Evaluating Parents' Self-Efficacy for Diabetes Management in Pediatric Type 1 Diabetes

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Abstract

Objective To examine the factor structure and construct validity of the Maternal Self-Efficacy for Diabetes Management Scale (MSED) in 135 youth ($M_{age} = 13.50 \pm 1.83$ years), with type 1 diabetes mellitus. **Method** The study used exploratory factor analysis (EFA) to examine the factor structure and correlations to examine relationships among MSED factors and select parent and child diabetes-related health behaviors and outcomes. **Results** EFA identified an 11-item three-factor solution ($\chi^2_{(25, \, n=133)} = 40.22$, $p < .03$, RMSEA = 0.07, CFI = 0.98, TLI = 0.97), with factors corresponding to parents' perceived ability to manage their child's diabetes (MSED-M), problem-solve issues surrounding glycemic control (MSED-P), and teach their child about diabetes care (MSED-T). Correlational analyses revealed significant associations between the MSED-M and MSED-T and parent-reported optimism and youth's diabetes-specific self-efficacy. The MSED-T was also associated with glycated hemoglobin and self-monitoring blood glucose. **Conclusion** Results provide preliminary evidence for the reliability and validity of a three-factor solution of the MSED.

Key words: adherence; adolescents; assessment; diabetes; parents.

Proper management of type 1 diabetes mellitus (T1DM) poses significant challenges for youth, as it involves frequent blood glucose monitoring, insulin injections or use of an insulin pump, and close monitoring of diet and physical activity (e.g., Silverstein et al., 2005). Given these demands, effective diabetes management generally requires substantial parental involvement through childhood with a gradual shift in responsibility to youth during adolescence (e.g., Anderson, Auslander, Jung, Miller, & Santiage, 1990; King, Berg, Butner, Butler, & Wiebe, 2014). Despite the importance of parental involvement, the demands of diabetes regimens are often burdensome and stressful for parents (e.g., Mellin, Neumark-Sztainer, & Patterson, 2004; Streisand, Swift, Wickmark, Chen, & Holmes, 2005). However, parental self-efficacy for diabetes

management is one mechanism that has been shown to help parents overcome the challenges and stressors associated with T1DM in order to facilitate better management of their child's diabetes, as well as to foster their child's development of acceptable diabetes management skills (Streisand et al., 2005, 2008). Indeed, available research suggests that high parental self-efficacy for diabetes management may be associated with positive parent outcomes, including lower levels of stress and anxiety when compared to parents with low self-efficacy (Streisand et al., 2005, 2008). Likewise, the research shows that parental self-efficacy for diabetes is associated with better glycemic control (e.g., Leonard, Skay, & Rheinberger, 1998) and higher perceived competency for diabetes management among youth (Kaugars, Kichler, & Alemzadeh, 2011; Leonard et al., 1998).

Thus, these associations underscore the potential benefit treatments that promote greater parental self-efficacy for diabetes management could have for families.

However, in a recent integrative review that critically evaluated self-efficacy measures developed for youth with T1DM and their caregivers (Rasbach, Jenkins, & Laffel, 2015), the authors noted that the most commonly used measures of parental self-efficacy (e.g., Grossman, Brink, & Hauser, 1987; Iannotti et al., 2006) were adaptations of youth measures. This is a notable point because accurate assessment of self-efficacy requires tailoring measures to the relevant domains of functioning for individuals (Bandura, 2006). Thus, measures developed for persons with T1DM should typically assess their competence in diabetes-specific domains, such as diabetes self-care and problem-solving (Frei, Svarin, Steurer-Stey, & Puhan, 2009; Iannotti et al., 2006), while measures designed for parents should focus on domains directly related to parenting a child with T1DM, such as the parents' ability to teach their child about T1DM or to give effective commands (e.g., Mitchell, & Fraser, 2011; Ranganathan & Montemayor, 2014). Despite these differences in parent and youth self-efficacy for diabetes management, parental self-efficacy measures adapted from youth measures primarily focus on domains of self-care (e.g., "Follow a consistent schedule for diabetes management [eating meals, snacks, giving insulin]," Grossman et al., 1987) and problem-solving (e.g., "Recognize patterns of blood glucose levels that indicate a need for insulin dose/basal rate adjustment," Grossman et al., 1987; "Adjust your child's insulin or food accurately based on how much exercise he/she gets," Iannotti et al., 2006), but do not include items directly relevant to parenting a child with T1DM, therefore weakening their ability to measure the specific domain of parental self-efficacy.

There is only one measure specifically designed for use among parents, the Maternal Self-Efficacy for Diabetes Scale (MSED; Leonard et al., 1998). A strength of the MSED is that it includes items that elicit parents' perceived self-efficacy for teaching diabetes management skills (e.g., "I can teach my child how to take more responsibility for diabetes management"). To develop the MSED, parents of youth with diabetes as well as nurse practitioners reviewed potential items to ensure good content validity. Then, a sample of mothers of youth attending a diabetes summer camp completed the MSED to obtain preliminary psychometrics. While previous research using the MSED has scored the measure based on a single summary score (i.e., summing all 17 items), thus assuming it only examines one dimension of parental self-efficacy, the diversity of items makes it likely that the MSED may represent more than one underlying construct. Thus, the primary purpose of this study was to conduct an exploratory factor analysis (EFA) of the MSED to examine its underlying factor structure. We determined that this was an important next step for this measures ongoing development because identifying underlying factors of the MSED would provide a more refined interpretation of the scale and would make it possible to explore individual differences in parental self-efficacy across domains, which may better identify potential treatment targets. Moreover, a factor structure with more than one underlying construct would also be more consistent with Bandura's original concept, which presupposed that beliefs in personal efficacy could differ across domains of functioning (Bandura, 2006). To assess for convergent and criterion validity, respectively, we also examined latent associations between the MSED factor(s) and parents' self-reported optimism as well as youths' glycated hemoglobin levels (HbA1c), daily self-monitoring blood glucose (SMBG), and diabetes-specific self-efficacy. These variables were selected based on published results which show direct associations between parents' perceived self-efficacy and parents' level of optimism (Bretherton & McLean, 2014), youth's management of T1DM (e.g., Leonard et al., 1998), and youth self-efficacy (e.g., Kaugars et al., 2011).

Method

Participants

This study reports on a subset of data collected during a larger trial, which recruited youth and their primary caregiver from two pediatric diabetes centers in the mid-western United States. Families were eligible to participate if youth had a T1DM diagnosis of greater than 6 months, youth were between 10 and 16 years old, and the family was English speaking. The study had an exclusion criterion for youth who had a concurrent developmental delay (i.e., autism, cerebral palsy, or mental retardation), as well as any psychiatric hospitalization within the last year. One hundred thirty-five families completed study measures (89% recruitment rate); each of which had one participating caregiver (82% mothers; 16% fathers; 1% caregivers; 2% of caregivers did not report their relationship to the youth). Youth had a mean age of 13.5 ± 1.83 years (range: 10–16 years), 54.9% were female, and their racial/ethnic composition was 76.7% Caucasian, 11.6% Hispanic, 6.2% African American, 2.3% Asian, and 3.2% other. At the time of data collection, the HbA1c target in youth 8–13 years old was $< 8.0\%$ and it was $< 7.5\%$ in youth 13–17 years old (Silverstein et al., 2005). The HbA1c values for the

present sample of youth ranged from 5.20 to 15.30% ($M = 9.17$, $SD = 2.16$; 37.9% of HbA1c were in the recommended range) and the majority (89.4%) reported using insulin pump therapy.

Procedure

The study recruited parent–youth dyads during their routine diabetes clinic appointments. Participants completed all study measures on a tablet during their scheduled clinic visit and were compensated $25. Prior to patient enrollment, the institutional review boards at each of the participating hospitals reviewed and approved all study procedures.

Measures

Maternal Self-Efficacy for Diabetes Management Scale

This is a 17-item scale, which asks parents or the primary caregiver to rate their confidence in independently managing diabetes-related tasks on a 5-point scale ranging from 1 (*not at all confident*) to 5 (*very confident without help*) (Leonard et al., 1998). Although we initially tested the MSED in only the 104 mothers included in the sample, we elected to expand the sample to include all familial caregivers, as the items do not reference mothers specifically.

Self-Efficacy for Diabetes Scale—Diabetes

The Self-Efficacy for Diabetes Scale—Diabetes (SED-D) is a 24-item measure (Grossman et al., 1987). For each item, youth report their perceived ability for a specific task (e.g., "Keep myself free of high blood sugar levels") using a 6-point scale ranging from 1 (*very sure I can't*) to 6 (*very sure I can*). Past research shows the SED-D has adequate internal consistency (α = .90; Kaugars et al., 2011); the internal consistency in the present study was .83.

The Life Orientation Test-Revised

The Life Orientation Test-Revised (LOT-R) is a 6-item measure (Scheier, Carver, & Bridges, 1994). For each item, parents reported their agreement (e.g., "In uncertain times, I usually expect the best") on a 5-point scale from 0 (*strongly disagree*) to 4 (*strongly agree*). Previous studies using the LOT-R provide evidence of its internal consistency (α = .85; Lipińska-Grobelny, 2011); the internal consistency in the present study was .86.

Glycated Hemoglobin Levels

As part of the medical appointment, all youth had a point-of-care HbA1c performed and reported to the electronic medical record (EMR), which we later extracted to use as a study demographic variable.

Self-Monitoring Blood Glucose

As part of the medical appointment, all youth provided SMBG data via an electronic download from their glucometer and reported to the EMR, which we later extracted to use as a study demographic variable. Using the most recent 14 days of data, we calculated youth's SMBG score by computing an average of the number of checks performed each day over the 14-day period.

Analytic Plan

Prior to conducting the EFAs, we screened the data for outliers and violations of normality and removed two univariate outliers. However, further evaluation revealed a negative skew for responses on all MSED items. As such, we elected to treat these data as categorical (Brown, 2006). There were two exceptions. For item 12 ("I can change my child's doctor if I don't like him/her") and item 13 ("I can adjust my child's management plan to allow for an overnight stay away from home without parents"), their distribution fell beyond the recommended guidelines for skewness (−3.51 and −2.26, respectively) and kurtosis (12.06 and 4.59, respectively), suggesting that these items may not accurately capture behaviors relevant to this population. Therefore, we elected to omit these items from all subsequent analyses.

To assess the underlying factor structure of the MSED, the present study used EFAs with Mplus 7.2 (Muthén & Muthén, 2012) using weighted least squares mean and variance adjusted (WLSMV) estimator and an oblique Geomin rotation. To evaluate each EFA model, we used multiple fit indices: chi-square (χ^2), the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA). The CFI and TLI values range from 0 to 1; values >.90 represent an acceptable model fit and values >.95 represent a good model fit (Bollen, 1989; Little, 2013). We used the RMSEA to indicate population error variance, with values between .08 and .05 indicative of acceptable model fit and values <.05 indicative of good fit (Hu & Bentler, 1999; Little, 2013). As a first step, we conducted EFAs specifying one to four factors, and retained factor solutions based on their fit indices and interpretability. Then, we reviewed these initial factor solutions examining their item loadings and any Heywood cases (i.e., factor loading >1; negative residual variance; Heywood, 1931), which can occur when solutions extract too many factors or trivial factors with only a few salient loadings. A priori, we had decided to remove any items with loadings ≤0.40 and double loadings ≥0.40. We had also decided to remove items resulting in a Heywood case in order to avoid multicollinearity. Thus, as a final step, we ran a new set of EFAs with items removed that either met our criteria for their loading or represented a

Table I. Fit Statistics for Exploratory Factor Analyses for MSED Models with One to Four Factors

Model	χ^2(df)	p	CFI	TLI	RMSEA
		15-item models			
One-factor	399.18/90	<.001	.78	.74	.16
Two-factor	229.28/76	<.001	.89	.85	.12
Three-factor	157.89/63	<.001	.93	.89	.11
Four-factor	87.76/51	<.001	.97	.95	.07
		14-item models			
One-factor	291.49/90	<.001	.84	.82	.13
Two-factor	149.32/64	<.001	.92	.89	.10
Three-factor	82.46/52	<.001	.97	.95	.07
		13-item model			
Three-factor	63.36/42	.02	.98	.96	.06
		11-item model			
Three-factor	40.22/25	.03	.98	.97	.07

	Number of items	Mean (SD)	Range	α
MSED total score	11	44.69 (6.82)	25–55	.83
MSED-M	2	7.77 (1.76)	4–10	.79
MSED-P	6	25.27 (4.44)	14–30	.79
MSED-T	3	11.65 (2.93)	3–15	.76

Note: 15-item models omit items 12 and 13; 14-item models omit items 12, 13, and 17; 13-item model omits items 12, 13, 17, and 8; and the 11-item model omits items 12, 13, 17, 8, 11 and 16.

Heywood case. We selected our final model based on our predetermined analytical plan, fit, and theoretical content. Once we had selected a final model, we used Mplus 7.2 (Muthén & Muthén, 2012) to determine the convergent and discriminant validity of the MSED (Campbell & Fiske, 1959; Holmbeck et al., 2008) based on correlations among the MSED factors, and between the MSED factors and parents' LOT-R scores, youth's SMBG, HbA1c, and youth's self-efficacy scores. To examine the alpha coefficients of the final model, we used SPSS Version 22 (IBM Corporation., 2013).

Results

In the first step, the EFAs used 15 items of the original MSED (items: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, and 17), and specified one to four factors (see Table I). Fit statistics suggested that the four-factor EFA model provided an acceptable fit to the data. However, in this factor solution, a Heywood case emerged for item 17 (i.e., factor loading = 1.19; residual variance = −0.40); thus we removed this item and conducted a subsequent set of EFAs estimating one-, two-, and three-factors (see Table I). Results of these analyses revealed an acceptable fit for a 14-item three-factor model (see Table I). Yet, there were three items (i.e., items 8, 11, and 16) with low factor loadings (<0.40) across two iterations, so we removed these items. Thus, the final model was an 11-item three-factor model (see Table I). Notably, item 9 cross-loaded onto factor 2 (.40) and factor 3 (.79); however, this item was retained on factor 3 given its sustainably high loading and theoretical fit with the remaining items loading on factor 3. A conceptual evaluation of the final 11-item three-factor model suggested factors evaluating parents' perceived ability to manage their child's diabetes (MSED-M), problem-solve issues surrounding glycemic control (MSED-P), and teach their child about diabetes care (MSED-T). Factor loadings of the final MSED items are presented in Table II.

Reliability and Validity

The MSED-M, MSED-P, MSED-T, and MSED total score all demonstrated adequate internal consistency (see Table I; Nunnally & Bernstein, 1994). The MSED demonstrated good convergent validity based on significant correlations between the MSED-M and MSED-T and LOT-R (see Table III). Further, significant associations among the MSED-M and MSED-T and youth's diabetes-specific self-efficacy, as well as between MSED-T and youth's SMBG and HbA1c levels, provide evidence of criterion-related validity (see Table III).

Discussion

A lack of validated research on measures of parental self-efficacy for diabetes management and limited availability of measures developed specifically for parents, underscored the importance of examining the

Table II. Factor Loadings of the Final MSED Items Based on Exploratory Factor Analysis

Study variable	Factor 1 (MSED-M)	Factor 2 (MSED-P)	Factor 3 (MSED-T)
1. I am confident in my ability to help my child manage diabetes	**.91**	.00	.00
2. I can help my child fit his/her diabetes management plan into a normal lifestyle	**.77**	.01	.16
5. I can adjust my child's management plan when s/he is more active than usual	−.02	**.85**	.07
4. I can determine what to do if my child's blood sugar is higher that it should be	.01	**.76**	−.11
7. I can adjust my child's management plan to avoid low blood sugar (insulin reactions)	.18	**.66**	−.06
6. I can adjust my child's insulin dose based on the results of blood or urine tests	.06	**.63**	.05
3. I can adjust my child's management plan if s/he gets a cold or the flu	.30	**.55**	.00
14. I can adjust my child's management plan with changes in schedule (for example, from school to summer schedule)	−.02	**.55**	.37
9. I can teach my child how to take more responsibility for diabetes management	.00	.40	**.79**
15. I can be successful in getting my child to follow his/her management plan, even when s/he may be reluctant or resistant at first	.38	−.01	**.74**
10. I can talk to my child about the realities of long-term complications without undue upset	.01	.34	**.59**
8. I can advocate for my child's best care in community settings[a]	−.03	.31	.37
11. Can advocate for better health care for my child if I am concerned about unfairness or unreasonableness[a]	−.05	.30	.39
16. I can organize our family mealtimes and schedule so that my child can eat most meals at the same time each day[a]	.09	.33	.40

Note: Items retained on each factor indicated in bold. MSED-M = parental self-efficacy to manage youth's diabetes; MSED-P = parental self-efficacy to problem-solve issues surrounding glycemic control; MSED-T = parental self-efficacy to teach their child diabetes care.
[a]Loadings reported for item 8 are from the 13-item model, whereas loadings reported for items 11 and 16 are from the 14-item model.

Table III. Intercorrelations Among MSED Factors and Parent and Child Outcomes

Study variable	1	2	3	4	5	6	7
1. MSED-M	—						
2. MSED-P	.62***	—					
3. MSED-T	.61***	.51***	—				
4. LOT-R	.28**	.05	.31***	—			
5. SED-D	.29**	.16	.42***	.11	—		
6. HbA1c	−.17	.06	−.32***	−.05	−.30***	—	
7. SMBG	.05	.00	.21*	−.12	.05	−.41***	—

Note. MSED-M = parental self-efficacy to manage youth's diabetes; MSED-P = parental self-efficacy to problem-solve issues surrounding glycemic control; MSED-T = parental self-efficacy to teach their child diabetes care; LOT-R = parents' self-reported optimism; SED-D = youth's diabetes-specific self-efficacy; SMBG = self-monitoring blood glucose.
*$p < .05$,
**$p < .01$,
***$p < .001$.

factor structure of the MSED (Rasbach et al., 2015), which was the focus of the present study. As mentioned previously, the MSED has previously been scored as a single-factor. However, current findings suggest a three-factor structure best represents the MSED. Model fit of the three-factor solution was good with factors corresponding to parents' perceived ability to manage their child's diabetes, problem-solve issues surrounding glycemic control, and teach their child about diabetes care.

It is notable that our results suggest that several of the original MSED items may not contribute to the measurement of parental self-efficacy for diabetes management. For instance, limited variability on two items (i.e., items 12 and 13) suggests that parents may have perceived these as low challenge items (Bandura, 2006). Indeed, the literature supports that most parents report a high level of confidence in their ability to communicate concerns or redirect their child's physician (Janicke & Finney, 2003). As such, it seems reasonable that parents of youth with T1DM would also report a high level of confidence for these items. Furthermore, the emergence of a Heywood case (i.e., item 17), and insufficient factor loadings for several items (i.e., 8, 11, and 16) indicates that these items may not provide meaningful information for the measurement of parental self-efficacy for diabetes management. For example, it is possible that a parent could interpret the use of "unfairness and unreasonableness" in item 11 differently or fail to see this as related to illness status versus another characteristic (e.g., child's age or ethnicity), which would limit this item's relevance to parental self-efficacy for diabetes management.

Reliability and validity analyses provided further support for the MSED three-factor solution. Internal consistency was adequate for all three factors, indicating that items loading onto the factors served as an appropriate measure of the construct. Further, examination of latent correlations among the factors suggests that MSED factors represent related, yet distinct constructs. In addition, latent correlations between the MSED-M and MSED-T and a measure of parents' self-report optimism provided support for the convergent validity of the scale. Consistent with previous research (e.g., Bretherton & McLean, 2014; Caprara & Steca, 2006; Magaletta & Oliver, 1999), self-efficacy was positively correlated with parents' reported levels of optimism. The results also showed evidence of criterion-related validity through the positive correlation found between MSED-T and SMBG as well as the negative correlation between MSED-T and youth's HbA1c. This is logical, as it suggests that youth may demonstrate greater frequency of SMBG and better glycemic control when their parents demonstrate greater confidence in diabetes management and/or in teaching youth about their diabetes care. In addition, youth's diabetes-specific self-efficacy was positively associated with the MSED-M and MSED-T. This suggests that high parental self-efficacy for diabetes management and teaching management skills may positively influence youth's confidence for managing their diabetes.

The MSED's proposed three-factor structure appears adequate and to contribute relevant information on the domains of parental self-efficacy for diabetes management. Although additional confirmatory research is necessary to establish whether covariance among MSED factors are best accounted for by a higher order factor, it is notable that correlations between the factors suggest this possibility, making it plausible to still report a total MSED score. Interpretation of the total score would likely provide a useful overview of parents' confidence surrounding diabetes management, and therefore, may be informative for screening purposes in both research and clinical practice. For example, researchers and clinicians may turn to the MSED total score to screen a large number of parents and identify those with lower self-efficacy who could benefit from further evaluation or intervention. Then within this smaller subset of parents, the MSED subscale scores could be used to identify specific areas of concerns and guide treatment.

Clinical Implications

The MSED is a practical and accessible measure of parental self-efficacy for diabetes management which can be easily administered in the context of clinical care, especially now in the proposed 11-item length. Use of the MSED as a screening tool may help clinicians identify parents with low levels of self-efficacy for diabetes management, an important component of maintaining youth's diabetes care. Further, the proposed three-factor structure may help clinicians identify the unique treatment needs of families, rather than broadly addressing parents' perceived abilities for managing their child's diabetes. For example, low scores on the MSED-P may prompt clinicians to discuss problem-solving skills with parents. In addition, MSED subscales may provide a better understanding of intervention targets that enhance adherence to pediatric diabetes regimens. Specifically, MSED subscales could be used by clinicians and researchers to identify intervention targets, track progress over time, assess treatment outcomes, and would allow for comparisons of subscale scores across various individual (e.g., parent depression, education) and family (e.g., conflict, cohesiveness) characteristics.

Limitations

A significant strength of the study was the examination of the MSED's relation with youth's diabetes-specific self-efficacy as well as an objective assessment of SMBG and HbA1c. However, there are also some limitations. First, similar to studies using other measures of diabetes-specific self-efficacy (Kappen, van der Bijl, & Vaccaro-Olko, 2001) as well as measures of academic self-efficacy (Diseth, Meland, & Breidablik, 2014; Toland & Usher, 2015), MSED items demonstrated limited variation, indicating that

the instrument may be vulnerable to response biases. This is problematic because it can limit researchers' ability to detect potentially meaningful differences in parents' self-efficacy. Alternatively, the MSED may suffer from method effects due to its format, which may influence participant response. For example, participant responding tends to show greater acquiescence with items, irrespective of item content, when response scales include a midpoint, perhaps because the midpoint leads to movement of otherwise negative responses in a positive direction (Weijters, Cabooter, & Schillewaert, 2010). However, research has also shown greater acquiescence for fully labeled response scales, perhaps because the labels increase the clarity and salience of items, which, in turn, leads to a greater positive response bias (Tourangeau, Rips, & Rasinski, 2000). The MSED includes both a midpoint and fully labeled responses. Thus, in the future, it may be valuable to test an updated form of the MSED to see if an optimal number of response items and number of labels can be determined to promote greater response variation. Second, the present study used a relatively homogeneous sample of parents, which also limits its generalizability. Therefore, future research is needed evaluating the MSED in parents from diverse racial-ethnic backgrounds as well as parents of both older and younger children. Third, it is notable that correlations between the factors suggest the presence of a higher order factor, making it possible to report a total MSED score. However, we believe future studies are needed to examine the stability of a MSED total score in the context of confirmatory factor analysis. Similarly, future studies are needed to establish the test–retest reliability and divergent validity of the MSED.

Conclusion

In conclusion, this study provided preliminary evidence for the reliability and validity of a MSED three-factor solution assessing parental self-efficacy for diabetes management. The MSED is the only measure of diabetes self-efficacy developed specifically for parents, and this study represents the only EFA validation of the measure. Unique associations among the three MSED subscales and parent- and child-report of diabetes-related health outcomes suggest that assessing domains of parental self-efficacy may be useful for clinicians and researchers alike. Moreover, use of the MSED in practice and research may provide an advantage over adapted measures given its ability to assess parents' unique efficacy beliefs for diabetes management. Therefore, we recommend that future research rely on the three-factor solution of the MSED for examining parental self-efficacy for diabetes management. Additionally, researchers are encouraged to

conduct further assessment of the MSED's validity, particularly through confirmatory work with diverse parent–youth samples.

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