Gender Differences in Adherence and Metabolic Control in Urban Youth with Poorly Controlled Type 1 Diabetes: The Mediating Role of Mental Health Symptoms

Sylvie Naar-King, PhD, April Idalski, MSW, Deborah Ellis, PhD, Maureen Frey, PhD, Thomas Templin, PhD, Phillippe B. Cunningham, PhD, and Nedim Cakan, MD
Wayne State University

Objective To examine gender differences in adherence and metabolic control and test the mediating role of mental health symptoms in a sample of predominantly African-American, low-income youth with chronically poor metabolic control. **Methods** Baseline questionnaire data from an intervention study were collected from 119 youth and their primary caregiver. **Results** Boys had worse adherence than girls, but there were no gender differences in hemoglobin A1C (HbA1C). Boys had more externalizing symptoms, whereas girls had more anxiety; there were no gender differences in depression. Externalizing symptoms were associated with poor adherence and metabolic control. Although anxiety was correlated with poor adherence, this relationship was not significant in the invariate analysis. Results of structural equation modeling (SEM) suggested that externalizing symptoms mediated the relationship between gender and adherence. **Conclusions** Results suggest that gender differences in adherence may be attributed, in part, to gender differences in externalizing symptoms in urban youth with poor metabolic control. Interventions targeting these symptoms may be necessary to improve adherence and HbA1C in both boys and girls.

Key words adherence; diabetes; gender; mental health; youth.

Type 1 diabetes mellitus (T1DM), an autoimmune disease characterized by high blood glucose levels resulting from a lack of insulin production, is the third most common severe, chronic childhood disease (American Diabetes Association, 2004). Treatment of type 1 diabetes requires a complex daily routine that includes insulin administration, blood glucose monitoring, following dietary guidelines, and participating in regular exercise. Adherence to this treatment regimen is difficult for many adolescents (Boland, Grey, & Mezger et al., 1999; Grossman, Brink, & Hauser, 1987). Poor adherence can result in poor metabolic control, which places the individual at risk for a host of medical complications (Diabetes Control & Complications Trial Research Group, 1993, 1994).

Although there have been attempts to investigate whether gender influences how well adolescents adhere to their diabetes regimen and their degree of glycemic control, prior studies have produced conflicting results. In addition, the mechanism by which gender might affect such outcomes remains unclear. Gender differences in mental health symptoms have been traditionally reported in the general population of adolescents, with the prevalence of internalizing symptoms (i.e., depression, anxiety) greater in adolescent girls (Birmaher et al., 1996) and the prevalence of externalizing symptoms (i.e., aggression, conduct problems) greater in boys (Dekovic, Buist, & Reitz, 2004; Leadbeater, Kuperminc, Blatt, & Hertzog, 1999). The research literature clearly links depression and poor metabolic control among

All correspondence concerning this article should be addressed to Sylvie Naar-King, PhD, Pediatric Prevention Research Center, University Health Center, 4201 St. Antoine, Detroit 48201, Michigan. E-mail: snaarkin@med.wayne.edu.

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adults with diabetes (Enzlin, Mathieu, & Demyttenaere, 2002; Lustman et al., 2000), although it is unclear whether depression affects adherence alone, metabolic control alone, or both. Similar biological mechanisms may influence depression and metabolic control. Alternatively, the lack of energy and interest, and feelings of helplessness and hopelessness associated with depression that undermine normal activities of daily living may similarly undermine adherence to the diabetes regimen.

In contrast to studies of adults, the link between mental health symptoms, adherence, and metabolic control for children and adolescents is less clear. Dantzer, Swendsen, Maurice-Tison, and Salamon et al. (2003) reviewed the last 10 years of anxiety and depression research with children and adolescents with diabetes finding eight studies that assessed relationships between internalizing symptoms and metabolic control. Only two studies clearly linked depression and metabolic control. Six studies found no association between depression and metabolic control, and none of the studies found an association between anxiety and metabolic control. Some studies have found that both internalizing and externalizing mental health symptoms have been associated with poorer metabolic control in adolescents (La Greca, Swales, Klemp, Madigan, & Skyler, 1995; Leonard, Jang, Savik, Plumbo, & Christensen, 2002; Lernmark, Persson, Fisher, & Rydelius, 1999). Mental health symptoms have been associated with admissions for diabetic ketoacidosis (DKA; Bryden, Dunger, Mayou, Peveler, & Neil, 2003; Dumont et al., 1995; Goldston, Kovacs, Obrosky, & Iyengar, 1995; Liss et al., 1998). Many of these studies, however, used relatively small samples and combined externalizing and internalizing symptoms. Although there is no hypothesized biological mechanism linking externalizing symptoms to metabolic control, aggression and conduct problems can interfere with the adolescent's ability to follow the rules associated with the diabetes regimen such as administering insulin at the right times and following a diet, which in turn can lead to poor metabolic control. There is limited research on relationships between mental health and adherence behaviors among adolescents with T1DM.

If males are more likely to have externalizing symptoms, they may also be more likely to have poor adherence and metabolic control. In fact, Grey, Lipman, Cameron, and Thurber (1997) found that boys had worse metabolic control and adherence based on a self-report questionnaire assessing multiple aspects of adherence. Perwien, Johnson, Dymtrow, and Silverstein (2000) found that males (7–14 years) demonstrated worse blood glucose skill performance based on behavior observation skill test. Bearman and La Greca (2002) found that boys (11–18 years) reported lower frequency of blood glucose testing. However, La Greca et al. (1995) found that females had poorer metabolic control, and this gender difference was attributed to gender differences in depression. Therefore, although more studies seem to suggest that male adolescents are at higher risk for poor health outcomes, the data is by no means clear.

Although the above studies were conducted with primarily Caucasian, middle-class samples, there is also evidence to suggest that among low socioeconomic status (SES) samples with poor metabolic control externalizing symptoms may be more highly linked to the development of poor health outcomes than internalizing symptoms. In a longitudinal study with an urban, economically disadvantaged sample with relatively poor metabolic control (mean HbA1C of 11.1), Cohen, Lumley, Naar-King, Partridge, and Cakan (2004) found associations between externalizing symptoms, but not internalizing, and metabolic control. Higher ratings of externalizing behavior were associated with worse metabolic control. Although there were no associations between behavior ratings and adherence, the authors note that methods used to assess adherence in this study were very limited and obtained via medical charts review.

There are very few studies of urban youth in poor metabolic control, a group at higher risk for T1DM complications compared to suburban youth with lower HbA1c (Delamater et al., 1999). It is not known whether there are gender differences in problems with adherence and metabolic control in such populations nor whether any such gender differences are related to differences in the expression of mental health symptoms. The primary aim of this study was to examine whether boys have worse adherence and metabolic control in a sample of predominantly African-American, low-income adolescents in chronically poor metabolic control. Second, we tested whether these gender differences were mediated (accounted for) by gender differences in mental health symptoms, primarily externalizing symptoms based on the prevalence of these symptoms among males.

Baron and Kenney (1986) have established empirical prerequisites for testing mediation. Applied to this study, these criteria would be (a) boys have poorer adherence and metabolic control compared to girls; (b) boys have higher levels of mental health symptoms; (c) high levels of mental health symptoms, when controlling for gender, are associated with poor adherence and metabolic control. Under those conditions, mediation

would be affirmed in the final step if the initial relationship between gender and adherence/metabolic control was eliminated or substantially reduced when variation in mental health symptoms was statistically held constant (controlled). Thus, in this disadvantaged sample of youth, we hypothesized that (a) males will have poorer adherence and metabolic control; (b) males will score higher on externalizing symptoms, whereas females will score higher on internalizing symptoms; (c) higher levels of externalizing symptoms will be more strongly associated with poorer adherence and metabolic control than internalizing symptoms; and (d) gender differences in adherence and metabolic control will be mediated by externalizing symptoms.

Method

Participants

Youth and their families were participants in a larger clinical trial investigating the effectiveness of home-based family therapy for improving health outcomes among youth with chronically poorly controlled T1DM. Baseline data were used in the analyses. To be eligible for the study, participants had to be diagnosed with T1DM for at least 1 year and to have a current HbA1C of 8% or higher as well as an average HbA1C of 8% during the year before study entry. Participants were required to be between 10 and 16 years of age. No child psychiatric diagnoses were exclusionary with the exception of moderate or severe mental retardation or psychosis. One hundred sixty-seven youth were identified as eligible and approached regarding participation. Of these 167, 134 (80%) consented to participate. Thirty-three (20%) refused to participate indicating either disinterest in research participation and/or home-based intervention services, a belief that the youth could improve their adherence and metabolic control independently or practical barriers, such as plans to move out of state. Fifteen (9%) families consented to participate but did not follow through with the baseline data collection. The sample represented in this article consists of 119 (71% of the 167 eligible families identified) youth and families who consented to participate and completed baseline data collection.

Of the 119 participants, 51% were male. Sixty-one percent were African-American, 26% were White, and the remaining 13% were Hispanic, Asian, or of mixed ethnicity. The mean age of the youth at study entry was 13.3 years ± 1.89 ranging from 9.9 to 16.8. The primary caregiver was identified as the biological parent by 85% of families. Other primary caregivers were adoptive parents (6%), guardians (5%), foster parents (1%), stepparents (1%), and other persons (2%). Fifty-three percent of the youth lived in a two-parent household, 41% lived in single parent households, and 6% lived in other family constellations or declined to respond. Fifty percent reported a family income of <$25,000. The average length of diabetes diagnosis was 4.9 years ± 3.09 with a range of 1–13 years. Ninety-four percent received insulin by injection, and 6% used an insulin infusion pump. All youth were advised by their medical providers to test their glucose levels three times a day minimally.

Procedures

Study eligible youth and their parents were identified by review of their medical chart and were recruited either by letter or telephone call to their home or during a visit to the endocrinology clinic within a tertiary care, children's hospital located in a major metropolitan area. The Human Investigation Committee of the university affiliated with the hospital approved the research protocol. Data collection was completed either in a research suite or in the family's home if the family was unwilling to come to the hospital.

Measures

Previous research has suggested that youth provide more accurate information about adherence and other behaviors because parents are less involved in their care (La Greca & Lemanek, 1996; Leonard et al., 2002), though youth may have an investment in hiding poor adherence behaviors. Parents are also a valuable source of information regarding externalizing behavior problems (Holmbeck, Li, Schurman, Friedman, & Coakley, 2002; La Greca & Lemanek, 1996). Previous research has also suggested that multiple informants should be used as reporters when assessing complex behaviors such as adherence, because each provides a unique perspective that is important and valuable (Holmbeck et al., 2002; La Greca & Lemanek, 1996). Thus, both parent and child report of behavioral symptoms and adherence were collected in this study.

Mental Health Symptoms

The Behavior Assessment System for Children (BASC; Kamphaus, Huberty, DiStefano, & Petoskey, 1997; Kamphaus, Petoskey et al., 1999) is a multimethod, multidimensional assessment system designed to evaluate the behavior of youth from age 4–18. In this study, both self-report and caregiver-report versions were used. Because the age range of study participants was 10–16, the child version was used if the participant

was 10 or 11, and the adolescent version was used if the participant was 12 or older. Because two versions of the BASC were used, age-normed *t* scores were utilized in the analyses to ensure comparability of scores. The authors have reported good reliability and validity for the measure (Kamphaus et al., 1997; Kamphaus, Petoskey et al.,1999).

The caregiver version of the BASC questionnaire yields 13 subscales that are summed to form three composite indices (behavioral symptoms index, externalizing problems, internalizing problems). However, the internalizing composite includes items that assess somatic complaints. Because multiple studies of behavioral adjustment in chronically ill children suggest that the inclusion of such items inappropriately inflates rates of internalizing symptoms in this population (La Greca et al., 1995; Liss et al., 1998; Lloyd, Dyer, & Barnett, 2000), the depression and anxiety subscales were used instead. The externalizing composite was used to assess externalizing behavior problems. The BASC self-report questionnaire yields 14 subscales that are summed to form four composite indices (clinical maladjustment, emotional symptoms, personal adjustment, and school maladjustment). As with the caregiver version, the depression and anxiety subscales were utilized to measure internalizing symptoms. School maladjustment was considered the closest index of self-report of externalizing symptoms as it includes sensation seeking behavior as well as attitudes toward school and teachers. A *t* score of 60–69 on the BASC identifies a youth "at-risk" for a mental health problem; a *t* score of 70 or higher indicates a clinically significant problem.

Adherence

The Diabetes Self-Management Scale (DMS), formerly the Diabetes Self-Care Practice Instrument (Frey & Denyes, 1989; Schilling, 2002), is a 25-item self-report questionnaire measuring self-care behaviors and caregiver support of adherence behaviors, including dietary compliance, insulin injections, blood glucose monitoring, and exercise. The responses are recoded as 0–100%, assessing "what percent of the time do you/your teen" complete each adherence behavior in the past month. Both the youth and primary caregiver completed this instrument. Good psychometric properties of earlier versions of the DMS have been reported (Frey & Denyes, 1989). In this sample, Cronbach's alpha was .86 for the youth self-report version and .83 for parent report version.

Metabolic Control

Hemoglobin A1C (HbA1C) was obtained from blood samples obtained at research data collection visits. HbA1C was assessed using the high pressure liquid chromatography (HPLC) method. HbA1C is a retrospective measure of average blood glucose levels over the preceding 2–3 months where a higher number represents poorer metabolic control. Typical HbA1C for a person without diabetes is between 4 and 6%; the target range for a person with diabetes is less than 7% (American Diabetes Association, 2003).

Data Analytic Plan

Potential demographic covariates were determined by examining associations between gender, ethnicity, income, and outcome variables. Any covariates that were significantly associated with adherence or metabolic control were included in subsequent analyses. Structural equation modeling (SEM) allows for the simultaneous examination of the relationships between latent constructs defined by multiple measures as well as directly observed variables (e.g., gender, HbA1C) while reducing the effect of measurement error on results. SEM is considered more appropriate than traditional multivariate analyses for testing mediation (Shrout & Bolger, 2002). Although SEM is traditionally utilized with large samples, bootstrap analyses allow model testing with small samples by utilizing the actual data to estimate standard error (Shrout & Bolger, 2002). SEM allows the both the assessment of goodness of fit of a specified model and testing of each estimated path coefficient.

Results

Demographic Covariates

There were significant associations between demographic variables. Although gender was not associated with age, disease duration, parental marital status, or family composition, girls were more likely to be African-American, $\chi^2(4, N = 119) = 8.80$, $p \leq .01$, and to come from lower income families, $\chi^2(4, N = 119) = 7.19$, $p \leq .01$. There were no associations between income and adherence or ethnicity and adherence. African American youth, $t(117) = 3.62$, $p < .01$ (two-tailed), and youth from lower income families had higher HbA1C, $t(115) = 3.17$, $p < .01$ (two-tailed) than youth of other ethnicities and those from higher SES families. Therefore, ethnicity and income were included as covariates in subsequent analyses.

Gender Differences in Adherence, Metabolic Control, and Mental Health Symptoms

Table I summarizes descriptive statistics for adherence, HbA1C, and mental health symptoms, as well as univariate

Table I. Descriptive Data and Gender Differences

	Mean females	Mean males	Mean (total sample)	*t*	*df*	% Above cut-off (*t* score = 60)
Anxiety self-report	48.45 ± 9.35	45.20 ± 7.93	46.81 ± 8.78	2.03*	115	10.3
Anxiety caregiver-report	50.76 ± 10.12	48.28 ± 10.09	49.49 ± 10.14	1.34	117	10.9
Depression self-report	48.22 ± 7.72	49.29 ± 8.76	48.76 ± 8.25	–0.70	115	14.5
Depression caregiver-report	52.38 ± 9.30	52.02 ± 11.91	52.19 ± 10.67	0.19	117	18.5
Externalizing symptoms self-report	45.48 ± 7.04	50.51 ± 8.80	48.02 ± 8.33	–3.41**	115	9.4
Externalizing symptoms caregiver-report	48.00 ± 8.4	54.98 ± 11.86	51.58 ± 10.87	–3.72*	108.35	17.6
Diabetes Management Scale self-report	66.17 ± 15.97	64.84 ± 12.18	65.49 ± 14.11	0.507	106.53	
Diabetes Management Scale caregiver-report	70.41 ± 12.71	65.79 ± 11.87	68.04 ± 12.45	2.05*	117	
A1C	11.39 ± 2.26	11.37 ± 2.38	11.38 ± 2.31	0.970	117	

*Denotes significance at the .05 level.
**Denotes significance at the .01 level.

analyses of gender differences in these variables. Although mean symptoms scores fell in the nonclinical range, a relatively high percentage of youth were in the "high-risk" range for caregiver-reported symptoms as indicated by a *t* score > 60 based on general norms for the BASC. Males had worse caregiver-reported adherence and worse self-reported and caregiver-reported externalizing symptoms. Females had higher scores on self-reported anxiety. There were no significant gender differences in depression or HbA1C. Thus criterion 1 for mediation, that boys had worse adherence and metabolic control, was met for adherence. Criterion 2 for mediation, that boys have higher levels of mental health symptoms, was met for externalizing symptoms, but the relationship between anxiety and gender was in the opposite direction.

Correlations Between Adherence, Metabolic Control, and Mental Health Symptoms

Table II summarizes the correlations between adherence, HbA1C, and mental health symptoms. Adherence measures were not associated with HbA1C. Lower levels of self-reported adherence were significantly correlated with higher self-reported anxiety, depression, and externalizing behaviors and with higher caregiver-reported depression and externalizing behaviors. Similarly, caregiver-reported adherence was significantly correlated to self- and caregiver-reported externalizing symptoms. HbA1C was significantly related to self-reported externalizing behavior in the expected direction. However, criterion 3 for mediation, that high levels of mental health symptoms were associated with poor adherence and metabolic control when controlling for gender, was tested with structural equation model below. Because depression was not associated with gender, adherence, or HbA1C, it was not included in subsequent analysis.

Structural Equation Modeling

The fourth and final step was to test mediation with structural equation model. Confirmatory analyses were first performed to ensure an adequate operationalization of the primary latent constructs. In the first attempted model, self-report and caregiver-report of externalizing symptoms (two measures) were used to define the latent construct

Table II. Intercorrelations Between Symptoms, Adherence, and A1C

		1	2	3	4	5	6	7	8	9
1	Anxiety self-report	–	.258**	.518**	.354**	.235**	.023	–.190*	.042	.122
2	Anxiety caregiver-report		–	.032	.512**	.040	.252**	.013	–.041	.050
3	Depression self-report			–	.261**	.468**	.185*	–.230**	–.131	.085
4	Depression caregiver-report				–	.192*	.524**	–.224**	–.133	.035
5	Externalizing symptoms self-report					–	.251**	–.271**	–.168*	.216**
6	Externalizing symptoms caregiver-report						–	–.226**	–.285**	.075
7	Diabetes Management Scale self-report							–	.466**	–.010
8	Diabetes Management Scale caregiver-report								–	.014
9	A1C									–

*Denotes significance at the .05 level.
**Denotes significance at the .01 level.

of externalizing symptoms and self- and caregiver-report of adherence were used to define the adherence construct. Self- and caregiver-report versions of anxiety (two measures) were used to define the latent construct of anxiety symptoms. This model fit poorly, $\chi^2(27, N = 119) = 93.56$, $p < .01$, comparative fit index (CFI) = .72, and root mean square error of approximation (RMSEA) = .15. Therefore, self-report and caregiver-report of mental health symptoms were standardized and summed to yield combined scores for anxiety and externalizing symptoms. This approach has been documented as a satisfactory alternative to reduce reporter bias and error variance (Bank & Patterson, 1992; Rushton, Brainerd, & Pressley, 1983). The resulting measurement model thus consisted of four constructs; externalizing symptoms (BASC-Ext combined score), anxiety symptoms (BASC-Anx combined score), and adherence (DMS-Teen and DMS-Parent) and HbA1C (A1C score). Latent constructs defined by single indicators are preferred to observed variables, because measurement error is taken into account (Hayduk, 1987). The resulting path coefficients are thus corrected for attenuation due to unreliability. This measurement model fit the data well, $\chi^2(3, N = 119) = 3.41$, $p = .33$, CFI = .99, and RMSEA = .03, and was used in the structural analysis for mediation.

A latent variable structural equation model was fit to the variance/covariance data. The model is depicted in Fig. 1 with standardized path values and indicator loadings. The model is symmetric in the structural variables with externalizing and anxiety symptoms as mediators of the relationship between gender and adherence outcomes. One factor loading on each construct was fixed to one, and the error variance of externalizing symptoms and anxiety symptoms and HbA1C were determined by the formula: Error = VAR(Y) * (1 – reliability) (Hayduk, 1987). The exogenous variables (gender, income, and race) were allowed to covary. The overall fit of this model was excellent, $\chi^2(12, N = 119) = 8.69$, $p = .73$, CFI = 1.00, and RMSEA = .00. The statistical significance of the path coefficients and indirect effects were determined with bootstrapped standard errors. Bootstrapped standard errors have been shown to be superior to maximum likelihood-derived standard errors when testing mediation and in particular when sample size is small (Shrout &

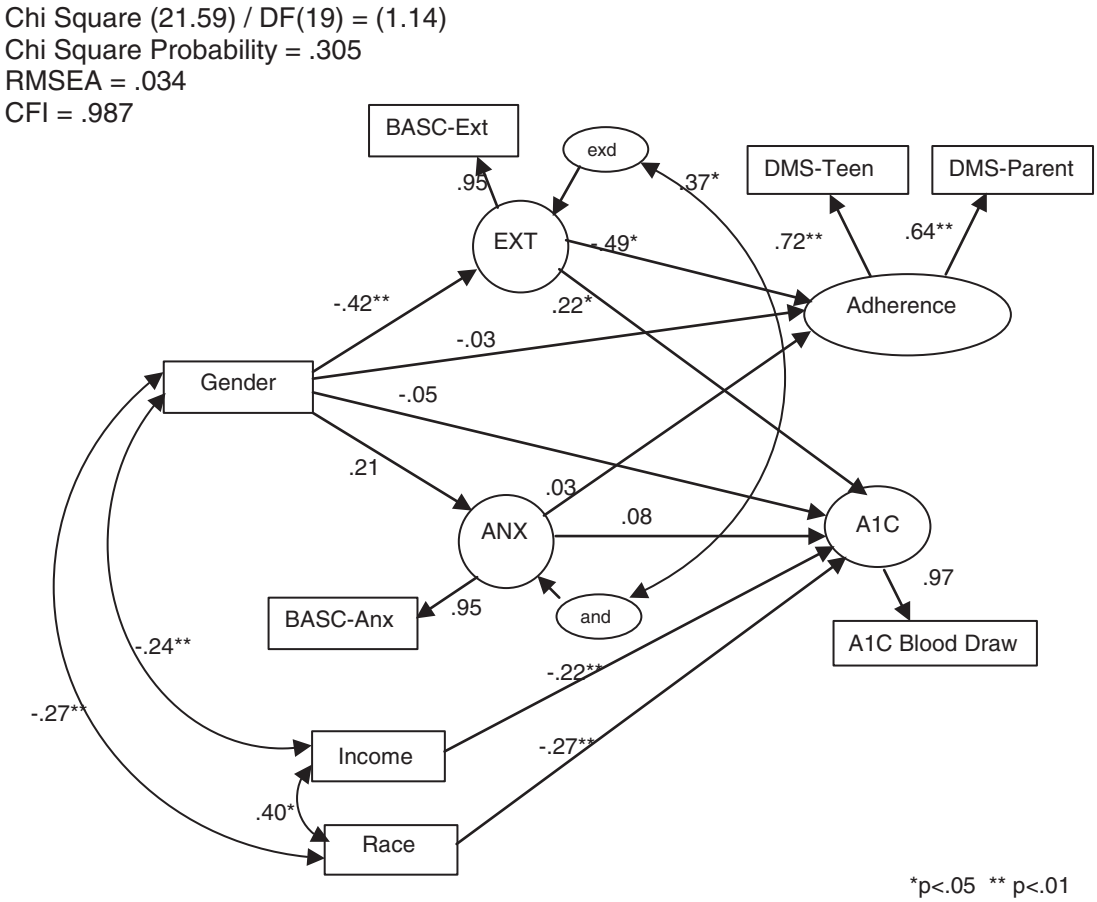

Figure 1. Final structural equation model.

Bolger, 2002). The results are shown in Fig. 1. Gender was not directly related to HbA1C and adherence in this model. The indirect effects of gender on adherence and HbA1C through externalizing symptoms were significant when assessed by bootstrapped standard errors, p = .02 and .03, respectively. The indirect effects of gender on adherence and HbA1c through anxiety were not significant. To ensure that the mediating relationship was not spurious due to other unrelated variables in the model (anxiety and HbA1C), a subsequent model only including the mediation model (gender, externalizing, and adherence) was run. Mediation was again confirmed, and path coefficients were essentially unchanged.

Discussion

The purpose of this study was to test for gender differences in adherence and metabolic control and to determine whether mental health symptoms mediated these differences in a low SES sample with poor metabolic control. The first criterion for mediation was that gender would be found to be associated with poor adherence and metabolic control in univariate analyses. This criterion was met. As hypothesized, boys scored lower on caregiver-reported adherence. However, there were no gender differences in HbA1C. This finding that boys are more at risk for adherence problems is consistent with other studies (Bearman & La Greca, 2002; Grey et al., 1997; Perwien et al., 2000), though these studies assessed only blood glucose testing versus other areas of adherence. Too few studies have assessed gender differences in HbA1C to make definitive conclusions about whether risk is related to gender. Furthermore, it is possible that in our high-risk sample of youth in very poor control, gender differences are minimized due to a restricted range of HbA1C.

To meet the second criterion for mediation, gender should be associated with mental health symptoms. Results suggested that boys had more externalizing symptoms, and girls had more anxiety, but there were no gender differences in depression. Consistent with prevalence rates of depression in adolescents with diabetes (Anderson, Freedland, Clouse, & Lustman, 2001; de Groot & Lustman, 2001; Grey, Whittemore, & Tamborlane, 2002), results indicated that the percent of youth at high risk for depression were higher than expected based on published general population norms (Reynolds & Kamphaus, 1998). Rates of externalizing symptoms were also higher than the normative population. Interestingly, rates of anxiety were not higher than the normative population. Anxiety as separate from the internalizing symptom cluster has received little attention in the adolescent diabetes literature.

The third prerequisite for testing for mediation required that that high levels of mental health symptoms be associated with poor adherence and metabolic control when controlling for gender. Both anxiety and externalizing symptoms were correlated with adherence, but only externalizing symptoms were associated with HbA1C. Furthermore, anxiety was no longer associated with adherence in the mediation model. In the final step, mediation was tested using SEM with bootstrap procedure for small samples. Results suggested that the final model was an excellent fit for the data. Externalizing symptoms mediated the relationship between gender and adherence. That is, gender was no longer associated with adherence when externalizing symptoms were included in the model. Although mediation did not hold for gender and HbA1C because of the lack of a univariate relationship between these two variables, there were likely indirect effects of gender on HbA1C through the avenue of externalizing symptoms. Anxiety symptoms were unrelated to adherence and HbA1C in the model. These findings are consistent with two other studies finding externalizing symptoms to be more relevant to adherence concerns than internalizing symptoms, particularly in an urban population (Cohen et al., 2004; Leonard et al., 2002). Results are also consistent with the predominance of studies finding no relationships between internalizing symptoms and HbA1C in a recent review (Dantzer et al., 2003).

Limitations

This study utilized a self-report questionnaire that was summed across multiple adherence behaviors. The lack of relationship between self-reported global adherence and HbA1C is consistent with other studies (Grey et al., 1997; Johnson, 1990; La Greca, 1990). A multimethod–multitrait approach to adherence measurement may show stronger relationships between adherence and HbA1C. Studies using more sophisticated adherence measurement may be better able to demonstrate that there are pathways from externalizing behavior to adherence to metabolic control. Furthermore, this study of youth in poor metabolic control had a restricted range of HbA1C, and possibly adherence, which may have limited associations between the two variables.

In addition, the School Maladjustment Composite, which was utilized to approximate externalizing behavior for the adolescent self-report version of the BASC, contains items which may be more related to school

achievement and/or peer relations than to oppositional or aggressive behavior in the home. Nevertheless, both caregiver and self-report of externalizing symptoms were associated with male gender and adherence, and utilizing mean scores of the two reporters yielded a good model fit. Although bootstrap analyses allow for modeling with small sample sizes, replications with larger samples of youth with T1DM in poor metabolic control are warranted. In addition, this sample was drawn from a single clinic site where 71% of approached families participated. Thus, generalizability to other populations of high-risk youth with diabetes requires further study, and findings may not generalize to families who refused to participate in intervention research. Finally, this study relied on cross-sectional data, and longitudinal studies are necessary to confirm mediation.

In summary, although boys may appear to be more at risk for adherence concerns, boys and girls with high levels of externalizing behavior are both at risk for poor adherence and metabolic control. Although further research is necessary to confirm these findings, results suggest that externalizing symptoms may be a major driver of adherence concerns and may be more relevant than depression and anxiety, particularly for disadvantaged, low-income youth. Interventions focusing on externalizing behavior such as behavior management, increasing parental monitoring, and improving impulse control, may be more effective than those targeting depression and anxiety for urban youth in very poor metabolic control.

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