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Original article

Alexithymia is associated with glycaemic control of children with type 1 diabetes

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Abstract

Aim. – This study examined the respective contributions of the demographics, medical variables and alexithymia characteristics of young diabetics to their glycaemic control. The goal was to replicate the role of the 'difficulty describing feelings' factor of alexithymia in the prediction of poor glycaemic control as has been found in adult diabetic populations.

Method. – The study included 45 type 1 diabetic children, aged 8–12 years (24 girls and 21 boys). Participants completed a sociodemographic questionnaire and provided medical information on their diabetes. HbA_{1c} values (glycated haemoglobin), and the number of severe hypoglycaemic episodes and hospitalizations for hyperglycaemia, were collected for the previous 12 months (3 months for severe hypoglycaemias). Alexithymia characteristics were measured by means of the Alexithymia Questionnaire for children.

Results. – Hierarchical regression analyses confirmed that both demographic (marital status and parental education; P < 0.05) and medical (duration of diabetes and daily self-monitoring of blood glucose frequency; P < 0.01) variables are associated with HbA_{1c} levels. More important, one alexithymia factor (difficulty describing feelings) was found to be an additional predictor over and above the other variables (P < 0.01), explaining an additional 12% of the total variance in HbA_{1c} levels.

Conclusion. – Confirming results already observed in diabetic adults, the present findings show, for the first time, that children who have difficulties in expressing their feelings to others are more at risk of poor glycaemic control. In future, it will be useful to identify the diabetic young people who have such difficulties and to consider interventions designed specifically for them. © 2010 Elsevier Masson SAS. All rights reserved.

Keywords: Type 1 diabetes; Alexithymia; Glycaemic control; Emotion regulation; Diabetic children

Résumé

L'alexithymie est associée avec un moins bon contrôle glycémique chez des enfants diabétiques de type 1.

Objectif. – L'étude examine la contribution respective de variables sociodémographiques, médicales et des caractéristiques alexithymiques de jeunes diabétiques de type 1 sur leur contrôle glycémique. L'objectif était de répliquer l'implication du facteur alexithymique « difficultés à verbaliser ses émotions » dans la prédiction d'un contrôle glycémique médiocre, trouvé dans une population d'adultes.

Méthodes. – L'échantillon se composait de 45 jeunes diabétiques de type 1 (8 à 12 ans, 24 filles et 21 garçons). Les valeurs d'hémoglobine glyquée (HbA_{1c}), le nombre d'hypoglycémies sévères et d'hospitalisations pour hyperglycémie ont été récoltés pour les 12 mois précédents (trois mois pour les hypoglycémies sévères). Chaque participant a complété le questionnaire d'alexithymie pour enfants.

Résultats. – Des analyses de régression hiérarchique montrent que tant les variables démographiques (statut marital et éducation parentale ; P < 0.05), que les variables médicales (durée du diabète et fréquence des autocontrôles quotidiens de la glycémie capillaire ; P < 0.01) étaient associées aux valeurs d'HbA_{1c}. En outre, une des caractéristiques de l'alexithymie (difficulté à décrire verbalement ses émotions) s'est avérée être un facteur prédictif additionnel au delà des deux précédents, (P < 0.01), expliquant 12 % de la variance de l'HbA_{1c}.

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Conclusion. – Confirmant les résultats observés chez des adultes, les résultats actuels indiquent pour la première fois que les enfants qui ont des difficultés à exprimer leurs émotions à autrui sont plus à risque de présenter un moins bon équilibre glycémique. Dans l'avenir, il serait important de détecter les jeunes diabétiques qui présentent de telles difficultés, et de considérer des interventions spécifiques pour réduire ce déficit. © 2010 Elsevier Masson SAS. Tous droits réservés.

Mots clés : Diabète de type 1 ; Alexithymie ; Contrôle glycémique ; Régulation émotionnelle ; Enfants diabétiques

1. Introduction

Good control of diabetes requires maintaining glycated haemoglobin (HbA_{1c}) levels to <7% to avoid both short- and long-term complications [1]. To achieve this goal, the diabetic must adhere to treatment conditions, adapt the treatment according to information given by glycaemic-control measures, and anticipate the long-term consequences of life choices on future health and well-being. With respect to these 'healthy behaviours', a good understanding of, and capacity to regulate the emotions can lead the diabetic patient to better understand and regulate their chronic illness. One construct that describes emotional regulatory skills is emotional competences (EC).

EC refers to the skills that help individuals to cope with emotions (their's and those from others), and adapt themselves and their behaviour to their physical and social environments. EC includes both emotional knowledge and emotional responses [2]. Within the concept of EC, Saarni [3] distinguishes the following features in particular: good understanding of one's own and others' emotions; the ability to express one's own emotions in an appropriate way, considering the context and the culture; the ability to manage one's emotions; and the capacity to make adequate use of the information contained in emotions to achieve one's goals.

EC, and especially emotion regulation, appears to be an important predictor of better inter- and intrapersonal functioning [4,5] and health [6,7]. Conversely, a personality dimension termed 'alexithymia', defined as a lack of EC, appears to be a vulnerability factor for health and a complicating factor in the management of some physical illnesses [8–10]. The alexithymia construct is characterized by three factors: (1) difficulty in identifying one's feelings; (2) difficulty in verbally describing one's feelings; and (3) an externally oriented thinking style [11,12].

Recent studies have investigated alexithymia as a possible predictor of glycaemic control in type 1 diabetics. One study, conducted with type 1 diabetic adults, showed that scoring higher on the factor 'difficulty describing feelings' (DDF) was associated with raised levels of glycated haemoglobin (HbA_{1c}) [13]. The predictive power of DDF on HbA_{1c} variance ($F_{change} = 3.10$; P < 0.05; $\Delta R^2 = 0.12$) was found to be over and above the predictive power of the other assessed predictive variables (sociodemographic data, health condition, depression and anxiety), which were not significant predictors. This finding suggests that DDF is a vulnerability factor for the severity and evolution of diabetes.

Another recent study [14], based on the hypothesis that the parents' emotional abilities are related to their children's glycaemic control, was conducted with 45 families that included young diabetics (25 girls and 20 boys; aged 6–18 years, mean: 12.2 ± 3.4). This study showed that patients with higher maternal alexithymia scores on the 'difficulties identifying feelings' (DIF) factor also had more frequent hospitalizations for severe hyperglycaemia. One possible explanation for this association is that mothers who have difficulties identifying feelings have less ability to read their children's behavioural cues and are, thus, unable to use this information to give their children the care they require.

The above studies suggest that alexithymia characteristics could be vulnerability factors for diabetes control. In particular, the DDF and DIF factors may be interfering with the diabetic patients' ability to take proper advantage of healthcare services and to manage their own illness.

The aim of the present study was to test whether diabetic children's alexithymia characteristics could also predict their level of glycaemic control. Although the treatment of type 1 diabetic children is largely managed by their parents, examining the role of the children's personality factors on health might also provide another means through which treatment could be improved. If there is a relationship between alexithymia and glycaemic control, then therapeutic interventions could be directed towards aspects of alexithymia to increase glycaemic control.

As in previous studies, the present study aimed to assess the power of alexithymia characteristics to predict glycaemic control after controlling for the role of other variables known to be associated with children's glycaemic control, including parents' marital status [14–17], parental education [18–20], duration of diabetes [16,21,22] and daily frequency of self-monitored blood glucose (SMBG) readings [23–25].

The following predictions were also made:

- higher scores for alexithymia factors in diabetic children (particularly for the DDF factor) will be associated with indicators of poorer glycaemic control (HbA_{1c} values, number of severe hypoglycaemic episodes, and number of hospitalizations for hyperglycaemia) [13,14];
- children from two-parent families (married or cohabiting) will have better indicators of glycaemic control than children from one-parent families (separated, divorced or widowed) [14–17];
- higher parental levels of education will be related to better indicators of glycaemic control [18–20];
- longer durations of diabetes will be related to indicators of poorer glycaemic control [16,21,22];
- the children's alexithymia characteristics will be predictive of glycaemic control over and above the predictive power of sociodemographic and medical variables [13].

Table 1

| Summary of the type | 1 diabetic children | 's demographic and | I medical information |
|---------------------|---------------------|--------------------|-----------------------|
|---------------------|---------------------|--------------------|-----------------------|

| Number | 45 |
|--|-------------------------------|
| Female gender | 53% |
| Age (years) | 10.3 ± 1.3 (8–12) |
| Belgian citizenship | 53% |
| Duration of diabetes (months) | 59.20±36.30 (8-136) |
| Number of SMBG readings/day | 4.47 ± 0.69 (4–6) |
| Four SMBG readings/day | 64.4% |
| Insulin treatment with two daily insulin | 84% |
| injections | |
| Body mass index (kg/m ²) | $19.61 \pm 4.19 (14 - 40)$ |
| HbA _{1c} mean value | $7.35 \pm 0.94\%$ (5.93–10.28 |
| Hospitalizations for hyperglycaemia (n) | $0.07 \pm 0.25 \ (0-1)$ |
| Severe hypoglycaemic episodes (n) | $0.47 \pm 0.84 \ (0-3)$ |
| Other relatives with type 1 diabetes | |
| Close family member | 7% |
| Distant family member | 20% |
| Level of parental education | |
| Primary school | 24% |
| Secondary school | 29% |
| University | 47% |
| Two-parent family | 84% |
| Children per family (<i>n</i>) | $2.92 \pm 1.63 (0-7)$ |
| Maternal employment | 60% |
| Paternal employment | 80% |
| | |

Data are expressed as means \pm SD (minimum-maximum) of the study population with the considered variable.

Compared with the previous research by Meunier et al. [14], the following modifications were made. First, the present study only assessed children, as adolescents' predictors of glycaemic control may differ from those of children and, second, the children assessed their own levels of alexithymia rather than being evaluated by their parents. To our knowledge, this is the first study to explore the role of alexithymia levels of diabetic children in their own glycaemic control.

2. Methods

2.1. Study population

The present study was conducted at the diabetology clinic of the University Children's Hospital Queen Fabiola in Brussels, Belgium. A total of 45 young type 1 diabetic patients, aged 8–12 years, took part in the study. From June 2007 to March 2008, all patients who fulfilled the inclusion criteria were invited to participate in the research. Inclusion criteria were: age 8–12 years (born during 1990–1994); a diagnosis of diabetes for > 6 months; and French as the first language or attendance at a French-speaking school. The study population's demographic and clinical characteristics is presented in Table 1.

2.1.1. Treatment and assessment of glycaemic control

The treatment of type 1 diabetes involves reducing glycaemia through several daily injections of insulin, adapting the insulin dose and delivery to glycaemia variations, as revealed by frequent and daily blood-glucose measurements, and glycaemiccontrol assessment with the help of periodic measures of glycated haemoglobin [26,27]. In the present study, the following dependent variables were collected: HbA_{1c} values for the previous 12 months; the number of severe hypoglycaemias in the previous 3 months; and the number of hospitalizations for hyperglycaemia in the previous 12 months.

Glycaemic control was defined as the number of severe hypoglycaemic events (coma and/or convulsions treated by glucagon or intravenous glycated serum injections within the past 3 months) and the number of hospitalizations for hyperglycaemia within the past 12 months (acidocetosis episodes). To maximize accurate recall, participants had to report only their severe hypoglycaemic episodes within the past 3 months. To provide a context for this data, in a study involving a young type 1 diabetic population treated at the same hospital [25], the frequency of severe hypoglycaemias was, on average, 0.2 per year. Hospitalized patients in this series had no reports of ketoacidosis, although their physical state was sufficiently serious as to require hospitalization to restore glycaemic control. In addition, glycaemic control was measured by determination of HbA_{1c} levels, using high-performance liquid chromatography (HPLC), which allowed calculation of the glycaemic-control profile for the past 2 months. The HbA1c normal upper limit is 6.2%. For each child taking part in the present study, HbA_{1c} values collected in the year prior to the study were entered into the annual mean calculation. This provided an objective measure by which to assess glycaemic control for the whole of the past year. Indeed, one aim of diabetes control is to ensure that the HbA_{1c} annual mean is no higher than 7% to avoid any long-term complications [1].

2.2. Design and methods

The present study's design and protocol was approved by the ethics committee of the University Children's Hospital Queen Fabiola. Participants were recruited from the diabetology clinic of the hospital. After a routine physician's appointment (on days that the researcher was on site), medical staff asked the diabetic children if they would like to participate in a study assessing the role of emotions in glycaemic control. If they agreed to participate and met the inclusion criteria, the staff introduced the first author (M.H.) to these children and their parents. Around 75% of the approached patients agreed to take part in the research. After giving their informed consent, both the children and their parents were asked to answer some sociodemographic questions and to provide information on the child's type 1 diabetes, such as disease duration, number of SMBG readings/day and other medical comorbidities. (It should be noted that the medical variables of the participants did not differ significantly from those of nonparticipants). The children were also asked to complete the Alexithymia Questionnaire (AQ; [28]). The dependent variables for assessing glycaemic control were as already described above.

2.3. Questionnaires

2.3.1. Sociodemographic questionnaire and diabetes information

The sociodemographic questionnaire asked about both parents regarding: age (in years); citizenship (Belgian or other); professional status (employed or unemployed); level of education (number of years of school from the first year of primary school, excluding repeats of a year or any higher diplomas obtained); and marital status (two-parent family, married, in a stable relationship; or single-parent family, unmarried, divorced or widowed). In addition, the questionnaire elicited information on the family: the number of children with type 1 diabetes per family; and the number of family members with type 1 diabetes (close and distant relatives).

In addition, the following data on the children were obtained from their medical files or their parents: gender; age (in years); number of insulin injections/day; number of SMBG readings/day (using a hemoglucotest); year of diabetes diagnosis; number of severe hypoglycaemic episodes in the previous 3 months and hospitalizations for hyperglycaemia in the previous 12 months; HbA_{1c} values for the previous 12 months; and investigations for subclinical complications using sensitive methods [29].

2.3.2. Alexithymia

All participating children were required to fill out a questionnaire to assess their alexithymia characteristics [28]. The AQ for children is used to measure the alexithymia construct in primary and secondary schoolchildren, and its concurrent, predictive, convergent and discriminant validity, reliability and stability have been demonstrated [28]. The scale is similar to the adult version (TAS-20; [11,12], although the items are formulated to be understood by younger people, and only three levels are considered on the Likert scales (*vs* five levels in the original version).

The questionnaire involves rating 20 items on a three-point Likert scale (from 0-2: 0 = not true; 1 = somewhat true; and 2 = true). Scoring is reversed for five items (Q4, Q5, Q10, Q18 and Q19), which have been formulated positively. The AQ is a self-reported scale, with a minimum score of 0 and a maximum score of 40. A higher score reflects stronger alexithymia tendencies. As in the adult version, threshold scores are rarely applied, as the continuous scores are more valid and relevant for statistical processing. Furthermore, clinicians prefer to use factor scores, as these allow therapeutic interventions to be more specifically tailored to a given individual's needs.

The French-language version of the AQ was used in our study [30]. The original AQ was adapted into French, using the translation-retranslation method to best retain the characteristics of the original questionnaire. The French AQ shows acceptable reliability and has a three-factor structure ($\alpha = 0.70$, 0.67 and 0.43, respectively) that is consistent with the adult's and original Dutch children's version of the AQ [31]. The three factors are: (F1) difficulty identifying feelings (DIF; 7 items), which assesses the respondent's ability to identify feelings, and to distinguish between feelings and bodily sensations of emotional arousal; (F2) difficulty describing feelings (DDF; 5 items), which reflects difficulties in communicating feelings to other people; and (F3) externally oriented thinking style (EOT; 8 items), which assesses the degree to which respondents are more concerned with external, objective events than their inner psychological states.

2.4. Statistical analysis

All analyses were performed with Statistical Package for Social Sciences (SPSS), version 15.0, software. To test the study hypotheses, correlational analyses were conducted, followed by hierarchical regression analyses, using the variables that revealed significant bivariate correlations to examine the predictive power of each independent variable on glycaemic control.

3. Results

3.1. Descriptive statistics

3.1.1. Population characteristics (sociodemographic variables)

The final study population comprised 45 children (75% acceptance rate) — 24 girls and 21 boys aged 8–12 years — with type 1 diabetes (Table 1). The children's mean age was 10.3 years (\pm 1.3); 24 children were Belgian citizens (53.3%), and 42 children had French as their first language; the remaining three were attending a French-speaking school. Three children (6.7%) had a close family member with type 1 diabetes, and nine (20%) had a distant family member with the disease. The mothers' mean age was 39.7 years (\pm 5.5) and the fathers' mean age was 43.9 (\pm 6.1). Thirty-three parents (84.4%) lived together (marital status: two-parent family), and 36 fathers (80%) and 27 mothers (60%) were employed. The parents were, on average, educated for 11.4 years (\pm 4.2), and the mean number of children per family, including the diabetic child, was 2.92 (\pm 1.63).

3.1.2. Medical variables

The mean HbA_{1c} value for the 45 children was 7.35% (± 0.94 ; minimum: 5.93%; maximum: 10.28%). The mean number of severe hypoglycaemic episodes in the last 3 months was 0.47 (± 0.84); 28.9% (13 children) had one to three severe hypoglycaemic episodes. The mean number of hospitalizations for hyperglycaemia during the past 12 months was 0.07 (± 0.25), and a detailed analysis showed that only three of the 45 children (6.7%) had been hospitalized once during the previous year. Given this floor effect, it was decided not to use this dependent variable to assess glycaemic control in the further analyses.

A total of 38 children were being treated with a regimen of two daily insulin injections (twice-daily free-mix injection regimen in a syringe), and seven with a basal-bolus regimen (≥ 4 daily injections). As in earlier studies [24,29], the mean HbA_{1c} in the present study did not differ significantly between the two groups using insulin treatment [t(43) = -1.03; P = 0.33]. Dietary management depends on the insulin regimen [31], and most of the children (n = 29, 64.4%) took an SMBG reading four times a day. The mean time since the time of diagnosis was 59.20 months (± 36.30). None of the patients had subclinical complications mentioned in their hospital medical files.

3.1.3. Alexithymia characteristics

The total mean AQ score was 17.42 (\pm 4.64), the mean DIF score was 6.22 (\pm 2.87), the mean DDF score was 4.11 (\pm 2.36)

Table 2Children's alexithymia and its factors.

| 6.22 ± 2.87 (0-14) |
|-------------------------|
| 4.11 ± 2.36 (0-8) |
| $7.09 \pm 2.48 (1-12)$ |
| $17.42 \pm 4.64 (9-29)$ |
| |

Data are expressed as means \pm SD (minimum-maximum) of the study population with type 1 diabetes.

and the mean EOT score was 7.09 (\pm 2.48) (Table 2). There were no significant differences between the scores of boys *vs* girls. However, older children tended to have lower scores on the DIF factor (Pearson's r = -0.26; P = 0.09), and Belgian citizens tended to have higher total AQ scores than did foreigners [t (43) = 1.85; P = 0.08].

3.2. Intercorrelations and mean comparisons

3.2.1. Sociodemographic variables and glycaemic control

There were no significant correlations among age, gender, children's nationality and HbA_{1c} levels. However, there was a near-significant negative correlation between mean years of parental education and HbA_{1c} levels (Pearson's r = -0.27; P = 0.07), which means that the more education the parents had, the lower their child's HbA_{1c} levels tended to be.

The age of the child was also almost significantly and negatively correlated with the number of severe hypoglycaemias (Pearson's r = -0.27; P = 0.07), indicating that older children tended to have less severe hypoglycaemic episodes. There was a significant negative correlation between the mean number of years of parental education and number of severe hypoglycaemias (Pearson's r = -0.34; P = 0.02), suggesting that the more education the parents had, the fewer severe hypoglycaemias their child had. Other sociodemographic variables showed no significant correlations with the number of severe hypoglycaemias.

HbA_{1c} levels of children from single-parent families (mean: 7.95 \pm 1.23%) tended to be higher than those of children from two-parent families (mean: 7.24 \pm 0.85%) [*t* (43) = 1.89; *P*=0.07]. Children of foreign citizenship had significantly higher numbers of severe hypoglycaemias (mean: 0.76 \pm 0.23) than children of Belgian citizenship (mean: 0.21 \pm 0.10) [*t* (28) = 2.21; *P*=0.04].

3.2.2. Medical variables and glycaemic control

There was a significant negative correlation between the number of SMBG readings/day and HbA_{1c} value (Pearson's r = -0.36; P = 0.01), indicating that the more frequently the children assessed blood glucose per day, the lower was their HbA_{1c} level. There was also a significant positive correlation between diabetes duration and HbA_{1c} (Pearson's r = 0.33; P = 0.03), suggesting that children with diabetes of longer duration had higher levels of HbA_{1c}. However, there were no significant correlations between HbA_{1c} and insulin regimen or between HbA_{1c} and familial diabetes, nor were there any significant correlations between the number of severe hypoglycaemias and the medical variables examined.

3.2.3. Alexithymia characteristics and glycaemic control

There was a near-significant positive correlation between the DDF factor score and HbA_{1c} (Pearson's r=0.28; P=0.07), which means that having greater difficulty in describing emotions verbally tended to be associated with higher HbA_{1c} values. However, there were no significant correlations between alexithymia scores and the number of severe hypoglycaemias (Table 3).

3.3. Regression analyses

For analyses using two dependent variables considered to be indicators of glycaemic control (mean glycated haemoglobin over the previous 12 months and number of severe hypoglycaemic episodes over the 3 previous months), only those variables that had a correlation (Bravais–Pearson) of P < 0.10with the outcome measures (Table 3) were selected as predictors. This was necessary due to the exploratory nature of the study and because marginally significant variables could, nevertheless, have a meaningful relationship with the studied outcomes. Thus, both HbA_{1c} levels and the number of severe hypoglycaemias were entered as predictors by blocks into two hierarchical regression analyses.

3.3.1. HbA_{1c}

Hierarchical regression analyses were carried out with the predictor variables in the following order of entry: first was a block containing demographic characteristics (marital status and parental education); second was a block containing medical data (diabetes duration and SMBG readings/day); and third was a block with the DDF factor of the alexithymia concept.

Demographic variables were entered first because they represented the most common predictors of type 1 diabetes difficulties [14]. Also, the analyses examined the extent to which medical variables could explain glycaemic control over and above the demographic characteristics. Finally, the alexithymia factor was entered in the final block as a potential predictor of glycaemic control in children.

The total regression model was significant [F(5.39) = 6.96; P < 0.001]. The analysis confirmed that levels of HbA_{1c} were predicted by demographic characteristics (marital status: B = -0.43, β : -0.34, P = 0.01; parental education: B = -0.06, β : -0.28, P = 0.03) as well as medical data (diabetes duration: B = 0.01, β : -0.32, P = 0.01; SMBG readings/day: B = -0.34, β : -0.28, P = 0.03). DDF was found to be an additional predictor of HbA_{1c} over and above the other variables (B = 0.14, β : 0.34, P = 0.01). This means that each one-point increase in DDF score was associated with a 0.14 increase in HbA_{1c} value. Inclusion of the alexithymia factor explained the additional variance of 12%. The total regression model explained 47% of the variance in HbA_{1c} levels.

These results (Table 4) indicate that, for the children in the present series, three variables predicted lower HbA_{1c} : twoparent family; higher parental level of education; and more frequent SMBG readings/day. On the other hand, two variables predicted higher HbA_{1c} : longer diabetes duration; and a greater difficulty in describing emotions verbally.

Table 3

Pearson's moment correlations of sociodemographic variables, medical variables and children's alexithymia with glycaemic control.

| | HbA _{1c} | Hypoglycaemia | | |
|---|-------------------|----------------|--|--|
| Sociodemographic variables [r Pearson (p)] | | | | |
| Age | ns | -0.27 (0.07)+ | | |
| Gender ^a | ns | ns | | |
| Citizenship ^b | ns | -0.33 (0.03)* | | |
| Language ^c | ns | 0.28 (0.07)+ | | |
| Number of brothers and sisters | ns | ns | | |
| Mother's age | ns | ns | | |
| Father's age | ns | ns | | |
| Parental citizenship | ns | 0.42 (0.00) ** | | |
| Parental employment ^d | ns | -0.32 (0.03)* | | |
| Marital status ^e | $-0.28(0.07)^{+}$ | ns | | |
| Number of years of parental education ^f | -0.27 (0.07)+ | -0.34 (0.02)* | | |
| Close family member with type 1 diabetes ^g | ns | ns | | |
| Distant family member with type 1 diabetesh | ns | ns | | |
| Medical variables [r Pearson (p)] | | | | |
| Number of insulin injections per day | ns | ns | | |
| Self-monitoring blood glucose readings per day | -0.36 (0.01)* | ns | | |
| Diabetes duration (months) | 0.33 (0.03)* | ns | | |
| Alexithymia characteristics [r Pearson (p)] | | | | |
| Alexithymia ⁱ | ns | ns | | |
| Difficulty identifying feelings | ns | ns | | |
| Difficulty describing feelings | 0.28 (0.07)+ | ns | | |
| Externally oriented thinking style | ns | ns | | |

ns: not significant; **P*<0.10; **P*<0.05; ***P*<0.01.

^a 1 = boy, 2 = girl.

^b Child and parents: 1 = Belgian, 2 = other.

^c 1 = French, 2 = other.

^d 0 =none, 0.5 =one, 1 =both.

^e 1 = single-parent family, 2 = two-parent family.

^f Number of years of education since the first year of primary school, without counting repeats of a year or higher diplomas obtained.

^g 0 = no, 1 = yes.

^h 0 = no, 1 = yes.

ⁱ Measured by the Alexithymia Questionnaire (AQ; [28]) for children.

3.3.2. Severe hypoglycaemias

Hierarchical regression analyses were performed using the following sociodemographic variables as predictors: age of the child; citizenship of the child; and mean number of years of parental education. The overall regression was significant [F (3.41)=4.07; P=0.01]. The analysis indicated that the age of

the child (B = -0.16; B: -0.25; P = 0.08) and the parents' level of education (B = -0.05; B: -0.25; P = 0.09) were close to significant in predicting the number of severe hypoglycaemias. These results indicate that higher levels of parental education and older patient's age tend to be associated with fewer episodes of severe hypoglycaemias.

Table 4

Hierarchical regression analysis predicting the HBA1c values over the past 12 months

| | В | SE | Final B | T value | R2 | R2 adj | R2 chg | df | F | F chg |
|---|-------|------|-----------|---------|------|--------|--------|------|--------|--------|
| Step 1 Demographic | | | | | | | | | | |
| Marital status ^a | -0.43 | 0.16 | -0.34 * * | -2.80 | 0.18 | 0.14 | 0.18 | 2-42 | 4.62* | NA |
| Parental education ^b | -0.06 | 0.03 | -0.28* | -2.31 | | | | | | |
| Step 2 Health condition | | | | | | | | | | |
| Diabetes duration (in months) | 0.01 | 0.00 | 0.32** | 2.78 | 0.36 | 0.29 | 0.18 | 4-40 | 5.56** | 5.50** |
| Self-monitoring blood glucose readings per day | -0.38 | 0.16 | -0.28* | -2.33 | | | | | | |
| Step 3 Emotional incompetence | | | | | | | | | | |
| Difficulty describing feelings (DDF) ^c | 0.14 | 0.05 | 0.34** | 2.91 | 0.47 | 0.40 | 0.12 | 5–39 | 6.96** | 8.44** |

P*<0.05; *P*<0.001.

a - 1 = separated, divorced or widower (one-parent family); 1 = together or married (two-parent family).

^b Number of years of education since the first year of primary school, without counting repeats of a year or higher diplomas obtained.

^c Measured by the Alexithymia Questionnaire (AQ; [28]) for children.

4. Discussion

4.1. Predictive factors of HbA_{1c}

Some sociodemographic variables were significantly associated with glycaemic control: for example, the more educated the parents, the lower their child's HbA_{1c} level. This result is consistent with the literature for childhood diabetes [18-20], and suggests that the parents' level of education and knowledge is important for achieving glycaemic control, especially in younger children for whom parents are the primary diabetes caregivers. This suggests that paediatric diabetology professionals should pay specific attention to less-educated families and give them medical instructions that are more in keeping with their level of understanding. Furthermore, coming from a two-parent family also appears to be a protective factor for HbA_{1c} levels. Children with two parents living together to support their diabetes treatment exhibited better glycaemic control than those who lived with only one parent [14-17]. This emphasizes the recommendation discussed by Meunier et al. [14] that diabetes care-providers need to be aware that changes in the family situation (such as changes in the family structure, parents' employment or moving house) are stressful, and that increased support is needed for patients experiencing such events. Taken altogether, these sociodemographic variables explained 18% of the variance in HbA_{1c} levels.

As for the medical variables significantly associated with HbA_{1c} , doing more SMBG readings/day was associated with lower HbA_{1c} values. As in other studies [23–25], our present results confirm that SMBG is a useful means of achieving glycaemic control and that encouraging patients to use this simple tool can lead to better long-term health. In contrast, longer diabetes duration was associated with higher HbA_{1c} values. This result could be explained by physiological and psychosocial changes, and is consistent with previous studies [16,21,22]. To encourage patients' adherence to the diabetic regimen, critical periods, such as the beginning of adolescence, need to coincide with a systematic reevaluation of the child's treatment and motives. Taken altogether, these medical variables explained a further 17% of the HbA_{1c} variance.

Finally, regarding the role of personality (alexithymia) in diabetes, the present findings indicate, for the first time, that children who have difficulties expressing their feelings to others are at greater risk of poor glycaemic control. Comparisons of AQ scores in diabetic and nondiabetic children of the same age showed that both groups have, on average, the same alexithymic profile but, in the case of the clinical population, the DDF appears to be a vulnerability factor for poor health. This finding confirms the results observed in type 1 diabetic adults [13]. Also, the predictive power of the DDF appears to be as strong in type 1 diabetic children as in type 1 diabetic adults, as it increased the explained variance in HbA_{1c} by 12% in both populations. This confirms the importance of DDF in glycaemic control.

However, the link between DDF and diabetes is likely to be different in adults compared with children. In children, their ability to communicate emotions is essential for informing parents explained by deficits in social support and their not taking proper advantage of healthcare services. It is also possible that glycaemic control has an impact on psychological factors, making the causal and consequential interactions between these variables less easy to determine. In light of the main concerns of the present study (to improve adaptive skills and the care offered to diabetic children and their families), our research was focused on the impact of psychological variables on medical variables.

The present study, along with others in the literature, provides evidence that diabetic patients who score higher on DDF are at greater risk of poor glycaemic control. For this reason, it is important to identify high degrees of DDF to find specific interventions focused on emotional expression. In the case of diabetic children, assessment of their family's characteristics in terms of emotional expression, such as parental emotional abilities, family discussions of emotions and parental reactions to their child's emotional behaviour, are also essential, as these factors are associated with the child's emotional comprehension and regulation abilities [32–34]. The assessment of emotional comprehension and regulation in both diabetic children and their families should help practitioners to implement tailor-made interventions (aimed at increasing EC and, thus, achieving the medical objective of glycaemic control) and to evaluate the intervention's efficacy.

4.2. Limitations and future perspectives

One limitation of the present study is that the retrospective nature of the data does not allow a feedback effect to be ruled out between the level of glycaemic control and the alexithymia dimension. It is possible that alexithymia characteristics are also influenced by disease severity. For this reason, HbA_{1c} values are currently being collected from the same population of diabetic children for the period from April 2008 to the present to determine whether or not the alexithymia scores from the first data collection are predictive of HbA_{1c} values over longer periods of time. In addition, future longitudinal studies may help to increase the validity of our results, determine the developmental steps in the acquisition of EC, and distinguish between the causes and consequences of the association between alexithymia and glycaemic control to allow predictions to be made.

Another limitation is that our sample size may have been too small, and could be the reason why some of our results were only marginally statistically significant. A further limitation is that the mediation and interaction processes between DDF and glycaemic control are difficult to assess, as other psychosocial variables were not measured in this initial exploratory study. In future, it may be useful to assess other variables, such as parental EC [14], the familial emotional environment [35,37], the child's coping style [36,37], adherence to the diabetes treatment regimen and the active role of the child in the application of the treatment [37], all of which are likely to mediate the relationship between alexithymia and objective health in our study. Finally, subjective health should also be assessed, for example, with quality-of-life questionnaires, to obtain a more global view of the diabetes experience, and to explore the links between objective and subjective health.

Conflict of interest statement

The authors of this manuscript have no conflicts of interest to declare.

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