Factors predicting glycaemic control in young persons with type 1 diabetes

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Summary

The International Study of Pediatric and Adolescent Diabetes (ISPAD) guidelines state the glycaemic treatment goal for children with type 1 diabetes to be HbA1c <57mmol/mol (<7.5% DCCT standard) to minimise the risk of severe late complications. Teenagers with diabetes have a higher risk of psychiatric disorders and impaired quality of life (QoL) compared to healthy teenagers and the guidelines highlights the importance of regular measurement of health and QoL. Previous studies have shown a correlation between glycaemic control and QoL.

The aim of this study was to explore which health and QoL factors correlate and predict outcome in glycaemic control (HbA1c) in young persons with type 1 diabetes. A convenience sample of 204 patients with type 1 diabetes, 12–17 years of age, from three centres in Sweden were recruited. Respondents completed four questionnaires at a regular visit. Check your Health and DISABKIDS chronic generic module DCGM-37 measures physical and emotional health, social relations and QoL. The diabetes-specific module (DCGM-37-DM) measures how the persons are affected by diabetes. The Swe-DES -23 measures four different empowerment factors and The SDD attitudes towards diabetes. Medical data were collected from the patients' medical records. The results from the questionnaires were analysed by multiple linear regression analysis.

A total 22% reached the treatment goal of HbA1c <57mmol/mol, while 28% had poor glycaemic control with HbA1c >73 (>8% DCCT-standard). There was a strong positive correlation between age and HbA1c. Adolescents with poor glycaemic control reported lower physical and mental health, higher burden of diabetes, lower empowerment, more negative attitudes towards diabetes and they thought diabetes was more difficult to handle. Age, physical health, social relations, problem solving, goal achievement, and object evaluation (object = diabetes), predicted 25% of the total variation in HbA1c. Several health-related quality of life factors predict variation in glycaemic control. Our study emphasises the need for regular evaluation of QoL factors and an active discussion about these factors of life in regular care for young persons with type 1 diabetes.

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Key words

type 1 diabetes, adolescent, quality of life, health, glycaemic control

Background

Adolescence is a period in life when hormones decrease insulin sensitivity, which makes it more difficult for young people to reach good glycaemic control.[1,2] There are also studies showing that girls have higher HbA1c than boys during puberty.[3]

The DCCT-study showed that glycaemic control is predictive for the risk of long-term complications.[4–6]

The International Society for Paediatric and Adolescent Diabetes (ISPAD)[6] states that the treatment goal for young people with diabetes should be HbA1c <57 mmol/mol (7.5% DCCT-standard).[7]

Young people with diabetes have a higher risk of psychiatric morbidity, lower health and quality of life (QoL) compared to healthy teenagers.[8–12] Hood *et al* found that the psychosocial burden, and particularly poor diabetes-specific QoL, already contributed to suboptimal glycaemic control during the first years of diabetes.[13] In another study the correlations between disease, management and psychosocial characteristics emphasise the need for increased understanding within this area.[14]

ISPAD guidelines highlight the importance of regular measurement of health and QoL in teenagers with diabetes.[15] Children and teenagers with type 1 diabetes need to manage their disease together with their parents with support from the diabetes team members. Depending on their age and maturity, responsibility for self-management should be gradually taken over by the adolescents themselves.

The transition of shared responsibility is a complicated process, and it is important that parent involvement during this time is constructive.[16] Adolescents may not be mature decision makers, especially in diabetes related issues,[16,17] which will also have a bearing on how they succeed with the diabetes management.

Most recent studies have shown that good glycaemic control correlates with better health and QoL, even if study results are diverse and the causality is unknown.[13,14,18–23]

The combination of complicating physical factors and a lack of maturity may make it difficult for young persons with diabetes to succeed with their self-management.

The aim of this study was to

explore if attitudes, empowerment and QoL predicts variation in glycaemic control.

Methods

Participants

A convenience sample of 204 patients with type 1 diabetes from three children's diabetes centres in Sweden were recruited (Table 1). Five were excluded due to diabetes duration less than six months. The children and their parents gave informed consent.

	Boys	Girls	Total
Number of patients	95	104	199
Mean HbA1c %	7.461% (SD=1.2) 68mmol/mol	7.458% (SD=1.4) 68mmol/mol	7.46% (1.3) 68mmol/mol n=197
Diabetes duration	6.2 (SD=3.6)	6.3 (SD=3.5)	6.3 (3.5) n=192
Mean age	14.75 (SD=1.6)	14.67 (SD=1.7)	14.7 (1.6) n=198
CSSI/MDI	10/82 (9%), n=92	27/61 (30%), n=88	37/147 (20%), n=184

Table 1. Description of the sample

Measures

The instrument **Check your Health**, measures perceived physical and emotional health, social relations and general QoL, using vertical thermometer scales ranging from 0–100 (zero indicates very low perceived health or QoL). On the same scales, a person reports what his/her imagined physical and emotional health, social relations and QoL would be if he/she did not have diabetes. The measured difference between health with and without diabetes is defined as either a positive or negative impact of diabetes. The marginal values for no impact, low impact (0–20), high impact (21–50) and very high impact (51–100) are arbitrary. The instrument has been validated on young people with diabetes.[24,25]

Swe-DES-23 the Swedish Diabetes Empowerment Scale uses a five-point Likert scales ranging from strongly agree (5) to strongly disagree (1). Twenty-three questions are arranged into four empowerment domains which together show general empowerment. The four empowerment domains are: goal achievement, self-awareness, stress management and readiness to change. The questions have been scored so that a person scoring a high value is more empowered than a person scoring a low value. The Swe-DES-23 has been tested on adults with type 1 diabetes and has been found to be valid and reliable.[26]

DCGM-37 is a generic measure for young persons with chronic diseases. The instrument measures Health Related Quality of Life (HRQL) on Likert scales, ranging from 1 to 5. Responses are transformed, resulting in scores ranging from 0 to 100. The questions represent three different domains – physical health, mental health and social relations – and the total score indicates general HRQL. The diabetes-specific module, in which 10 questions represent two different domains (impact on diabetes and treatment) and question 11 consists of three sub-questions with raw scores from 1 to 5 indicates perceived disease severity, including hypoglycemia. The instrument has been tested for reliability and validity.[27]

SDD (Semantic Differential in Diabetes) uses a semantic differential technique, with nine bipolar seven-point adjective scales to measure attitudes towards diabetes. A score of 7 reflects the most positive attitude and 1 the most negative. The nine scales are summed up in to four factors:
Factor 1: self-esteem/autonomy: comprising the scales from valuable to worthless, independent to dependent, and unsafe to safe.
Factor 2: object evaluation: including dominant to submissive and difficult to easy.
Factor 3: a QoL supporting factor, from varied to monotonous.
Factor 4: self-strength/vulnerability: includes the scales from free to constrained, tense to relaxed and weak to strong.

The instrument has been tested on adults with diabetes.[28]

HbA1c was measured using high-performance liquid chromatography (HPLC), either as blood collected on filter paper (values were converted to the Mono-S method using the formula *Mono-S = DCCT standard x 1.0678 – 1.34) 1* or the DCA2000 (Siemens, gives Mono-S values). The normal reference value is 44 mmol/mol (<5.2%).

Data on severe hypoglycaemia and ketoacidosis one year before and one year after collection of the questionnaires were collected from the medical journals.

Data collection procedure

The patients completed the questionnaires at the outpatient clinic before or after a regular visit. Teenagers completed the questionnaires, without help from their parents. Data on HbA1c and disease

duration were collected from the patients' medical records.

Statistics

Linear regression analysis was used to evaluate the relationship between HbA1c and health and QoL variables divided in five different blocks, Health, Burden, Swe-DES, DCGM and SDD. Stepwise regression analyses were performed within each block and the significant variables from each analysis were then included in a final stepwise regression model. For the stepwise selection we used a criterion for entry of a *p*-value <0.10 and for removal of a *p*-value >0.10.

All analyses were performed using Statistica 10.0, StatSoft, Inc. Tulsa OK, USA.[29]

The ethics committee at the Karolinska Institute in Stockholm, registration no. 2005/1352–31, approved the study.

Results

Forty-four patients (22%) achieved the treatment goal HbA1c <57mmol/mol (<6.5%), 98 patients (50%) had suboptimal control 57–73mmol/mol (6.5–8%), and 55 (28%) had poor glycaemic control >73mmol/mol (>8%) according to ISPAD guidelines.

There was no difference in reported frequency of severe hypoglycemia or ketoacidosis between the different HbA1c groups during the year before the study.

The overall strongest correlation with glycaemic control was age. Older patients had higher HbA1c. There were no correlations with gender or disease duration.

Check your Health

There was a correlation between HbA1c and perceived physical health ($p<0.001$, r=–0.36), and perceived emotional health ($p<0.05$, r=–0.17). HbA1c and overall burden of diabetes were strongly correlated ($p<0.001$, r=–0.31). HbA1c correlate to three factors, physical ($p<0.001$, r=–0.35), emotional ($p<0.005$, r=0.22) and QoL ($p<0.005$, r=0.23).

Swe-DES-23

Patients with poor glycaemic control felt significantly less empowered ($p<0.0001$, r=0.29). The strongest correlation was with factor 1, goal achievement ($p<0.0001$, r=–0.31).There were also correlations between glycaemic control and self awareness ($p<0.005$, r=–0.23), stress management ($p<0.005$, r=–0.23) and readiness to change ($p<0.01$, r=–0.20).

DCGM-37and DCGM-37 DM

General poor health correlated to HbA1c ($p<0.05$, r=–0.19). Patients with good glycaemic control perceived better mental ($p<0.005$, r=–0.24) and physical ($p<0.05$, r=–0.17) health.

The diabetes treatment was more difficult to manage ($p<0.0001$, r=–0.29), and diabetes had more negative impact ($p<0.001$, r=–0.27) for those with high HbA1c.

SDD

Patients with good glycaemic control had more positive attitudes towards diabetes ($p<0.0001$, r=–0.27). They perceived higher autonomy ($p<0.05$, r=–0.18), evaluated diabetes as less difficult ($p<0.0001$, r=–0.31) and felt less vulnerable ($p<0.001$, r=–0.21).

Final model of the multiple regression analysis: Age, object evaluation, physical health, empowerment and social relations explained 25% of the variation in HbA1c, but the strongest correlation was with age.

Discussion

Several previous studies have explored the correlation between glycaemic control and QoL in young people with diabetes. Some, but not all, show a negative correlation,[13,14,18–23] These results are supported in the present study, where glycaemic control correlated to several health-related factors. Age was the strongest predictor for variation in HbA1c, but also object evaluation, physical health, empowerment and social relations predicted variation in HbA1c. However the correlations are complex, as also described in the study by Ingerski *et al.*[14]

Girls often have higher HbA1c than boys during puberty,[3] and also report lower emotional health.[12,19,21,27] However no correlations with gender or diabetes duration was found in our study.

The causality between glycaemic control and QoL is not known. People with poor QoL from the onset of diabetes may not have the same prerequisites for reaching good glycaemic control, and may feel more stressed if we push them towards a goal they are not able to reach. On the other hand, if good glycaemic control leads to better QoL it is very important to support young persons in reaching the medical treatment goal.

De Witt *et al* showed in a randomised controlled study that an office-based health-related quality of life intervention had positive effects on psycho-social well-being and satisfaction with care.[30] In a subsequent cross-over study they found that the effect decreased when the intervention stopped. The results implicate that ongoing monitoring and discussions about quality of life issues in routine consultations are important.[14,31]

ISPAD guidelines propose that we measure health and QoL in young people with diabetes regularly, which is supported by our results, as we have shown that there is a correlation between glycaemic control and those factors.

There are several instruments validated for young healthy

persons, for young persons with a generic chronic disease or for young persons with diabetes. The DCGM-37 is tested in different countries, which is important, and is recently validated in Sweden in association with the Swedish national paediatric diabetes registry (Swediabkids), and found to be reliable for repeated measures of health-related quality of life in children with diabetes,[27] Check your Health is very easy and fast to complete,[24] It is important that the instruments for use in daily clinical practice and research are validated, and easy to use and understand.

Conclusions

Several health-related quality of life factors predict variation in glycaemic control. Although the correlations are complicated health-related factors may explain outcome in glycaemic control in individual persons. Our study emphasises the need for regular evaluation of QoL-factors and an active discussion about these factors of life in regular care for young persons with type 1 diabetes.

Declaration of interests

There are no conflicts of interest declared.

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