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A New Self-Report Measure of Self-Management of Type 1 Diabetes for Adolescents

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Abstract

Background—The development of instruments to measure self-management in youth with type 1 diabetes has not kept up with current understanding of the concept.

Objective—To report the development and testing of a new self-report measure to assess self-management of type 1 diabetes in adolescence (SMOD-A).

Methods—Following a qualitative study, items were identified and reviewed by experts for content validity. A total of 515 adolescents, 13 to 21 years old, participated in a field study by

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The instrument described in this manuscript, Self-Management of Type 1 Diabetes in Adolescents (SMOD-A) is available from Lynne S. Schilling, RN, Ph.D. (Lynne.Schilling@umassmed.edu)

completing the SMOD-A (either once or twice) and additional measures of diabetes related self-efficacy (SEDS), quality of life (DQOL), self-management (DSMP), and adherence (SCI). Data were collected also on metabolic control (HbA1c).

Results—The content validity of the scale (CVI) was .93. Exploratory alpha factor analyses revealed five subscales: Collaboration with Parents, Diabetes Care Activities, Diabetes Problem-Solving, Diabetes Communication, and Goals (α = .71 to .85). The stability of the SMOD-A ranged from .60 to .88 at 2 weeks (test-retest) to .59 to .85 at 3 months. Correlations of SMOD-A subscales with SEDS-Diabetes; DQOL satisfaction, impact, and worry; DSMP; and SCI were generally significant and in the expected direction. Collaboration with Parents and HbA1c values were related significantly and positively (r =.11); all other SMOD-A subscales were related significantly and negatively to HbA1c (r = −.10 to −.26), demonstrating that better self-management is associated somewhat with better metabolic control and supporting construct validity of the new measure.

Discussion—The SMOD-A has been found to be a reliable, stable, and valid measure of self-management of type 1 diabetes in adolescence.

Keywords

self-management; type 1 diabetes; adolescence; instrument development

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The management of type 1 diabetes in youth has changed dramatically in recent years. The American Diabetes Association (Silverstein et al., 2005) now recommends that all youth over the age of 7 years be managed with flexible regimens. Such regimens include the use of insulin pumps (continuous subcutaneous insulin infusion [CSII]) and basal-bolus injectable insulin (Weinzimer, Sikes, Steffen, & Tamborlane, 2005). Self-management is important to the overall management of the disease and becomes even more important as individuals and families make the complex (and frequent) management decisions that flexible regimens demand.

There has been conceptual confusion about the definitions of *self-management* and *adherence*. This confusion has seeped into descriptions of how youth self-manage type 1 diabetes and into selection of the measures used in research reports. Researchers often use the two terms interchangeably in the same paper, or use a measure of self-management and discuss results in terms of adherence.

The following distinctions between the two concepts are intended to contribute to a more nuanced understanding of how youth care for their type 1 diabetes. Adherence is described usually as the degree to which an individual follows medical advice (Greening, Stoppelbein, & Reeves, 2006). In contrast, self-management is a multidimensional concept that includes activities that youth and their parents perform to care for the disease, as well as processes of collaboration between youth and their parents and between youth and health care providers as youth move toward the goal of assuming full responsibility for managing their diabetes (Schilling, Grey, & Knafl, 2002). Self-management is an evolving process reflecting a trajectory that begins with dependence on parents and moves toward a more collaborative relationship with them. There is an overlap between self-management and adherence in that some of the things youth and their parents do to care for diabetes (self-management) is what they were told to do (thus, also adherence). Implicit in this view of self-management is the perspective that youth are developmentally unable to manage diabetes independently, thus their families (particularly their parents) are an integral part of youths' self-management. Therefore, the concept self-management is used broadly to include the participation of both youth and their families.

The development of instruments to measure self-management in youth has not kept pace with the evolving concept of self-management. The most commonly used instrument is the Diabetes Self-Management Profile (DSMP), an interview measure developed by Harris et al. (2000) and later revised by Iannotti et al. (2006). The DSMP (Harris et al., 2000) has five subscales (exercise, management of hypoglycemia, diet, blood glucose testing and insulin administration, and adjustment). These subscales are used to assess the performance and adjustment of diabetes care activities, but not to evaluate the process (including collaboration with parents and health care providers) and goals of self-management. As such, the DSMP provides a more circumscribed assessment of self-management than does the SMOD-A.

The Self-Management of Type 1 Diabetes in Adolescence (the SMOD-A) was developed to broaden the scope of measurement of self-management and to give researchers the option of a self-report instrument. The instrument is needed both to advance the science of self-management and to provide clinicians with a tool to evaluate and promote self-management in youth with type 1 diabetes. Researchers, too, will benefit from a more comprehensive measure of self-management when evaluating the effects of interventions to improve diabetes management. The purpose of this presentation is to report on the development of the SMOD-A and the results of the reliability and validity assessments.

Research Design and Methods

In developing this instrument state of the art methods were used in a three-step process. The steps included a qualitative study to identify potential item content and create the initial items for the instrument, expert review for item refinement (and elimination of some items), and field testing to assess psychometric characteristics of the new instrument. Results from the first two phases (Schilling et al., 2007; Schilling, Knafl, & Grey, 2006) are summarized here.

In the qualitative descriptive study, semistructured interviews were conducted with 22 youth (8 to 19 years of age) and one parent of each youth (Schilling et al., 2006). From these data, 99 potential items for the SMOD-A were written in three different categories. The three categories were identified previously in a concept analysis (Schilling et al., 2002) and included activities of self-management, processes of self-management, and goals of self-management.

Content Validity

The content validity of these potential SMOD-A items was assessed by three panels of expert judges: 12 clinicians from two university pediatric diabetes clinics, 5 behavioral diabetes researchers, and a group of "experiential experts" (p. 363) composed of 6 adolescents judged to be good self-managers of type 1 diabetes by clinic health care providers and 5 of their parents (Schilling et al., 2007). The details of the content validity assessment have been reported previously (Schilling et al., 2007). In summary, the judgments of multiple groups of experts, obtained via content validity questionnaires focused on the relevance and clarity of items, were used to decide which items should be kept, eliminated, or rewritten. Based on these judgments, 13 items were eliminated. The content validity index (CVI) based on the remaining 86 items was a robust .93. The CVI was computed by averaging item CVIs as recommended by Polit and Beck (2006).

Field Study

The psychometrics and underlying structure of the 86 items remaining after content validity analysis were tested in a field study conducted at two university-based diabetes centers in the northeast. Institutional review board approval was obtained from each institution.

Sample—Eligible adolescents were approached in clinic waiting rooms to assess their interest in participating. Criteria for participation were: (a) age 13–21 years, (b) English speaking, (c) diagnosed with type 1 diabetes for at least 1 year, (d) not pregnant, and (e) having no condition or chronic illness that could impact how the individual cared for their diabetes (e.g., mental disability or illness, celiac disease). Since there are no agreed-upon ages for adolescence, the definition of adolescence was taken from Dahl (2003), who has written that adolescence is "…that awkward period between sexual maturation and the attainment of adult roles and responsibilities" (p. 9).

The majority of the participants reported that they were currently living with their parents (87.7%, n = 452) or at college (10.3%, n = 53), indicating for this sample that the overwhelming majority had not attained adult roles and responsibilities. For interested adolescents under age 18, written parental consent and adolescent assent were obtained; for adolescents over age 18 years, written consent was obtained. Of 595 adolescents approached, 60 declined to participate, giving reasons such as not being interested, not having time, disliking questionnaires, or not accompanied by parent (to give consent). Twenty adolescents either were excluded after consenting when it became apparent they did not meet enrollment criteria or they failed to complete the questionnaire packet.

Procedures—To assess the temporal stability of the SMOD-A, participants at both sites were selected randomly to retake the SMOD-A at either 2 weeks (± 3 days) or 3 months (± 1 week). The 2-week interval was conceptualized as a traditional assessment of test-retest reliability of the SMOD-A. In contrast, the 3-month interval was used as an exploration of the stability of self-management over a more extended period. After numbers sufficient for calculating correlations had been recruited for the assessment of stability (n = 187), remaining participants (n = 328) completed the SMOD-A only one time. At one of the sites, 16 participants also completed the original DSMP (Harris et al., 2000) over the telephone.

Measures—All participants completed a Demographic Form and three other measures to assess the construct validity of the SMOD-A. Most participants completed the packet of instruments in 20 minutes or less. The DSMP (Harris et al., 2000) was administered separately to a small subset of participants in a further effort to assess the construct validity of the SMOD-A.

In addition to the SMOD-A and the DSMP, the following measures were used: The Self-Efficacy for Diabetes Scale (SEDS; Grossman, Brink, & Hauser, 1987), The Diabetes Quality of Life for Youth Questionnaire (DQOL-Y; Ingersoll & Marrero, 1991), and the Self-Care Inventory (SCI; La Greca, Swales, Klemp, & Madigan, 1988; La Greca, Swales, Klemp, Madigan, & Skyler, 1995), These measures were selected to assess the construct validity of the SMOD-A either because they have been linked theoretically (Grey, Knafl, & McCorkle, 2006) and empirically to self-management (or adherence), or because they are used to measure the same (DSMP) or related (SCI) concepts. Palardy, Greening, Ott, Holderby, and Atchison (1998) found a significant relationship between self-efficacy and adherence to self-care activities in adolescents with type 1 diabetes. Ott, Greening, Palardy, Holderby, and DeBell (2000) identified self-efficacy as a significant mediator of adherence to self-care in adolescents with type 1 diabetes. Likewise, diabetes quality of life has also been linked empirically to self-management. Better diabetes quality of life in adolescents has been linked to better self-management (Harris et al., 2000) and to better diabetes problem-solving (Cook, Aikens, Berry, & McNabb, 2001).

It was hypothesized that there would be a significant negative relationship between SMOD-A subscale scores and scores on the Diabetes-Specific Self-Efficacy subscale of the SEDS (since higher self-efficacy scores indicate less self-efficacy) and a significant positive relationship between the SMOD-A subscales and DQOY-Y Satisfaction scores. Additionally, it was hypothesized that there would be significant negative relationships between SMOD-A subscales and DQOL-Worry and DQOL-Impact subscales, such that better self-management would be associated with less worry and impact. It was hypothesized also that there would be significant positive relationships between the SMOD-A subscale dealing with the activities of diabetes management and the DSMP, and between that SMOD-A subscale and the SCI. Data were collected also on metabolic control (HbA1c) since HbA1c also has been linked empirically to self-management (Harris et al., 2000), such that better metabolic control (lower HbA1c value) is linked to better self-management.

The SMOD-A, as it was used in the field study, consisted of 86 items divided into two parts. Part I was made up of items related to the activities and processes of self-management. Part II was made up of items related to the potential goals of self-management. Participants were asked to respond to items on a 4-point scale, ranging from *never* (0) to *always* (3) for items in Part I and from *never a goal for me* (0) to *met this goal* (3) for items in Part II. Some items were worded negatively (and then reverse-coded) to control for systematic response bias.

The original DSMP (Harris et al., 2000) is a semistructured interview measure used to assess self-management of type 1 diabetes by youth over the past 3 months. Harris et al. (2000) reported the Cronbach's alphas for the total scale and five subscales to be >.50. Test-retest reliability over 3 months was reported as .67 for the total scale and ranged from .34 to .47 for the 5 subscales. Lewin et al. (2006) reported a Cronbach's alpha for the total scale of .72.

The SEDS (Grossman et al., 1987) is used to measure self-perceptions or expectations held by youth with diabetes about their confidence regarding successfully managing their diabetes. The SEDS has three subscales addressing different aspects of self-efficacy: diabetes-specific, medical, and general situations. For the purpose of this report, only the diabetes-specific subscale scores (24 items) are reported. To complete the SEDS, the respondent rates his or her degree of confidence for items on a five-point scale ranging from *very sure I can* to *very sure I can't*. Lower scores indicate higher self-efficacy. Reliability coefficients on the diabetes-specific subscale are reported to be .90 to .92 (Grossman et al., 1987). Chui (2005) more recently reported a Cronbach's alpha on this subscale to be .88.

The DQOL-Y (Ingersoll & Marrero, 1991) is used to measure perceptions of the impact of diabetes, general satisfaction with life, and worries over social, school, and relationships with peers among youth with type 1 diabetes. The three subscales are Diabetes Life Satisfaction (17 items), Disease Impact (23 items), and Disease-Related Worries (11 items). Faulkner and Chang (2007) recently have reported Cronbach's alphas for these subscales: Diabetes Life Satisfaction (.85), Disease Impact (.83), and Disease-Related Worries (.82). Each item is in a 5-point response format. Higher scores on the Satisfaction scale indicate higher quality of life; higher scores on the Impact and Worries scales indicate lower quality of life.

The SCI (La Greca et al., 1988, 1995) is a measure of adherence to performing diabetes self-care activities as recommended by health care providers. The measure is composed of 13 items regarding such things as insulin administration, blood glucose testing, and treatment of hypoglycemia. Respondents rate items on a five-point scale reflecting how frequently they follow recommendations for the performance of a self-care activity. The scale has good internal consistency (Cronbach's alpha = .87; La Greca et al., 1995).

Glycosylated hemoglobin (HbA1c) was used as a measure of metabolic control. The majority of participants (n = 484) had HbA1c assessed using the Bayer Diagnostics DCA2000 (normal range = 4.0 to 6.3%) method. Thirty-one participants had HbA1c assessed using another method and were excluded from analyses involving HbA1c for this paper.

Analyses—Descriptive statistics were compiled on all study measures and demographic variables. Cronbach's alphas were computed for the measures used in concert with the SMOD-A. Item analyses were conducted on the SMOD-A items, and 13 items with little or no variability were eliminated. These 13 items included ones from each of the three original item categories (activities, processes, goals). For example, for one of the eliminated items (“My parents encourage me to take care of my diabetes”), 460 of the 515 (89%) participants reported that this was *always* the case.

A series of exploratory factor analyses was conducted with the remaining 73 items. As suggested by various experts (Dixon, 2005; Ferketich & Muller, 1990; Youngblut, 1993), the multiple analyses were conducted to select the solution yielding factors with adequate internal consistency and also deemed most meaningful by the research team. Since response options were different for items of Part I (61 items) and Part II (12 items), these were analyzed in separate factor analyses. Total missing data ranged from 0 to 16 (3.1%) subjects per item. Subjects with missing data were not included in factor analyses, leaving 432 for these analyses. Number of factors to be rotated was based on examination of scree plot, through which magnitude of eigenvalues by factor are visualized. The final proposed structure of the instrument was obtained using the alpha method of factor extraction which is especially well-suited for studies of new instruments.

The alpha extraction method for factor analysis was developed by Kaiser and Caffrey (1965) for psychometric analysis, with the goal of maximizing alpha reliability of the derived factors (Norusis, 2003). That is, assuming that variables chosen for measurement are a sample of all potential variables in the domain (universe) of interest, the goal of alpha factor analysis is defined as "determining common factors from the sample of measured variables that will have maximum correlation with corresponding factors in the universe of variables" (MacCallum, Browne, & Cai, 2007, p. 168). This is accomplished by extraction of factors that maximize Cronbach's alpha. Tabachnick and Fidell (2007) assert that "the greatest advantage (of alpha extraction method) is that it focuses the researcher's attention squarely on the problem of sampling variables from the domain of variables of interest" (p. 637). Given the importance of Cronbach's alpha among psychometric characteristics of new instruments, Ferketich and Mueller (1990), in a classic article published in *Nursing Research*, suggested that the alpha extraction approach should be considered for instrument development, especially initial stages as reported here. However, despite its potential strength for instrument development work, the alpha extraction method is not well-known by researchers and it is not used commonly--perhaps the major disadvantage of the method (Tabachnick & Fidell, 2007, p. 637). However, researchers comparing factor analytic methods have found that alpha extraction method gives equivalent results to other extraction methods (Leonard & Harvey, 2007; Youngblut, 1993); or that, in the context of substantial overlap between variables, it represents an "optimal compromise between sensitivity to the dissolved factors on the one hand and stability of results on the other" (Beauducel, 2001, p. 93).

Consistent with the exploratory process, items with loadings of .20 or higher were retained for further consideration, based on subscale reliability. Next, Cronbach's alpha was computed for each of the derived subscales, and subscales were refined further by eliminating items that detracted from subscale reliability, then scale scores were computed for each study participant on each of the subscales. The final phases of data analysis included evaluating the stability of repeated SMOD-A scores over 2 weeks (test-retest) and 3 months, and also evaluating the relationship of SMOD-A scale scores to both demographic variables and participant scores on the other study measures.

Results

Participants

Data were gathered from 515 adolescents. Participants ranged in age from 13 to 21 years (mean = 15.8 years ± 2.14 years). The sample was 80% White (n = 412); 9.7% Black (n = 50); 1.6% Asian (n = 8); and 8.7% American Indian or Alaskan Native, Unknown, or Multiple (n = 45), and was divided fairly equally between genders (53% male). About 6%

(5.8%, n = 10) reported Hispanic ethnicity. Almost half of the participants used CSII (n = 250, 48.5%) and 66.4% were on flexible rather than conventional regimens (n = 342). The mean glycosylated hemoglobin (HbA1c), taken from the chart at the time of the clinic visit, was 8.47% ± 1.78% (range = 5.1–14.0). A small number of adolescents (6.2%, n = 32) had HbA1c values under 6.3%. The mean duration of diabetes was 6.92 years ± 3.92 years (range = 1–17 years).

Readability

The SMOD-A was evaluated using the Flesch-Kincaid Grade Level score that is calculated in Microsoft Word and found to be at the 5.9 grade level.

Factor Analysis and Subscale Development

Five subscales were identified through exploratory (alpha) factor analysis, based on a four-factor solution for Part I items and a one-factor solution for Part II items. These accounted for 27.9% and 29.6% percent of interitem variance, respectively. Varimax (orthogonal) rotation of the four-factor solution from Part I yielded conceptually interpretable factors which were named Collaboration with Parents, Diabetes Care Activities, Diabetes Problem-Solving, and Diabetes Communication. Eigenvalues of rotated factors ranged from 3.1 to 5.9, and proportion of variance accounted for ranged from 5.3% to 10.1%. The single factor (Eigenvalue = 3.3) from Part II was named Goals. Through the iterative process of removing items that did not achieve loadings of .20 or greater in the factor analysis, or that detracted from Cronbach's alpha in the reliability analysis, 34 items (of the 86 items field-tested) were eliminated and 5 items were retained. The entire process of item elimination is summarized in Figure 1. The SMOD-A subscales, with items ordered by item-total correlations, are shown in Table 1.

For each of the five subscales, the minimum possible score is 0. Maximum possible scores are 39 (Collaboration with Parents), 45 (Diabetes Care Activities), 21 (Diabetes Problem-Solving), 30 (Diabetes Communication), and 21 (Goals). Higher scores indicate more collaboration with parents, activities, problem-solving, communication, and goals, respectively.

Reliability

The SMOD-A subscale definitions, reliabilities (internal consistency and temporal stability), and descriptive statistics (mean and standard deviation) are displayed in Table 2.

Internal consistency—Cronbach's alphas for the five SMOD-A subscales range from .71 to .85 and were considered acceptable (DeVellis, 2003).

Temporal stability—Correlations assessing temporal stability ranged from .60 to .88 for the 2-week interval (n = 74), and from .59 to .85 for the 3-month interval (n =113). The 2-week interval is the traditional timeframe for test-retest reliability correlations. Although these two analyses involved different subsets of the sample, stability followed similar patterns, with highest stability found for the Collaboration with Parents factor, and lowest stability for the Goals factor in both the 2-week and 3-month periods.

Construct Validity Testing

Intercorrelations between the 5 SMOD-A subscales were calculated. All correlations were statistically significant (ranging in magnitude from .14 to .45), with 8 of the 10 in the positive direction. Two intercorrelations were negative (Collaboration with Parents and Diabetes Problem-Solving, $r = -.22$, $p < .0001$; and Collaboration with Parents and Goals, $r = -20$, $p. < .0001$).

Alpha reliabilities for study measures and correlations with SMOD-A subscales are presented in Table 3. With the exception of short DSMP subscales (those with only 3–6 items), reliabilities of study measures were acceptable, ranging between .82 and .92. For the three measures obtained from the full sample (DQOL--Satisfaction, Impact, and Worry; SEDS, SCI), most correlations with SMOD-A subscales were statistically significant, and in the hypothesized direction (positive for DQOL-Satisfaction and SCI; negative for SEDS, DQOL-Impact, and DQOL-Worry). As expected, the correlation between SCI scores and the Diabetes Care Activities subscale ($r = .62$, $p = .0001$) was of high magnitude. Other statistically significant correlations ranged from .14 to .38 in magnitude. Only correlations with the Collaboration with Parents subscale followed a different pattern. The positive association between Collaboration with Parents and SEDS-Diabetes (where higher scores indicate less self-efficacy) makes intuitive sense because if parental participation is high, adolescents' self-efficacy (self-confidence) in their abilities to carry out diabetes-related activities might, indeed, be lower rather than higher ($r = .23$, $p = .0001$). As hypothesized, self-management was related positively to satisfaction with quality of life, and adherence as measured by the SCI; self-management was related negatively to diabetes-related self-efficacy and quality of life--impact and worries (better self-management, less impact and worries).

Only 16 of the 515 study participants completed the DSMP interview, so only correlations of high magnitude achieved statistical significance. All five DSMP subscales and total scores also were associated positively with the SMOD-A Diabetes Care Activities subscale, with correlations ranging from .35 to .80 (range of variance accounted for was 12–64%). The 95% confidence intervals for the significant correlations were broad; for example, for the total DSMP score, the lower and upper bounds were .41 and .91, respectively. Finally, there were small but significant relationships between HbA1c and all SMOD-A subscale scores, ranging in magnitude from .10 to .26, with all except Collaboration with Parents in inverse direction, as expected.

Discussion

The SMOD-A, a 52-item self-report measure, has excellent content validity (CVI = .93), acceptable subscale reliability ($\alpha = .71$ to .85), and was stable as assessed at 2 weeks ($r = .60$ to .88) and at 3 months ($r = .59$ to .85). It should be noted that test-rest coefficients (2 weeks) and stability at 3 months for the subscale Goals were under .70. Experts have varying opinions about what is minimum acceptable test-retest reliability, in the range of .50 to .70 (Dilorio, 2005; Nunnally & Bernstein, 1994; Streiner & Norman, 2003). It is possible, given the higher test-retest reliabilities for the other subscales, that self-management goals for diabetes are influenced to a greater degree by daily events and adolescents' day-to-day mood swings.

Preliminary assessment of construct validity testing was promising as well, with the SMOD-A having relationships in the expected directions with QOL (impact, worry, and satisfaction), SED-Diabetes, SCI, DSMP, and HbA1c. It was particularly promising that the SMOD-A had a similar pattern of associations with QOL and HbA1c as the DSMP (Harris et al., 2000), since the SMOD-A goes further than the DSMP in assessing aspects of the process and goals of self-management and has higher reliability estimates. While further information about construct validity will be obtained about the SMOD-A in subsequent uses, the evidence obtained thus far leads us to the conclusion that it fills a heretofore unfilled niche in focus (self-management) and target population (adolescents). On this latter point, the SMOD-A was well-accepted by the adolescents and their parents. This reflects the focus on areas of particular importance in the adolescents' progress towards independence. This additional asset of the SMOD-A derives from the origin of the items being adolescents and parents themselves. Moreover, during the content validity assessment phase of instrument development, adolescents and parents provided valuable feedback on the relevance and clarity of items.

The SMOD-A offers an opportunity for clinicians and researchers who want to look at self-management in adolescents. A frequently used measure, the SCI (La Greca, Follansbee, & Skyler, 1990; La Greca et al., 1988, 1995), is a measure of adherence that, as noted earlier, provides a limited view of self-management. While the Diabetes Care Activities subscale of the SMOD-A was associated with the SCI score (r = .62), it is clear that the SMOD-A subscales and the SCI do not measure the same construct. This research demonstrates that self-management as measured by the SMOD-A is a broad (multidimensional) construct that includes collaboration between adolescents and their parents; how frequently key diabetes care activities are performed (the subscale most strongly associated with adherence); how frequently the adolescent adjusts his or her diabetes regimen; how frequently the adolescent communicates about his or her diabetes with parents, health care providers, and friends; and the degree of endorsement of relevant diabetes-related goals. The SMOD-A may be a useful addition to the battery of measures that are used to evaluate how adolescents with type 1 diabetes are managing their disease (e.g., SEDS, DQOL-Y, HbA1c).

The SMOD-A, in its entirety, may be too long to be useful to clinicians. However, depending on which aspect of self-management is of interest to clinicians (and this may change from setting to setting and patient to patient), individual subscales of the SMOD-A may be administered and prove useful as talking points.

This study is limited by the relative homogeneity of the sample. The sample was predominately White, middle class, and in reasonably good metabolic control. Although data were collected in two different settings, both are in the same geographic region, the northeast. The reliability and validity of the SMOD-A in more diverse populations needs to be explored. Additionally, the number of participants who completed the DSMP was small (n = 16), thus confidence intervals for correlations of DSMP subscales with SMOD-A were large, indicating some imprecision of this aspect of the results.

A total score on the SMOD-A was not calculated and is not recommended. Rather, five unique subscales were identified, each of which captures a meaningful aspect of self-management, and each of which shows acceptable reliability and beginning validity evidence. It is suggested that they are best used as separate indicators, which, in combination, may provide a holistic picture of self-management status.

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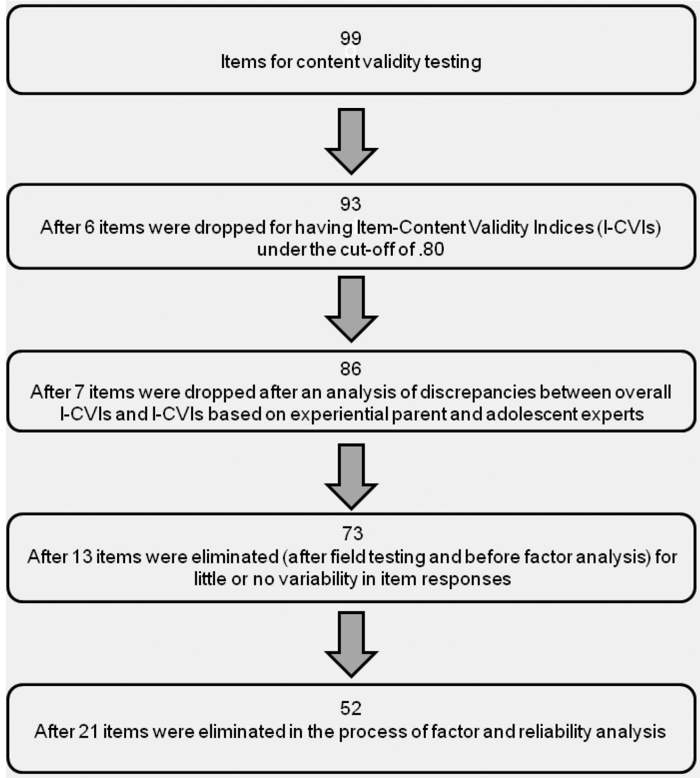

figure 1.
Process of Item Elimination for the SMOD-A

Table 1

SMOD-A Subscales with truncated items and item-subscale correlations

Subscale	Item	Item-total (scale) correlation
Collaboration with Parents		
	Parents help decide insulin.	.64
	Parents tell insulin.	.62
	Parents count carbohydrates.	.59
	Ask parents when sugar out of range.	.56
	Tell parents when sugar out of range.	.52
	Parents and I look at readings.	.52
	Parents check insulin.	.49
	Handle high sugars. (R)	.46
	Parents talk about eat.	.45
	Parents check meter.	.43
	Ask parents carbohydrates.	.41
	Consult parents when not sure.	.40
	Adjust insulin myself. (R)	.39
Diabetes care activities		
	Check sugar before eating.	.52
	Eat without checking. (R)	.48
	Check without being reminded.	.47
	Follow plan or count.	.43
	If sugar high, check again.	.41
	Carry glucose or sugars.	.40
	Test ketones.	.39
	Keep record of numbers	.39
	If sugar low, treat and check later.	.36
	Need reminded insulin. (R)	.34
	Argue about when test. (R)	.34
	Skip insulin. (R)	.32
	Carry something says diabetes.	.27
	Out without supplies. (R)	.25
	Don't like it when someone reminds. (R)	.19
Diabetes Problem-solving		
	Decide insulin	.55
	To figure insulin, consider sugar and what eat.	.50
	Adjust insulin based on numbers.	.49
	When exercise, change eat or insulin.	.37
	If sugar high, insulin.	.37
	Remember HbA1c (A1c) from last visit.	.33
	Know what HbA1c (A1c) should be.	.32
Diabetes Communication		

Subscale	Item	Item-total (scale) correlation
	When diabetes bothers, talk about it.	.55
	If bothers, talk to parents.	.49
	Change diabetes routine if asks.	.45
	If parents problem, we talk.	.40
	Think about what say to nurse or doctor.	.40
	Contact nurse or doctor when can't get sugars into range.	.40
	Stay informed.	.36
	Review records with nurse or doctor.	.33
	Time alone with nurse or doctor.	.27
	Tell friends diabetes.	.25
Goals		
	Take care on my own.	.53
	Be in charge.	.53
	Try not problems in future.	.50
	Feel good.	.50
	Do with friends.	.44
	Stay away overnight.	.41
	Understand why blood sugar numbers.	.35

(R) – Item responses are reversed before subscale total is calculated.

Table 2

SMOD-A Subscale Definitions, Reliability Estimates, Means, and Standard Deviations

Subscale	Definition	# Items	Reliability estimate: alpha	2-week	3-month	Mean	SD
Collaboration with Parents	how frequently parents are involved in diabetes management	13	.85	.88	.85	13.7	7.0
Diabetes Care Activities	how frequently the adolescent performs key activities of diabetes management	15	.77	.78	.76	30.9	6.1
Diabetes Problem-Solving	how frequently the adolescent adjusts regimen and knows HbA1c numbers and goals	7	.71	.72	.78	16.1	3.6
Diabetes Communication	how frequently the adolescent communicates with parents, health care providers, and friends about their diabetes	10	.73	.69	.70	16.8	5.0
Goals	the degree to which the adolescent has endorsed seven potential diabetes goals	7	.75	.60	.59	14.2	3.3

Table 3

Alpha Reliability for Study Measures and Correlation with SMOD-A Subscales

				Correlations with SMOD-A Subscales				
Measure	**n**	**Items**	**α[1]**	**Collaboration with Parents**	**Diabetes Care Activities**	**Diabetes Problem-Solving**	**Diabetes Communication**	**Goals**
DQOL-Impact	490	23	.85	.04	−.28****	−.14**	−.18****	−.23****
DQOL-Worry	511	11	.88	−.00	−.24****	−.13**	−.08	−.17***
DQOL-Satisfaction	494	17	.92	.04	.25****	.17***	.19****	.15***
SEDS-Diabetes	471	24	.87	.23****	−.30****	−.38****	−.35****	−.35****
SCI	515	7	.83	.29****	.62****	.21****	.34****	.24****
DSMP-Exercise	14	3	.04	.51	0.43	0.24	.52*	0.3
DSMP-Hypoglycemia	16	3	.33	.12	.35	.03	.21	.21
DSMP-Diet	16	6	.50	.59*	.80***	.35	.32	−.01
DSMP-Insulin	16	4	.43	.28	.53*	.26	−.01	.32
DSMP-Glucose Testing	16	9	.82	.20	.56*	.00	.26	.29
DSMP-Total	16	25	.82	.40	.75***	0.14	0.3	0.28
HbA1c	484	--	--	.11**	−.24****	−.26****	−.10*	−.26****

Notes.

DQOL = The Diabetes Quality of Life for Youth Questionnaire; SEDS = The Self-Efficacy for Diabetes Scale; SCI = Self-Care Inventory; DSMP = Diabetes Self-Management Profile; HbA1c = glycosylated hemoglobin

[1] Standardized alphas

* $p = \leq .05$

** $p = \leq .01$

*** $p = .001$

**** $p = .0001$