

Research: Educational and Psychological Aspects

Mindfulness and fear of hypoglycaemia in parents of children with Type 1 diabetes: results from Diabetes MILES Youth – The Netherlands

J. Aalders¹ , E. Hartman¹, G. Nefs^{1,2,3}, A. Nieuwesteeg^{1,4}, C. Hendrieckx^{5,6} , H.-J. Aanstoot² , P. Winterdijk², E. van Mil⁷, J. Speight^{5,6,8,9}  and F. Pouwer^{5,9} 

¹Department of Medical and Clinical Psychology, Center of Research on Psychological and Somatic Disorders (CoRPS), Tilburg University, Tilburg, The Netherlands, ²Diabeter, Centre for Pediatric and Adolescent Diabetes Care and Research, Rotterdam, The Netherlands, ³Department of Medical Psychology, Radboud University Medical Centre, Radboud Institute for Health Science, Nijmegen, The Netherlands, ⁴Máxima Medical Centre, Veldhoven, The Netherlands, ⁵School of Psychology, Deakin University, Geelong, Melbourne, Australia, ⁶Australian Centre for Behavioural Research in Diabetes, Diabetes Victoria, Melbourne, Australia, ⁷Kidz&Ko, Jeroen Bosch Hospital, 's-Hertogenbosch, The Netherlands, ⁸AHP Research, Hornchurch, UK and ⁹Department of Psychology, University of Southern Denmark, Odense, Denmark

Accepted 25 January 2018

Abstract

Aims To identify the sociodemographic and clinical correlates of fear of hypoglycaemia among parents of children (aged 4–18 years) with Type 1 diabetes and to examine the relationships between parental fear of hypoglycaemia, mindfulness and mindful parenting.

Methods Sociodemographic, self-reported clinical and psychological data were extracted from the cross-sectional Diabetes MILES Youth – The Netherlands dataset. Questionnaires included the Hypoglycaemia Fear Survey – Parent Worry (parental fear of hypoglycaemia), the Freiburg Mindfulness Inventory – Short version (mindfulness) and the Interpersonal Mindfulness in Parenting Scale (mindful parenting).

Results A total of 421 parents (359 mothers) participated. Hierarchical linear regression analyses showed that greater parental fear of hypoglycaemia was related to younger parental age, low educational level, non-Dutch nationality, more frequent blood glucose monitoring, and less general mindfulness. Adding mindful parenting to the model negated the previous contribution of general mindfulness. In this model, lower mindful parenting was related to greater parental fear of hypoglycaemia. In particular, parents with an increased ability to be less judgemental of themselves as parents and less reactive to emotions within parenting interactions reported less fear of hypoglycaemia. In total, 21% of the variance in parental fear of hypoglycaemia was explained.

Conclusion Parental fear of hypoglycaemia was associated largely with parental characteristics, including non-modifiable sociodemographics (i.e. age, education, nationality) and modifiable psychological factors (i.e. mindful parenting). These findings suggest that it is important to further explore mindfulness-based interventions for parents to reduce fear of hypoglycaemia next to interventions to reduce hypoglycaemia.

Diabet. Med. 35, 650–657 (2018)

Introduction

Hypoglycaemia is a prevalent, acute complication in children with Type 1 diabetes [1]. Because hypoglycaemia can have adverse short-term consequences (e.g. dizziness, fatigue,

unconsciousness, seizures and even death) [2] and long-term consequences (e.g. structural brain abnormalities) [3], most parents are worried or scared about the occurrence and consequences of low blood glucose levels. Given the seriousness of severe hypoglycaemia (defined as need for glucagon injection/hospitalization), parental vigilance can be regarded as an adaptive response; however, fear of hypoglycaemia may also lead to counterproductive preventive behaviours which may contribute to elevated blood glucose levels (e.g. snacking before bedtime). Moreover, parental fear of hypoglycaemia has been linked to emotional parental distress [4–6].

Correspondence to: Esther Hartman.

E-mail: E.E.Hartman@TilburgUniversity.edu

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

What's new?

- This is the first study to simultaneously examine both child and parent characteristics, in terms of sociodemographic, clinical and modifiable psychological factors (general mindfulness and mindful parenting), in relation to parental fear of hypoglycaemia.
- Greater parental fear of hypoglycaemia was related to younger parental age, low educational level, non-Dutch nationality, more frequent blood glucose monitoring and less parental mindfulness.
- These findings can be used to identify parents who are at risk of fear of hypoglycaemia and to inform the development of mindfulness interventions targeted at reducing parental fear of hypoglycaemia.

Previous studies focusing on sociodemographic and clinical correlates of parental fear of hypoglycaemia have had inconsistent results [4–13]. Most of these studies had small sample sizes ($N \leq 200$) [4,5,8–12] and did not investigate demographic and clinical characteristics simultaneously [4,6–13], limiting the exploration of independent effects. In addition, the associations between parent demographic characteristics (e.g. age, nationality, employment status) and parental fear of hypoglycaemia are largely unknown, and studies investigating the role of modifiable psychological factors are limited. One such modifiable psychological factor is mindfulness, which can be defined as ‘the consciousness that emerges from intentionally directing attention to the present moment, without judging the experience that unfolds moment to moment’ [14].

In a previous study on chronic conditions, parents reported that a higher level of mindfulness enhanced their ability to cope with parenting distress [15]. Mindfulness may thus be a factor that contributes to parental resilience to fear of hypoglycaemia. Moreover, mindful parenting (bringing mindfulness into the parenting context and parent–child interactions) has been shown to have positive effects on parental well-being in challenging parenting situations [16,17].

The aim of the present study was to determine which sociodemographic and clinical characteristics are associated with parental fear of hypoglycaemia, and to evaluate whether general mindfulness and mindful parenting offer additional explanatory value.

Methods**Procedure and participants**

The present study was conducted in the framework of Diabetes MILES (Management and Impact for Long-term Empowerment and Success) Youth - The Netherlands [18], a

national, cross-sectional survey of children with diabetes and their parents, conducted in 2011/2012. In total, 533 primary caregivers (i.e. parent in the family who is most involved in diabetes care) participated. A detailed description of the research methods is published elsewhere [19]. Additionally, parents of children attending one of several Dutch paediatric diabetes clinics (Diabeter, Kidz&Ko, Amphia Hospital) were invited by post to participate. Parents received information about the study, an informed consent form, a booklet with questionnaires and a pre-paid return envelope. The study was approved by the Psychological Ethics Committee of Tilburg University (EC-2011 5).

Measures**Parental fear of hypoglycaemia**

Fear of hypoglycaemia was assessed using the Worry subscale of the Hypoglycaemia Fear Survey – Parent (HFS-P) [20]. The HFS-P Worry subscale includes 15 statements rated on a five-point Likert-scale ranging from 1 (never) to 5 (almost always). Item scores are summed to obtain a total score (range 15–75), with higher scores indicating higher levels of parental fear of hypoglycaemia. The HFS-P Worry subscale has been shown to have sufficient psychometric properties [7], and in the present study, internal consistency was good ($\alpha = 0.88$). In case of 15% or fewer missing values, within-person mean values were entered.

Sociodemographic and clinical characteristics

A parent-reported questionnaire was used to collect sociodemographic and clinical characteristics: gender and age (parent, child); diabetes duration; age at onset; insulin pump therapy (yes vs no); and the average number of blood glucose measurements per day (continuous and categorical: ≥ 7 vs 4–6 vs 0–3). Parent’s nationality, marital status, educational level and employment status were subsequently categorized into, respectively, non-Dutch vs Dutch nationality, having a partner vs not having a partner, high educational level (i.e. university level) vs low educational level and having a paid job vs not having a paid job. In addition, parents were asked to report their child’s frequency of severe hypoglycaemia, ketoacidosis and diabetes-related hospitalizations during the preceding 12 months. Severe hypoglycaemia was defined as ‘hypoglycaemia that required injected glucagon and/or hospital admission and/or a call to the emergency number’. Ketoacidosis was defined as ‘ketoacidosis that required hospital admission’. The number of ketoacidosis episodes and hospitalizations were corrected by one event for children with a diabetes duration ≤ 1 year, as these events were probably related to the diagnosis of diabetes. The number of severe hypoglycaemic events, ketoacidosis episodes and hospitalizations were dichotomized (≥ 1 vs none). In addition, parents were asked to report their child’s most recent HbA_{1c} value. According to

international recommendations, glycaemic control was defined as optimal when HbA_{1c} values were $\leq 7.5\%$ (58 mmol/mol).

Mindfulness

Mindfulness was assessed using the validated Freiburg Mindfulness Inventory (FMI) – Short version [21], including 14 statements rated on a four-point Likert scale ranging from 1 (rarely) to 4 (almost always). Items are summed to produce a total score (range 14–56), with higher scores reflecting higher levels of general mindfulness. In the present study, the internal consistency of the FMI was good ($\alpha=0.83$). In case of 15% or fewer missing values, within-person mean values were entered.

Mindful parenting

Mindful parenting was measured using the Interpersonal Mindfulness in Parenting Scale (IM-P) [22]. The IM-P scale has 31 items rated on a five-point Likert scale ranging from 1 (never) to 5 (always). These items are summed to provide a total score (range 31–155; $\alpha=0.85$), with higher scores indicating higher levels of mindful parenting. The Dutch IM-P scale has also six validated subscales, including: (1) listening with full attention (five items, $\alpha=0.81$); (2) compassion for the child (six items, $\alpha=0.75$); (3) non-judgmental acceptance of parental functioning (six items, $\alpha=0.71$); (4) emotional non-reactivity in parenting (five items, $\alpha=0.74$); (5) emotional awareness of the child (three items, $\alpha=0.70$); and (6) emotional awareness of self (four items, $\alpha=0.43$) [23]. Since the internal reliability of the Emotional Awareness of Self subscale was low, it was excluded from all analyses. In case of 40% or fewer missing values, within-person mean values were entered (syntax of De Bruin *et al.* [23]).

Statistics

All analyses were performed with SPSS version 20.0 (IBM, Somers, NY, USA). The level for statistical significance was set at $\alpha=0.05$. Preliminary analyses were conducted to check whether assumptions of multicollinearity (i.e. correlations, variance inflation factor and tolerance scores), normality of residuals (i.e. Q-Q plots, Shapiro–Wilks tests), homoscedasticity and linearity (i.e. residual vs fits and predictor plots) were met. A hierarchical linear regression analysis was performed to examine the relationship of parental fear of hypoglycaemia with sociodemographic and clinical characteristics, general mindfulness and mindful parenting. Independent variables were entered in the following blocks: 1) sociodemographics: parent's and child's age and gender, partner status, parent's education, employment status and nationality; 2) clinical characteristics: diabetes duration, age at onset, average frequency of daily blood glucose measurements, insulin pump use and severe hypoglycaemia, ketoacidosis and hospitalizations in the past 12 months; 3) general mindfulness; and 4) mindful parenting. This analysis was

repeated with (a) the categorical instead of the continuous blood glucose measurements variable, and (b) the addition of HbA_{1c} value. A second hierarchical linear regression analysis was conducted in which steps 1 to 3 remained identical, but total mindful parenting score was replaced by subscale scores in the fourth step.

Results

In total, 421 parents (359 mothers, 61 fathers, one stepfather) of children (aged 4–18 years) with Type 1 diabetes completed the questionnaires used in the present study (Table 1). For the majority of children (80%), diabetes duration was >1 year. Parent-reported mean HbA_{1c} was 61 mmol/mol (7.8%) ($n=355$), with 56% above recommended target [>58 mmol/mol (7.5%)]. The correlations between general mindfulness and parental fear of hypoglycaemia and mindful parenting and parental fear of hypoglycaemia were -0.18 ($P<0.01$) and -0.23 ($P<0.01$), respectively.

In all models, assumptions of homoscedasticity, linearity and normality of residuals were met. Age at onset was removed from all models to avoid multicollinearity, as indicated by the moderate correlation between age at onset and, respectively, diabetes duration ($r=-0.57$, $P<.001$) and the age of the child ($r=0.50$, $P<0.001$) and collinearity diagnostics. Moderate correlations ($r>0.5$) were also found between the child's age and parental age ($r=0.63$, $P<0.001$) and between general mindfulness and mindful parenting ($r=0.55$, $P<0.001$), but variance inflation factor and tolerance scores indicated no multicollinearity problems, therefore, these variables were retained in the analyses. The Shapiro–Wilks test was significant ($P=0.049$) only in the main regression analysis without age at onset. In large samples, however, this test can be significant even when the scores are only slightly different from a normal distribution. Given that Q-Q plots gave no indication of non-normality, scores were not transformed.

Sociodemographic characteristics explained 6% of the variance in parental fear of hypoglycaemia ($P<0.001$; Table 2). When clinical characteristics were added (step 2), the regression model improved significantly compared with model 1 ($P<0.001$). Sociodemographic and clinical characteristics significantly explained 14% of the variance in parental fear of hypoglycaemia. After addition of general mindfulness (step 3), the model significantly improved again ($P<0.001$), with 17% of the variance in parental fear of hypoglycaemia explained. In the final step, the addition of total scores on mindful parenting resulted in a significant improvement of the model ($P=0.006$). Together, sociodemographics, clinical characteristics, general mindfulness and total scores on mindful parenting explained 19% of the variance in parental fear of hypoglycaemia. Within this final regression model, younger parental age ($P=0.006$), low parental educational level ($P=0.018$), non-Dutch nationality of the parent ($P=0.003$), higher number of blood glucose

Table 1 Sample characteristics of 421 parents of children (aged 4–18 years) with Type 1 diabetes

	% (n)	Mean (SD)	Range
Demographic characteristics			
Age child (years)		11.3 (3.5)	4–18
Age parent (years)		43.1 (5.3)	29–66
Sex child, girls	46 (194)		
Sex parent, women	85 (359)		
Partner status, has partner	89 (374)		
Education, high educational level	38 (161)		
Employment status, paid job	83 (348)		
Parent nationality, non-Dutch	3 (13)		
Clinical characteristics			
Diabetes duration (years)		4.6 (3.7)	0–16
Age at onset (years)		7.1 (3.8)	1–16
Frequency of blood glucose measurements per day		5.6 (2.0)	0–15
0–3 measurements per day	9 (37)		
4–6 measurements per day	66 (278)		
≥7 measurements per day	25 (106)		
Most recent HbA _{1c} (%)*		7.8 (1.2)	4.1–18.0
Most recent HbA _{1c} (mmol/mol)*		61 (13)	21–173
Insulin pump therapy	73 (307)		
≥1 Severe hypoglycaemia (past 12 months)	7 (30)		
≥1 Ketoacidosis (past 12 months)†	13 (55)		
≥1 Diabetes-related hospitalization (past 12 months)†	9 (37)		
Psychological constructs			
Parental Fear of Hypoglycaemia (HFS-P – Worry; range 15–75)		34.7 (8.9)	15–65
General Mindfulness (FMI-Short; range 14–56)		37.2 (5.8)	20–54
Mindful Parenting (IM-P; range 31–155)		112.8 (10.4)	79–146
Listening with full attention (range 5–25)		18.8 (2.6)	11–25
Compassion for the child (range 6–30)		25.7 (2.6)	19–30
Non-judgemental acceptance of parental functioning (range 6–30)		19.5 (3.6)	7–30
Emotional non-reactivity in parenting (range 5–25)		17.9 (2.9)	9–25
Emotional awareness of the child (range 3–15)		11.0 (1.8)	5–15

HFS-P, Hypoglycaemia Fear Survey – Parent; FMI-Short, Freiburg Mindfulness Inventory – Short version; IM-P, Interpersonal Mindfulness in Parenting Scale.

*n=355. †Unrelated to diagnosis.

measurements per day ($P<0.001$) and mindful parenting ($P=0.006$) were related to higher parental fear of hypoglycaemia. Although general mindfulness was significantly related to parental fear of hypoglycaemia in the third step ($P<0.001$), general mindfulness was no longer significant after the addition of mindful parenting in the final step ($P=0.075$).

When the average daily frequency of blood glucose measurements was added in categories (≥ 7 vs 4–6 vs 0–3) instead of a continuous variable (data not shown), only parents of children with ≥ 7 blood glucose measurements per day reported more parental fear of hypoglycaemia compared with parents of children with 0–3 blood glucose measurements per day ($P=0.012$).

Because of the high percentage of missing data (16%), self-reported HbA_{1c} was not included in the main hierarchical linear regression analysis (as described above) in order to preserve a large sample size. When the analysis was repeated with HbA_{1c} entered at the second step (data not shown, $n=355$), HbA_{1c} was not related to parental fear of hypoglycaemia ($P=0.779$).

When, in a second hierarchical linear regression analysis, the total score on mindful parenting was replaced by subscale

scores (Table 2), the full regression model explained 22% of the variance in parental fear of hypoglycaemia ($P<0.001$). With respect to the subdomains of mindful parenting, less non-judgemental acceptance of parental functioning ($P=0.001$) and less emotional non-reactivity in parenting ($P=0.019$) were related to higher parental fear of hypoglycaemia.

Discussion

This study in 421 parents of children with Type 1 diabetes showed that higher fear of hypoglycaemia was associated with several non-modifiable sociodemographic characteristics: younger parental age; low parental educational level; and non-Dutch nationality. With respect to self-reported clinical factors, only a higher average frequency of daily blood glucose measurements was related to greater fear. Finally, greater fear of hypoglycaemia was also associated with less general mindfulness, but this association was superseded by less mindful parenting in a second model.

Consistent with several others studies [4,9,12], mothers reported similar levels of fear of hypoglycaemia to those of

Table 2 Standardized regression coefficients and percentages of explained variance of the association of sociodemographics, clinical characteristics, mindfulness and mindful parenting (total and subscale scores) with parental fear of hypoglycaemia

Parental fear of hypoglycaemia (n=421)		Step 1	Step 2	Step 3	Step 4	Step 4
		β	β	β	β	β
Sociodemographics	Age child (years)	0.04	0.08	0.09	0.10	0.07
	Age parent (years)	-0.19**	-0.18**	-0.17**	-0.17**	-0.14*
	Sex child, girls	-0.08	-0.07	-0.09	-0.08	-0.08
	Sex parent, women	-0.01	0.03	0.03	0.03	0.02
	Partner status, has partner	0.06	0.06	0.05	0.05	0.07
	Education, high educational level	-0.14**	-0.13**	-0.11*	-0.11*	-0.11*
	Employment status, paid job	-0.04	-0.01	-0.01	0.00	0.01
Clinical characteristics	Parent nationality, non-Dutch	0.14**	0.15**	0.15**	0.14**	0.12**
	Diabetes duration (years)		0.10	0.11*	0.09	0.08
	Frequency of blood glucose measurement per day		0.25**	0.26**	0.26**	0.25**
	Insulin pump therapy		0.01	0.01	0.01	0.02
	≥1 severe hypoglycaemic event (past 12 months)		0.04	0.04	0.04	0.05
General mindfulness	≥1 ketoacidosis episode (past 12 months)		0.08	0.08	0.07	0.07
	≥1 diabetes-related hospitalization (past 12 months)		0.08	0.08	0.08	0.06
Mindful parenting	General mindfulness			-0.18**	-0.10	-0.06
	Mindful parenting				-0.15**	
	Listening with full attention					0.06
	Compassion for the child					0.04
	Non-judgemental acceptance of parental functioning					-0.19**
	Emotional non-reactivity in parenting					-0.14*
	Emotional awareness of the child					-0.03
Adjusted R ²	0.06**	0.14**	0.17**	0.19**	0.22**	
R ² change	0.08	0.09	0.03	0.02	0.05	

Note: For mindfulness and mindful parenting, higher scores indicate more mindfulness. All dichotomous sociodemographic and clinical variables have binary codings: girl=1 vs boy=0, woman=1 vs man=0 etc. * $P < 0.05$. ** $P < 0.01$.

fathers. Only in the study by Haugstvedt *et al.* [5] mothers reported greater fear of hypoglycaemia than fathers. This contrast in findings could be attributable to the low number of fathers in the present sample. However, Haugstvedt *et al.* included both parents in their study, and it was not known which parent was most involved in diabetes care, whereas the present study included only the parent who was most involved. The difference in maternal and paternal scores for fear of hypoglycaemia reported by Haugstvedt *et al.* could be explained by the larger responsibility mothers often bear in the diabetes care of their child compared with fathers [24].

Because previous research into parental fear of hypoglycaemia did not include any other parent characteristics, such as age and nationality, or had discrepancies in the categorization of educational levels [10,13], it is not possible to relate our findings to other studies. Nevertheless, in population-based studies, younger age, low educational level and non-Dutch nationality have been linked to higher levels of anxiety [25–27]. The similarity in risk factors between anxiety and parental fear of hypoglycaemia suggests a shared underlying factor that leads to a vulnerability to experiencing both anxiety and fear of hypoglycaemia.

The only clinical factor of importance was the average number of daily blood glucose measurements; parents of children who checked their blood glucose more frequently experienced greater fear of hypoglycaemia. When the average number was categorized in clinically meaningful

categories, only parents of children with ≥ 7 blood glucose measurements per day reported more parental fear of hypoglycaemia compared with parents of children who measured their blood glucose zero to three times per day. For the present study it was unknown if children used continuous glucose monitoring devices. Although the average number of blood glucose measurements was not related to parental fear of hypoglycaemia in previous studies [5,11], the present findings are in line with a recently published study [13]. In that study, continuous glucose monitoring was unrelated to parental fear of hypoglycaemia [13]. This may indicate that fear of hypoglycaemia may lead to more parental behaviour to prevent severe hypoglycaemia, e.g. measuring blood glucose levels more often. More frequent observations of low or fluctuating blood glucose levels, however, may provoke fear of hypoglycaemia.

In contrast to a previous study [5], but consistent with several other studies [4,6–13], HbA_{1c} was not related to parental fear of hypoglycaemia. HbA_{1c} was assessed by parental report, and therefore may not be reliable. However, the mean HbA_{1c} reported by parents in the present study was similar to the mean HbA_{1c} in a large multicentre study ($n=27\,035$) among children and adolescents with Type 1 diabetes [28], supporting the hypothesis that parents in the present sample did not deliberately elevate blood glucose levels in response to fear of hypoglycaemia to an extent that it affected HbA_{1c}.

Severe hypoglycaemia in the preceding 12 months was not related to parental fear of hypoglycaemia. This finding is in line with studies that classified severe hypoglycaemia as a hypoglycaemic event resulting in seizure, unconsciousness or hospital admission [5,6,8,9,11–13]. Based on previous studies, the frequency of hypoglycaemia [5,12] and hypoglycaemic events at school [8] seem to be more important factors in relation to parental fear of hypoglycaemia than severe hypoglycaemia. The present study might, however, have been underpowered to detect a relationship with parental fear of hypoglycaemia. Nevertheless, how much fear a parent experienced with respect to a hypoglycaemic event (e.g. problematic hypoglycaemia based on their own definition, or a hypoglycaemic event without the presence of a parent) could have a stronger association with parental fear of hypoglycaemia than the medical seriousness of hypoglycaemia (e.g. need for glucagon injection/hospitalization).

With respect to psychological factors, less mindful parents reported more fear of hypoglycaemia. After adding mindful parenting to the model, the previous contribution of general mindfulness to parental fear of hypoglycaemia was negated, showing that lower mindful parenting was related to higher fear of hypoglycaemia. These results suggest that mindfulness, especially in the parenting context, makes parents less prone to experiencing fear of hypoglycaemia. More specifically, parents with a greater ability to be less judgemental of themselves as a parent (e.g. forgiving when regretting parenting actions, acceptance of parenting challenges) and parents with an increased ability to be less reactive to emotions within parenting interactions reported less fear of hypoglycaemia. According to Baer *et al.* [29], these two facets of mindfulness facilitate acceptance. By being less self-critical about experiencing fear of hypoglycaemia and being less impulsive to fear of hypoglycaemia (e.g. not worrying about hypoglycaemia), parents may be able to cope better with their worries about their child's risk of hypoglycaemia. A positive relationship between mindful parenting and parental well-being is documented in several other studies, which evaluated the effect of mindful parenting training on parental well-being in stressful parenting situations [16,17].

Several limitations of the present study should be considered. First, only five out of six subscales of the IM-P scale could be included in the analyses because the internal consistency of the mindful parenting subscale Emotional Awareness of Self was unsatisfactory. Consequently, it remains unclear how emotional awareness of self is related to parental fear of hypoglycaemia. Second, since no data were collected on parents who did not participate, it was difficult to determine to what extent selection bias may have played a role. Compared with other studies of parental fear of hypoglycaemia using the same scale and scoring [4,5,8], parents in this sample reported relatively low levels of fear. In addition, insulin pump therapy was more prevalent in this sample and

more children had HbA_{1c} values as recommended compared with previous studies. In comparison with the general Dutch population (CBS StatLine), a similar rate of parents in the present sample reported having a partner (population 84% vs present sample 89%), but parents in the present study were more likely to have a paid job (population 71% vs present sample 83%), Dutch nationality (population 89% vs present sample 97%) and higher education (population 28% vs present sample 38%) than adults in the general population. Furthermore, few predictors were significantly related to parental fear of hypoglycaemia (regression with total scores of mindful parenting: 5 out of 15; regression with subscale scores of mindful parenting: 6 out of 20) and the contribution of psychological factors to the final model was small (8%), signalling that important unmeasured factors are likely to have played a role. An important factor that could affect fear of hypoglycaemia is the education/counselling provided by diabetes educators (e.g. information about healthcare behaviours to avoid severe hypoglycaemia, addressing fear of hypoglycaemia). Additionally, more studies are needed to examine for which families continuous glucose monitoring could be beneficial in reducing parental fear of hypoglycaemia. Finally, this study only focused on parents. In a study among relatives of adults with diabetes, worries about hypoglycaemia were also common in siblings and other relatives [30]. Future studies on fear of hypoglycaemia should also include other family members.

The present study also has several strengths. To the best of our knowledge, this is the first study to simultaneously examine child and parent sociodemographic characteristics, clinical factors and modifiable psychological constructs (mindfulness and mindful parenting) in relation to parental fear of hypoglycaemia in a large sample, making it possible to examine independent associations. The results showed that mostly parent characteristics (e.g. younger age, low educational level, non-Dutch nationality, lower level of mindfulness) were related to an increased risk of experiencing parental fear of hypoglycaemia, while child's age and gender and parent-reported clinical characteristics (diabetes duration, type of insulin therapy, complications) were not. These findings suggest that parental fear of hypoglycaemia is parent-related rather than child-related, signalling the importance of developing interventions for parents to reduce fear of hypoglycaemia next to interventions to reduce hypoglycaemia (e.g. blood glucose awareness training). Since general mindfulness and mindful parenting are modifiable factors [17], training parents to become more mindful and respond in a more mindful way, especially within the parenting context, may address a great demand for effective interventions to make parents more resilient to fear of hypoglycaemia [5,11]. Specifically, the ability to be less judgemental in their functioning as a parent and less reactive to parental emotions may function as a buffer to parental fear of hypoglycaemia. Intervention studies are needed to examine the causal

relationships between mindful parenting and parental fear of hypoglycaemia.

Funding sources

This study was supported by the Prof. Dr. J. Terpstra Young Investigator Award 2010 from the Dutch Association for Diabetes Research (Nederlandse Vereniging voor Diabetes Onderzoek)/Lilly Diabetes to GN. The funding source was not involved in the study design, data collection, data analysis, manuscript preparation or the decision to submit the manuscript for publication.

Competing interests

None declared.

Acknowledgements

We thank all the parents of children with Type 1 diabetes who participated in Diabetes MILES Youth – The Netherlands. We also thank the Dutch Diabetes Association, the Dutch Diabetes Research Foundation and all hospitals and Diabetes Centres for their kind and very valuable assistance in the recruitment of participants.

References

- Davis EA, Keating B, Byrne GC, Russell M, Jones TW. Hypoglycemia: incidence and clinical predictors in a large population-based sample of children and adolescents with IDDM. *Diabetes Care* 1997; 20: 22–25.
- Workgroup on Hypoglycemia ADA. Defining and reporting hypoglycemia in diabetes: a report from the American Diabetes Association Workgroup on Hypoglycemia. *Diabetes Care* 2005; 28: 1245–1249.
- Perantie DC, Wu J, Koller JM, Lim A, Warren SL, Black KJ et al. Regional brain volume differences associated with hyperglycemia and severe hypoglycemia in youth with type 1 diabetes. *Diabetes Care* 2007; 30: 2331–2337.
- Haugstvedt A, Wentzel-Larsen T, Aarflot M, Rokne B, Graue M. Assessing fear of hypoglycemia in a population-based study among parents of children with type 1 diabetes—psychometric properties of the hypoglycemia fear survey—parent version. *BMC Endocr Disord* 2015; 15: 2.
- Haugstvedt A, Wentzel-Larsen T, Graue M, Søvik O, Rokne B. Fear of hypoglycaemia in mothers and fathers of children with Type 1 diabetes is associated with poor glycaemic control and parental emotional distress: a population-based study. *Diabet Med* 2010; 27: 72–78.
- Shepard JA, Vajda K, Nyer M, Clarke W, Gonder-Frederick L. Understanding the Construct of Fear of Hypoglycemia in Pediatric Type 1 Diabetes. *J Pediatr Psychol* 2014; 39: 1115–1125.
- Gonder-Frederick L, Nyer M, Shepard JA, Vajda K, Clarke W. Assessing fear of hypoglycemia in children with type 1 diabetes and their parents. *Diabetes Manag (Lond)* 2011; 1: 627–639.
- Gonder-Frederick LA, Fisher CD, Ritterband LM, Cox DJ, Hou L, DasGupta AA et al. Predictors of fear of hypoglycemia in adolescents with type 1 diabetes and their parents. *Pediatr Diabetes* 2006; 7: 215–222.
- Hawkes CP, McDarby V, Cody D. Fear of hypoglycemia in parents of children with type 1 diabetes. *J Paediatr Child Health* 2014; 50: 639–642.
- Monaghan MC, Hilliard ME, Cogen FR, Streisand R. Nighttime caregiving behaviors among parents of young children with Type 1 diabetes: associations with illness characteristics and parent functioning. *Fam Syst Health* 2009; 27: 28.
- Patton SR, Dolan LM, Henry R, Powers SW. Parental fear of hypoglycemia: young children treated with continuous subcutaneous insulin infusion. *Pediatr Diabetes* 2007; 8: 362–368.
- Patton SR, Dolan LM, Henry R, Powers SW. Fear of hypoglycemia in parents of young children with type 1 diabetes mellitus. *J Clin Psychol Med Settings* 2008; 15: 252–259.
- Van Name MA, Hilliard ME, Boyle CT, Miller KM, DeSalvo DJ, Anderson BJ et al. Nighttime is the worst time: Parental fear of hypoglycemia in young children with type 1 diabetes. *Pediatr Diabetes* 2018; 19: 114–120.
- Kabat-Zinn J. Mindfulness-based interventions in context: past, present, and future. *Clin Psychol Sci and Pract* 2003; 10: 144–156.
- Minor HG, Carlson LE, Mackenzie MJ, Zernicke K, Jones L. Evaluation of a mindfulness-based stress reduction (MBSR) program for caregivers of children with chronic conditions. *Soc Work Health Care* 2006; 43: 91–109.
- Bögels SM, Helleman J, van Deursen S, Römer M, van der Meulen R. Mindful Parenting in Mental Health Care: Effects on Parental and Child Psychopathology, Parental Stress, Parenting, Coparenting, and Marital Functioning. *Mindfulness* 2014; 5: 536–551.
- de Bruin EI, Blom R, Smit FMA, van Steensel FJA, Bögels SM. MYmind: Mindfulness training for Youngsters with autism spectrum disorders and their parents. *Autism* 2014; 19: 906–914.
- Nefs G, Bot M, Browne JL, Speight J, Pouwer F. Diabetes MILES—The Netherlands: rationale, design and sample characteristics of a national survey examining the psychosocial aspects of living with diabetes in Dutch adults. *BMC Public Health* 2012; 12: 925.
- Serkel-Schrama IJP, de Vries J, Nieuwesteeg AM, Pouwer F, Nyklicek I, Speight J et al. The Association of Mindful Parenting with Glycemic Control and Quality of Life in Adolescents with Type 1 Diabetes: Results from Diabetes MILES—The Netherlands. *Mindfulness* 2016; 7: 1227–1237.
- Clarke WL, Gonder-Frederick LA, Snyder AL, Cox DJ. Maternal fear of hypoglycemia in their children with insulin dependent diabetes mellitus. *J Pediatr Endocrinol Metab* 1998; 11: 189–194.
- Walach H, Buchheld N, Buttenmüller V, Kleinknecht N, Schmidt S. Measuring mindfulness—the Freiburg mindfulness inventory (FMI). *Pers Individ Dif* 2006; 40: 1543–1555.
- Duncan LG. *Assessment of mindful parenting among parents of early adolescents: Development and validation of the Interpersonal Mindfulness in Parenting scale*. (Doctoral dissertation) Pennsylvania State University, 2007.
- de Bruin EI, Zijlstra BJH, Geurtzen N, van Zundert RMP, van de Weijer-Bergsma E, Hartman EE et al. Mindful Parenting Assessed Further: Psychometric Properties of the Dutch Version of the Interpersonal Mindfulness in Parenting Scale (IM-P). *Mindfulness* 2014; 5: 200–212.
- Dashiff C, Morrison S, Rowe J. Fathers of children and adolescents with diabetes: what do we know? *J Pediatr Nurs* 2008; 23: 101–119.
- de Graaf R, Ten Have M, van Gool C, van Dorsselaer S. Prevalence of mental disorders and trends from 1996 to 2009. Results from the Netherlands Mental Health Survey and Incidence Study-2. *Soc Psychiatry Psychiatr Epidemiol* 2009; 2012: 203–213.
- de Wit MA, Tuinebreijer WC, Dekker J, Beekman A-JT, Gorissen WH, Schrier AC et al. Depressive and anxiety disorders in different

- ethnic groups. *Soc Psychiatry Psychiatr Epidemiol* 2008; **43**: 905–912.
- 27 Jorm AF. Does old age reduce the risk of anxiety and depression? A review of epidemiological studies across the adult life span. *Psychol Med* 2000; **30**: 11–22.
- 28 Gerstl E-M, Rabl W, Rosenbauer J, Gröbe H, Hofer S, Krause U *et al*. Metabolic control as reflectet by HbA1c in children, adolescents and young adults with type-1 diabetes mellitus: combined longitudinal analysis including 27,035 patients from 207 centers in Germany and Austria during the last decade. *Eur J Pediatr* 2008; **167**: 447–453.
- 29 Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L. Using self-report assessment methods to explore facets of mindfulness. *Assessment* 2006; **13**: 27–45.
- 30 Nefs G, Pouwer F, Holt RIG, Skovlund S, Hermanns N, Nicolucci A *et al*. Correlates and outcomes of worries about hypoglycemia in family members of adults with diabetes: The second Diabetes Attitudes, Wishes and Needs (DAWN2) study. *J Psychosom Res* 2016; **89** (Supplement C): 69–77.