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Adolescents with poorly controlled type 1 diabetes: psychological flexibility is associated with the glycemic control, quality of life and depressive symptoms

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Highlights:

- Adolescents with poorly controlled type 1 diabetes were investigated
- Psychological flexibility (PF) was associated with glycaemic control (HbA1c)
- PF was also associated with quality of life (QoL)
- Diabetes-related PF mediated the relationship between HbA1c and QoL
- Increased PF skills might help in achieving better glycaemic control

ABSTRACT

This study investigates the role of psychological flexibility in relation to glycaemic control (HbA1c) and quality of life among adolescents with poorly-controlled diabetes. Adolescents (n = 65, aged 12–16 years) completed the Children and Adolescents Mindfulness Measure (CAMM), the Diabetes Acceptance and Action Scale for Children and Adolescents (DAAS), the Depression Scale (RBDI), and the Health-Related Quality of Life Scale (KINDL-R). HbA1c values were collected from medical records. A higher level of psychological flexibility was associated with better glycaemic control, better quality of life, and lower levels of depressive and anxiety symptoms. Mediation analysis showed that diabetes-related psychological flexibility mediated the relationship between glycaemic control and depressive symptoms as well as quality of life. The observations in the current study support the view that adolescents with type 1 diabetes would benefit from training their psychological flexibility skills.

Keywords: type 1 diabetes, adolescence, psychological flexibility, quality of life

INTRODUCTION

Maintaining optimal glycaemic control in type 1 diabetes (T1D) requires intensive daily management involving checking blood glucose levels multiple times a day, multiple insulin injections or the use of an insulin pump, and careful attention to nutrition and physical activity. Metabolic control has been shown to deteriorate in adolescence as a result of pubertal and behavioural changes (Luyckx et al., 2010). In adolescence, the treatment of diabetes is often associated with neglect of self-monitoring, higher rates of ketoacidosis, and eventually microvascular complications (Insabella et al., 2007). Although the achievement of the optimal

glycaemic target has both immediate and long-term health benefits, only 21% of adolescents meet the target values of HbA1c (Wood et al., 2013).

There are several psychological factors that affect diabetes management (e.g. immaturity of problem-solving skills, adolescent rebellion, and the desire to belong to peer groups without seeming different (Anderson, 2003; Insabella et al., 2007)). Additionally, shifting diabetes management responsibility from parents to youth can be demanding (Wiebe et al., 2014). Poor adjustment to diabetes in adolescence tends to persist into young adulthood (Insabella et al., 2007).

The rates of psychological symptoms have been estimated to be elevated in several studies of adolescents with T1D (Buchberger et al., 2016; Butwicka et al., 2015). Adolescents with T1D have displayed an increased incidence of anxiety, eating disorders, and depression (Kongkaew et al., 2013). In addition, distress specifically related to diabetes is common (Anderson, 2011). However, the results are mixed; a meta-analysis by Reynolds and Helgeson (2011) showed that adolescents with T1D have only slightly elevated levels of symptoms of depression and anxiety, and some studies have found no differences (Sivertsen et al., 2014).

The connection between depression and glycaemic control can be seen as reciprocal: poor glycaemic control is a risk factor for depression, and on the other hand, depression is estimated to have a negative impact on glycaemic control (Lustman & Clouse, 2005). Adolescents with depressive symptoms may have difficulties in initiating tasks for diabetes management, carrying them out, and believing they will be effective (McGrady et al., 2009). Anxiety has also been connected to glycaemic control (Buchberger et al., 2016). In general, although adolescents with T1D experience burden and worries about their illness, they still evaluate their general quality of life as being similar to their peers (Murillo et al., 2017; Nieuwesteeg et al., 2012).

One option to promote wellbeing, quality of life, and possibly glycaemic control

among adolescents with T1D is to enhance their psychological flexibility skills. This has been argued to be crucial for health as it aids individuals in handling their thoughts, feelings, and behaviours to navigate through various situations and to have a meaningful life according to one's personal values (Hayes et al., 2006; Kamody et al., 2017; Kashdan & Rottenberg, 2010).

Psychological flexibility is composed of six core processes: clarification of one's values, committed action, self as a context, defusion, acceptance, and contact with the present moment (Hayes et al., 2006). The concept of psychological flexibility is the core of Acceptance and Commitment Therapy (ACT). ACT has been successfully used in the treatment of numerous health conditions, including type 2 diabetes (Gregg et al., 2007), obesity (Lillis & Kendra, 2014), chronic pain (Wicksell et al., 2009), and depression (Kyllönen et al., 2018; Lappalainen et al., 2007).

In addition, psychological inflexibility has been found to be linked to anxiety, somatic complaints, problem behaviours, and decreased quality of life among adolescents (Greco et al., 2008), and psychological flexibility has been found to be connected to emotional wellbeing and prosocial skills among 14–16-year-old adolescents (Ciarrochi et al., 2011). Problems in the treatment of adolescents with T1D have been proposed to be connected to psychological inflexibility, especially to experimental avoidance and defusion (Hadlandsmyth et al., 2013). An adolescent might, for example, avoid treatment when around other people to avoid difficult thoughts like, "Other people think that I'm different." In line with this, high acceptance of thoughts and emotions related to diabetes has been connected to lower HbA1c values and better quality of life among type 1 and 2 diabetes patients (Misra & Lager, 2008; Richardson et al., 2001). A diabetes-avoidance coping style has been associated with infrequent blood glucose monitoring (Weijman et al., 2005). Similarly, adolescents who use avoidant coping styles have been shown to experience more diabetes-specific distress, to be

less likely to adhere to treatment, and to have poorer glycaemic control (Iturralde et al., 2017). Overall, relatively few studies have been conducted concerning psychological flexibility in adolescents with T1D, and more studies are needed.

It has been suggested that glycaemic control has an impact on the moods of adolescents (Buchberger et al., 2016). Also, earlier studies (Li et al., 2019) have shown evidence that chronic illness can contribute to elevated depressive symptoms and anxiety and weaken quality of life. Meta-analyses have suggested that children with chronic illness have higher levels of behavioural and social problems, including anxiety and depression, than healthy peers (Pinquart & Shen, 2011) and, further, that children with chronic illness tend to under-report their symptoms (Pinquart & Shen, 2011). As a consequence, it has been recommended that clinicians screen for psychological distress among children with chronic physical illness, and that future studies should analyse the interplay of processes that mediate the effect of chronic illness on behavioural problems (Pinquart & Shen, 2011).

The aims of the present study were to determine among adolescents with T1D: (1) whether glycaemic control is associated with quality of life, and depression and anxiety symptoms; (2) whether high psychological flexibility is associated with better glycaemic control and better quality of life; and (3) whether psychological flexibility mediates the relationship between glycaemic control (independent variable), and quality of life and depressive and anxiety symptoms (dependent variables).

Based on earlier research, regarding our aim 1, it was hypothesized that better glycaemic control would be associated with better quality of life (Li et al., 2019; Pinquart & Shen, 2011). Concerning aim 2, it was expected that high psychological flexibility would be associated with better glycaemic control and quality of life. In addition, we expected psychological skills to mediate the relationship between chronic disease and psychological distress and quality of life. First, based on previous findings (e.g. Li et al., 2019; Pinquart &

Shen, 2011) it was assumed that there is a causal relationship between chronic illness (in the current study, poorly managed T1D) and symptoms of depression and anxiety as well as quality of life (path c in the mediation model, Figure 1). Second, we proposed, based on earlier findings (Hadlandsmyth et al., 2013), that adolescents with T1D show psychological inflexibility and a tendency towards experimental avoidance and defusion (path a, Figure 1). Third, we proposed regarding path b (Figure 1), that adolescents who use avoidant coping styles (report low flexibility) experience more diabetes-specific distress and poorer glycaemic control and quality of life (Iturralde et al., 2017; Misra & Lager, 2008; Richardson et al., 2001; Weijman et al., 2005). Thus, we expected that psychological flexibility would mediate the relationship between chronic illness (e.g. glycaemic control), and psychological symptoms and quality of life (indicated by a significant indirect effect in path a x b, Figure 1).

MATERIALS AND METHODS

The current article is a part of a larger study investigating the use of an ACT-based group intervention for adolescents with type 1 diabetes. This paper presents the findings from the pre-measurements prior to the intervention. The study was conducted at the paediatric outpatient clinic of the Central Finland Health District in cooperation with the University of xxx.

Participants and recruitment

All 12–16-year-old adolescents with T1D within the diabetes clinic whose HbA1c was above the recommendation (7.5%) at the paediatric outpatient clinic were invited to participate. The exclusion criterion was current psychiatric or psychological treatment. Recruitment was conducted during the visits to the paediatric clinic. Oral and written information about the study was given, and written informed consent was obtained. Ethics approval was obtained from the Research Ethical Committee of the Central Finland Health

Care District (reference number #7U2015). Thirteen adolescents cancelled participation before pre-measurement for unknown reasons (seven females, six males, mean HbA1c = 9.38%). Table 1 describes the background information of the participants (n = 65) who took part in the current study. All participants were Caucasian and Finnish-speaking.

Measures

Glycaemic control

HbA1c is a commonly-used marker of glycaemic control, and it is used as a general indicator to reflect the average blood glucose levels of the preceding weeks/months. HbA1c values were obtained from the medical records, and the most recent value, collected within a period of two months, was used.

Quality of life

To measure quality of life, the Revised Children's Quality of Life Questionnaire (KINDL-R) was used (Ravens-Sieberer & Bullinger, 1998). We used the generic, youth-specific module consisting of 24 questions and the diabetes-specific module consisting of 17 questions (41 items total). The generic module consists of the following areas: physical wellbeing, emotional wellbeing, self-esteem, family–social, and school. The answers were given on a Likert scale from 1 to 5. The subscales were combined to form a total score with a maximum of 120 in the generic module and 85 in the diabetes module, with higher scores indicating better QoL. For the analysis, the scores were scaled from 0 to 100 points. Cronbach's alpha was 0.91 for general QoL and 0.87 for diabetes-related QoL.

Symptoms of depression and anxiety

To measure symptoms of depression and anxiety, we used the Revised Beck Depression Inventory (RBDI), a Finnish modification of the 13-item version of the BDI (Beck & Beck, 1972). It consists of 13 questions measuring depressive symptoms and one question measuring anxiety (Raitasalo, 2007). In each question, there are five possible

answers to choose from, and scores are given from 0 to 3. The maximum score for depressive symptoms is 39. Scores under 5 indicate no symptoms, scores between 5 and 7 indicate mild symptoms, scores between 8 and 15 indicate moderate symptoms, and scores above 16 indicate severe depressive symptoms. The maximum score for the question measuring anxiety is 3. The score indicates possible anxiety and its severity (1 for mild, 2 for moderate, and 3 for severe anxiety symptoms). Cronbach's alpha for the measurement was 0.93.

Psychological flexibility

Psychological flexibility was measured using the Child and Adolescent Mindfulness Measure (CAMM) and the Diabetes Acceptance and Action Scale for Children and Adolescents (DAAS).

CAMM was developed to measure general mindfulness and acceptance skills, and it assesses the degree to which children and adolescents observe their internal experiences, act with awareness, and accept internal experiences without judging them (Greco et al., 2011). We used the 10-question version, consisting of statements such as "At school, I walk from class to class without noticing what I'm doing," or "I push away thoughts that I don't like." The answers are given on a Likert scale from 0 to 4, and the maximum score is 40. Higher scores indicate higher levels of general mindfulness and acceptance. Cronbach's alpha for the measurement was 0.84.

Diabetes-related acceptance was measured with DAAS, developed by Greco and Hart (2005). The questionnaire consists of 42 questions, and responses are given on a Likert scale from 0 to 4; the maximum score is 168. It includes statements such as, "I do things that are important to me even though I have diabetes." The questionnaire assesses constructs such as acceptance, cognitive fusion, and experimental avoidance. In particular, DAAS measures how the child handles their feelings related to diabetes and whether the child uses avoidance strategies when dealing with their diabetes. A higher sum refers to higher psychological

flexibility, better acceptance of diabetes, and more action (Greco & Hayes, 2008). The Finnish version was translated from English by the authors, with permission from Dr Laurie Greco. Cronbach's alpha for the measurement was 0.91.

Statistical analysis

Data analyses were carried out using the IBM SPSS statistics program, version 26. To describe the investigated sample, the number of participants classified with mild, moderate, and severe symptoms of depression and anxiety was reported. Additionally, QoL measures (mean, standard deviation, 95% CI) were compared to the available reference values of a German population of adolescents of the same age (n = 1895; Ravens-Sieberer et al., 2008) because a Finnish reference group was not available. Correlation coefficients were used to examine the associations between the variables. Correlations with $r \geq 0.50$ were regarded as strong and $r \geq 0.30$ as moderate (Kraemer et al., 2003).

We conducted mediation analyses (see Figure 1) using bootstrapping (Preacher & Hayes, 2008) to determine whether psychological flexibility mediates the relationship between glycaemic control (the independent variable), and QoL and depressive and anxiety symptoms (the dependent variables). In the analysis, the effect of gender was controlled since it is known that adolescent girls have more symptoms of depression and anxiety and report lower quality of life (Cavallo et al., 2006; Hood et al., 2006).

Mediation exists when the independent variable (HbA1c level) is associated with the dependent variable (e.g. QoL) indirectly through the mediator (DAAS). Using 1000 bootstrap resamples, 95% bias-corrected bootstrap confidence intervals were derived for indirect effects. If the lower and upper bounds did not contain zero, the indirect effect was considered significant. We also calculated the percentage of mediation (a x b / c) to estimate the proportion of the total relationship between the X and the Y explained by the indirect effect. Figure 1 illustrates the mediation model. In our hypothesized mediation model, our predictor

variable was glycaemic control (X), the mediator was diabetes-related psychological flexibility (DAAS), and our outcome variables were QoL and depressive and anxiety symptoms.

Power analysis for the mediation analysis was conducted post hoc by using M+ software (version 8.4) and Monte Carlo simulations with 10,000 replications. We applied two models in order to investigate the power in our mediation analysis. The first model included the average blood glucose levels (IV= HbA1c), symptoms of depression (DV), and diabetes-related flexibility (DAAS) as the mediator. The power for indirect effects was 0.877, and the power for the total direct effect was 0.761. The second model included the average blood glucose levels (IV= HbA1c), general quality of life (DV), and diabetes-related flexibility (DAAS) as the mediator. The power of the indirect effect was 0.875, and the power of the total direct effect was 0.623. A power of 0.80 is estimated to be sufficient. This indicated that our sample size was large enough to obtain significant mediation effects (e.g. Hinton et al., 2004). The mediation analysis was not conducted on general psychological flexibility (CAMM) because the power was lower than desired (< 0.80). The power for the indirect effect was 0.570 and for the total effect 0.622 when IV = HbA1c and DV = quality of life.

RESULTS

Symptoms of depression and anxiety and quality of life

At least mild depressive symptoms were reported by 20% of participants, and at least mild anxiety symptoms were noted by 39%. Symptoms of depression and anxiety are presented in Figure 2. Table 2 describes the means, confidence intervals, and minimum and maximum values of quality of life (QoL). Based on the 95% confidence intervals (Table 2), the general level of QoL, the level of QoL related to self-esteem, friends and school were

higher in our group than in the healthy reference group (Ravens-Sieberer et al., 2008). The other dimensions of QoL did not differ from the non-diabetic reference group.

Is glycaemic control associated with depressive symptoms and anxiety as well as with quality of life?

Glycaemic control (HbA1c) correlated significantly with the level of symptoms of depression and anxiety; the higher the HbA1c (i.e. poorer control), the higher the level of symptoms (Table 3). The correlations were moderate ($r \geq 0.30 < 0.50$). Glycaemic control was significantly associated with general QoL, QoL related to self-esteem, QoL at school, and with diabetes-related QoL. The correlations varied from small to moderate ($r = 0.25–0.47$). Thus, the higher the HbA1c (i.e. poorer control), the lower the QoL (Table 3).

Is psychological flexibility associated with symptoms of depression and anxiety, quality of life, and glycaemic control?

Psychological flexibility (both general and diabetes-related) correlated moderately or strongly ($r = 0.36–0.64$) with symptoms of depression and anxiety (Table 3). Thus, a higher level of psychological flexibility was associated with lower levels of symptoms. Psychological flexibility (both general and diabetes-related) was significantly correlated with all dimensions of QoL. The correlations were moderate or strong ($r = 0.33–0.76$). In particular, diabetes-related flexibility (DAAS) correlated strongly with many dimensions of QoL (emotional, self-esteem, school, diabetes). This suggests that the higher the psychological flexibility skills, the higher the QoL (Table 3). Psychological flexibility also correlated significantly and moderately with glycaemic control. The higher the level of psychological flexibility, the better the glycaemic control (lower HbA1c).

Psychological flexibility as a mediator

Table 4 shows the outcomes of the mediation analysis. The results indicated that diabetes-related psychological flexibility (DAAS) mediated the relationship between

glycaemic control and depressive symptoms. For anxiety, the mediation effect was not found. Diabetes-related psychological flexibility also mediated the relationship between glycaemic control and quality of life, including general QoL and all the subscales.

We also calculated the percentage of mediations to estimate the proportion of the total relationship between X and Y explained by the indirect effect (Table 4). DAAS explained 69% of the total relationship between glycaemic control and depressive symptoms and 86% of the relationship between glycaemic control and general quality of life (QoL). Among the subscales of quality of life, the largest proportion explained was found for the subscales of QoL related to family (85%) and self-esteem (78%).

DISCUSSION

Among adolescents with poor glycaemic control, psychological flexibility was associated with glycaemic control: the higher the psychological flexibility skills, the better the glycaemic control. In line with this, Hadlandsmyth et al. (2013) proposed that problems in the treatment of diabetes in adolescence could be related to psychological inflexibility. Attempts to avoid facing problems through behavioural or emotional disengagement or avoidance are a way for adolescents with diabetes to handle difficulties (Jaser & White, 2011). Avoidance of diabetes treatment, such as delaying checking blood glucose or taking insulin, may offer momentary relief from the negative emotions associated with diabetes. The avoidance pattern may, however, lead to an attitude of diabetes being unmanageable, as well as feelings of guilt. Diabetes-related distress may interfere with further self-management and weaken glycaemic control (Iturralde et al., 2017).

In the current study, psychological flexibility was also associated with the quality of life of the adolescent and the levels of depressive and anxiety symptoms. There is previous

research supporting psychological flexibility being connected to depressive (Plumb et al., 2004) and anxiety symptoms (Karekla et al., 2004) and quality of life (Di Battista et al., 2009), and our results are in line with these studies.

Based on earlier findings (e.g. Li et al., 2019; Pinquart & Shen, 2011) we assumed that there is a causal relationship between poorly-managed diabetes, and symptoms of depression and anxiety, and quality of life. Further, based on previous evidence, we proposed that psychological flexibility would mediate this relationship. Our findings supported our assumptions for the most part. Diabetes-related psychological flexibility mediated the relationship between glycaemic control and depressive symptoms, as well as quality of life. In fact, how the child handles emotional reactions related to diabetes, and whether the child uses avoidance strategies or not when dealing with diabetes (as measured by DAAS), mediated a great amount of the association between glycaemic control and quality of life. A high proportion of the total relationship between glycaemic control and quality of life relating to family and self-esteem was explained by DAAS. However, anxiety was not mediated by psychological flexibility, which was against our hypothesis. The mediation was marginally not significant (CI -0.001; 0.11); however, it is possible that with a larger study population, the mediation would have been significant.

In our study, the diabetes-related psychological flexibility measure, DAAS, appeared to be a useful instrument for obtaining knowledge of adolescents' thoughts and emotional reactions towards diabetes. Further, the DAAS correlated strongly with quality of life. Based on the current findings, we recommend clinicians use DAAS or an equivalent measure in order to obtain information on an adolescent's attitudes and behavioural patterns towards their diabetes. Further, diabetes-related psychological flexibility was associated with glycaemic control, suggesting that diabetes-related psychological flexibility (e.g. how the child handles their feelings related to diabetes and whether the child uses avoidance strategies when dealing

with their diabetes) could be a potential target for intervention among adolescents with poor glycaemic control.

When compared to Finnish adolescents in general (Strandholm & Ranta, 2013; Wargh et al., 2015), the prevalence of moderate or severe depressive and anxiety symptoms was not higher among the group of adolescents investigated in this study. Also, quality of life was not lower in our sample compared to the non-diabetic reference group.

Glycaemic control was significantly associated with general quality of life, diabetes-related quality of life, and quality of life related to school and self-esteem; the higher the HbA1c, the lower the quality of life. There are other studies supporting this observation, showing that good glycaemic control has been connected to better quality of life (Hilliard et al., 2013). As reported above, we found that poorer control of diabetes (higher HbA1c) was associated with lower school-related quality of life. Adolescents spend long days at school and need to take care of their diabetes during lunch, breaks, gym, and other activities. This tends to be difficult for many adolescents who do not want to look different from their peers. Avoiding diabetes treatment in social situations may worsen the self-management of the illness.

Poorer glycaemic control was associated with a higher level of anxiety and depressive symptoms. This is consistent with previous studies (Buchberger et al., 2016; Hassan et al., 2006; Kongkaew et al., 2013). The co-occurrence of depression and anxiety with diabetes can worsen the quality of life (Goldney et al., 2004) and potentially predispose the individual to problems in adulthood (Insabella et al., 2007). In clinical practice, in addition to diabetes-related psychological flexibility, it is important to pay attention to symptoms of depression and anxiety as well as quality of life among adolescents with type 1 diabetes.

One significant limitation of the current study is the small sample size, which limits the generalizability of the results. The power analysis was conducted for the mediation

analysis, and the power was estimated to be sufficient. However, this limitation must be observed when drawing conclusions from the current data since it has been shown that the between-study heterogeneity estimate can decrease or alternatively increase when underpowered studies have been excluded from the meta-analyses. This is probably due to the fact that underpowered studies tend to observe more extreme effect estimates. This can increase the possibility that underpowered studies often show different results compared to larger studies (Turner et al., 2013).

It also needs to be observed that the pre-measurement of an intervention study was used in the current study, and the exclusion criterion for participation was regular psychiatric or psychological contact, which may have affected the results. Also, these findings represent adolescents with poorly-controlled diabetes and their families who were motivated to participate in an intervention study. This can have an effect on generalizing the results to all adolescents with T1D. Measures were based on a limited number of self-reports, and they measure what is asked in specific questions included in the measure. Finally, due to the cross-sectional nature of the data, we need to be cautious in drawing causal relations based on the current findings.

In summary, we observed that psychological flexibility skills were associated with glycaemic control, quality of life, and depressive and anxiety symptoms among adolescents who poorly manage their diabetes. Diabetes-related psychological flexibility skills also mediated the associations between glycaemic control and quality of life and the levels of depression symptoms. Thus, interventions aiming to increase psychological flexibility skills could be useful for enhancing diabetes management and quality of life among adolescents with poorly-controlled diabetes.

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Table 1.
The background information of the participants (n = 65).

	Male (n = 24) *36.9%*	*Female (n = 41)* *63.1%*	*All (n=65)*
Age			
Mean (sd)	13.29 years (1.12)	13.63 years (1.22)	13.51 years (1.19)
12–13 years	n = 13	n = 19	n = 32
14–16 years	n = 11	n = 22	n = 33
Illness duration			
Mean (sd)	6.59 years (3.85)	6.78 years (4.30)	6.71 years (4.11)
Min.-max. values	0.4–12.75 years	0.4–15.0 years	0.4–15.0 years
95%CI	5.03–8.17	5.50–7.96	5.67–7.71
*HbA1c**			
Mean (sd)	9.19% (1.94)	9.48% (1.76)	9.34% (1.83)
Min.-max. values	6.8%–15.80%	6.3%–14%	6.3%–15.8%
95%CI	8.37–9.94	8.95–10.06	8.91-9.79

*Recommended blood glucose level ≤ 7.5%

Table 2.

General and different dimensions of quality of life. Means, standard deviations (SD), confidence intervals (95 % CI), and minimum and maximum values in the current study (n=65) and reference values from a German study are presented (* = Ravens-Sieberer et. al, 2008; N=1895).

	Diabetes population in this study					Non-diabetic reference group*		
	Mean	SD	95 % CI	min.	max.	Mean*	SD*	95% CI
KINDL General	76.53	10.65	73.82–79.06	37.50	94.17	73.00	10.20	72.53–73.47
KINDL Physical	74.94	14.23	71.02–78.40	30	100	70.70	16.80	69.93–71.47
KINDL Emotional	79.08	12.12	76.08–81.84	35	100	81.60	12.60	81.03–82.18
KINDL Self Esteem	68.38	15.96	64.31–71.92	25	100	58.40	18.30	57.56–59.24
KINDL Family	83.23	15.14	79.15–86.85	30	100	82.50	15.30	81.80–83.20
KINDL Friends	81.23	12.06	78.54–84.38	45	100	77.50	14.60	76.83–78.17
KINDL School	72.69	14.84	69.16–76.08	30	100	67.20	16.90	66.42–67.98
KINDL Diabetes	75.82	14.04	72.42–79.17	31.76	98.82	-	-	-

KINDL= Health-Related Quality of Life Scale

Table 3.
The correlations between psychological flexibility and glycaemic control (HbA1c), and general QoL and different dimensions of QoL and depressive and anxiety symptoms of the adolescents (n = 65)

	KINDL General (sum)	KINDL Physical	KINDL Emotional	KINDL Self Esteem	KINDL Family	KINDL Friends	KINDL School	KINDL Diabetes	RBDI depr.	RBDI anx.	HbA1c
DAAS	0.64**	0.34**	0.53**	0.53**	0.45**	0.38**	0.67**	0.76**	-0.64**	-0.45**	-0.39**
CAMM	0.58**	0.41**	0.44**	0.44**	0.33**	0.47**	0.58**	0.54**	-0.49**	-0.36**	-0.31*
HbA1c	-0.29*	-0.16	-0.18	-0.25*	-0.20	-0.04	-0.43**	-0.47**	0.33**	0.43**	-

* = $p < 0.05$, ** = $p < 0.01$

DAAS = Diabetes Acceptance and Action Scale for Children and Adolescents

CAMM= The Child and Adolescent Mindfulness Measure

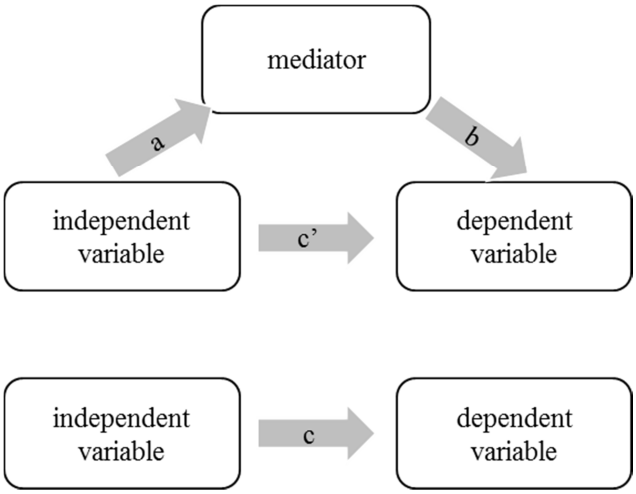
KINDL = Health-Related Quality of Life Scale

Table 4. Direct and indirect effects of depressive and anxiety symptoms and quality of life on glycaemic control (HbA1c) using diabetes-related psychological flexibility (DAAS) as the mediator (indirect effect).

X Independent variable	Y Dependent variable	m mediator	a path coefficient	b path coefficient	Total effect (c)	Direct effect (c')	Indirect effect (ab)	Indirect Effects CI (95%) Lower	Upper	Percent mediation
HbA1c	Depressive symptoms	DAAS	-3.99**	-.15***	.87*	.27	.59	.19	1.60	69%
	Anxiety	DAAS	-3.99**	-.01*	.15***	.11**	.04	-.001	.11	25%
	General QoL	DAAS	-3.99**	.32***	-1.50*	-.21	-1.31	-2.78	-.45	86%
	QoL Physical	DAAS	-3.99**	.21*	-1.10	-.24	-.86	-2.51	-.02	78%
	Qol Emotional	DAAS	-3.99**	.31***	-1.02	.23	-1.27	-2.77	-.41	-
	QoL self-esteem	DAAS	-3.99**	.39***	-2.00	-.43	-1.55	-3.08	-.52	79%
	QoL family	DAAS	-3.99**	.34**	-1.59	-.25	-1.38	-3.10	-.04	85%
	QoL friends	DAAS	-3.99**	.23**	-.067	.86	-.91	-2.36	-.24	-
	QoL school	DAAS	-3.99**	.43***	-3.36***	-1.65*	-1.72	-3.56	-.64	51%
	Diabetes-related QoL	DAAS	-3.99**	-46***	-3.34***	-1.49*	-1.86	-3.24	-.68	55%

* = p < .05, ** =p < .01, ***=p < .001 DAAS= Diabetes Acceptance and Action Scale for Children and Adolescents

Notes: 1) Indirect effects were analysed by bootstrapping 2) Percent mediations for two of the subscales of QoL (emotional and friends) could not be calculated due to inconsistent mediation.



a = the effect of independent variable on mediator
b = the effect of mediator on dependent variable
c = total effect of independent variable on dependent variable = ab+c'
c'= direct effect of independent variable on dependent variable

Figure 1. Simple mediation model (Preacher & Hayes, 2008)

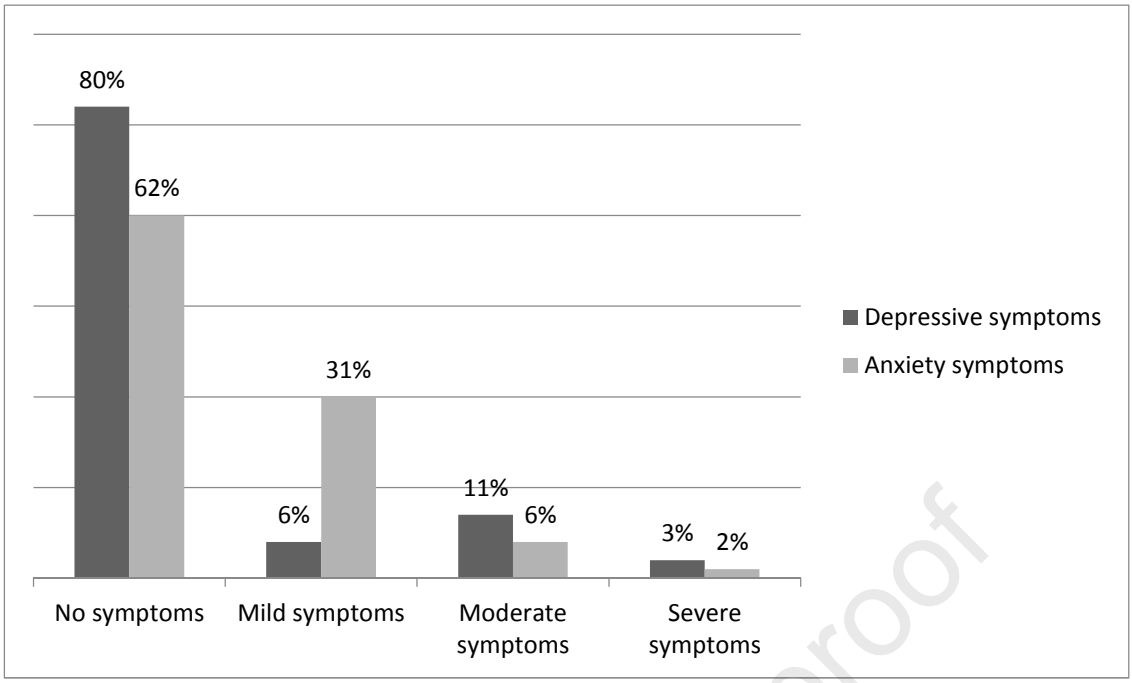


Figure 2. Depressive and anxiety symptoms of the adolescents (n=65).

The authors declare that they have no conflicts of interest.