Adolescents (SPPA) (14). Social support was assessed by the 24-item Social Support Scale for Children (SSSC), which taps adolescents' perceived social support from four sources (classmates, friends, parents and teachers, with 6 items in each subscale), from which a total score ( $\alpha=.84$ ) combining all four subscales was computed. Tangible support from parents and friends was measured on the Modified Diabetes Specific Support Questionnaire (MDSSQ; Family, Friend), using the 70-item MDSSQ-Family ( $\alpha=.82$ ) and the 54-item MDSSQ-Friends ( $\alpha=.82$ ), respectively. The MDSSQ are structured questionnaires about the frequency of supportive behaviours regarding insulin administration, blood glucose testing, following a meal plan, exercising regularly, and 'feeling good' about diabetes. The adolescent rates the supportiveness of each behaviours, which is multiplied by the frequency score of the respective behaviours. Scores from similar categories of tangible support from parents and friends were combined to compute a tangible support score ( $\alpha=.87$ ).

**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.,  $r=.16$ ,  $p=.05$ , and  $r=.17$ ,  $p=.05$ ) for girls and boys, respectively. Of the demographic and disease characteristics, age was correlated only with tangible support ( $r=-.20$  for girls,  $r=-.27$  for boys), and duration of diabetes correlated positively with HbA1c for boys (for correlations, see Table A1 available in the online appendix at <http://care.diabetesjournals.org>). 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 HbA1c 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 HbA1c and did not mediate the relationship between HbA1c and adjustment (see Table A2, available in the online appendix, for a summary of the mediation analysis).

After controlling for gender, age, and diabetes duration in a first block, HbA1c was added in the second block and explained a 3.8% variance in diabetes quality of life ( $\beta=-.18$ ,  $p<.01$ ); 1% in general well-being ( $\beta=-.14$ ,  $p<.01$ ); and 3.9% in psychopathology ( $\beta=.17$ ,

$p<.01$ ). To investigate the mediation of the association between HbA1c and adjustment both diabetes-related and general stress were added in the third step (Block 4). Diabetes-related stress fully mediated the relationship between HbA1c and two aspects of adjustment (i.e., diabetes quality of life, and general well-being)  $p<.01$  by Sobel test, and partially mediated the relationship between HbA1c and psychopathology ( $p<.05$  by Sobel test). Mediation of diabetes-related stress was accounted for an overall 43.3% of variance in diabetes quality of life, 39.4% in general well-being, and 41.1% 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 gender, age, and diabetes duration in the first block and for HbA1c in the second block. Protective factors were inserted in the third block (Model 4). Results indicated that global self-worth ( $\beta=.43$ ,  $p<.01$ ) and general social support ( $\beta=.25$ ,  $p<.01$ ) accounted for an increase of 25.7% variance explained in diabetes quality of life; global self-worth ( $\beta=.45$ ,  $p<.01$ ) and general social support ( $\beta=.16$ ,  $p<.01$ ) accounted for an increase of 32.6% variance explained in general well-being; and global self-worth ( $\beta=-.40$ ,  $p<.01$ ), general social support ( $\beta=-.21$ ,  $p<.01$ ), and tangible support ( $\beta=.18$ ,  $p<.01$ ) 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 ( $\beta=-.46$ ,  $p<.01$ ) 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 ( $p < .01$  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 ( $p < .01$  by Sobel test) the relationship between global self-worth and well-being with a substantial decrease in the regression coefficient, and fully mediated ( $p < .01$  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 including risk factors in the equation. Both diabetes-related ( $\beta = .39$ ,  $p < .01$ ) and general stress ( $\beta = .26$ ,  $p < .01$ ) significantly predicted psychopathology (i.e.,  $\Delta R^2 = .19$ ,  $p < .01$ ) 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 ( $p < .01$  by Sobel test). Diabetes-related stress fully mediated the association between tangible support and psychopathology ( $p < .01$  by Sobel test). No conclusion can be drawn for mediation by general stress as 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. Centred interaction terms were computed between three protective and two risk factors. Multiple regression analyses were conducted for all three outcome adjustment factors by controlling demographic and diabetes duration in the first block, HbA1c in the second block, protective factors in the third block, 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**

This study investigated the role of diabetes-specific and psychosocial factors in the adjustment of adolescents with type 1 diabetes, using an adapted version of Wallander and Varni's disability-stress-coping model. The results of the present study are consistent with those of studies reporting the negative effects of HbA1c on adjustment of adolescents (16-17). As expected, the level of HbA1c emerged as a significant predictor of diabetes-related quality of life as well as general well-being and psychopathology. However, the amount of variance in adjustment explained by HbA1c was small, which is in line with Wallander and Varni's (1998) tenet 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 (1).

Diabetes-related stress, on the other hand, fully mediated the relationship between HbA1c and diabetes quality of life and well-being. Contrary to our hypothesis, general stress did not mediate the relationship between HbA1c and adjustment, despite its strong associations with all aspects of adjustment. Diabetes-related stress had strong effects on all three aspects of adjustment, while general stress independently predicted quality of life and psychopathology. The partial mediating effect of diabetes-related stress on the relationship of HbA1c and psychopathology as compared to full mediation on the relationship of HbA1c and diabetes-related quality of life confirmed our hypothesis that diabetes-related stress is important in explaining diabetes-related aspects of adjustment as compared to generic aspects of adjustment. Our findings are in line with the work of Quiggins and Varni, who

found that perceived disease-related stress was associated with higher negative affectivity and behaviour problems in cancer patients even after controlling for demographic and medical variables (1). The strong effects of diabetes-related stress could be explained by several factors, including the emotional trauma of being diagnosed with 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 found 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 diagnosis, however, adverse effects can be expected after diagnosis due to the extra burden of blood testing and external insulin administration. Evidence for this comes from a recent study showing that outpatients selected from seven hospitals on long-standing high HbA1c, perceived self-care behaviours 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 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 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 suggesting that both disease-specific and generic perceived stress are associated with maladjustment (1).

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 behaviours 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 behaviour 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 regimes. 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 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 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.

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Table 1. Demographic and disease characteristics and study variables

|                          | Valid N | Boys          | Girls         | Total Sample  |
|--------------------------|---------|---------------|---------------|---------------|
| Gender (%)               | 437     | 199 (45.5%)   | 238 (54.5%)   | -             |
| Age                      | 437     | 14.8 (1.9)    | 14.7 (1.8)    | 14.7 (1.9)    |
| Age at diabetes onset    | 412     | 8.5 (4.2)     | 8.6 (3.7)     | 8.6 (3.9)     |
| Diabetes duration        | 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%)    | -             |
| Hba1c                    | 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) |

Note: Table entries include Ns and means (SD and percentages in parentheses)

Table 2. Results of Mediation Analysis:

| Dependent Variable       | Predictors             | $\beta$ Model 1 | $\beta$ Model 2 | $\beta$ Model 3 | $\beta$ Model 4 | $\beta$ Model 5 |
|--------------------------|------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Diabetes Quality of Life | Block 1                |                 |                 |                 |                 |                 |
|                          | Gender                 | 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                |                 |                 |                 |                 |                 |
|                          | HbA1c                  |                 | -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 Square                 |                        | 0.10            | 0.114           | 0.433           | 0.371           | 0.533           |
| General Well-Being       | Block 1                |                 |                 |                 |                 |                 |
|                          | Gender                 | 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                |                 |                 |                 |                 |                 |
|                          | HbA1c                  |                 | -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 Square                 |                        | 0.013           | 0.050           | 0.394           | 0.376           | 0.535           |
| Psychopathology          | Block 1                |                 |                 |                 |                 |                 |
|                          | Gender                 | -0.069          | -0.063          | 0.052           | -0.048          | 0.013           |

Adjustment of Adolescents with Type 1 Diabetes

|         |                        |        |         |         |          |          |
|---------|------------------------|--------|---------|---------|----------|----------|
|         | 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 |                        |        |         |         |          |          |
|         | HbA1c                  |        | 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 Square               | 0.027  | 0.066   | 0.448   | 0.345    | 0.557    |

β Model 1: Controlled variables (gender, age, and diabetes duration)

β Model 2: Effect of HbA1c controlling for variables in Model 1

β Model 3: Effect of risk factors controlling for variables in Model 1 and 2

β Model 4: Effect of protective factors controlling for variables in Model 1 and 2

β Model 5: Effect of risk factors controlling for variables in model 1, 2, and 4

\* Regression coefficient significant at .05

\*\* Regression coefficient significant at .01

Note: All Betas presented in table are standardized regression coefficients.

Difference of R Square between any two models presents unique effect of variables included in later model.