Published in final edited form as:

Diabetes Res Clin Pract. 2011 October ; 94(1): 77–83. doi:10.1016/j.diabres.2011.06.010.

Development and Initial Validation of the Barriers to Diabetes Adherence Measure for Adolescents

Shelagh A. Mulvaney, PhD^{1,2,3}, Korey K. Hood, PhD⁴, David G. Schlundt, PhD⁵, Chandra Y. Osborn, PhD, MPH⁶, Kevin B. Johnson, MD, MS^{2,3}, Russell L. Rothman, MD, MPP⁶, and Kenneth A. Wallston, PhD¹

¹Vanderbilt University Medical Center, School of Nursing

²Vanderbilt University Medical Center, Department of Biomedical Informatics

³Vanderbilt University Medical Center, Department of Pediatrics

⁴Cincinnati Children's Hospital Medical Center, Division of Behavioral Medicine and Clinical Psychology

⁵Vanderbilt University, Department of Psychology

⁶Vanderbilt University Medical Center, Center for Health Services Research

Abstract

Aims—The purpose of this study was to develop a measure of psychosocial barriers to adherence in adolescents with type 1 diabetes (T1D) and examine relationships to patient characteristics, adherence, and hemoglobin A1C (A1C).

Methods—Barriers to Diabetes Adherence (BDA) items were generated by researchers, clinicians, and patients. Adolescents aged 12–17 with T1D completed the BDA and an adherence measure. Hemoglobin A1C was obtained through medical chart review.

Results—Factor analysis from 123 adolescents resulted in a 21-item, five-component solution that accounted for 63.09% of the variance. The components were stress and burnout, time pressure and planning, social support, parental autonomy support, and stigma. The BDA total and subscales were internally consistent. The BDA total and some components were associated with adherence and A1C. The BDA was the only predictor of A1C compared to demographic, clinical, and adherence variables ($F 6.17, p < .05$). Subjects with higher A1C (> 8.5) showed a higher level of barriers ($F 15.20, p < .001$) and a differential profile of barriers ($F 5.75, p < .05$).

Conclusions—The BDA may be useful in research and clinical settings as a complement to adherence measures and to tailor educational programs. Additional research is necessary to establish test-retest reliability and discriminant validity.

Keywords

adherence; adolescents; type 1 diabetes; barriers; assessment

© 2011 Elsevier Ireland Ltd. All rights reserved

Corresponding Author: Shelagh A. Mulvaney, PhD Vanderbilt University Medical Center School of Nursing 461 21st Avenue South Nashville, TN 37240 615-322-1198 shelagh.mulvaney@vanderbilt.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Conflict of Interest The authors declare that they have no conflict of interest.

INTRODUCTION

Adolescents with T1D are at risk for poor adherence and glycemic control. Adherence in T1D involves performing many tasks over the course of each day, such as carrying supplies, monitoring blood glucose levels, dosing insulin according to glucose meter readings, managing carbohydrate intake, and taking insulin or using an insulin pump. Many self-care tasks need to be carried out around mealtimes, and in contexts such as restaurants, social gatherings, school, and sports. Given the frequency and nature of these tasks, it is not surprising that adherence and glycemic control in adolescents are often suboptimal [1–5].

Assessment of adherence frequency is an important part of diabetes research and clinical care. However, self-report questionnaires that assess the frequency of performing self-care tasks do not provide insight regarding reasons for inadequate adherence. Measurement of barriers to adherence complements adherence frequency, as it provides unique information regarding why adherence frequencies may be suboptimal. The examination of barriers to self-care has provided useful information for educators, and predicted glycemic control [6–11]. Educational programs may use barriers assessments to tailor intervention content.

Assessment of barriers to adherence within research or clinical practice may also help address social desirability and restriction of range observed on adherence frequency measures. Adherence assessment may be subject to socially desirable responding [12, 13]. Socially desirable responding results in an overestimate of adherence levels. However, unlike adherence, there may be less pressure for socially desirable responses in the assessment of barriers to adherence. There are no “gold standards” or expectations from adults regarding the level of barriers adolescents might experience. Adolescents may more freely admit to factors that act as barriers to adherence, and thus measures of barriers to adherence may be less vulnerable to social desirability effects. This may be particularly true when adolescents report frequent adherence in the context of poor glycemic control. Further investigation using a barriers instrument may provide insights for education and communication about adherence with young patients.

A large number of psychosocial factors have been identified that negatively influence adherence in adolescents with T1D. For example, many studies have identified stress as negatively associated with adherence and glycemic control [14–17]. Interventions that reduce stress have resulted in improved levels of adherence and glycemic control [18–20]. Social support has been consistently positively related to adolescent diabetes outcomes [21–23] as has autonomy support, a key motivation during adolescent development [24–26]. An area of self-care barriers not well-studied in this population, but very relevant, are those related to the awareness of time, rushing, and planning. Several studies have found that time management, feeling pressured, or an unwillingness to take the time for self-care create barriers to adherence [27–29].

Finally, stigma and embarrassment associated with chronic illness have been well-documented as a negative influence on quality of life, self-care, and medical outcomes. In pediatric chronic illness, the impact of stigma has been documented in various conditions such as cancer, HIV/AIDS, epilepsy, and cystic fibrosis [30–34]. Embarrassment and perceived stigma may impact the ability of the individual to communicate needs, seek help, or perform self-care tasks around others. In adolescent diabetes, limited research has documented levels of stigma or the extent to which it impacts self-care [28, 35, 36].

Measures of psychosocial barriers to adherence have been developed for pediatric asthma, cystic fibrosis, and other chronic illnesses [37, 38] as well as adult type 1 and type 2 diabetes

[7, 11]. However, available measures focus on and have been validated with adults, focus on one type of self-care task, on one domain of barriers or measure to which a barrier causes negative feelings [6, 39–42]. Given a lack of appropriate barriers to self-care adherence measures in T1D, the purpose of the present study was to develop and provide initial validation for a measure of barriers to adherence for use in clinical and research settings. We limited development and the review here to psychosocial barriers that have been related to diabetes adherence or glycemic control, are modifiable, and did not already have clinically feasible or brief measures associated with them. For example, we did not attempt to include barriers to adherence that may be better assessed separately, such as depression. A measure of barriers to diabetes adherence will allow clinicians and researchers to identify patient- and population-based barriers to adherence and tailor educational resources to overcome them.

2. SUBJECTS, MATERIALS, and METHODS

2.1 Development of the Barriers to Diabetes Adherence Measure

Items were initially generated through a literature review and discussion with a multidisciplinary team of diabetes professionals (pediatric, social, and health psychologists; a pediatrician, a pediatric nurse, and a pediatric endocrinologist) and two young adults with T1D. A total of 33 items were developed and edited by the team. Next, 10 adolescents with T1D participated in cognitive interviews to improve wording, content, and face validity. Based on adolescent feedback, the response format was changed from a frequency rating to a subjective opinion scale, and the measure was reduced to the 23 items analyzed here. Items were eliminated if they did not work well with the new response format, or because of feedback for the need for improved wording or clarity. The items were prefaced by these instructions: “The following statements are about taking care of diabetes. How true are these statements for you?” For each item, response options ranged from 1 (not at all true) to 5 (completely true). Three items were reverse scored to be consistent with the other items, in which higher scores indicate increased barriers.

2.2 Participants and Procedures

Adolescents were recruited from an outpatient diabetes clinic within a large academic medical center. Adolescents were included in the study if they were 12–17 years old and had been diagnosed with T1D for at least 1 year. All behavioral measures were individually administered within the clinic by a trained research assistant using an online survey system (REDCap)[43]. Demographic and some clinical information (e.g., duration of diabetes) were obtained from parents. The study was approved by the Vanderbilt University Institutional Review Board. Parent consent and adolescent assent were obtained prior to participation.

2.3 Measures

The Diabetes Behavior Rating Scale (DBRS) was administered to measure adherence to self-care recommendations. The DBRS is a 37-item validated measure of pediatric T1D adherence with documented internal consistency (Cronbach's alpha .70), concurrent validity with the Diabetes Self-Management Profile (DSMP) and predictive validity in relation to glycemic control [44]. Hemoglobin A1C was obtained via medical chart review. Response options focus on frequency and range from Never to Always.

2.4 Statistical Analysis

The goal was to develop and provide initial support for the Barriers to Diabetes Adherence measure. The factor structure of the scale was analyzed using principal components analysis with promax rotation. Items were included on a component if the loading was greater than .40. The number of components were determined in accordance with the recommended Kaiser-Guttman criterion of eigen values >1 and a plot of the scree values [45]. The internal

consistencies of the scales were assessed using Cronbach's alpha, and by calculating item-total correlations (using Spearman rho). Relationships between the BDA total and subscales and other measures were estimated using Spearman rho correlation coefficients. Mann-Whitney or t-tests were conducted for tests of mean differences. General linear modeling (GLM) using Type I Sums of Squares was used to predict A1C from study variables. Type I Sums of Squares (as opposed to simultaneous Type III Sums of Squares) allows for estimation of separate variable parameter estimates, and is useful when there may be collinearity amongst predictors. Profile analysis of barriers sub-scale scores was conducted using multivariate repeated measures ANOVA [46]. All analyses were conducted using SPSS v.18.0.

3. RESULTS

Demographic and clinical characteristics of the sample are shown in Table 1. The majority of the sample (91.7%) was Caucasian, the modal household income was greater than \$70,000/year, average age of participants was approximately 15, just over half of the sample was male (52.2%), duration of diabetes was 6.6 years, and average A1C for the sample was 8.87.

3.1 Item Reduction, Reliability, and Inter-correlations

Using eigen values >1 and Cattell's elbow criteria on the scree plot, five components were indicated [45]. Two items did not have loadings of at least .40 and were eliminated. Principal components analysis was rerun with 21 items. Item total correlations ranged from .39 to .70. All 21 items loaded above .40 on their components and were retained [45]. Internal consistency reliability (Cronbach's alpha) for the BDA total score was .88. Table 2 shows component loadings, Cronbach's alpha, and subscale and item means for the retained 21 items. The revised rotated matrix with 5 components accounted for 63.09% of the variance in BDA total score. The identified components were labeled: 1) stress and burnout, 2) time pressure and planning, 3) social support, 4) autonomy support, and 5) stigma. Table 3 shows bivariate correlations between the components.

3.2 Relation of BDA to Participant Characteristics

Using Mann-Whitney Tests, females indicated greater barriers to adherence overall ($p=.037$; males 2.11, SD .71; females 2.38, SD .73) and, specifically, greater barriers associated with social support ($p=.042$; males 1.88 SD 1.01; females 2.40 SD 1.21) and stigma ($p=.010$; males 1.75 SD 0.91; females 2.14 SD 0.90). Age, duration of diabetes, and use of an insulin pump were not related to the BDA total or subscale scores. Race was not analyzed due to the predominantly Caucasian type 1 sample.

3.4 Relationship of BDA to Adherence and Glycemic Control

Table 4 shows bivariate correlations for the BDA total and subscales with A1C and adherence. The BDA total score, and the stress and burnout and parental autonomy support subscales were related to A1C in the expected (positive) direction. The BDA total, stress and burnout, and time pressure and planning were (appropriately) negatively related to adherence. Table 5 shows results of the general linear model predicting A1C from participant characteristics, adherence, and the BDA. The BDA was the only variable that significantly predicted A1C.

3.4 Barriers Prevalence

In order to report prevalence rates for barriers as measured by the total score and barriers subscales, the percent of (total and subscale) scores with an average over 3.0 (mid-point of

the response range) was calculated. The prevalence of barriers was as follows: BDA total (16%), stress and burnout (36%), time pressure and planning (23%), social support (22%), stigma (16%), and parental autonomy support (10%).

3.5 Barriers Profiles

In order to determine the relationship of level and pattern of barriers to A1C, profile analysis was conducted using multivariate repeated measures ANOVA. Two groups were created for A1C using the median for the sample (8.5) as the cut-score. Figure 1 shows the level and pattern of barriers scale scores for the A1C groups. The overall level of barriers was significantly different between the groups ($F 15.20, p < .001$). The group by sub-scale interaction was also significant, indicating differential patterns of barriers between the groups ($F 5.75, p < .05$). Although the patterns appear visually similar, post hoc tests of mean differences between the higher and lower A1C groups were significant for four of the five scales: stress ($t 3.60, p < .001, df = 121$), time ($t 2.26, p < .05$), social support ($t 2.79, p < .01, df = 121$), and autonomy support ($t 3.55, p < .01, df = 121$). This pattern indicates that those individuals with higher A1C values showed significantly more adherence barriers related to stress, time, social support, and autonomy support (see Figure 1). Perception of stigma did not differ between the profiles.

4. DISCUSSION

Assessment of barriers to adherence is an important step in identifying reasons for suboptimal adherence and predicting glycemic control in adolescent T1D. In order to address the need for a relevant measure for that population, a brief measure of psychosocial barriers to adherence was developed and validated. Results provide initial support for the psychometric properties, and construct and predictive validities of the Barriers to Diabetes Adherence measure (BDA). Five components related to stress and burnout, time pressures and planning, social support, autonomy support, and stigma were identified. The BDA total score was related to adherence and glycemic control (A1C), and predicted glycemic control better than adherence or participant characteristics. The subscales measuring stress/burnout and autonomy support were also related to glycemic control. Some scales were not related to the adherence measure. Future research with this new measure should utilize multiple or alternate measures of adherence.

Adolescents endorsed a range of psychosocial barriers to adherence, with the most prevalent barriers related to stress and burnout. Adolescents reported feeling frustrated, stressed, anxious, and having a lack of motivation about diabetes. Stress and burnout may influence many adherence tasks or even perception of barriers. Negative emotions related to stress and burnout may act as a “damper” across multiple self-care tasks and situations, and thus provide the greatest leverage for improving glycemic control through cognitive-behavioral interventions. Interventions focused on helping children and adolescents with diabetes cope with and problem solve negative emotions have been related to improved outcomes [47–49]. Similarly, addressing time pressures and planning, another prevalent barrier, may impact multiple self-care tasks across multiple contexts. Other barriers may be more specific to an interaction between adolescent beliefs and a particular social context. For example, an individual embarrassed about diabetes may not monitor blood glucose in certain social situations, but feel comfortable in others. Frequently encountered challenging situations may provide leverage points for improving adherence and glycemic control.

Results highlight the utility and unique information obtained by examination of profiles of barriers subscale scores. The scale as a whole may be useful in predicting outcomes or in models where including multiple subscale scores is not feasible. However, average (or total) scores may obscure relevant patterns or levels of specific barriers. The subscale scores may

have greatest utility when tailoring interventions for individuals or targeting groups of individuals, either clinically or within intervention research. For example, females reported greater overall psychosocial barriers, and specifically those related to social support, social situations, and stigma. This is congruent with previous research indicating that girls look to friends for support more often than boys and tend to participate in social networking activities more frequently than boys [23, 28, 50]. Examination of individual profiles allows insight into the nature of the total score, a more efficient use of intervention resources, and may help to maintain adolescent engagement during interventions by directing them to barriers that are most personally relevant.

4.1 Study limitations

Although internally consistent, not all subscales were related to glycemic control or adherence. Next steps include validation of the BDA on a larger sample with additional measures for divergent and convergent validities. Test-retest reliability needs to be assessed as well, although high levels of stability may not be expected in all barriers. For example, embarrassment may vary with changing social challenges and social maturation. Barriers were not linearly related to age here, but further research is needed to assess longitudinal and developmental aspects of adherence barriers, and relationships between executive functions, such as insight, and self-reports of psychosocial issues. Interventions that improve self-awareness, or insight, may, in the absence of any other educational experience, shift the level and nature of perceived barriers.

4.2 Implications

The results provide encouraging data to support this new instrument. We have identified modifiable psychosocial barriers to adherence and a clinically feasible measure for them. The measure may be used in research and to guide educational and support programs and clinical effort. Specifically, the use of barriers profiles may provide a more efficient and evidence-based means to guide adolescents toward relevant educational experiences and interventions.

Acknowledgments

The authors wish to thank Mr. Eric Pittel and Ms. Kathleen Smith for assistance with data collection. This research was supported by a Pilot and Feasibility grant to Dr. Mulvaney from the Vanderbilt Diabetes Research and Training Center (P60DK020593) and by the Vanderbilt Institute for Clinical and Translational Research (1 UL1 RR024975 from NCRR/NIH).

REFERENCES

- [1]. Delamater, AM. Critical issues in the assessment of regimen adherence in children with diabetes. In: Drotar, D., editor. Promoting adherence to medical treatment in chronic childhood illness: concepts, methods and interventions. Lawrence Erlbaum Associates; Mahwah, NJ: 2000. p. 173-95.
- [2]. Greening L, Stoppelbein L, Konishi C, Jordan SS, Moll G. Child routines and youths' adherence to treatment for type 1 diabetes. *J Pediatr Psychol*. 2007; 32:437–47. [PubMed: 17030526]
- [3]. Holmes CS, Chen R, Streisand R, Marschall DE, Souter S, Swift EE, et al. Predictors of youth diabetes care behaviors and metabolic control: a structural equation modeling approach. *J Pediatr Psychol*. 2006; 31:770–84. [PubMed: 16221954]
- [4]. Delamater AM. Improving Patient Adherence. *Clin Diabetes*. 2006; 24:71–7.
- [5]. Hood KK, Peterson CM, Rohan JM, Drotar D. Association between adherence and glycemic control in pediatric type 1 diabetes: a meta-analysis. *Pediatrics*. 2009; 124:e1171–9. [PubMed: 19884476]

- [6]. Glasgow RE, Toobert DJ, Gillette CD. Psychosocial barriers to diabetes self-management and quality of life. *Diabetes Spectrum*. 2001; 14:33–41.
- [7]. Glasgow RE, McCaul KD, Schafer LC. Barriers to regimen adherence among persons with insulin-dependent diabetes. *J Behav Med*. 1986; 9:65–77. [PubMed: 3517352]
- [8]. Hanna KM, Guthrie D. Adolescents' perceived benefits and barriers related to diabetes self-management? Part 1. *Issues Compr Pediatr Nurs*. 2000; 23:165–74. [PubMed: 11310236]
- [9]. Siminerio LM. Approaches to Help People With Diabetes Overcome Barriers for Improved Health Outcomes. *The Diabetes Educator*. 2008; 34:18S–24. [PubMed: 18268002]
- [10]. Auslander WF, Sterzing PR, Zayas LE, White NH. Psychosocial Resources and Barriers to Self-management in African American Adolescents With Type 2 Diabetes. *Diabetes Educ*. 2010; 36:613–22. [PubMed: 20479133]
- [11]. Lancaster BM, Pfeiffer B, McElligott M, Ferguson AT, Miller M, Wallace D, et al. Assessing treatment barriers in young adults with type 1 diabetes. *Diabetes Res Clin Pract*. 2010; 90:243–9. [PubMed: 21035226]
- [12]. Paulhus, DL. Measurement and control of response bias. In: Robinson, JP.; Shaver, PR.; Wrightsman, LS., editors. *Measures of personality and social psychological attitudes*. Academic Press; San Diego: 1991. p. 17-59.
- [13]. Glasgow RE, Toobert DJ, Hampson SE, Brown JE, Lewinsohn PM, Donnelly J. Improving self-care among older patients with type II diabetes: the “Sixty Something...” study. *Patient Educ Couns*. 1992; 19:61–74. [PubMed: 1298950]
- [14]. Hanson, CL. Developing systemic models of the adaptation of youths with diabetes. In: LaGreca, ASL.; Wallander, J.; Walker, E., editors. *Stress and Coping in Child Health*. Guilford; New York: 1992. p. 213-41.
- [15]. Farrell SP, Hains AA, Davies WH, Smith P, Parton E. The impact of cognitive distortions, stress, and adherence on metabolic control in youths with type 1 diabetes. *J Adolesc Health*. 2004; 34:461–7. [PubMed: 15145403]
- [16]. Hains AA, Berlin KS, Davies WH, Parton EA, Alemzadeh R. Attributions of Adolescents With Type 1 Diabetes in Social Situations. *Diabetes Care*. 2006; 29:818–22. [PubMed: 16567821]
- [17]. Delamater AM, Kurtz SM, Bubb J, White NH. Stress and coping in relation to metabolic control of adolescents with type 1 diabetes. *Developmental and Behavioral Pediatrics*. 1987; 8:136–40.
- [18]. Soo H, Lam S. Stress management training in diabetes mellitus. *Journal of Health Psychology*. 2009; 14:933–43. [PubMed: 19786520]
- [19]. Ellis DA, Frey MA, Naar-King S, Templin T, Cunningham PB, Cakan N. The Effects of Multisystemic Therapy on Diabetes Stress Among Adolescents With Chronically Poorly Controlled Type 1 Diabetes: Findings From a Randomized, Controlled Trial. *Pediatrics*. 2005; 116:e826–e32. [PubMed: 16322140]
- [20]. Hains AA, Davies WH, Parton E, Totka J. A stress management intervention for adolescents with type 1 diabetes. *The Diabetes Educator*. 2000; 3:417–24. [PubMed: 11151289]
- [21]. Skinner T, John M, Hampson S. Social support and personal models of diabetes as predictors of self-care and well-being: a longitudinal study of adolescents with diabetes. *J Pediatr Psychol*. 1998; 25:257–67. [PubMed: 10814692]
- [22]. Burrows TE, Harris MA, Pontious SL, Santiago JV. Research on social support in adolescents with IDDM: a critical review. *The Diabetes Educator*. 1997; 23:438–48. [PubMed: 9305010]
- [23]. Wysocki T, Greco P. Social support and diabetes management in childhood and adolescence: influence of parents and friends. *Current Diabetes Reports*. 2006; 6:117–22. [PubMed: 16542622]
- [24]. Williams GC, Freedman ZR, Deci EL. Supporting autonomy to motivate patients with diabetes for glucose control. *Diabetes Care*. 1998; 21:1644–51. [PubMed: 9773724]
- [25]. Ryan R, Deci E. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol*. 2000; 55:68–78. [PubMed: 11392867]
- [26]. Williams GC, Niemiec C, Patrick H, Ryan R, Deci E. The Importance of Supporting Autonomy and Perceived Competence in Facilitating Long-Term Tobacco Abstinence. *Ann Behav Med*. 2009; 37:315–24. [PubMed: 19373517]

- [27]. Schlundt DG, Pichert JW, Rea MR, Puryear W. Situational obstacles to adherence for adolescents with diabetes. *The Diabetes Educator*. 1994; 20:207–11. [PubMed: 7851234]
- [28]. Mulvaney SA, Rothman RL, Osborn CY, Lybarger C, Dietrich MS, Wallston KA. Self-management problem solving for adolescents with type 1 diabetes: intervention processes associated with an internet program. *Patient Educ Couns*. 2010 In Press, Corrected Proof.
- [29]. Travis T. Patient Perceptions of Factors That Affect Adherence to Dietary Regimens for Diabetes Mellitus. *The Diabetes Educator*. 1997; 23:152–6. [PubMed: 9155313]
- [30]. Casillas J, Kahn KL, Doose M, Landier W, Bhatia S, Hernandez J, et al. Transitioning childhood cancer survivors to adult-centered healthcare: insights from parents, adolescent, and young adult survivors. *Psychooncology*. 2010; 19:982–90. [PubMed: 20017115]
- [31]. Hayes RA, Vaughan C, Medieros T, Dubuque E. Stigma directed toward chronic illness is resistant to change through education and exposure. *Psychol Rep*. 2002; 90:1161–73. [PubMed: 12150401]
- [32]. Admi H, Shaham B. Living With Epilepsy: Ordinary People Coping With Extraordinary Situations. *Qual Health Res*. 2007; 17:1178–87. [PubMed: 17968035]
- [33]. Baars RM, Atherton CI, Koopman HM, Bullinger M, Power M. The european DIABKIDS project: development of seven condition-specific modules to measure health related quality of life in children and adolescents. *Health and quality of life outcomes*. 2005; 3:1–9. [PubMed: 15634354]
- [34]. Riekert, K.; Drotar, D. Adherence to medical treatment in pediatric chronic illness: critical issues and answered questions. In: Drotar, D., editor. *Promoting adherence to medical treatment in chronic childhood illness*. Lawrence Erlbaum; Mahwah, NJ: 2000. p. 3-32.
- [35]. Mulvaney SA, Mudasiru E, Schlundt DG, Baughman CL, Fleming M, VanderWoude A, et al. Self-management in type 2 diabetes: the adolescent perspective. *Diabetes Educ*. 2008; 34:674–82. [PubMed: 18669809]
- [36]. Di Battista AM, Hart TA, Greco L, Gloizer J. Type 1 Diabetes Among Adolescents: reduced diabetes self-care caused by social fear and fear of hypoglycemia. *The Diabetes Educator*. 2009; 35:465–75. [PubMed: 19321802]
- [37]. Simons LE, Blount RL. Identifying Barriers to Medication Adherence in Adolescent Transplant Recipients. *J Pediatr Psychol*. 2007; 32:831–44. [PubMed: 17522111]
- [38]. Logan D, Zelikovsky N, Labay L, Spergal J. The illness management survey: identifying adolescents perceptions of barriers to adherence. *J Pediatr Psychol*. 2003; 28:383–92. [PubMed: 12904450]
- [39]. Polonsky WH, Fisher L, Earles J, Dudl RJ, Lees J, Mullan J, et al. Assessing psychosocial distress in diabetes: development of the diabetes distress scale. *Diabetes Care*. 2005; 28:626–31. [PubMed: 15735199]
- [40]. Schlundt D, Rea M, Hodge M, Flannery M, Kline S, Meek J, et al. Assessing and Overcoming Situational Obstacles to Dietary Adherence in Adolescents with IDDM. *J Adolesc Health*. 1996; 19:282–8. [PubMed: 8897106]
- [41]. Larkin ME, Capasso VA, Chen C-L, Mahoney EK, Hazard B, Cagliero E, et al. Measuring Psychological Insulin Resistance: Barriers to Insulin Use. *Diabetes Educ*. 2008; 34:511–7. [PubMed: 18535324]
- [42]. Weissberg-Benchell J, Antisdel-Lomaglio J. Diabetes-specific emotional distress among adolescents: feasibility, reliability, and validity of the problem areas in diabetes-teen version. *Pediatr Diabetes*. 2011; 12:341–4.
- [43]. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009; 42:377–81. [PubMed: 18929686]
- [44]. Iannotti RJ, Nansel TR, Schneider S, Haynie DL, Simons-Morton B, Sobel DO, et al. Assessing Regimen Adherence of Adolescents With Type 1 Diabetes. *Diabetes Care*. 2006; 29:2263–7. [PubMed: 17003304]
- [45]. DeVellis, RF. *Scale development: theory and applications*. 2nd ed.. Sage Publications; Newbury Park, CA: 2003.

- [46]. Tabachnick, BG.; Fidell, LS. Using Multivariate Statistics. 5th ed. Allyn & Bacon; 2007.
- [47]. Grey M, Boland EA, Davidson M, Li J, Tamborlane WV. Coping skills training for youth with diabetes mellitus has long-lasting effects on metabolic control and quality of life. *J Pediatr.* 2000; 137:107–13. [PubMed: 10891831]
- [48]. Mulvaney SA, Rothman RL, Wallston KA, Lybarger C, Dietrich MS. An internet-based program to improve self-management in adolescents with type 1 diabetes. *Diabetes Care.* 2010; 33:602–4. [PubMed: 20032275]
- [49]. Fisher EB, Thorpe CT, DeVellis BME, DeVellis RF. Healthy coping, negative emotions, and diabetes management: a systematic review and appraisal. *Diabetes Educ.* 2007; 33:1080–103. [PubMed: 18057276]
- [50]. Lenhart, A.; Madden, M. Teens, privacy & online social networks how teens manage their online identities and personal information in the age of MySpace. 2007. p. 1-55.

Figure 1.
Profiles of barrier means by high and low A1C

Table 1

Characteristics of the sample.

Variable	Mean (SD) or %
Ethnicity	
Caucasian	91.7%
African American	6.0%
Pacific Islander	1.2%
Hispanic / Latino	1.2%
Household Income	
Less than \$20,000	6.4%
\$20,001–\$40,000	15.4%
\$40,001–\$70,000	30.8%
More than \$70,000	45.3%
Decline to answer	2.1%
Age	14.96 (1.62)
Gender (male)	52.2%
Using insulin pump (yes)	54.1%
Duration of diabetes (years)	6.60 (3.69)
HbA1c	8.87 (1.67)

Table 2

Component structure for the Barriers to Diabetes Adherence scale.

	Component Loading	Mean (SD)
Total Barriers to Diabetes Adherence Scale (Total Alpha=.88)		2.24 (0.72)
Stress and Burnout (Alpha = .85)		2.74 (1.22)
I feel burned out with diabetes.	.824	2.97(1.57)
I feel angry or frustrated about diabetes.	.893	3.04 (1.42)
I feel stressed, anxious, or overwhelmed about diabetes.	.806	2.73 (1.39)
I feel like I'm not motivated to do things for my diabetes.	.527	2.08 (1.45)
Time Pressure and Planning (Alpha= .75)		2.45 (0.91)
I am too busy outside of school.	.732	2.31 (1.37)
I don't like to take the time to stop what I am doing.	.617	2.80 (1.45)
I forget to carry supplies.	.725	2.17 (0.99)
I get hungry and don't take care of diabetes.	.647	2.06 (1.23)
I get distracted and forget.	.588	2.74 (1.28)
Social Support (Alpha = .77)		2.09 (1.13)
I feel like I don't have anyone to talk to about diabetes problems.	.704	1.84 (1.32)
I feel all alone in dealing with my diabetes.	.803	1.97 (1.47)
When it comes to my diabetes, I have people in my life who understand what I go through. (R) *	.609	2.40 (1.32)
Autonomy Support (Alpha =.70)		2.02 (0.89)
My parents usually want to hear my opinions about diabetes.(R)	.775	2.72 (1.35)
My parents don't try to include me in diabetes decisions.	.712	1.46 (0.85)
My parents try to support me. (R)	.710	1.82 (1.07)
Stigma (Alpha = .78)		1.88 (0.87)
Parties and social gatherings get in the way of taking care of diabetes.	.648	2.11 (1.11)
Restaurants are challenging for me.	.799	1.85 (1.09)
I need to find a private place to take care of diabetes.	.690	1.60 (1.04)
I try not to deal with diabetes in front of friends.	.532	2.09 (1.46)
I have a hard time telling people that I have diabetes.	.731	1.73 (1.28)
I feel embarrassed taking care of diabetes in front of other people.	.826	1.81 (1.33)

*
(R) indicates a reverse-scored item.

Table 3

Bivariate correlations between the components.

	Stress	Time	Social Support	Autonomy	Stigma
Stress	-	.30	.38	.28	.35
Time	-	-	.31	.06	.24
Social Support	-	-	-	.12	.29
Autonomy	-	-	-	-	.04
Stigma	-	-	-	-	-

Table 4

Bivariate relationships between BDA, adherence, and A1C.

	Adherence	A1C
Stress	-.21 *	.38***
Time	-.21 *	.18
Social Support	-.07	.17
Autonomy	-.13	.35**
Stigma	-.01	-.05
BDA Total	-.21 *	.32**

*
<.05**
<.01***
<.001

Table 5

Results of a general linear model predicting A1C.

	B	F	Partial η^2
Age	-.04	0.0	.001
Gender	.14	.18	.002
Income	-.02	.23	.003
Insulin pump	-.20	1.08	.012
Duration of diabetes	.06	.39	.004
Adherence	.94	3.34	.037
Barriers (BDA Total)	.62	6.17*	.067

*
<.05