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Psychosocial Correlates of Continuous Glucose Monitoring Use in Youth and Adults with Type 1 Diabetes and Parents of Youth

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Abstract

Background: Continuous glucose monitoring (CGM) has been shown to improve glycemic control and reduce hypoglycemia with consistent use. Youth, however, are unlikely to use CGM consistently. We compared psychological characteristics of youth with type 1 diabetes, their parents, and adults with type 1 diabetes randomized to CGM or standard blood glucose monitoring (BGM). This study was an ancillary study, and participants completed the questionnaires at the 6-month visit of the main study.

Subjects and Methods: Participants enrolled at a single site of the Juvenile Diabetes Research Foundation CGM trial completed questionnaires and provided diabetes management data. Participants were randomized to the CGM or BGM group for 6 months.

Results: Parents in both groups reported more fear of hypoglycemia than youth in the corresponding groups. CGM youth and parents reported more negative affect around BGM than those in the BGM group. CGM youth reported more trait anxiety than BGM youth, whereas CGM adults reported less state and trait anxiety than BGM adults. CGM parent-proxy report of depression was significantly higher than that reported by BGM parents.

Conclusions: Youth, their parents, and adults report different psychological impacts of CGM use. In some groups and with some variables, CGM use was associated with a positive psychosocial impact, whereas in others CGM use was associated with a negative psychosocial impact. Future research should explore the psychological consequences of CGM use.

Introduction

Continuous glucose monitoring (CGM) improves glycemic control in patients with type 1 diabetes (T1D) when used consistently.[1,2] Despite this, youth with T1D show less sustained use of CGM than adults.[1] The psychological impact of CGM remains unclear and could be negative because of the need for substantial patient input, availability of overwhelming amounts of glucose data, disruptions caused by frequent CGM alarms, etc.[3] The current study aimed to evaluate psychological variables commonly associated with T1D and their associations with the use of standard blood glucose (BG) monitoring (BGM) compared with adjunctive CGM use in youth and adults using intensive insulin therapy for the management of T1D. In addition, we compared psychological characteristics reported by youth with T1D, parents of youth, and adults with T1D.

Subjects and Methods

Participants were children (8–17 years old) and adults (≥18 years old) enrolled at a single site of the Juvenile Diabetes Research Foundation CGM trial. Participants were randomized to BGM (BGM group) or CGM (CGM group) for 6 months. Description of the study has been previously reported.[1]

The site's 51 participants were invited to participate in an ancillary study at the 6-month visit; 49 participants enrolled. Participants were compensated for their additional participation in the ancillary study. The ancillary study protocol was approved by the main trial steering committee and the local Institutional Review Board. Informed consent/assent was obtained from participants. Participants completed the ancillary measures after 6 months of participation in the main study; for those randomized to the CGM group, they completed measures after 6 months of wearing the CGM device. Ancillary study measures were chosen as variables that are

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commonly associated with diabetes management and/or that have been shown to have an impact on diabetes management.

Measures

Hypoglycemia Fear Survey.[4] The Hypoglycemia Fear Survey is a previously validated measure of fear of hypoglycemia. The 15-item worry subscale of the Hypoglycemia Fear Survey was completed by youth, parents, and adults, and the eight-item behavior subscale was completed by adults. Higher scores indicate greater fear of hypoglycemia.

Pediatric Quality of Life Inventory—15-item Psychosocial subscale and Treatment and Worry Diabetes subscales (14 items).[5,6] The 29-item Pediatric Quality of Life Inventory, a previously validated measure, was completed by youth and parents to assess the perception of youth and parents of youth's quality of life. The Psychosocial scale consists of three domains (Social, Emotional, and School), and the Diabetes subscale consists of two domains (Treatment and Worry). Higher scores indicate better quality of life.

12-item Short Form Health Survey.[7] The 12-item Short Form Health Survey, a previously validated measure, was completed by adults to measure health-related quality of life. Scoring is norm-based, making it possible to compare the physical and mental component scores. Higher scores indicate better quality of life.

Children's Depression Inventory.[8] Youth completed the 27-item Children's Depression Inventory, and parents completed the 17-item Children's Depression Inventory: Parent to assess youth's depressive symptoms. The Children's Depression Inventory is a previously validated measure; higher scores indicate greater depressive symptoms.

Center for Epidemiologic Studies—Depression Scale.[9] The Center for Epidemiologic Studies—Depression Scale, a 20-item, previously validated measure, was completed by adults to assess depressive symptoms. Higher scores indicate greater depressive symptoms.

State-Trait Anxiety Inventory.[10,11] The State-Trait Anxiety Inventory, a previously validated measure of anxiety, was completed by adults and parents (State-Trait Anxiety Inventory; two 20-item subscales) and youth (State-Trait Anxiety Inventory-C; two 20-item subscales) to assess current feelings of anxiety (state) as well as long-term characteristics of anxiety (trait). Parents also completed the State-Trait Anxiety Inventory-CP (26 items), a parent-proxy report of their child's anxiety. Higher scores indicate greater anxiety.

Blood Glucose Monitoring Communication questionnaire.[12] The BGM Communication questionnaire, an eight-item, previously validated measure, was completed by youth, parents, and adults to assess negative affect related to BGM. Higher scores indicate greater negative affect around BGM.

Diabetes Family Conflict Scale.[13] The Diabetes Family Conflict Scale, a 19-item, previously validated measure, was completed by youth and parents to assess diabetes-specific family conflict. Higher scores indicate greater conflict.

Problem Areas in Diabetes survey.[14,15] The Problem Areas in Diabetes survey, a 20-item, previously validated measure, was completed by adults to assess burden related to having diabetes. The Problem Areas in Diabetes-Parent Revised survey (18 items), also previously validated, was completed by parents to assess burden related to having a child with diabetes. Higher score indicates greater burden.

Biologic and health variables. Hemoglobin A1C (A1C) (reference range, 4.0–6.0%) was measured centrally.[1] Patient/parent report, medical record review, and meter downloads provided diabetes treatment data.

Statistical analysis

Analyses used SAS (version 9.2 for Windows, SAS Institute Inc., Cary, NC). Data are presented as mean±SD values or percentages. Statistical analyses included unpaired t tests and general linear models comparing survey scores between BGM and CGM groups. Comparisons of survey scores at 26 weeks were adjusted to control for baseline characteristics (diabetes duration, frequency of BGM, insulin modality, A1C) using general linear models. Because of the small number of participants and exploratory nature of the study, trends are reported ($P \leq 0.1$), as the study was not sufficiently powered.

Results

The study sample consisted of 28 youth (61% female), 28 parents (71% female), and 21 adults (52% female). At baseline, mean age was 13.4±3.2 years for youth and 23.7±6.3 years for adults. Mean diabetes duration was 7.2±3.7 years for youth and 11.7±6.0 years for adults. The majority of participants were treated with an insulin pump (86% of youth, 57% of adults). Youth and adults monitored blood glucose 7.5±2.7 times/day and 5.7±2.4 times/day, respectively. At baseline, mean A1C of youth was 7.6±0.6%; mean A1C of adults was 7.6±0.9%.

There were no differences in reported fear of hypoglycemia between CGM and BGM groups (Table 1). However, parents in both groups reported significantly more fear of hypoglycemia than youth ($P = 0.01$, both groups). CGM youth and their parents and CGM adults reported more negative affect around BGM than the BGM group. Reported levels of diabetes-specific family conflict were similar between groups. CGM adults reported lower diabetes-related burden than BGM adults, although not significantly. CGM adults also reported significantly less burden than parents of CGM youth.

CGM youth reported more trait anxiety than BGM youth, and CGM adults reported less state and trait anxiety than BGM adults. Youth report, parent-proxy report, and adult report of quality of life were similar, regardless of group. Parent-proxy report of anxiety did not differ between the BGM and CGM groups; however, CGM parent-proxy report of depression was significantly higher than that reported by BGM parents.

Discussion

This exploratory study aimed to identify psychological variables in youth with T1D, parents of youth with T1D, and adults with T1D, using CGM. The study was not powered to assess differences but to advance understanding of the impact

Table 1. Survey Results for Comparisons Between Groups Using General Linear Models Controlling for Baseline Covariates: Diabetes Duration, Frequency of Blood Glucose Monitoring, Insulin Modality, and Glycosylated Hemoglobin

	Youth (n=28)		Parent (n=28)		Adult (n=21)	
	BGM (n=12)	CGM (n=16)	BGM (n=12)	CGM (n=16)	BGM (n=9)	CGM (n=12)
A1C						
At baseline	7.6±0.4	7.6±0.7	NA	NA	7.6±1.1	7.7±0.7
At 6 months	7.5±0.6	7.5±1.0	NA	NA	7.8±1.0	7.1±0.9
Fear of hypoglycemia	15.8±12.2	17.9±14.1	23.1±17.2	18.8±20.0	24.8±12.2	32.0±8.3
Negative affect around BGM	11.4±5.4	14.0±6.2[a]	13.7±5.2	15.8±6.0[a]	11.2±5.0	14.6±3.4[a]
Diabetes-specific family conflict	25.9±10.3	24.9±11.8	22.9±5.4	24.4±6.3	NA	NA
Diabetes-related burden	NA	NA	48.1±28.6	52.4±33.1	31.5±29.6	14.5±20.1
Anxiety						
State	29.4±6.1	29.1±7.0	34.5±17.8	36.1±20.6	35.6±13.7	25.9±7.9[a]
Trait	32.3±8.8	36.0±10.2[a]	36.5±16.6	38.4±19.2	41.1±13.3	28.5±7.7[b]
Depression (CDI; CDI-P)	3.8±4.3	5.1±5.0	NA	NA	NA	NA
Depression (CES-D)	NA	NA	NA	NA	12.0±12.5	6.9±8.5
Quality of life	78.8±18.4	74.5±21.3	74.7±19.0	73.0±22.1		
Physical subscale					57.2±5.6	54.8±3.8
Mental subscale					39.6±19.0	49.5±12.9
Parent proxy measures						
Anxiety	42.2±12.0	46.8±13.4	NA	NA	NA	NA
Depression	8.4±8.1	13.1±9.4[b]				

[a]$P \leq 0.1$, [b]$P \leq 0.05$.

A1C, hemoglobin A1C; BGM, blood glucose monitoring; CDI and CDI-P, Children's Depression Inventory and Children's Depression Inventory-Parent, respectively; CES-D, The Center for Epidemiologic Studies—Depression Scale; CGM, continuous glucose monitoring; NA, not applicable.

of CGM on psychological variables that may influence diabetes treatment adherence.

We found differences between adult BGM and CGM groups and between youth, their parents, and adults, regarding psychological characteristics. CGM was associated with more negative affect around BGM, as reported by youth, parents of youth, and adults. Although not significant, CGM was also associated with less diabetes-related burden, as reported by adult participants. CGM use was associated with more trait anxiety in youth and less state and trait anxiety in adult participants compared with BGM use alone. In addition, parent-proxy report of depression was significantly higher in the CGM group compared with the BGM group.

Although this study was not powered to find significant results, we did find several interesting trends, which suggest there was a difference in psychosocial variables between those using and not using CGM. In addition, the study design would have been stronger if the ancillary measures were completed at baseline; however, the ancillary study measures were not approved by the Institutional Review Board in time for participants to complete measures at baseline.

This study only examined psychosocial correlates of CGM use over 6 months, but future studies may examine these correlates over longer duration, which might provide further insight into this relationship. Exploration of the relationship between psychological factors and CGM is essential to inform the development of implementation strategies to sustain CGM utilization, particularly for youth with T1D.

Author Disclosure Statement

No competing financial interests exist.

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