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Examining Mealtime Behaviors in Families of Young Children with Type 1 Diabetes on Intensive Insulin Therapy

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Abstract

This study examined mealtime behaviors in families of young children with type 1 diabetes (T1DM) on intensive insulin therapy. Behaviors were compared to published data for children on conventional therapy and examined for correlations with glycemic control. Thirty-nine families participated and had at least three home meals videotaped while children wore a continuous glucose monitor. Videotaped meals were coded for parent, child, and child eating behaviors using valid coding system. A group difference was found for child request for food only. There were also associations found between children's glycemic control and child play and away. However, no associations were found between parent and child behaviors within meals and children's corresponding post-prandial glycemic control. Results reinforce existing research indicating that mealtime behavior problems exist for families of young children even in the context of intensive therapy and that some child behaviors may relate to glycemic control.

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Contributors:

Drs. Patton and Powers designed the study and wrote the protocol. Drs. Patton, Dolan, and Smith recruited families, collected the data, and managed all of the data. Dr. Brown conducted the statistical analysis. Dr. Patton wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Conflict of Interest:

All of the authors declare that they have no conflicts of interest.

1. Introduction

Research demonstrates that parents of young children with type 1 diabetes (T1DM) perceive mealtimes as problematic and videotaped studies of home meals confirm the occurrence of disruptive child and ineffective parent behaviors (Patton et al., 2004; Patton, Dolan, & Powers, 2006; Powers, Byars, et al., 2002). These early studies were conducted in samples of young children primarily following a conventional, twice daily injection regimen, which demands greater consistency in the timing and amount of food consumed (Patton et al., 2004; Patton et al., 2006; Powers, Byars, et al., 2002; Silverstein et al., 2005). For young children with T1DM, an intensive insulin regimen involving multiple daily injections or an insulin pump is now the standard of care (Silverstein et al., 2005). Intensive therapy has the potential to be superior to conventional therapy because insulin is administered at the time of each food intake thus allowing for greater flexibility in eating. Greater flexibility in diet may translate into reduced parental perceptions of mealtime problems because parents are no longer required to meet a specific carbohydrate target at meals. Unfortunately, in a recent study of families of young children on intensive therapy, we found that parents still reported mealtime problems and that disruptive child behavior was positively correlated with average child blood glucose (Patton, Williams, Dolan, Chen, & Powers, 2009).

In this study, we expand upon the examination of mealtimes in families of young children with T1DM by comparing videotaped home meals for young children on intensive therapy to published data for children on conventional therapy (Patton et al., 2006). In addition, we examine whether family mealtime behaviors relate to children's glucose levels in the context of intensive therapy. Based on the extant literature, we tested the following hypotheses:

1. Family mealtime behaviors for young children on intensive therapy will differ from published data for families of young children on conventional therapy.
2. Young children who exhibit disruptive mealtime behaviors will have poor glycemic control.
3. Parents who exhibit ineffective behaviors will have children in poor glycemic control.
4. Controlling for carbohydrate intake and insulin, disruptive mealtime behaviors will positively correlate with children's post-prandial glycemic control.
5. Controlling for carbohydrate intake and insulin, parents' use of ineffective behaviors will positively correlate with children's post-prandial glycemic control.

2. Materials and Methods

2.1 Participants

The sample consisted of 39 young children and a parent from two children's hospitals in the mid-western United States. Families were eligible to participate if they were English speaking and they had a child with T1DM who was less than 7 years old and following an intensive insulin regimen (e.g., insulin pump or multiple daily injections). Seventy-seven families were contacted about the study. Of these, 38 refused to participate because of time constraints and concerns about continuous glucose monitoring (CGM). Thus, the overall recruitment rate was 51%.

2.2 Procedure

The study was approved by the Institutional Review Boards at each participating site. Parents who agreed to participate completed the informed consent. Then, parents were taught how to keep a three-day diet record according to a standardized protocol (Patton,

Dolan, Chen, & Powers, 2013; Patton, Dolan, & Powers, 2007; Powers, Patton, et al., 2002) and how to record their child's meals based on a standardized protocol (Powers, Patton, et al., 2002; Stark et al., 1995; Stark et al., 1997). Children had their height and weight collected and a CGM placed by a trained research team members. Families were asked to record their child's food and beverage intake and to videotape at least three home meals while their child wore the CGM. On the last day of the CGM profiling, a research team member picked up the video camera, diet records, and the CGM and downloaded children's insulin pump to record insulin use. For families using insulin pens, a written diary of insulin use during the CGM profiling was obtained. A medical chart review was used to collect children's most recent glycated hemoglobin A1c (HbA1c). Families were compensated \$50 for their time and parents received a copy of their child's CGM profiling. Children earned a \$20 gift card to a national toy store for their participation.

2.2.1 Mealtime observations—Videotaped meals were coded using the Dyadic Interaction Nomenclature for Eating (DINE) (Stark et al., 1995), which includes definitions for Parent behaviors, Child behaviors, and Child Eating behaviors (individual behaviors listed in Table 2). Based on the DINE, all but six behaviors were coded on an occurrence/nonoccurrence basis within 10 second intervals during the meals. The remaining behaviors were coded for frequency within 10 second intervals (viz, direct and interrupted commands, child noncompliance to commands, parental feeding, child bites, and child sips). Inter-rater reliability was obtained from a random subset of meals (33%) using the Kappa coefficient of agreement. The average Kappa coefficients were 0.78 for Parent behaviors, 0.82 for Child behaviors, and 0.84 for Child Eating behaviors, which all exceeded the minimum threshold for acceptable for inter-rater reliability (Cohen, 1960).

2.2.2 Continuous Glucose Monitoring—Children's glucose levels were measured using the Minimed Continuous Glucose Monitoring System Gold® (CGM). This blinded CGM unit provides a relatively non-invasive approach to measuring glucose concentrations continuously over a 72-hour period. Young children had the sensors placed just under the skin on the buttocks, hip, or abdomen using a spring-loaded insertion device and a topical anesthetic to reduce discomfort. The sensors recorded an average glucose concentration every five minutes. Young children had an average of 275 ± 43 (range: 83- 288) separate glucose measurements per 24 hours of sensing. Data lost was primarily due to sensor or calibration error.

2.2.3 Carbohydrate intake—Children's carbohydrate intake for each of the videotaped meals was measured from diet diaries, which were reviewed by a registered dietitian and analyzed using the Minnesota Nutrition Data System for Research (Nutrition Coordinating Center, University of Minnesota, 1996).

2.2.4 Statistical Analyses—A priori, a comparison of the current sample with published data revealed no differences in child age ($p = 0.13$) or gender ($p = 0.35$) (Patton et al., 2006), suggesting it was reasonable to proceed with independent sample t-test comparisons of family mealtime behaviors (Hypothesis 1). To test hypotheses 2 and 3, Pearson Product-moment correlations were used. Specific child behaviors considered disruptive and parent behaviors considered ineffective were selected based on the existing literature (Patton et al., 2004; Patton et al., 2006; Patton, Dolan, & Powers, 2008). Disruptive child behaviors included: noncompliance to parental commands, food refusal, child away, and child spit-outs. Ineffective parent behaviors included: interrupted commands, coaxes, physical prompts, and feeds. To test hypotheses 4 and 5, within-subject correlations were computed for each meal paired with children's post-prandial glucose levels. We computed summary scores for parent and child behaviors and then an average score for each was calculated per

minute. Parent and child summary scores were comprised of the behaviors judged ineffective or disruptive based on the extant literature (see above). Summary scores had a maximum of 6, which indicated positive occurrences during each 10-second interval in the minute. To measure post-prandial excursion, we calculated the proportion of glucose readings above 200 mg/dl out of the total number of readings recorded during the meal and up to 30 minutes after the meal and used these values in the correlations ($M = 53 \pm 42\%$ of readings were above 200 mg/dl). The within-subject correlations were then obtained by adjusting for child-to-child differences. A priori, alpha was set at 0.01 to control for multiple tests.

3. Results

3.1 Participants

Table 1 summarizes the sample characteristics.

3.2 Mealtime behaviors

Table 2 lists summary data for parent and child behavior during the videotaped home meals. The average meal length for the current sample was 21.5 ± 10.6 minutes, which was comparable to the published meal length (Patton et al., 2006). Contrary to hypothesis 1, parent and child behaviors were generally consistent with published data ref), with only one exception. In the present sample, children were observed to request food significantly more often than children from the previous sample (1.72 ± 1.61 and 0.81 ± 1.06 , respectively; $p < 0.01$).

3.3 Mealtime behaviors and children's glycemic control

In partial support of hypothesis 2, there were positive correlations found between child play and children's average glucose levels ($r = 0.50$, $p < 0.01$) and between child away and children's average glucose levels ($r = 0.45$, $p < 0.01$). Contrary to hypothesis 3, no correlations were found between parents' use of ineffective behaviors at mealtimes and young children's average glycemic control. Likewise, when examining hypotheses 4 and 5, no correlation was found between children's disruptive behavior and their post-prandial glycemic control and between parents' use of ineffective behaviors at mealtimes and young children's post-prandial glycemic control.

4. Discussion

We contribute to the literature by using videotaped home meals to compare family mealtime behaviors in young children on intensive therapy versus published data for children on conventional therapy. We also use CGM to collect new data exploring associations between family mealtime behaviors and children's post-prandial glucose control. Failure to find broad differences in family mealtime behaviors based on children's insulin regimen (viz., intensive versus conventional) suggests that simply switching young children to intensive therapy may not have an effect on modifying problematic child mealtime behaviors (Patton et al., 2009). We suspect the difference we did see in child requests for food, may indicate that families of children on intensive therapy perceive greater flexibility in their child's eating than families of children on conventional therapy. Unlike conventional therapy, where families need to time food intake to match peak insulin levels (Silverstein et al., 2005), intensive therapy allows families to dose for insulin with each meal and to more easily titrate their food intake either up or down based on their appetite levels. Thus, it is possible the flexibility allowed by intensive therapy has encouraged some young children to begin to request food during meals. Unfortunately, a recent study also suggests that young children on intensive therapy continue to exceed daily recommendations for percent calories from fat and saturated fat and

do not meet guidelines for their daily intake of fruits, vegetables, and whole grains (Patton et al., 2013). Therefore, if children on intensive therapy are perceiving greater flexibility in their eating, but choosing to consume a diet that is less healthful, focused nutritional education may be needed to address this potential negative health outcome,

Our secondary goal was to examine associations between mealtime behaviors and young children's glucose levels. Consistent with the extant literature, we recorded positive associations between children's average daily glucose levels and child play and child away (Patton et al., 2006). However, when we specifically looked for an association between child disruptive behaviors and post-prandial glucose levels, no association was found. Similarly, there was no association found between parents' behavior and children's post-prandial control. Given these new findings, it remains unclear how child play and child away may correlate with children's average glucose levels and if intervening on these behaviors can impact young children's glycemic control. For example, it is possible the underlying relation between these mealtime behaviors and children's average glucose levels may be indicative of other factors including child temperament, parenting stress, or parenting style, which may have a more direct relation to children's glycemic control and therefore would be more potent intervention targets than child mealtime behaviors. Thus, future research is needed to determine if outside of meals, there are variables that are more predictive of children's glucose levels.

There are limitations to report. First, the study had a relatively low recruitment rate, which could impact generalizability of our data. However, we note our recruitment rate is comparable to rates for other studies which have used a similar videotaping procedure (Patton et al., 2004; Patton et al., 2006; Powers, Patton, et al., 2002; Stark et al., 1995). Second, our sample was primarily comprised of families who were White, married, and from the middle to upper-middle class. Although representative of our clinics, our data may not generalize to a diverse sample of families. Third, families knew that meals were being videotaped which could have resulted in a Hawthorne Effect. To minimize the likelihood of a Hawthorne Effect, we asked families to record at least three meals so that families had the opportunity to adjust to the videotaping. Finally, this study used published data to compare mealtime behaviors (Patton et al., 2006). A priori, we took care to ensure the two samples were comparable based on their demographics. But a randomized controlled study would be needed to definitely show no effect on mealtime behaviors based on insulin regimen.

5. Conclusions

Mealtimes problems exist even in the context of intensive therapy. Our data suggest within a typical meal children spend an average of two minutes away from the table and over six minutes talking, all which translate into less time eating. Behavior therapy can help to reduce the occurrence of mealtime problems and may be an important addition to diabetes education and routine care (Powers et al., 2005; Stark et al., 1993; Stark et al., 1996; Stark, Powers, Jelalian, Rape, & Miller, 1994).

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Highlights

- Intensive insulin therapy allows for more flexible eating at mealtimes.
- Young children on intensive insulin therapy were disruptive at mealtimes.
- Parents of young children engaged in ineffective mealtime management strategies.
- Children's disruptive behaviors relate child average glycemic control.
- Families reporting mealtime problems should be referred for behavior therapy.

Table 1

Demographic and physiological information

	Mean $\pm$ SD	N (%)
Child age (years)	5.1 $\pm$ 1.1	
Child gender (male)		20 (51)
Ethnicity (Caucasian)		32 (82)
Insulin regimen (pump)		24 (62)
Parent marital status (married)		29 (74)
Family income >\$50,000		21 (54)
HbA1c (mg/dl)	8.6 $\pm$ 1.3%	
Average daily CGM level (mg/dl)	211 $\pm$ 44	

Table 2

Summary of observed mealtime behaviors for the current study and published data

	Current Sample	Patton et al., 2006
DINE Behaviors	Mean $\pm$ SD	Mean $\pm$ SD
Parent behaviors		
Direct commands	2.42 $\pm$ 1.95	2.92 $\pm$ 3.19
Interrupted commands	2.67 $\pm$ 2.81	3.09 $\pm$ 4.50
Coax	3.74 $\pm$ 3.17	3.95 $\pm$ 4.81
Feed	0.23 $\pm$ 0.77	3.23 $\pm$ 12.14 [†]
Physical prompt	1.70 $\pm$ 1.65	1.43 $\pm$ 1.72
Reinforcement	0.51 $\pm$ 0.82	0.36 $\pm$ 0.51
Parent talk	33.90 $\pm$ 18.2	34.35 $\pm$ 25.32
Child behaviors		
Away from table	11.6 $\pm$ 10.8	14.05 $\pm$ 18.61
Child talk	39.8 $\pm$ 20.9	40.92 $\pm$ 31.44
Food refusal	1.91 $\pm$ 1.74	1.69 $\pm$ 1.90
Requesting food	1.72 $\pm$ 1.61 [*]	0.81 $\pm$ 1.06 [*]
Noncompliance	1.10 $\pm$ 1.41	1.06 $\pm$ 1.41
Child play	1.45 $\pm$ 6.50	7.63 $\pm$ 36.78
Child eating behaviors		
Bites	69.31 $\pm$ 29.90	62.51 $\pm$ 22.69
Sips	6.60 $\pm$ 4.55	7.83 $\pm$ 4.77
No plate	0.99 $\pm$ 1.68	0.89 $\pm$ 3.25
Spit-out	0.21 $\pm$ 0.27	0.24 $\pm$ 0.42

Note.

^{*} Comparison significantly different at $p < 0.01$.[†] Mean includes 2 outliers. Removing these data and the mean $\pm$ SD is 0.32 $\pm$ 1.0.