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Fear of Hypoglycemia in Parents of Young Children with Type 1 Diabetes Mellitus

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Abstract The current study examined fear of hypoglycemia in 81 mothers and 64 fathers of young children with type 1 diabetes (T1DM) using the Hypoglycemia Fear Survey-Parents of Young Children (HFS-P-YC possible range = 26–130). Mothers and fathers completed the HFS-P-YC at enrollment and mothers completed it 2 weeks later. Families recorded daily blood glucose on a standardized meter for 2 weeks. Mothers' mean total HFS-P-YC score was 75.0 (SD = 17.2) and fathers' mean score was 66.5 (SD = 18.0). Mothers reported greater HFS-P-YC total and behavior subscale scores than fathers. Mothers' HFS-P-YC scores were comparable to published HFS scores for mothers of preadolescents with T1DM and higher than adult patients with T1DM. The HFS-P-YC had good internal consistency and test–retest reliability in this sample. These findings suggest parents of young children with T1DM report a high level of fear of hypoglycemia. Additionally, the HFS-P-YC appears to be a reliable measure in this population.

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Introduction

Hypoglycemia is a common problem in patients with type 1 diabetes mellitus. Hypoglycemia may be caused by inappropriate administration of insulin, a mismatch of insulin to carbohydrate intake, and/or vigorous exercise (ADA, 2005; Ryan, Gurtunca, & Becker, 2005; Silverstein et al., 2005). The symptoms of mild hypoglycemia include nausea, confusion, faintness, trembling, and irritability. However, moderate to severe hypoglycemia can result in seizures, coma, and death (ADA, 2005; Silverstein et al., 2005). In addition, for young children, some studies suggest that frequent episodes of hypoglycemia may lead to at least transient problems with attention management, information processing, and executive skills (Ryan et al., 2005). Because of the possible adverse events associated with hypoglycemia, patients with type 1 diabetes and their families are encouraged to be vigilant about their blood glucose control and to respond quickly to low blood glucose levels (Clarke, Gonder-Frederick, Snyder, & Cox, 1998; ADA, 2005; Silverstein et al., 2005). This may be especially true in families of young children with type 1 diabetes, where the risk of hypoglycemia is more pronounced due to greater insulin sensitivity and developmental factors, such as variable food preferences/intake and food refusal (Kaufman et al., 2002; Linscheid, Budd, & Rasnake, 2003; Silverstein et al., 2005; Sullivan-Bolyai, Deatrick, Gruppuso, Tamborlane, & Grey, 2002; Sullivan-Bolyai, Deatrick, Gruppuso, Tamborlane, & Grey 2003).

In adult patients with type 1 diabetes, fear of hypoglycemia has been well-documented (Cox, Irvine, Gonder-

Frederick, Nowacek, & Butterfield, 1987). Using the Hypoglycemia Fear Survey (HFS), researchers have found that patients who report fear of hypoglycemia often participate in behaviors that may purposefully elevate their blood glucose levels (Irvine, Cox, & Gonder-Frederick, 1994). In addition, researchers have found that adult patients' fear of hypoglycemia appears related to higher perceived stress, general fearfulness, and anxiety (Irvine, Cox, & Gonder-Frederick, 1992).

Because parents of children with type 1 diabetes often bear the majority of responsibility for caring for diabetes, it is expected that they would report significant fear of hypoglycemia and data have supported this assumption. In fact, a recent study supported this assumption as researchers adapted the HFS to examine fear of hypoglycemia in 46 mothers of preadolescent children with type 1 diabetes and discovered higher HFS scores among mothers of preadolescents than adult patients with type 1 diabetes (Clarke et al., 1998). However, save for a small number of studies conducted among mothers of preadolescent and adolescent patients with type 1 diabetes, there is limited research examining parental fear of hypoglycemia (Clarke et al., 1998; Gonder-Frederick et al., 2006; Marrero, Guare, Vandagriff, & Fineberg, 1997) and almost no research examining parental fear regarding young children (less than 8 years) with type 1 diabetes (Patton, Dolan, Henry, & Powers, 2007. Additionally, data is virtually non-existent regarding fathers as it relates to their fear of hypoglycemic reactions and involvement in blood glucose control in young children with type 1 diabetes.

The nearly complete absence of research specific to parental fear of hypoglycemia in young children with type 1 diabetes presents a noteworthy gap in the literature for several reasons. First, young children are developmentally very different from preadolescents and adolescents. Thus, it is important to examine parental fear in a sample of young children as the previous research in mothers of older children may not generalize to this population. Second, young children lack the ability and reasoning to manage and provide important data about their diabetes. Therefore, parents are often left to manage insulin dosing and carbohydrate intake based on experience and intuition, which may leave them vulnerable to anxiety and feelings of uncertainty. Thus, it is an important empirical question to quantify fear of hypoglycemia in parents of young children and to determine if fear may impact parents' management decisions. Third, because of the unpredictability of blood glucose in young children with type 1 diabetes and frequent reminders from the medical team to monitor for hypoglycemia, parents of young children may be more highly sensitized to hypoglycemia than parents of older children. Finally, it is important to investigate parental fear of hypoglycemia in a sample of young children with type 1 diabetes because the prevalence of type 1 diabetes in young children is increasing (Amos, McCarty, & Zimmet, 1997; Dahlquist & Mustonen, 2000) and parental fear, if intense and left untreated, could result in impaired functioning in a growing clinical population (Patton et al., 2007).

Presently, there are no measures specifically designed to examine fear of hypoglycemia in parents of young children with type 1 diabetes. The purpose of the current study was to examine parental fear of hypoglycemia in a large sample of young children with type 1 diabetes and to present data on the reliability of a modified version of the Hypoglycemia Fear Survey-Parents (HFS-P), called the Hypoglycemic Fear Survey-Parents of Young Children (HFS-P-YC), in this sample. This study also examined the relationships between parental fear of hypoglycemia and children's health outcomes and compared parents' HFS-P-YC scores within the sample and to published scores for mothers of preadolescent children and adult patients with type 1 diabetes. The study hypotheses were: (1) when modified to be completed by parents of young children with type 1 diabetes, the HFS-P-YC would provide a reliable measure of fear of hypoglycemia, (2) mothers' fear of hypoglycemia would be greater among mothers of children with a history of frequent hypoglycemic events and poorer blood glucose control, and (3) mothers of young children with type 1 diabetes would report higher fear scores than published scores provided by mothers of preadolescent and adult patients with type 1 diabetes.

Additional exploratory analyses compared HFS-P-YC scores for 64 mother–father dyads of young children with type 1 diabetes. For these analyses, it was hypothesized that mothers of young children with type 1 diabetes would report greater fear of hypoglycemia than fathers.

Methods

Participants

Participants were 81 mothers and 64 fathers of young children with type 1 diabetes, with a total of 64 mother–father dyads available for planned comparisons. Mothers and fathers were eligible to participate if they had a child between 2 and 8 years old who had (1) a confirmed diagnosis of type 1 diabetes as determined by a need for daily subcutaneous injections of insulin to prevent the metabolic cascade of diabetic ketoacidosis, (2) type 1 diabetes for at least 6 months to allow time for parents and children to adjust to the diagnosis and treatment, and (3) established their child's diabetes treatment through the Pediatric Diabetes Center (PDC) at the Cincinnati Children's Hospital Medical Center (CCHMC). Using these criteria, a preliminary list of 109 eligible families was obtained from the PDC and 81 families

consented to the study, reflecting a recruitment rate of 73%. Families who declined the study indicated that they did not want to participate because of the extra time involved. Table 1 presents descriptive statistics and clinical data for the children and parents who participated in this study. The children were 32 boys and 49 girls with a mean age of 5.6 years (SD = 1.6 years). The mean time since diagnosis of type 1 diabetes was 3.4 years (SD = 1.5 years). Children had a mean hemoglobin A1c (HbA1c) of 8.1 (SD = 1.0) with a range of 5.4–10.4. Sixty-three percent of children who participated followed a conventional insulin regimen consisting of 2–3 injections per day of short and long acting insulin [e.g., regular and either NPH ($n = 49$) or glargine ($n = 8$)]. The remaining 27% of children followed an intensive insulin regimen and received insulin via a continuous subcutaneous insulin infusion pump. At the time families were recruited for this study, about 75% of young children attending the PDC followed a conventional insulin regimen.

Table 1 Sample characteristics and Hypoglycemia Fear Survey-P scores

Variable	*M*	SD
Child age (years)	5.6	1.6
Child age at diagnosis (years)	2.3	1.6
Child time since diagnosis (years)	3.4	1.5
Child blood glucose level (mg/dl)	207	49
Number of blood glucose checks performed per day for the study	5.5	1.9
Number of observed blood glucose checks below 60 mg/dl for the study	4.1	6.3
Child HbA1c	8.1	1.0

Variable	Frequency	%
Child gender		
Girl	49	60%
Child race		
White	72	89%
Child insulin regimen		
Conventional	51	63%
Parent-reported frequency of hypoglycemia (< 60 mg/dl)		
Once per day	7	9%
1-2 per week	27	33%
3–5 per week	31	38%
Once per month	9	11%
Once every few months	7	9%
Parent-reported history of hypoglycemic seizure		
Yes	26	32%
Family marital status		
Married	64	79%
Single	7	9%
Divorced	6	9%
Separated	2	2%
Widow	1	1%
Family socioeconomic status[a]		
I	8	10%
II	4	5%
III	20	25%
IV	32	40%
V	17	20%

[a] The Hollingshead four-factor scale is measured from I (lowest level) to V (highest level)

Procedure

Families were invited to participate via a letter, telephone call, or by in clinic solicitation. Parents completed the informed consent, study questionnaires, and learned how to use a standardized home blood glucose meter during one of their child's regular PDC appointments. Approximately 2 weeks later, a research assistant conducted a home visit with families at which time mothers completed a retest of the HFS-P-YC and data were downloaded from the home blood glucose meter. Families received a $20 gift card to Toys R' Us for their participation. In addition, all families were allowed to keep the blood glucose meter they received for the study. This study was reviewed and approved by the CCHMC Institutional Review Board.

Dependent Measures

Children's Average Daily Blood Glucose Levels

To measure children's average daily blood glucose control, families were given one FreeStyle (TheraSense, Alameda, CA) home blood glucose meter to check their child's blood glucose during the study. Families were instructed to check their child's blood glucose via a finger stick at least four times daily for 2 weeks.

Parents' Fear of Hypoglycemia

Parents' fear of hypoglycemia was assessed using a modified version of the Hypoglycemic Fear Survey-Parent (HFS-P) (Clarke et al., 1998) called the Hypoglycemic Fear Survey-Parents of Young Children (HFS-P-YC). The HFS-P is a valid 25-item questionnaire that examines fear of hypoglycemia in parents of preadolescent children. Similar to the original Hypoglycemic Fear Survey (HFS) (Cox et al., 1987) from which the HFS-P was modified, the HFS-P has two subscales that measures parents' behaviors related to preventing an episode of hypoglycemia and their worry that their child may experience a hypoglycemic episode. For each item, parents are asked to report how often the item is true for them using a 5 point Likert scale ("1 = never" to "5 = very

often"). The HFS-P yields a subscale score for each of the behavior and worry scales and a total score, with higher scores indicating greater fear of hypoglycemia (Clarke et al., 1998). For the HFS-P-YC, seven items of the original HFS-P were reworded to be more appropriate for families of young children with type 1 diabetes. For the majority of these items, the change reflected the addition or substitution of more age appropriate activities for young children with type 1 diabetes (e.g., day care and school). However, for items that originally sought to measure behavior or worry specific to hypoglycemia when children were alone ($n = 3$), the phrase "away from me and in someone else's care" was added to the item, as it was expected that the young children were never left alone. In addition to rewording items, one question from the original HFS which related to fear of having a hypoglycemic event while driving, was added to the HFS-P-YC and was reworded so that it described the parents' fear their child might have a low blood glucose while the parent was driving (Clarke et al., 1998; Cox et al., 1987). This item was added to the HFS-P-YC to reflect a concern many parents had shared in the clinic about anxiety related to having their small child strapped into a safety car seat in the back of the car and, in many cases, out of both their direct sight and reach. Items that were reworded or added to the HFS-P-YC were reviewed by a five member panel of health care providers (e.g., one physician, one nurse, one diabetes educator, two psychologists) who work with families of young children with type 1 diabetes. To be included in the final version of the HFS-P-YC, all panel members needed to agree that the item was relevant to families of young children with type 1 diabetes and clearly worded.

Medical History Form

Children's medical history was obtained using a parent-report questionnaire which asked parents for general demographic and medical information about their child such as his/her age when he/she was diagnosed with type 1 diabetes, the child's previous frequency of hypoglycemia, and the presence or absence of hypoglycemic seizures. For this study, a hypoglycemic event was defined as an episode wherein the child had a blood glucose level of 60 mg/dl or less and/or received any treatment for low blood glucose levels (e.g., glucagon, orange juice).

Results

Reliability

To assess the reliability of the HFS-P-YC among parents of young children with type 1 diabetes, the internal consistency and test–retest reliability of the HFS-P-YC were examined. Internal consistency was calculated using Cronbach's alpha coefficient. Cronbach's alpha coefficient for the HFS-P-YC total score and the behavior and worry subscale scores were .90, .70, .93, respectively for mothers and .92, .74, .93, respectively for fathers. These findings suggest that the HFS-P-YC retained good internal consistency when administered to parents of young children with type 1 diabetes. The 2-week test–retest reliability of mothers' HFS-P-YC scores revealed Pearson correlations of .81 ($p < .001$), .49, ($p < .001$), and .82 ($p < .001$) for the total score and the behavior and worry subscale scores, respectively, indicating good stability of scores in mothers of young children with type 1 diabetes.

HFS-P-YC Scores and Sample Characteristics

Correlations were run to examine associations between mothers' HFS-P-YC scores with the frequency of hypoglycemic events, children's average daily blood glucose for the 2 week study period, the number of blood glucose checks below 60 mg/dl, and children's HbA1c level for the study period. Children's frequency of hypoglycemic events was obtained by parent-report. Children's average daily blood glucose was 207 mg/dl (SD = 49). The mean number of observed hypoglycemic events during the 2 week study period (blood glucose checks below 60 mg/dl) was 4.1 (SD = 6.3). The total number of blood glucose checks recorded by the study meters for the 2 week recording period ranged from 31 to 199, with a mean number of checks per day of 5.1 (SD = 1.9). Results found a positive correlation between mothers' scores on the worry subscale of the HFS-P-YC and their reporting of the frequency of hypoglycemic events ($r = .24$, $p < .05$), suggesting that mothers of children who have more frequent hypoglycemic events may experience greater worry about hypoglycemia. No significant correlations were found between mothers' HFS-P-YC total and behavior scores and children's frequency of hypoglycemic events. Similarly, no significant correlations were found between mothers' HFS-P-YC scores and children's mean daily blood glucose levels, number of hypoglycemic events during the 2 week study period, and HbA1c levels. Within the sample, 26 children (32%) had experienced at least one hypoglycemic seizure in their lifetime. A comparison of mothers' HFS-P-YC scores found higher total scores for mothers of children who had a positive seizure history versus mothers of children who had never had a seizure ($M = 80.5$, SD = 17.7 and $M = 72.4$, SD = 16.7, respectively, $p = .05$). A statistical trend was found when comparing mothers' reporting on the behavior subscale, with mothers of children who had had a hypoglycemic seizure reporting higher scores than mothers of children

who had never had a seizure ($M = 34.7$, SD = 6.4 and $M = 31.9$, SD = 6.1, respectively, $p = .07$).

Comparisons of Mothers' and Fathers' HFS-P-YC Scores

Table 2 summarizes the mean scores for the HFS-P-YC when completed by mothers and fathers of young children with type 1 diabetes. Scores were compared using a series of Student *t*-tests with the a priori alpha level set at .01 to correct for multiple tests. Results of these tests found that mothers of young children with type 1 diabetes reported greater fear of hypoglycemia than fathers of young children ($M = 75.0$, SD = 17.2 and $M = 66.5$, SD = 18.0, $p = .006$). Differences were also found when comparing mothers and fathers on their scores for the behavior subscale, ($M = 33.0$, SD = 6.2, and $M = 29.0$, SD = 6.5, $p = .001$). Comparisons of parents' scores for the worry subscale found no differences for mothers and fathers ($M = 42.0$ SD = 13.5 and $M = 38.0$, SD = 13.4, $p = .06$).

Two Sample Comparisons of Mothers' HFS-P-YC Scores

Finally, to provide a context for interpreting the HFS-P-YC scores of mothers of young children with type 1 diabetes, a series of two sample t-tests with unequal variances were used to compare scores with published findings in mothers of preadolescent children and adult patients with type 1 diabetes (Clarke et al., 1998). Results of the *t*-tests comparing fear of hypoglycemia for mothers of young children with type 1 diabetes to mothers of preadolescents, revealed no differences for the worry, behavior, and total scores. In contrast, comparisons to a sample of adult patients with type 1 diabetes found higher scores across all three HFS-P-YC scores for mothers of young children. Specifically, mothers of young children were found to report more fear of hypoglycemia in their children than adult patients with type 1 diabetes ($p < .000$). The worry ($p < .000$) and behavior ($p < .000$) scores were also higher for mothers of young children with type 1 diabetes versus adult patients with type 1 diabetes (Table 3).

Table 2 Comparison of Hypoglycemia Fear Survey-Parents of Young Children (HFS-P-YC) scores for mothers and fathers of young children with type 1 diabetes

Variable	Mothers $N = 81$		Fathers $N = 64$		$p=$
	M (SD)	Range	*M* (SD)	Range	
HFS-P-YC total	75.0 (17.2)	46–118	66.5 (18.0)	34–117	.006
HFS-P-YC worry	42.0 (13.5)	16–80	38.0 (13.4)	18–78	.06
HFS-P-YC behavior	33.0 (6.2)	18–46	29.0 (6.5)	16–45	.001

Discussion

The purpose of this study was to report on fear of hypoglycemia in a sample of parents of young children with type 1 diabetes mellitus. Data were gathered using the Hypoglycemia Fear Survey-Parents, which was renamed the Hypoglycemic Fear Survey-Parents of Young Children (HFS-P-YC) and modified to assess parents' worry about hypoglycemia and the behaviors parents may engage in to avoid hypoglycemic episodes for their young child with type 1 diabetes (Clarke et al., 1998). This study found good internal consistency and test–retest reliability for the HFS-P-YC when completed by parents of young children with type 1 diabetes. The behavior subscale of the HFS-P-YC had the lowest measures of internal consistency and test–retest reliability, which may have been due to the fact that this subscale has the fewest items (e.g., 10 vs. 16 items) and that there was less variability in parent reporting. However, previous studies using the HFS and the HFS-P have also found lower internal consistency for the behavior subscale (Clarke et al., 1998; Cox et al., 1987). Thus, it is also possible that this may be a weakness of the original HFS because the items of the behavior subscale involve less subjective interpretation as they seek to measure behaviors related to preventing an episode of hypoglycemia rather than worries related to hypoglycemia (Cox et al., 1987).

Contrary to study hypotheses, mothers' total scores for the HFS-P-YC did not correlate with their estimation of the frequency of children's hypoglycemic episodes, average daily blood glucose levels, number of identified episodes of hypoglycemia during the 2 week study, or HbA1c levels. The lack of association between mothers' fear and children's average daily blood glucose levels may be due to limited power and the fact that families identified very few episodes of hypoglycemia during the 2 week study period. Similarly, because the majority of children had an HbA1c level within the target range for young children or higher, it is possible that the lack of an association with mothers' fear may be due to a relative infrequency of episodes of hypoglycemia in general for these children. These results are consistent with previous research, which has also failed to demonstrate a relationship between mothers' HFS-P total scores and their reporting of children's hypoglycemic episodes and glycemic control in a sample of preadolescent children with type 1 diabetes (Clarke et al., 1998). However, unlike previous research, a significant positive correlation was found between mothers' reporting on the worry subscale of the HFS-P-YC and their recall of the frequency of children's hypoglycemic episodes, suggesting that mothers who report more frequent episodes of hypoglycemia may report greater worry about hypoglycemia. There are two possible explanations for this new result.

Table 3 Comparison of variations of the Hypoglycemia Fear Survey scores for mothers' of young children with type 1 diabetes with published scores for mothers' of pre-adolescent children and adult patients[a]

	Mothers of young children $N = 81$ M (SD)	Mothers of pre-adolescents[b] $N = 46$ M (SD)	$p=$	Mothers of young children $N = 81$ M (SD)	Adult patients[b] $N = 78$ M (SD)	$p<$
HFS-total	2.88 (.7)	2.94 (.6)	.61	2.88 (.7)	1.88 (.6)	.000
HFS-worry	2.63 (.8)	2.68 (.8)	.73	2.63 (.8)	1.82 (.8)	.000
HFS-Behavior	3.28 (.6)	3.32 (.6)	.71	3.28 (.6)	1.96 (.5)	.000

Note: [a] Scores were transformed to adjust for differences in the number of items for each version of the HFS. [b] Data from Clarke et al. (1998)

First, if these are also the children who tend to experience hypoglycemia more frequently, then the observed association with mothers' worry scores would suggest that these mothers' may be reporting greater worry because they have a child at risk for hypoglycemia. Second, it is possible that the observed association between mothers' recall of hypoglycemic episodes and their worry scores may be due to priming and the possibility that mothers' were primed to think about their fear when asked to estimate the frequency of these events.

Consistent with the finding relating mothers' worry scores to their recall of the frequency of hypoglycemic episodes, a comparison of mothers' total HFS-P-YC scores found higher scores for mothers of young children who had had a seizure versus mothers of young children who had never had a seizure. Indeed, it would follow that mothers may report greater fear of hypoglycemia if they had experienced an extreme episode of hypoglycemia, such as one resulting in a seizure, versus a more mild episode. This finding is also consistent with the previous study of mothers of preadolescents with type 1 diabetes which found significant differences in HFS-P scores reported by mothers of preadolescents who had lost consciousness due to severe hypoglycemia versus mothers of preadolescents who had not had this experience (Clarke et al., 1998).

This is the first study to examine fear of hypoglycemia in a large sample of both mothers and fathers of young children with type 1 diabetes. Because fathers were also recruited to participate in this study, data are available to compare mothers and fathers in their level of fear. Results of these analyses suggested that mothers reported higher total HFS-P-YC scores and higher scores on the behavior subscale than fathers. In contradiction to the study hypothesis, no difference was found between mothers and fathers for the worry subscale. It is interesting that no difference was observed for parents' worry subscale scores, suggesting that concern about hypoglycemia may be universal among mothers and fathers. Differences for the HFS-P-YC total scores and behavior subscale suggest that mothers may have a greater tendency to engage in treatment behaviors that keep blood glucose levels higher and thus reduce the risk of a hypoglycemic event. While parents in this study were not asked to provide an estimate of the amount of time they engaged in diabetes-specific activities each day, research suggests that mothers of young children with type 1 diabetes often assume the majority of care for their child's diabetes (Sullivan-Bolyai, Knafl, Deatrick, & Grey, 2003; Sullivan-Bolyai, Rosenberg, & Bayard, 2006). Thus, it is possible that the differences observed were due to differences in the amount of time spent by mothers and fathers caring for their child's diabetes. If mothers indeed spent more time caring for their child's diabetes than fathers, then they may have had more first hand experience in managing hypoglycemia and thus may have adopted treatment behaviors to avoid hypoglycemic events. Future research should examine parents' fear of hypoglycemia within the context of the amount of time spent caring for diabetes by each parent to see if a relationship exists between these two variables.

Also, contrary to study hypotheses, comparisons of mothers' HFS-P-YC scores with published scores yielded mixed results, with mothers of young children reporting comparable scores to mothers of preadolescents and higher scores than adult patients with type 1 diabetes (Clarke et al., 1998). Because young children may not be able to recognize or report symptoms of hypoglycemia, it was thought that mothers of young children might report more fear of hypoglycemia than mothers of preadolescents. Rather, the findings suggest that all mothers may experience fear of hypoglycemia equally despite the age of their child. Given the responsibility that mothers' bear for caring for their child, it was expected that mothers of young children would report greater fear than adult patients with type 1 diabetes and this outcome was consistent with the literature (Clarke et al., 1998).

The lack of economic and ethnic diversity in the sample is a limitation of this study and may be a concern for researchers looking to use the HFS-P-YC in a diverse sample of families of young children with type 1 diabetes. Similarly, this study is limited in the conclusions that can be drawn for the association between children's HbA1c levels and mothers' fear of hypoglycemia. While the

sample of children appeared to be diverse with respect to range of glycemic control, a closer examination of the data revealed that the majority of children had an HbA1c level within the target range for their age (range = 7.5–8.5%). Future research is needed to see if parents' fear of hypoglycemia among children is different for parents of young children with poor glycemic control. This study did not collect data concerning parents' level of general anxiety, which may have been helpful in examining the validity of the HFS-P-YC in parents of young children with type 1 diabetes as well as providing a context for understanding parents' HFS-P-YC scores. It is possible that in some parents of young children with type 1 diabetes, fear of hypoglycemia may reflect a greater propensity for general anxiety and not fear of hypoglycemia specifically. Thus, research is needed to determine if parents of young children with type 1 diabetes are more anxious in general about the health of their child or focused specifically on hypoglycemia and to use these data to begin to examine the validity of the HFS-P-YC.

In summary, this study presents reliability and outcome data on the HFS-P-YC, which was administered to 81 mothers and 64 fathers of young children with type 1 diabetes. Findings of this study demonstrate good reliability for the HFS-P-YC, which is available upon request for research and clinical use. Fear of hypoglycemia is common among parents of young children with type 1 diabetes and exploratory analyses suggest that mothers of young children may report greater use of strategies that increase blood glucose levels than fathers. Mothers' fear may also be significantly greater than the level of fear experienced by adult patients with type 1 diabetes. To reduce the likelihood of a hypoglycemic event, parents may be tempted to maintain higher than optimal blood glucose levels in their children, which ultimately could impact their child's health outcomes (Ryan et al., 2005).

The findings of this study suggest that psychologists and other health care providers should talk to parents about their feelings and concerns related to hypoglycemia and develop patient-specific strategies to manage diabetes more effectively and reduce parents' fear. To facilitate this discussion, the HFS-P-YC may be useful in clinics. This measure takes less than 10 min to complete and can be scored quickly to provide a measure of fear of hypoglycemia. HFS-P-YC scores may be helpful in tracking parents' fear levels and determining if cognitive-behavioral interventions can bring about an appropriate decrease in fear. Moreover, parents' responses to individual items may help to guide patient-specific interventions. For example, psychologists may be able to use data from the behavior scale to identify strategies parents are using to avoid hypoglycemia in their children and to help parents problem solve new strategies. These strategies might include identifying and training other adults to manage their child's diabetes while parents are away from their child; testing blood glucose more frequently; working with their physician to incorporate new technology in their diabetes management, such as continuous insulin infusion pumps and/or continuous blood glucose monitors; carrying small snacks to feed their child if their glucose runs low; and logging their child's blood glucose levels to identify common patterns. Items from the worry subscale also can provide targets for cognitive-behavioral therapy and help parents to recognize their thoughts and feelings related to hypoglycemia, their concerns related to how other people/the medical team may perceive these events, the presence of all or nothing thinking (e.g., if my child has a low blood glucose he will have a seizure), and to teach parents new strategies for managing their thoughts and feelings related to hypoglycemia.

Future research is needed to replicate our results pertaining to the reliability and utility of the HFS-P-YC. Research is also needed to determine if behaviorally based interventions can be successful in reducing parents' fear of hypoglycemia without compromising children's health status.

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References

American Diabetes Association. (2005). Defining and reporting hypoglycemia in diabetes: A report from the American Diabetes Association Workgroup on Hypoglycemia. *Diabetes Care, 28*, 1245–1249. doi:10.2337/diacare.28.5.1245.

Amos, A. F., McCarty, D. J., & Zimmet, P. (1997). The rising global burden of diabetes and its complications: Estimates and projections to the year 2010. *Diabetic Medicine, 14*(Suppl 5), S1–S85. doi:10.1002/(SICI)1096-9136(199712)14:5+<S7::AID-DIA522>3.3.CO;2-I.

Clarke, W. L., Gonder-Frederick, A., Snyder, A. L., & Cox, D. J. (1998). Maternal fear of hypoglycemia in their children with insulin dependent diabetes mellitus. *Journal of Pediatric Endocrinology and Metabolism, 11*(Suppl 1), 189–194.

Cox, D. J., Irvine, A., Gonder-Frederick, L., Nowacek, G., & Butterfield, J. (1987). Fear of hypoglycemia: Quantification, validation, and utilization. *Diabetes Care, 10*, 617–621. doi:10.2337/diacare.10.5.617.

Dahlquist, G., & Mustonen, L. (2000). Analysis of 20 years of prospective registration of childhood onset diabetes – time trends and birth cohort effects. Swedish Childhood Diabetes Study Group. *Acta Paediatrica (Oslo, Norway), 89*, 1231–1237. doi:10.1080/080352500750027628.

Gonder-Frederick, L. A., Fisher, C. D., Ritterband, L. M., Cox, D. J., Hou, L., DasGupta, A. A., et al. (2006). Predictors of fear of

hypoglycemia in adolescents with type 1 diabetes and their parents. *Pediatric Diabetes, 7*, 215–222. doi:10.1111/j.1399-5448.2006.00182.x.

Irvine, A. A., Cox, D., & Gonder-Frederick, L. (1992). Fear of hypoglycemia: Relationship to physical and psychological symptoms in patients with insulin-dependent diabetes mellitus. *Health Psychology, 11*, 135–138. doi:10.1037/0278-6133.11.2.135.

Irvine, A. A., Cox, D., & Gonder-Frederick, L. (1994). The Fear of Hypoglycemia Scale. In C. Bradley (Ed.), *The handbook of psychology and diabetes* (pp. 133–155). Great Britain: Harwood Academic Publishers.

Kaufman, F. R., Austin, J., Lloyd, J., Halvorson, M., Carpenter, S., & Pitukcheewanont, P. (2002). Characteristics of glycemic control in young children with type 1 diabetes. *Pediatric Diabetes, 3*, 179–183. doi:10.1034/j.1399-5448.2002.30402.x.

Linscheid, T., Budd, K., & Rasnake, L. (2003). Pediatric feeding disorders. In M. Roberts (Ed.), *Handbook of pediatric psychology* (3rd ed., pp. 481–498). New York: The Guilford Press.

Marrero, D. G., Guare, J. C., Vandagriff, J. L., & Fineberg, N. S. (1997). Fear of hypoglycemia in the parents of children and adolescents with diabetes: Maladaptive or healthy response? *The Diabetes Educator, 23*, 281–286. doi:10.1177/014572179702300306.

Patton, S. R., Dolan, L. M., Henry, R., & Powers, S. W. (2007). Parental fear of hypoglycemia: Young children treated with continuous subcutaneous insulin infusion. *Pediatric Diabetes, 8*, 362–368. doi:10.1111/j.1399-5448.2007.00242.x.

Ryan, C., Gurtunca, N., & Becker, D. (2005). Hypoglycemia: A complication of diabetes therapy in children. *Pediatric Clinician North America, 52*, 1705–1733. doi:10.1016/j.pcl.2005.08.002.

Silverstein, J., Klingensmith, G., Copeland, K., Plotnick, L., Kaufman, F., Laffel, L., et al. (2005). Care of children and adolescents with type 1 diabetes: A statement of the American Diabetes Association. *Diabetes Care, 28*, 186–212. doi:10.2337/diacare.28.1.186.

Sullivan-Bolyai, S., Deatrick, J., Gruppuso, P., Tamborlane, W., & Grey, M. (2002). Mothers' experiences raising young children with type 1 diabetes. *Journal for Specialists in Pediatric Nursing, 7*, 93–103. doi:10.1111/j.1744-6155.2002.tb00158.x.

Sullivan-Bolyai, S., Deatrick, J., Gruppuso, P., Tamborlane, W., & Grey, M. (2003a). Constant vigilance: Mothers' work parenting young children with type 1 diabetes. *Journal of Pediatric Nursing, 18*, 21–29. doi:10.1053/jpdn.2003.4.

Sullivan-Bolyai, S., Knafl, K., Deatrick, J., & Grey, M. (2003b). Maternal management behaviors for young children with type 1 diabetes. *MCN. The American Journal of Maternal Child Nursing, 28*, 160–166. doi:10.1097/00005721-200305000-00005.

Sullivan-Bolyai, S., Rosenberg, R., & Bayard, M. (2006). Fathers' reflections on parenting young children with type 1 diabetes. *MCN. The American Journal of Maternal Child Nursing, 31*, 24–31. doi:10.1097/00005721-200601000-00007.