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Family Functioning at Meals Relates to Adherence in Young Children with Type 1 Diabetes

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Abstract

Aims—This study examined associations between mealtime family functioning, dietary adherence and glycemic control in young children with type 1 diabetes (T1DM). We hypothesized that poorer family functioning would correlate with poorer dietary adherence and glycemic control.

Methods—Thirty-five families of children ($M = 5.6 \pm 1.5$ years) with T1DM had meals videotaped in their home, which were coded for family functioning according to the McMaster Interaction Coding System (MICS). Children's dietary adherence was assessed according to deviations from the prescribed number of carbohydrate units per meal and recommended carbohydrate intake levels per day. Glycemic control was measured via 14-days of self-monitoring of blood glucose levels.

Results—Findings demonstrated significant negative associations between children's dietary adherence and two dimensions of family functioning: Task Accomplishment ($r = -0.43, p = 0.03$) and Behavioral Control ($r = -0.54, p = 0.00$). Affect Management correlated negatively with the percent of blood glucose levels below the normal range ($r = -0.33, p = 0.05$). Eleven families (31%) of young children with type 1 diabetes demonstrated mealtime family functioning in the unhealthy range.

Conclusions—This was the first study to examine the relationship between mealtime family functioning and children's dietary adherence and glycemic control in families of young children with T1DM. Previous research has found mealtime family functioning to be impaired in families of young children with T1DM when compared to families of children without diabetes. Research is needed to determine if family functioning and dietary adherence can be improved via specific family-based behavioral training around mealtimes.

Type 1 diabetes (T1DM) is a common pediatric chronic illness that impairs glucose functioning and puts patients at increased risk for blood glucose levels that are outside of the normal range (1). Research in children with T1DM has focused on understanding factors

that lead to better adherence to self-care and improved glycemic control. One factor which has been the subject of many studies is the role of family functioning in the management of T1DM (2–6). It is known that family functioning factors, including family conflict (3), lack of responsibility-taking for diabetes care tasks (4), and perceptions of non-supportive parental behaviors (5) are related to poorer diabetes adherence and glycemic control in children with T1DM. In contrast, research has found a relationship between better diabetes adherence and families' guidance/control, a generally positive dimension of family functioning (6,7).

An emerging area of research in T1DM is the role of family functioning within the context of mealtimes. Mealtimes provide the optimal context to examine adherence in T1DM because they involve multiple components of diabetes self-care, including blood glucose testing, insulin administration, and dietary planning to ensure children consume an adequate amount of carbohydrates to match insulin levels (1). Moreover, for parents of young children, mealtimes are universally challenging due to problems with food refusal, picky eating, disruptions at mealtime behaviors, and noncompliance with parental requests (8–10). One study, which compared family functioning in families of young children with T1DM and matched controls, found significantly poorer functioning for families of young children with T1DM, suggesting that the rigors of following a diabetes treatment plan may increase the risk of unhealthy functioning at mealtimes for families of young children with T1DM (11). What is not known is if the differences observed in family functioning at mealtimes also translate into greater diabetes risk for children. Thus, the goal of the current study was to extend the mealtime research by examining the impact of family functioning on dietary adherence and glycemic control in families of young children with T1DM. We hypothesized that poorer family functioning, as evidenced by lower scores on the Mealtime Interaction Coding System (MICS) would be related to poorer dietary adherence and average daily glycemic control for families of young children with T1DM.

RESEARCH DESIGN AND METHODS

Participants

Thirty-five children with T1DM and their families participated in the current study. Families were recruited from the Pediatric Diabetes Center (PDC) at a tertiary hospital in the mid-western region of the United States. Eligibility criteria were 1) a child between 2 and 8 years old, 2) a confirmed diagnosis of T1DM for at least one year, 3) no other diseases/conditions known to affect growth, and 4) English spoken in the home. Within the PDC, 83 families were contacted to participate in clinical research. The first 35 families who agreed to complete both questionnaires and videotaping of home meals were enrolled in the current study.

Children who participated followed all types of insulin management. However, the majority (77%) followed a conventional insulin regimen which consisted of two injections each day of a short and intermediate-acting insulin (e.g., humalog/NPH) combined with one daily injection of a long-acting insulin (e.g., Lantus). The remaining eight children followed an intensive insulin regimen consisting of 4–5 insulin injections (e.g., Novolog and Lantus) or a continuous insulin infusion pump. At time of recruitment, 75% of young children with T1DM were using conventional insulin therapy.

Procedure

This study received Institutional Review Board approval prior to participant recruitment. Families were contacted about the study via a letter from the Principal Investigator and a follow up telephone call made by a member of the research team. Families who consented to participate scheduled a home visit with a research assistant to complete the informed consent

and begin the study. Data concerning children's dietary intake and family functioning at mealtimes were collected from three representative home meals which were video taped according to a standardized protocol (9,10). The mean number of home visits needed to obtain at least three representative meals was 3.11 ± 0.33 . At study completion, families were reimbursed \$70 for their time and effort.

Dependent Measures

Dietary Adherence—Children's diet records from each of the videotaped meals were analyzed by a registered dietitian using the Minnesota Nutrition Data System (Nutrition Coordinating Center, University of Minnesota, 1996). For children on conventional therapy ($n=27$), we calculated two measures of dietary adherence based on the number of carbohydrate units added or deleted from each videotaped meal that deviated from the child's individual diet plan for that meal (12). To calculate the deviation scores, children's meal records were reviewed by a team of trained research assistants. Inter-rater reliability was assessed using a Kappa coefficient. The Kappas were 0.88 for additions and 0.81 for deletions, which exceed the minimum considered acceptable for inter-rater reliability (13).

Children's Daily Glycemic Control—To measure of children's daily glycemic control during the videotaping, families used a standardized FreeStyle (TheraSense, Alameda, CA) home blood glucose meter. Families were instructed to use this meter to test their child's blood glucose at least four times daily for the two weeks they were also completing the mealtime videotaping. On average children had 76 ± 32 blood glucose readings (range 31 to 159) or approximately 4.8 ± 1.8 blood glucose checks per day of recording.

Family Functioning—Family functioning at mealtimes was assessed using the Mealtime Interaction Coding System (MICS), an observational coding system based on the McMaster Model of Family Functioning (14). The MICS evaluates family functioning according to six dimensions (task accomplishment, communication, affect management, interpersonal involvement, behavioral control, roles) and one separate scale of general functioning. For each of the dimensions, a 7 point scale is used to indicate quality of family functioning according to the following scale (1 = very unhealthy and 7 = very healthy). A clinical cut off score can be applied to each dimension, with scores of 5 and higher suggesting functioning in the healthy range. Coding for the MICS began with the start of the meal, which may be indicated by the presentation of food and the initiation of eating by at least one family member. Coding concluded at the end of the meal or after 20 minutes, whichever occurred first. For the current study, two trained psychology postdoctoral fellows completed the MICS coding and reliability assessment. Reliability was evaluated based on 33% of the meals and inter-rater reliability (intraclass correlation coefficient) for each dimension of the MICS ranged from $r = 0.66 - 0.93$, suggesting good reliability (15).

Data Analyses

All data were analyzed using SPSS statistical software (16). Descriptive data were calculated for sample characteristics and variables of interest (e.g., MICS scores, children's dietary adherence). To examine children's average glycemic control during the study, we used the percent of blood glucose tests that fell above, below, and within the target range for blood glucose control for young children (e.g., 70–180mg/dl). Pearson Product-Moment Correlations were used to examine associations between MICS scales, dietary adherence, and daily glycemic control.

RESULTS

Participants

Table 1 presents descriptive statistics for the 35 children with T1DM who participated in this study as well as mean scores for each dimension of the MICS and mean scores for dietary adherence. With respect to family functioning, eleven families demonstrated scores on the individual dimensions of the MICS that were in the unhealthy range based on established clinical cut-offs (e.g., scores < 5; (14)).

Family Functioning and Health Outcomes

Table 2 lists the correlations between each dimension of the MICS and children's dietary adherence and average glycemic control. We predicted that families with poorer family functioning at mealtimes would have children with poorer dietary adherence and more blood glucose checks outside of the normal range. Consistent with our hypothesis, we found significant negative correlations between two dimensions of family functioning, Task Accomplishment and Behavioral Control, and the number of carbohydrate units children deleted from the videotape meals ($r = -0.43$ and $r = -0.54$, respectively). A statistical trend was also found for poorer Role Functioning and the number of carbohydrate units deleted ($r = -0.36$, $p = 0.07$). With respect to carbohydrate additions, no significant relationships were found with MICS scales. When we correlated the dimensions of the MICS with the percent of readings below the normal range, we found a negative relationship with families' Affect Management ($r = -0.33$, $p = 0.05$), suggesting families who demonstrate appropriate emotional expression during the meal have children who experience fewer low blood glucose concentrations. Likewise, we found a statistical trend between families' Affect Management and the percent of readings above the normal range for children ($r = 0.31$, $p = 0.07$), suggesting families with better ability to manage emotions at mealtimes have children with higher glycemic concentrations. Contrary to our hypothesis, no other dimensions of the MICS were found to correlate with children's glycemic control.

DISCUSSION

This is the first study to examine the relationship between family functioning at mealtimes and children's dietary adherence and average glycemic control. The results are consistent with previous research examining mealtimes in families of young children with T1DM. Specifically, the extant literature demonstrates negative correlations between children's disruptive behavior at mealtimes and the number of carbohydrate units deleted from children's meals. Similarly, the literature demonstrates negative correlations between parents' use of coercive management strategies and the number of carbohydrate units deleted from children's meals (17). Within the MICS, Task Accomplishment reflects the flow of the meal and how well families are able to minimize or respond to disruptions to the meal (e.g., complaints about the meal, members not eating, members leaving the table before the end of the meal). The Behavioral Control domain reflects parents' management style for the meal and if they demonstrate a style that is flexible and responsive to the child's behavior, a style that is disorganized and chaotic, or a style that is overly rigid (14,18). Thus, common to the literature, the results of this study suggest that children with T1DM may experience poorer dietary adherence if they experience family meals characterized by frequent disruptions and their parents use primarily rigid and coercive management strategies during the meal.

This study has implications for research and clinical care in families of young children with T1DM. From a research perspective, this study supports the existing literature linking diabetes adherence with better family functioning (6,7). Moreover, our use of an

observational measure of family functioning as well as actual family mealtime data provide a more objective assessment of family functioning and dietary adherence. This study also is one of only a small number of studies to focus on the experiences of families of young children with T1DM. Epidemiological reports suggest that the incidence of T1DM is increasing in children who are less than seven years old (19–21). However, behavioral research focused on the experiences of parenting and managing T1DM in a young child is evolving at a slower rate. Therefore, this study provides important data for a previously under-represented population of families and directs research to consider the role of family functioning as a predictor of child adherence and a possible opportunity for intervention.

Clinically, the results of this study suggest that even in our present era of carbohydrate counting and fewer dietary restrictions for children with T1DM, the added burden of feeding a young child with T1DM and achieving optimal dietary adherence may disrupt family functioning. For example, current study results suggest that families who may be more disorganized at mealtimes or parents who lack the ability to manage behaviors and negative emotions (i.e., frustration) at the meal experience problems persuading their child to consume an adequate number of carbohydrates at the meal. Because patients with T1DM work to achieve normal blood glucose levels through a balance of carbohydrate intake and insulin, failure to consume the recommended number of carbohydrates in a meal could increase the risk of a hypoglycemic episode for children (1). Moreover, if parent and child behavioral problems and poor food intake occur regularly at meals, this could promote greater stress for families of young children with T1DM (22).

Thus, our results suggest that families of young children with T1DM could benefit from behavioral-based interventions that teach parents how to establish limits, set contingencies for child behavior and eating at mealtimes, and use positive reinforcement to manage mealtime behaviors. Within the broader pediatric psychology literature, studies have demonstrated improvements in dietary adherence, child behavior, and parenting behaviors as the result of behavioral interventions targeting these strategies (23,24). These interventions could be adapted for use with families of young children with T1DM and may help to improve mealtime management and decrease family stress.

Although this is the first study linking family functioning to dietary adherence and glycemic control in a sample of young children with T1DM, some limitations are noted. We elected to use observational data to assess family functioning. Observational data can provide a more objective and reliable measure of family functioning than parent report. Yet, because of the time and expense involved in collecting these data, studies may be limited with respect to sample size. Indeed, our study recruited a relatively small sample of families of young children with T1DM who were generally White and from the middle to upper middle class. Because of our relatively small sample size and the lack of heterogeneity in our sample, it is possible that results of this study are not completely generalizable. Future research is needed to examine family functioning and health outcomes in a larger sample of young children with T1DM who come from a more diverse background. Additionally, with the growing popularity of flexible insulin regimens for young children with T1DM (25), research is needed examining family functioning in a sample of intensively managed young children to see if the relationships between family functioning and health outcomes are maintained. This study is the first to examine the relationship between family functioning at mealtimes and children's health outcomes in a sample of young children with T1DM. To examine these data, a number of correlations were run, which may increase the risk for error. We elected not to correct for the number of tests because we felt our findings are novel and lay a foundation for future research in this area. However, the reader is cautioned against over-interpreting the outcomes of this study without confirmation from future research. Finally, because this study used cross-sectional data, causality of the findings cannot be determined.

Thus, it is unclear whether poorer family functioning at mealtimes results in poorer dietary adherence and glycemic control for young children with T1DM or if dietary adherence and glycemic control lead to greater family stress and consequently poorer functioning at mealtimes. To identify the direction of causality, research incorporating a longitudinal study design will be needed.

KEY POINTS

1. Families of young children with type 1 diabetes mellitus have poorer family functioning at mealtimes when compared to families of same-aged children without diabetes.
2. Poorer family functioning at mealtimes is correlated with poorer dietary adherence in families of young children with type 1 diabetes mellitus. In contrast, parents with effective emotional expression at mealtimes have children with fewer low blood glucose concentrations.
3. Interventions to improve diabetes adherence and health outcomes for young children with type 1 diabetes mellitus should include behavioral components that target improved family functioning at mealtimes.

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Table 1

Demographic, Anthropometric, and Outcome Data

Variable	M	SD
Age (years)	5.6	1.6
Weight (kg)	22.3	5.0
Height (cm)	113.2	11.6
Blood glucose level (mg/dl)	213	48
HbA1c	8.3	1.0
Dietary Deviation Scores [†] :		
Carbohydrate unit additions (per meal)	0.20	0.30
Carbohydrate unit deletions (per meal)	0.37	0.74
MICS Dimensions [‡] :		
Task Accomplishment	4.64	1.41
Communication	4.56	1.00
Affect Management	4.60	1.08
Interpersonal Involvement	4.56	1.32
Behavioral Control	4.92	1.19
Roles	4.52	1.19
Overall Family Functioning	4.56	1.19
	Frequency	%
Gender Boy	14	40%
Race White	29	83%
Non-white	6	17%
Socioeconomic Status [§]		
I	6	17%
II	0	0%
III	8	23%
IV	16	46%
V	5	14%
Marital Status		
Married	28	80%

[†] Average of deviation in carbohydrate units for all three meals. Higher scores reflect poorer dietary adherence.

[‡] Mealtime Interaction Coding System (MICS). Scores range from 1 to 7, with higher scores indicating better functioning.

[§] The Hollingshead Four-Factor Scale is measured from I (lowest level) to V (highest level).

Table 2

Correlations between family functioning and health outcome variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Average daily blood glucose	1	-0.93**	-0.57**	0.96**	-0.11	-0.003	0.27	-0.32	-0.17	-0.15	-0.06	0.57	-0.11
2. % values in range		1	0.35*	-0.96**	0.02	0.02	-0.27	0.03	0.09	0.08	0.02	-0.39*	-0.27
3. % values below			1	-0.55**	-0.09	-0.15	-0.33*	-0.08	-0.05	0.01	-0.009	-0.16	0.09
4. % values above				1	-0.005	0.01	0.31	-0.006	-0.07	-0.08	-0.02	0.38*	-0.03
5. Task Accomplishment					1	0.70**	0.66**	0.67**	0.75**	0.75**	0.82**	-0.43*	0.05
6. Communication						1	0.75**	0.83**	0.69**	0.72**	0.88**	-0.22	-0.05
7. Affect Management							1	0.70**	0.70**	0.68**	0.82**	-0.17	0.16
8. Interpersonal Involvement								1	0.72**	0.68**	0.86**	-0.18	0.006
9. Behavioral Control									1	0.72**	0.80**	-0.54**	0.13
10. Roles										1	0.79**	-0.36	0.35
11. Overall Family Functioning											1	-0.25	-0.02
12. # carbohydrate units deleted from meals												1	-0.32
13. # carbohydrate units added to meals													1

* Note, $p \leq 0.05$

** $p \leq 0.01$