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Psychometric Properties of the Revised Parental Monitoring of Diabetes Care Questionnaire (PMDC-R) in Adolescents with Type 1 Diabetes

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Abstract

Purpose—We evaluated the psychometric properties of a revised version of the Parental Monitoring of Diabetes Care (PMDC) questionnaire designed to evaluate parental supervision and monitoring of adolescent diabetes care behaviors. The revised measure was intended to capture a broad range of ways used by parents to gather information about youth adherence to diabetes care.

Methods—267 caregivers of 12–18 year old adolescents with type 1 diabetes completed the PMDC-R. Measures of parental knowledge of youth illness management, illness management behavior and metabolic control were also obtained.

Results—The PMDC-R demonstrated good internal consistency (alpha coefficient = .91) and test-retest reliability ($r = .79$, $p < .001$). Supporting the instrument's construct validity, a bifactor model with one primary factor and three secondary factors had an acceptable fit to the data [comparative fit index (CFI) = .92, and root mean square error of approximation (RMSEA) = .06]. Concurrent validity was also supported. In structural equation models, parental monitoring as assessed by the PMDC-R had a significant direct effect on parental knowledge of adolescent diabetes management and through knowledge, an indirect effect on adolescent diabetes management and metabolic control.

Conclusions—The PMDC-R displayed strong psychometric properties and represents an important next step in refining the measurement of parental monitoring for youth with chronic illnesses.

Keywords

Diabetes; Parental Monitoring; Adolescents

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Implications and Contributions

Despite evidence regarding the importance of parental monitoring to health outcomes of youth with diabetes, diabetes-specific measures of parental monitoring are lacking. The Parental Monitoring of Diabetes Care Scale-Revised (PMDC-R) displayed strong psychometric properties and represents an important step in refining parental monitoring measures for youth with chronic illnesses.

Introduction

Parental monitoring has been defined as “a set of correlated parenting behaviors involving attention to and tracking of the child’s whereabouts, activities and adaptations” [1]. Although the term “parental supervision” has sometimes been used in place of “parental monitoring”, Dishion & McMahon [1] encourage the use of the term monitoring because it encompasses a wider range of parenting behaviors than direct oversight of the child, including activities such as oversight through contacts with other adults or the youth’s peers. Parental monitoring has been repeatedly identified as an important predictor of adolescent behavioral outcomes, including risky sexual behavior [2, 3], school failure [4], use of alcohol and drugs [5, 6], and involvement in antisocial activities [7, 8]. Recent studies of youth with diabetes have shown that parental monitoring appears to play a protective role in this population just as it does among healthy youth [9, 10, 11]. For instance, Horton et al [9] found that higher levels of parental monitoring were associated with better illness management and glycemic control among young adolescents with type 1 diabetes.

Despite growing evidence regarding the importance of parental monitoring to the health outcomes of youth with diabetes, diabetes-specific measures of parental monitoring are lacking. The only measure that evaluates parental monitoring of diabetes care behaviors for which psychometric properties have been reported is the Parental Monitoring of Diabetes Care scale (PMDC) [12]. However, the PMDC is limited by a number of problems. First, the measure confounds parental monitoring of youth diabetes care (information gathering) with parental knowledge of diabetes care completion (the outcome of information gathering). A seminal paper by Stattin & Kerr [13], as well as several recent reviews [14–16], suggests that parental monitoring needs to be viewed as conceptually distinct from parental knowledge and both should be measured.

Second, the PMDC only evaluates a few ways that parents might gather information about their adolescent’s diabetes care. One important source of parental information about youth behavior is the youth’s disclosure of their diabetes care activities to their parents [16, 17]. Items evaluating youth disclosure were not included in the PMDC. Finally, the original instrument was developed with a sample that was predominantly minority. Hence, the purpose of the present study was to develop and evaluate the psychometric properties of a revised parent-report measure of parental monitoring of the illness management of adolescents with diabetes, the Parental Monitoring of Diabetes Care Questionnaire-Revised (PMDC-R), within a larger, more diverse sample of youth with diabetes.

Method

Participants

Participants were recruited from two pediatric diabetes clinics in a large Midwestern city at scheduled clinic visits. The first clinic was a university-affiliated clinic in an urban children’s hospital. The second clinic was part of a large hospital-affiliated private practice in a suburban area. The research was approved by the respective hospital Institutional Review Boards. Participants provided informed consent and assent to participate.

Eligible parent participants were the primary caregiver of an adolescent who was 1) 12 – 18 years of age, 2) diagnosed for at least one year with type 1 diabetes, 3) without known developmental delay or other chronic medical conditions and 4) English-speaking. Of eligible participants, 62% of those approached in the urban clinic and 65% of those approached in the suburban clinic agreed to participate. The most frequent reason for non-participation was the extra time required to complete the study. The final sample consisted

of 267 participants (94 from the suburban clinic, 173 from the urban clinic). Participants were provided with a \$5 gift certificate for completing the study measures.

The average age of parents and adolescents was 43.4 ($SD = 7.3$) and 14.6 years ($SD = 2.0$), respectively. Eighty-one percent of parents were female. Fifty-one percent of youth were male. Sixty-one percent of parents were white, 36% were African-American, and the rest were of other race/ethnicity. Mean family income was \$54,642 ($SD = \$35,676$). The majority of adolescents (86%, $n = 229$) used basal-bolus insulin injections or continuous subcutaneous insulin infusion (pump) while the remaining 14% ($n = 38$) were on mixed short and intermediate-acting insulin injection regimens. Mean duration of diabetes for youth was 5.9 years ($SD = 3.7$) and mean HbA1c was 9.7% ($SD = 2.4\%$). Mean HbA1c in contemporary pediatric samples of children and adolescents with diabetes has been reported to be 9% [18]; HbA1c was slightly higher in the current sample due to 1) the focus upon the adolescent period when glycemic control is known to deteriorate and 2) the large number of minority youth in the sample given the known association between minority status and poorer metabolic control [19].

Procedure

Development of the Parental Monitoring of Diabetes Care Questionnaire-Revised (PMDC-R)—First, items were generated by four experienced diabetes researchers in six subdomains using the existing PMDC as a starting point. Items were generated so as to ask about monitoring of adherence [“How often did your child come to you and tell you about the blood glucose testing they did during the day (e.g. how often they tested, what the values were) without your asking them?”] as well as non-adherence (“When your child skipped a blood glucose test, how often did they tell you about it without your asking them?”) for the three primary components of diabetes care. The six subdomains were based on recent literature on the development of parental monitoring instruments [15, 20]. The first was *direct observation* of diabetes care completion, for example “How often did you watch your child give their insulin?” The second was *parental presence* during diabetes care, for example “When your child took insulin or tested their blood glucose away from home, how often were you present?” The third was *soliciting information* about diabetes care *from the adolescent*, for example “How often did you ask your child what they had eaten?” The fourth and fifth were *soliciting information from other people* (e.g. another parent/caregiver, teachers/school personnel, peers) and *receiving information from other people*. For example, the former items asked how often the parent asked teachers about the youth’s diabetes care and the latter items asked how often teachers provided information to the parent about the youth’s diabetes care without the parent inquiring. The sixth was *youth disclosure* about diabetes care, for example “How often did your child come to you and tell you about the blood glucose testing they did during the day (e.g. how often they tested, what the values were) without you asking them?”.

Next, items were reviewed by a pediatric endocrinologist for face validity and by five parents of youth with diabetes for clarity of wording and meaning as well as for the purposes of soliciting other methods of parental monitoring not captured by the item pool. No new items were generated. A total of 27 items were retained for administration in the present study. Item response was on a five point Likert scale. Higher scores reflected a higher level of parental monitoring.

Data Collection—Measures were collected by a trained research assistant. The first 25 participants were asked to complete the monitoring measure a second time two weeks after initial completion in order to evaluate test-retest reliability, based on literature

demonstrating that 15–20 subjects is an appropriate sample size [21]. Twenty-one parents returned the questionnaires.

Measures

Parental Monitoring of Diabetes Management—PMDC-R items are shown in Table 1, ordered by sub-domain.

Parental Knowledge of Diabetes Management—Parents' knowledge about their adolescent's diabetes care completion was measured by a 14-item investigator-developed measure. The measure consisted of items included in the original PMDC but now removed based upon recommendations from the measurement development literature [13]. Several new items were also generated as described above for new monitoring items. Sample items from the knowledge measure included "How often did you know if your child administered insulin correctly (for example, at the right times, the right dose)?" The alpha coefficient was .91. The adolescent completed a parallel version regarding their parent's knowledge ($\alpha=.93$).

Illness Management—The Diabetes Management Scale (DMS) [22] is a questionnaire measuring a broad range of diabetes management behaviors. It has demonstrated adequate reliability and validity [23, 24]. For the present study, adolescents rated their own diabetes management and parents completed a parallel form. Illness management was also measured by frequency of blood glucose (BG) testing. Data were obtained directly from the adolescent's blood glucose meter. Frequency of testing during the fourteen day period immediately preceding data collection was recorded and an average daily testing frequency was subsequently calculated.

Metabolic control—Metabolic control was calculated using hemoglobin A1c (HbA1c), a retrospective measure of average blood glucose during the past two to three months. Values were obtained during the medical appointment in the diabetes clinic with a DCA 2000 system (Bayer, Elkhart, IN) that uses an immunoglobulin-agglutination methodology.

Statistical Analyses

Analyses were conducted using Predictive Analytics Software Statistics (PASW), version 18.0, including the AMOS module. Missing data were estimated using the missing values analysis module of PASW. Item-level missing data ranged from a minimum of 0.4% ($n = 1$) to a maximum of 6.7% ($n = 18$).

Psychometric analyses of the PMDC-R were conducted using confirmatory factor analyses (CFA). The first stage of these analyses used the common factor model [25] in an exploratory way in order to determine how the 27 parental monitoring items conformed to the six subdomains that were used in item generation. This analysis was followed by a bifactor confirmatory factor analysis [26]. The bifactor CFA model consists of one general factor and several secondary factors. In contrast to the more commonly used second order CFA model in which the primary factor is superordinate, all factors in the bifactor model are first order factors and are orthogonal, facilitating interpretation and scaling [27, 28, 29].

Structural equation modeling (SEM) was used to examine the concurrent validity of the PMDC-R. Monitoring constructs identified in the bifactor CFA were used to predict parental knowledge of diabetes care, adolescent diabetes management, and metabolic control. CFA and SEM analyses were performed on the variance-covariance matrix of the 27 items using the maximum likelihood procedure in AMOS. Because some items exhibited significant

skewness, final estimation was performed using the parametric bootstrap procedure [30, 31]. Total scale reliability was evaluated using internal consistency (alpha) and test-retest.

Results

Psychometric Properties of the PMDC-R

Item means and standard deviations are shown in Table 1. Each item was significantly ($p < .05$) correlated with the scale total score, with correlations ranging from .36 to .70. Thus, all 27 items were used in the subsequent analyses.

A six-factor CFA representing the proposed subdomains was first fit to the 27 PMDC-R items using the common factor model [32]. This CFA had a poor data fit (see Model 1, Table 2) and several factors were nearly perfectly correlated [Direct Observation with Parental Presence ($\rho = .97$) and Soliciting Information from Others with Receiving Information from Others ($\rho = .99$)]. These factors were combined and a four factor CFA model was estimated. The fit of Model 2 was not better than the fit of Model 1 (see Table 2), yet it was considerably more parsimonious.

Because the PMDC-R was expected to consist of one general factor and several subdomains and the common factor model did not fit the data, a bifactor modeling approach was next used. The model was estimated with all items loading on one general factor and with the subdomain items identified in the previous CFA loading onto four secondary factors. This bifactor model resulted in a substantial improvement in fit according to change in Akaike's Information Criterion (AIC) (see Model 3, Table 2). The factor loadings on one secondary factor, "Solicit /Receive Information From Others", were small and not statistically significant. This factor was omitted and a bifactor model with three secondary factors was estimated. This model fit the data well and all remaining factor loadings were significant (see Model 4, Table 2).

Results of the final bifactor model are shown in Table 1 and Figure 1. The standardized factor loadings on the primary factor ranged from .30 to .71 and each was significant ($p < .05$), meeting McDonald's [25] criteria for item retention. This indicates that the 27 items measured a unitary parental monitoring construct. However, the presence of three secondary factors revealed additional systematic variance among groups of items in three domains: Direct Observation/Parental Presence (DOP), Youth Disclosure(YD), and Solicit Information from Youth(SIY).

The construct and concurrent validity of the PMDC-R was further explored using SEM. In the SEM, the PMDC-R primary and secondary factors were latent exogenous variables, parental knowledge and adolescent illness management were endogenous latent constructs, and youth metabolic control was an endogenous observed variable. The Parental Knowledge of Diabetes Care construct was defined by the parent- and adolescent-report measures. The Youth Illness Management construct was defined by three measures of illness management, DMS parent-report, DMS adolescent-report, and BG testing frequency from the meter. Metabolic control was represented by a single indicator variable (HbA1c) (see Figure 1).

The model had a good fit [X^2 (df =166) = 875.9, $p < .01$, RMSEA = .058, CFI = .91.] to the data. The primary parental monitoring factor had the strongest relationship with parental knowledge about diabetes care [standardized structure coefficient (β) =.65]. This was closely followed by YD ($\beta = .50$) and then DOP ($\beta =.24$). Each of these paths was significant ($p < .05$). However, the SIY subscale was not significantly related to parental knowledge ($\beta = -.03$) despite the fact that the Solicit Information from Youth items were significantly related to the primary PMDC-R factor.

In the SEM, parental knowledge of diabetes care was a significant predictor of adolescent illness management ($\beta = .75$) and illness management was a significant predictor of metabolic control ($\beta = -.39$). The indirect effect of parental knowledge on metabolic control was highly significant ($p < .01$). Using the AMOS bias corrected bootstrapping procedure, the primary monitoring factor was also found to have a significant indirect effect on metabolic control through adolescent illness management and parental knowledge ($p < .01$). Based upon the regression of HbA1c on the four factors, the PMDC-R accounted for 21% of the variance in metabolic control in total.

Estimation of factor scores

The most common approach to calculation of instrument factor scores has been simple summation of items [26]. The bifactor model used in the present analyses allows the identification of items that may lead to factor scores that are not optimally predictive and therefore should be excluded. In the case of SIY, as noted above, the items making up this secondary factor did not relate significantly to parental knowledge of diabetes care completion ($\beta = -.03$, *ns.*). This implies that the items contained specific systematic variance that was not relevant to the prediction of parental knowledge despite having shared variance with the other PMDC-R items. Therefore the PMDC-R primary factor score [i.e., Parental Monitoring Total (PM)] was calculated as the mean of the remaining 23 items without the SIY items.

Table 3 shows means and standard deviations for the total PM score and each of the three subscales as well as their interrelationships and relationships to health outcomes. Consistent with SEM results, the SIY subscale was not significantly related to either youth illness management or to metabolic control, while the DOP and YD subscales were significantly related to both illness management and metabolic control. Despite this, inspection of means showed that SIY was the most frequently endorsed form of parental monitoring.

Reliability of the PMDC-R

The internal consistency of the PMDC-R was evaluated by Cronbach's alpha. Test-retest was estimated using a subset ($n = 21$) of the 267 cases. Cronbach's alpha for total parental monitoring (PM) was .91. Test-retest reliability for PM using Pearson's r was .79 ($p < .001$), indicating that the measure had a high degree of stability over a two-week interval.

Discussion

The purpose of the present study was to revise the PMDC questionnaire in light of recent findings from the child development literature regarding parental monitoring, and to evaluate the psychometric properties of the revised instrument. Consistent with recent conceptualizations, the revised instrument separated the processes of parental monitoring from the outcome of monitoring (knowledge of youth diabetes care activities). Additional methods of parental monitoring of youth diabetes management, such as asking other adults and peers for information, were also included and the PMDC-R was developed within a larger and more representative sample of adolescents.

Results of the present study support the reliability of the PMDC-R. The measure had good internal consistency, and was relatively stable over a two-week interval. Study results also demonstrated construct validity. Results of the bifactor CFA supported a unitary parental monitoring construct, with three subscales explaining additional item variance. These findings from a chronic illness sample also support the conceptual distinction between parental monitoring and parental knowledge of youth activities. Concurrent validity of the PMDC-R was supported by SEM results. Through knowledge, the general monitoring

construct had an indirect effect on adherence and, through adherence, on metabolic control. This supports emerging findings from the diabetes literature [9, 10] regarding the importance of parental monitoring as a parenting behavior that is separate from involvement, support, and other means by which parents encourage good diabetes care. It also suggests that concerns that careful parental monitoring of adolescents with diabetes could represent a form of over-involvement [33] that may negatively affect adjustment or health outcomes have likely been overstated. The PMDC-R can be used in future studies to further determine what level of monitoring, if any, is detrimental to youth self-efficacy for diabetes care or self-management.

Three PMDC-R subscales-DOP, SIY and YD- accounted for significant additional variance beyond that explained by the general parental monitoring factor. The most frequent method of monitoring was soliciting information followed by direct observation/presence and youth disclosure. However, in multivariate analyses, only two subscales, DOP and YD, were predictive of parental knowledge. Furthermore, SIY items were not significantly related to youth illness management or metabolic control.

Findings suggest that although asking youth about their care completion is a common way that parents monitor diabetes care, asking youth is unrelated to either actual diabetes care completion or to metabolic control. Parents who frequently ask about diabetes care completion may be perceived by their children as nagging. Frequent asking about diabetes care completion may also indicate fewer opportunities to directly observe diabetes care. Since the purpose of the present study was to establish the psychometric properties of the PMDC-R, we did not examine whether particular patterns of parental monitoring were associated with poorer youth outcomes. It is possible that high levels of asking the youth about diabetes care is primarily related to poor diabetes outcomes when it occurs in combination with low levels of youth disclosure and/or parental direct observation. Future research can help to clarify these processes and to determine how the PMDC-R subscales might be utilized to allow identification of high risk families. Nevertheless, results of the current study suggest that high SIY scores may indicate that parents are using suboptimal strategies for gaining knowledge about their adolescent's diabetes management. For this reason, SIY items may be used as a subscale that can be estimated independently of the total PMDC-R score.

The current investigation also contributes to the debate regarding the importance of parent-driven monitoring processes (e.g., parents gathering information about youth activities) versus youth-driven processes (e.g., youth disclosure of their activities) [34] for parental knowledge of youth activities and, thus, for youth behavioral outcomes. Some researchers [16] have suggested that parenting styles such as high behavioral control and high relationship quality create the conditions under which youth disclose their activities (parent-driven process). However, a recent study by Kerr, Stattin & Burk [34] indicated that neither parent solicitation of information nor parental limit-setting affected parental knowledge of youth activities or youth behavioral outcomes (youth-driven process).

Our findings are more consistent with the former perspective. Although youth disclosure was an important contributor to parental knowledge (and, hence, to diabetes management and metabolic control), parental surveillance via presence during diabetes care was also independently related to these same outcomes. Although longitudinal data are needed, the findings suggest that youth may be more likely to spontaneously disclose their activities when they know that parents are aware of them anyway. Psycho-education with parents to encourage them to supervise adolescent diabetes care completion or to check for evidence of care completion if they are not present may help protect against the development of non-adherence and poor metabolic control.

Study limitations include evaluation of the PMDC-R instrument with cross-sectional data. The measure's predictive validity should be assessed in future studies. Although the sample was relatively diverse, it consisted predominantly of white and African American families. Replication of findings with other samples is warranted. Recent studies have suggested that fathers' and mothers' monitoring may be differentially related to youth outcomes [35]. However, the present study was conducted with a sample of predominantly female caregivers; the PMDC-R's psychometrics with fathers requires further investigation. Likewise, future studies with the measure should focus upon its psychometric properties within samples of younger and older adolescents and youth using a variety of insulin delivery systems (insulin pump versus injected insulin). Lastly, development of an adolescent-report version of the measure could add an important perspective regarding the relationship of parental monitoring to youth outcomes.

The PMDC-R represents an important step in the development of illness-specific measures of parental monitoring for use with adolescents with chronic medical conditions. Additional studies will help identify the ways in which instrumental parenting behaviors, such as monitoring, contribute to the maintenance of optimal adherence and health outcomes for adolescents, as well as fostering the development of interventions to promote effective parenting in youth with chronic conditions.

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References

1. Dishion TJ, McMahon RJ. Parental monitoring and the prevention of child and adolescent problem behavior: A conceptual and empirical formulation. *Clinical Child & Family Psychology Review*. 1998; 1:61–75. [PubMed: 11324078]
2. French DC, Dishion T. Predictors of early initiation of sexual intercourse among high-risk adolescents. *Journal of Early Adolescence*. 2003; 23:295–315.
3. Rose A, Koo HP, Bhaskar B, et al. The influence of primary caregivers on the sexual behavior of early adolescents. *Journal of Adolescent Health*. 2005; 37(2):135–144. [PubMed: 16026723]
4. Rodgers KB, Rose HA. Personal, family, and school factors related to adolescent academic performance: A comparison by family structure. *Marriage & Family Review*. 2001; 33(4):47–61.
5. Chilcoat HD, Anthony JC. Impact of parent monitoring on initiation of drug use through late childhood. *Journal of the American Academy of Child & Adolescent Psychiatry*. 1996; 35:91–100. [PubMed: 8567618]
6. Li X, Stanton B, Feigelman S. Impact of perceived parental monitoring on adolescent risk behavior over 4 years. *Journal of Adolescent Health*. 2000; 27:49–56. [PubMed: 10867352]
7. Griffin KW, Botvin GJ, Scheier LM, et al. Parenting practices as predictors of substance use, delinquency, and aggression among urban minority youth: Moderating effects of family structure and gender. *Psychology of Addictive Behaviors*. 2000; 14:174–184. [PubMed: 10860116]
8. Pettit GS, Bates JE, Dodge KA, et al. The impact of after-school peer contact on early adolescent externalizing problems is moderated by parental monitoring, perceived neighborhood safety, and prior adjustment. *Child Development*. 1999; 70(3):768–778. [PubMed: 10368921]
9. Horton D, Berg CA, Butner J, et al. The role of parental monitoring in metabolic control: Effect on adherence and externalizing behaviors during adolescence. *J. Pediatr. Psychol.* 2009; 34(9):1008–1018. [PubMed: 19420225]
10. Ellis D, Podolski C, Moltz K, et al. The role of parental monitoring in adolescent health outcomes: Impact on regimen adherence in youth with type 1 diabetes. *Journal of Pediatric Psychology*. 2007; 32(8):907–917. [PubMed: 17426045]

11. Eckshtain D, Ellis DA, Kolmodin K, et al. The effects of parental depression and parenting practices on depressive symptoms and metabolic control in urban youth with insulin dependent diabetes. *J. Pediatr. Psychol.* 2010; 35(4):426–435. [PubMed: 19710249]
12. Ellis D, Templin T, Podolski C, et al. The parental monitoring of diabetes care scale: Development, reliability and validity of a scale to evaluate parental supervision of adolescent illness management. *Journal of Adolescent Health.* 2008; 42(2):146–153. [PubMed: 18207092]
13. Stattin H, Kerr M. Parental monitoring: A reinterpretation. *Child Development.* 2000; 71:1072–1082. [PubMed: 11016567]
14. Fletcher AC, Steinberg L, Williams-Wheeler M. Parental influences on adolescent problem behavior: Revisiting Stattin and Kerr. *Child Development.* 2004; 75(3):781–796. [PubMed: 15144486]
15. Crouter AC, Bumpus MF, Davis KD, et al. How do parents learn about adolescents' experiences? Implications for parental knowledge and adolescent risky behavior. *Child Development.* 2005; 76(4):869–882. [PubMed: 16026502]
16. Soenens B, Vansteenkiste M, Luyckx K, et al. Parenting and adolescent problem behavior: An integrated model with adolescent self-disclosure and perceived parental knowledge as intervening variables. *Developmental Psychology.* 2006; 42(2):305–318. [PubMed: 16569169]
17. Eaton NR, Krueger RF, Johnson W, et al. Parental monitoring, personality, and delinquency: Further support for a reconceptualization of monitoring. *J Res Pers.* 2009; 43(1):49–59. [PubMed: 20046969]
18. Hood KK, Peterson CM, Rohan JM, et al. Association Between Adherence and Glycemic Control in Pediatric Type 1 Diabetes: A Meta-analysis. *Pediatrics.* 2009; 124(6):e1171–e1179. [PubMed: 19884476]
19. Frey MA, Templin T, Ellis DA, Gutai J, Podolski CL. Predicting metabolic control in the first five years after diagnosis for African American and European American youths with type 1 diabetes: The role of ethnicity and family structure. *Pediatric Diabetes.* 2007; 8:220–227. [PubMed: 17659064]
20. Waizenhofer RN, Buchanan CM, Jackson-Newsom J. Mothers' and fathers' knowledge of adolescents' daily activities: Its sources and its links with adolescent adjustment. *Journal of Family Psychology.* 2004; 18(2):348–360. [PubMed: 15222842]
21. Fleiss, JL. The design and analysis of clinical experiments. New York: John Wiley & Sons;; 1986. Reliability of measurements; p. 2-31.
22. Frey MA, Ellis DA, Naar-King S, et al. Diabetes management of adolescents in poor metabolic control. *The Diabetes Educator.* 2004; 30(4):647–657. [PubMed: 15669780]
23. Frey MA, Denyes MJ. Health and illness self-care in adolescents with IDDM: A test of Orem's theory. *Advances in Nursing Science.* 1989; 12:67–75. [PubMed: 2506800]
24. Schilling LS, Grey M, Knafl K. A review of measures of self-management of type 1 diabetes by youth and their parents. *Diabetes Educator.* 2002; 28(5):796–808. [PubMed: 14625965]
25. McDonald, RP. Test Theory: A unified treatment. Mahwah, NJ: Lawrence Erlbaum; 1999.
26. Chen FF, West SG, Sousa KH. A comparison of bifactor and second-order models of quality of life. *Multivariate Behavioral Research.* 2006; 41(2):189–225.
27. Gignac GE. The WAIS-III as a nested factors model: A useful alternative to the more conventional oblique and higher-order models. *Journal of Individual Differences.* 2006; 27(2):73–86.
28. Weiss, DJ.; Gibbons, RD. Computerized Adaptive Testing with the bifactor model. Paper presented at the 2007 GMAC Conference on Computerized Adaptive Testing; Minneapolis, MN. 2007. Available at www.psych.umn.edu/psylabs/CATCentral/
29. Martel MM, Gremillion M, Roberts B, et al. The Structure of Childhood Disruptive Behaviors. *Psychological Assessment.* 2010; 22(4):816–826. [PubMed: 21133546]
30. Bollen KA, Stine R. Direct and Indirect effects: Classical and bootstrap estimates of variability. *Sociological Methodology.* 1990; 20:115–140.
31. Shrout PE, Bolger N. Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods.* 2002; 7(4):422–442. [PubMed: 12530702]
32. Joreskog KG. Statistical analysis of sets of congeneric tests. *Psychometrika.* 1971; 36:109–133.

33. Hanna KM, DiMeglio LA, Fortenberry JD. Parent and adolescent versions of the diabetes-specific parental support for adolescents' autonomy scale: Development and initial testing. *Journal of Pediatric Psychology*. 2005; 30:257–271. [PubMed: 15784922]
34. Kerr M, Stattin H, Burk WJ. A reinterpretation of parental monitoring in longitudinal perspective. *Journal of Research on Adolescence*. 2010; 20(1):39–64.
35. Palmer DL, Osborn P, King PS, Berg CA, Butler J, Butner J, Horton D, Wiebe DJ. The structure of parental involvement and relations to disease management for youth with type 1 diabetes. *Journal of Pediatric Psychology*. 2010 Advance online publication.

Figure 1. Structural model showing concurrent validity of the Parental Monitoring of Diabetes Care instrument. DMS = Diabetes Management Scale; BGM = Blood Glucose Monitoring; HbA1c = Hemoglobin A1c.
* $p < .001$

Table 1

Factor Analysis Results and Descriptive Item Statistics: Final Bifactor Model with One General Factor and Three Subdomains [Direct Observation or Presence (DOP), Youth Disclosure (YD), and Solicit Information from Youth (SIY)]

Items	Mean	S. D.	General Factor	DOP	YD	SIY
17. When child tested blood glucose at home, how often were you present?	4.09	1.19	.53	.67		
19. How often did you watch your child test his/her blood glucose?	3.88	1.31	.55	.66		
25. When your child took his/her insulin at home, how often were you present?	4.27	1.07	.53	.64		
1. How often did you watch your child give his/her insulin?	3.97	1.28	.49	.58		
27. When your child ate meals at home, how often were you present?	4.39	0.88	.45	.53		
23. How often did you observe child during a meal to see what and how much he/she ate?	4.08	1.19	.53	.25		
3. When your child ate meals away from home how often were you present?	3.30	0.90	.30	.21		
14. How often did you look at the readings in your child's blood glucose meter?	2.92	1.42	.59	.15		
26. If your child ate in a way that caused problems with their diabetes (for instance, skipped a meal, didn't count carbohydrates), how often would he/she tell you about it without your asking him/her?	2.99	1.35	.35	.77		
16. If child missed insulin dose, would he/she tell you without asking?	3.02	1.52	.40	.75		
7. If child skipped a blood glucose test, how often would he/she tell you without asking?	2.79	1.37	.45	.75		
12. How often did he/she tell you about the blood glucose testing he/she did during the day without asking?	2.59	1.46	.64	.38		
11. How often did child tell you about the insulin took during the day without your asking?	2.40	1.50	.65	.35		
4. How often did your child tell you what he/she ate without asking him/her?	2.50	1.43	.51	.24		
20. How often did you ask your child if they tested his/her blood glucose?	4.36	1.01	.42	.74		
24. How often did you ask child if he/she took his/her insulin?	4.27	1.08	.49	.57		
5. How often did you ask your child what his/her blood glucose readings were?	4.36	1.01	.47	.49		
22. How often did you ask your child what he/she had eaten?	4.24	0.96	.54	.47		
10. How often you check child's test strips and lancets to see if the expected number had been used?	2.89	1.63	.71			
6. How often did you check insulin vials to see if the expected amount had been used?	3.33	1.68	.64			
21. How often did you ask child's friends or parents about child's diabetes care?	2.96	1.62	.61			
9. When child took insulin or tested blood glucose outside of your home, how often were you present?	2.26	1.25	.57			
8. How often did child's friends or parent's tell about child's diabetes care without asking?	2.81	1.55	.55			
13. How often did you ask school personnel about child's diabetes care in school?	1.93	1.43	.52			
18. How often did family members tell you about child's diabetes care without you asking?	2.93	1.61	.51			
2. How often did you ask family members whether your child had completed diabetes care?	3.31	1.61	.39			
15. How often did school personnel provide tell about child's diabetes care without asking?	1.78	1.36	.37			

Note. DOP = Direct Observation/Presence; YT = Youth Tells; AY = Ask Youth

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Table 2

Statistics Used To Evaluate Factor Model Fit

Statistic	Criteria for "Good" Fit	Model 1 ^a	Model 2 ^b	Model 3 ^c	Model 4 ^d
Chi Square		1141.60	1185.46	827.10	596.52
<i>df</i>		309	318	297	301
<i>p</i>	>.05	<.001	<.001	<.001	<.001
CFI	>.90	.78	.77	.86	.92
RMSEA	<.08	.10	.10	.08	.06
AIC	Smaller is better	1279.60	1305.46	989.10	750.52

Note. CFI = comparative fit index; RMSEA = root mean square error of approximation; AIC = Akaike information criteria.

^aModel 1 = 6 Factor Confirmatory Factor Analysis.

^bModel 2 = 4 Factor Confirmatory Factor Analysis.

^cModel 3 = Bifactor Model with 4 secondary factors.

^dModel 4 = Bifactor Model with 3 secondary factors.

Table 3

Descriptive Statistics and Correlation Matrix of Study Variables

	PM	DOP	SIY	YD	DMS-P	DMS-T	BGM	HbA _{1c}
DOP	.756***							
SIY	.394***	.569***						
YD	.790***	.435***	.133*					
DMS-P	.446***	.430***	.089	.471***				
DMS-T	.273***	.273***	.010	.341***	.555***			
BGM	.313***	.333***	.096	.226***	.376***	.406***		
HbA _{1c}	-.113 ⁺	-.160**	.071	-.134*	-.258***	-.300***	-.375***	
M	3.06	4.04	2.76	2.72	72.41	72.34	2.75	9.70
SD	0.82	0.82	0.52	1.14	15.37	15.31	1.54	2.38

Note: DOP = Direct Observation or Presence, SIY = Solicit Information from Youth, YD = Youth Disclosure, PM = Parental Monitoring Total, PKD-P = Parental Knowledge of Diabetes-Parent Report, PKD-T = Parental Knowledge of Diabetes-Teen Report, DMS-P = Diabetes Management Scale-Parent Report, DMS-T = Diabetes Management Scale-Teen Report, BGM = Blood Glucose Monitoring

* $p < .05$,

** $p < .01$,

*** $p < .001$,

⁺ $p < .10$