Published in final edited form as:
Ann Behav Med. 2011 August ; 42(1): 29–41. doi:10.1007/s12160-011-9262-4.

Children with Diabetes Compared to Peers: Depressed? Distressed?:

A Meta-Analytic Review

Kerry A. Reynolds, Ph.D. and
The RAND Corporation, 4750 Fifth Avenue, Pittsburgh, PA 15213, USA, Kerry_Reynolds@rand.org

Vicki S. Helgeson, Ph.D.
Department of Psychology, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, USA, vh2e@andrew.cmu.edu

Abstract

Background—It is not clear from the literature whether children with diabetes have more psychological difficulties than their peers.

Purpose—This study aims to use meta-analysis to determine if children with diabetes differ from children without a chronic illness in a variety of domains reflecting psychological well-being.

Method—A meta-analysis was undertaken of 22 studies that compared children with diabetes to a comparison group. Outcomes included depression, anxiety, behavioral problems, and related constructs.

Results—Children with diabetes were more likely than comparison groups to experience a variety of psychological difficulties. However, these effects were small to medium in magnitude and were typically smaller among more recent studies and studies with well-matched comparison groups.

Conclusions—This meta-analysis suggests that children with diabetes are at slightly elevated risk for psychological difficulties. Future work will need to help identify children at the highest risk, and to identify factors associated with resilience.

Keywords

Diabetes; Meta-analysis; Child; Depression; Anxiety; Peers; Psychosocial functioning

Introduction

Type 1 diabetes is one of the most common childhood chronic illnesses. It is a lifelong illness that requires intensive daily treatment management. Children with diabetes must learn how to test their blood sugar regularly, administer insulin properly, monitor their dietary intake and physical activity, and adjust insulin dosages based on current blood sugar, diet, and exercise. Failure to properly engage in all of these activities could lead to acute episodes of low blood sugar (i.e., hypoglycemia) or high blood sugar (i.e., hyperglycemia)—

Correspondence to: Kerry A. Reynolds.

Data from this project was presented at the Annual Meeting of the Society of Behavioral Medicine in April 2010.

Conflict of Interest The authors have no relevant conflicts of interest to disclose.

each of which is associated with hazardous implications for health. Low blood sugar levels can have immediate health consequences with the potential to lead to coma or death if left untreated. High blood sugar levels can have immediate health consequences in the form of ketoacidosis. Furthermore, chronic hyperglycemia can lead to longer-term health consequences, such as circulatory problems, kidney disease, and blindness [1].

The burden of having to manage this disease, the knowledge that the illness is chronic, and the potential for the illness to disrupt normal childhood activities could certainly pose psychological difficulties for children with diabetes. Prior work suggests that children with chronic medical problems are at greater risk for psychosocial difficulties. For example, Lavigne and Faier-Routman [2] conducted a meta-analytic review of children with physical disorders in 1992. Their review concluded that children with physical disorders had more adjustment problems, higher rates of internalizing and externalizing problems, and lower levels of self-esteem than comparison groups. The review included seven studies that compared children with diabetes to comparison groups. The effect sizes across the studies were extremely heterogeneous but led to an overall moderate effect size in the direction of more adjustment problems for those with diabetes. The review also noted that group differences became smaller when studies with better comparison groups were used, and that group differences were larger when comparisons to population norms were used.

A subsequent meta-analysis of children with chronic medical problems conducted in 1994 focused solely on the outcome of depression. Bennett [3] concluded that children with medical disorders are at a slightly higher risk for depressive symptoms than healthy children (d=0.27) but that there is not a substantially higher risk for clinical depression. When the 12 studies of children with diabetes were examined, a modest effect size appeared (d=0.22) indicating that children with diabetes experienced more depressive symptoms than comparison groups. Across medical disorders, time since diagnosis, sex, and age did not moderate the findings. Effect sizes were larger when parent ratings were used compared to child ratings. Unlike the previous meta-analysis, effect sizes were larger when studies employed comparison groups rather than making comparisons to normative data.

Several narrative reviews have focused on the comparison of children with diabetes to comparison groups. These reviews generally indicate that diabetes is associated with *some* psychosocial difficulties during childhood and adolescence—most notably anxiety and depression ([4, 5]; both conducted in 2003). However, this conclusion is largely derived from a contradictory set of findings. Whereas some case–control studies show that diabetes is not associated with any psychosocial difficulties (e.g., [6-8]), other studies have found important differences when comparing children with diabetes to children without chronic illness [9, 10]. One literature review noted the inconsistency in the literature and concluded that it is premature to draw conclusions ([11]; 1997), whereas another suggested that these adjustment difficulties might be limited to the initial period after diagnosis ([12]; 2000) and another suggested the difficulties might be magnified among adolescents ([13]; 1997). The goal of the present paper is to integrate these, and other, findings using rigorous meta-analytic techniques to determine whether children with diabetes differ from children without a chronic illness in terms of psychological well-being.

One limitation of the prior meta-analyses and narrative reviews is that many of the studies were conducted some time ago. The most recent meta-analysis in this area was conducted 15 years ago. Thus, it is important to determine whether there are current differences in psychological functioning between children with diabetes and their peers.

There are several advantages of a meta-analytic review compared to the narrative reviews that have been completed in the past. First, comparisons between children with and without

diabetes are quantified in terms of an overall effect size, which can be evaluated for statistical significance. This effect size can be weighted so that studies with larger samples contribute more to the overall effect than studies with smaller samples. Second, meta-analysis can statistically examine variables that might moderate the relation of the independent variable to the outcome (e.g., average level of metabolic control for children with diabetes, or average age of the sample).

In the present paper, we conduct a meta-analysis of all studies conducted since 1990 that compared children with diabetes to comparison groups on a range of outcomes reflective of well-being. In the majority of cases, these comparison groups consisted of children who were healthy, which was typically defined as the absence of chronic illness. We did not include earlier studies because the treatment for diabetes has changed vastly over the past several decades. We began with a wide range of well-being outcomes, but ended by focusing only on those that were assessed by enough studies to meta-analyze: depression, anxiety, general psychological distress, psychopathology, behavioral problems (internalizing, externalizing), self-esteem, and peer difficulties. We distinguished between outcomes that were reported by children and outcomes that were reported by parents.

We also examined whether several variables moderated these associations. First, we examined whether effects were influenced by year of publication. As diabetes treatment has steadily improved, one might observe that differences in well-being between those with diabetes and their peers have diminished over time. By contrast, treatment also has become more intensive over time and initiation of intensive insulin therapy may be associated with increases in distress for certain groups [14]. Thus, there is the possibility that group differences in well-being could have increased over time. Second, we examined whether child age moderated the findings. Because self-care behavior declines during adolescence [15, 16], as does metabolic control [15, 17], it is possible that group differences in well-being emerge or change during this period of time. Third, we examined child sex as a moderator variable. Some studies have suggested that girls have a more difficult time adjusting to diabetes than boys (e.g., [18, 19]). However, it also is the case that girls in general report more psychological distress than boys beginning in early adolescence [20]. Here, we examined whether group differences were larger for studies with a larger percentage of girls as compared to studies that included fewer girls. Fourth, we examined whether time since diagnosis moderated the findings. One might expect group differences to be larger shortly after diagnosis when the child with diabetes is facing the initial shock of the disease and learning how to adjust. Fifth, we examined whether metabolic control moderated the findings. We hypothesized that differences between children with diabetes and comparison groups would be larger when children with diabetes exhibited poor metabolic control. Numerous studies have linked poor metabolic control to depression [21-23], but there have been exceptions in which good metabolic control is related to depression (e.g., [24]). Again, the meta-analysis will be able to address this question.

Finally, we also examined whether comparison group equivalence moderated the findings. Studies varied greatly in the extent to which the comparison group matched the diabetes group on key demographic variables (e.g., age, sex, race, socioeconomic status). When group differences were found on demographic variables, only some of the studies statistically controlled for these differences in their analyses. It is important to examine whether group differences become larger, smaller, or are unaffected by the comparability of the comparison group.

Method

Article Identification

We conducted a literature search focused on papers that compared the psychological well-being of children with diabetes to a group of peers who were typically unaffected by chronic illness. We restricted our search to published, peer-reviewed studies to ensure that our meta-analysis was based on the most rigorous research available. Articles were identified by conducting literature searches of PsycInfo and Medline databases through December 2009. In each database, we conducted multiple searches, using one keyword from each of the following categories until all combinations had been exhausted: (1) *diabetes*, (2) *control group, controls* or *healthy*, (3) *child* or *adolescent*, (4) *adjustment, psycholog* health, well-being, distress, depression, anxiety, quality of life*, or *mental health*. As we identified relevant articles, we also examined articles' reference sections to identify additional articles that met our criteria. Only articles that were published in English were examined.

We excluded articles that focused on adults with diabetes and those that solely compared individuals with diabetes to individuals with other chronic diseases. We also excluded articles published prior to 1990, as diabetes care has changed substantially in the past two decades. For clinical purposes, it is more important to determine whether there are current differences in well-being between children with diabetes and children without chronic illnesses.

To be included in the meta-analysis, articles had to include at least one measure of psychological well-being. We did not include studies that focused on social support, personality characteristics, cognitive functioning, disordered eating, or physical well-being. It was also necessary that each study compare children with type 1 diabetes to a comparison group. Studies that compared children with diabetes to published norms for a given instrument were included only if sufficient statistical information about the norm group was available in the journal article (one study with norms met inclusion criteria).

Procedure

We identified 44 studies for review, of which 22 met the inclusion criteria. The majority of studies were ineligible because they focused on adults rather than children or adolescents (n=14); six were excluded because participants were compared to a normative group for which inadequate information was given; one was excluded because there was no comparison group; and one was excluded because insufficient information was provided to compute an effect size. Eligible studies were coded independently by two research assistants, who recorded effect sizes and other relevant study information. One of the authors (VH) reviewed the coded articles and resolved any discrepancies. Each study was allowed to contribute only one effect size for each construct [25]. Thus, for studies that administered multiple measures of the same construct (e.g., two different types of psychopathology), effect sizes were averaged [25, 26]. Although it is also appropriate to randomly select one effect size, there were few cases in which this issue applied, and the authors did not want to introduce additional noise into the analysis based on the selection of one effect size. Similarly, for longitudinal studies in which the relation between a construct and an outcome were reported for multiple occasions, effect sizes for each wave of measurement were averaged. There was not a sufficient number of longitudinal studies to examine whether effect sizes changed over time.

We next examined each category of well-being to determine whether we had a sufficient number of studies to proceed with the meta-analysis. We separated outcomes reported by children from those reported by parents. Although only two studies are technically required for meta-analysis, three is the minimum number of studies for which moderation analyses

can be conducted [26]. Thus, only those constructs that included at least three studies from one type of respondent (i.e., parent or child) were included in the analysis. Several constructs were measured in fewer than three papers, and were thus excluded from further analysis: anger/hostility, general quality of life, and positive affect. In the end, we were able to examine effect sizes for parent reports of child psychological distress, general behavioral problems, internalizing problems, and externalizing problems. For child reports, we were able to acquire a sufficient number of studies to examine depressive symptoms, clinical depression, anxiety, psychological distress, self-esteem, peer difficulties, and psychopathology.

In addition to the effect sizes for psychological wellbeing, we also coded additional information about each article, including demographic information for the diabetes and comparison groups, information about whether the diabetes and comparison groups were comparable on key demographic variables, metabolic control of the diabetes group, and year of publication.

Coded Outcomes and Moderating Variables

Depressive Symptoms—Typical measures of depressive symptoms included a variety of self-report instruments (e.g., Children's Depression Inventory [27]) and interview assessments (e.g., Schedule for Affective Disorders and Schizophrenia for School-Age Children [28]).

Clinical Depression—Measures of clinical depression distinguished between participants who experienced severe symptoms of depression from those that did not. Most measures employed cutoff scores from self-report instruments (e.g., Children's Depression Inventory [27]; Center for Epidemiological Studies—Depression Scale [29]).

Anxiety—Measures of anxiety used both self-report (e.g., Revised Children's Manifest Anxiety Scale [30, 31]) and interview assessments (e.g., Schedule for Affective Disorders and Schizophrenia for School-Age Children [28]).

Psychological Distress—Measures of psychological distress were global instruments that typically assessed multiple domains of psychological distress without differentiating among them (e.g., psychosocial functioning from Pediatric Quality of Life Inventory [32]; emotional functioning from the Manchester–Minneapolis Quality of Life Instrument [33]). Studies that differentiated anxiety and depression outcomes are included in those categories and are not represented in the psychological distress construct.

Behavioral Problems (Parent-Rated Only)—Behavioral problems were typically measured by instruments such as the Child Behavior Checklist [34] or the Behavior Assessment System for Children [35]. Primary domains of behavioral problems are internalizing problems and externalizing problems. When possible, we recorded and analyzed these effects separately. However, three of the studies that examined behavioral problems did not distinguish between internalizing and externalizing problems. Thus, we also examined general behavioral problems. In this category, we examined all six studies by including effect sizes for the three studies that did not distinguish between internalizing and externalizing problems, and by averaging the effect sizes across the two domains of behavior problems in the three studies that made the distinction.

Self-Esteem—Measures of self-esteem assessed children's feelings of self-worth with self-report measures (e.g., general self-worth from the Self-Perception Profile for Children [36]; Rosenberg Self-Esteem Scale [37]).

Peer Difficulties—Peer difficulties included poor social functioning as well as difficulties with peers such as victimization (e.g., social functioning scale of the Pediatric Quality of Life Inventory 4.0 [32]; Social Experience Questionnaire [38]).

Psychopathology—This construct included psychiatric symptoms and diagnoses other than anxiety and depression (e.g., obsessive-compulsive issues). Psychopathology was typically assessed with a diagnostic interview (e.g., Child Assessment Schedule Interview [39]).

Moderating Variables—We assessed several characteristics that could moderate effect sizes, including average age, sex distribution, and average time since diagnosis and average level of metabolic control among the diabetes groups and year of publication.

We also created a measure of comparison group equivalence by examining the match between the diabetes and comparison groups on demographic variables and by assessing the nature of the comparison group. Other investigators who have assessed the quality of comparative studies have heavily emphasized the aspects of comparison group equivalence that we examined [2, 40, 41]. Each study received up to five points, with one point being awarded for matching on each of four variables—age, race, sex, socioeconomic status—and one point being awarded for studies that recruited their own comparison group rather than using a convenience sample from other studies or population norms. Studies were given credit for matching if they tested and found no difference between the diabetes and comparison groups or if they found a group difference but statistically controlled for it in their analyses. Zero points were awarded when the study did not test for differences on demographic variables, or if a difference was demonstrated but the variable was not included as a covariate in subsequent analyses.

Effect Size Extraction

Cohen's *d* was used as the effect size statistic for this meta-analysis. This statistic represents the magnitude of the difference between groups. As a rule of thumb, effect sizes are categorized as small (*d*=0.20), medium (*d*=0.50) or large (*d*=0.80) [42]. Cohen's *d* values were extracted for each study based on available information presented in the printed article, and in some cases, by contacting the authors for further information on the study. Some effect sizes were calculated from descriptive information (e.g., means and standard deviations), whereas other effect sizes were calculated from secondary statistical tests (e.g., *t* tests). When possible, we used an Excel macro created by Lipsey and Wilson [25] to compute effect sizes. Effect sizes were coded as zero for studies that conducted a test and reported no significant differences. This is a conservative strategy as non-significant effects were unlikely to be zero.

Meta-Analytic Procedure

SPSS macros designed by Lipsey and Wilson [25] for meta-analytic procedures were used in the current study. Effect sizes and the weights are entered into the SPSS file and the macro performs a weighted aggregation of the effect sizes. In the current study, we used the inverse variance to weight the effect sizes. Weighting with inverse variance provides larger weights for studies with larger sample sizes, which are characterized by more precise estimates of effect size, and smaller weights for studies with smaller sample sizes, which are characterized by less precise estimates of effect size [25, 43]. This procedure calculates an overall effect size (accounting for study weights) and indicates whether it is significantly different from zero. In addition, we examined the *Q* statistic for each effect size to determine the heterogeneity of the effect. Significant *Q* values indicate that there is sufficient variability across effect sizes to test for moderating variables. When appropriate, we tested

the role of several moderating variables. Moderator analyses were conducted using modified weighted multiple regression for meta-analysis, using an SPSS macro developed by Lipsey and Wilson [25]. This macro is used to compute regression coefficients and properly adjusts standard errors to yield appropriate assessments of statistical significance.

Results

Twenty-two articles met the criteria for inclusion in the meta-analysis. Descriptive information on these studies is displayed in Table 1. The majority of comparison groups were recruited from physician offices or schools. In the majority of cases, comparison groups consisted of children without chronic illness. In a couple of cases, the comparison group consisted of or included children with an acute illness. In a few cases (typically schools), there was no information provided about the health status of the comparison group. The precise definition of each comparison group is shown in Table 1. The majority of studies also examined large age ranges of children and adolescents. Although the moderating effect of age can be examined within an individual study that has a wide age range of participants, large age ranges make it more difficult to examine age as a moderator in a meta-analysis. With meta-analysis, each study is represented by the average age of the sample. Thus, it may be difficult for meta-analysis to determine the moderating effect of age in these studies.

There was wide variety in the comparison group equivalence index. The mean comparison group equivalence score was 2.36 (out of 5). Forty-one percent of studies scored 0 or 1, 27% scored 2 or 3, and 32% scored 4 or 5.

Results of the meta-analysis are shown in Table 2. Significant effect sizes were small to medium in magnitude [42] and revealed that across studies, parents indicated that children with diabetes experienced more psychological distress and more overall behavioral problems than comparison groups. Among the studies that distinguished between internalizing and externalizing problems, parents reported that children and adolescents with diabetes experienced more internalizing problems but not more externalizing problems than the comparison group. The homogeneity test (i.e., *Q* statistic) revealed that none of the parent-reported constructs demonstrated sufficient heterogeneity to allow examination of moderator variables.

Across studies that examined child reports of psychological well-being, significant effect sizes were again in the small to medium range [42]. Children with diabetes reported more depressive symptoms, more clinical depression,1 more anxiety, and more psychological distress than the comparison group. There were no group differences in self-esteem, peer difficulties, or psychopathology. Each of the significant effect sizes was heterogeneous, as indicated by the *Q* statistic. Thus, the role of moderating variables was examined.

Moderator Analyses

The results of moderator analyses are shown in Table 3.We examined moderation only when the *Q* statistic revealed sufficient variability in effect sizes. We examined moderators one at a time and only in cases when there were sufficient numbers of studies that assessed that moderator variable. While it would be preferable to examine multiple moderators simultaneously, each study did not provide reports of each moderating variable. Thus,

[1]We were initially puzzled that the effect size for clinical depression was larger than the effect size for depressive symptoms. Because all five studies that assessed clinical depression also included assessments of depressive symptoms, we conducted an additional analysis of depressive symptoms, restricting inclusion to those that had also assessed clinical depression. The results of this analysis revealed a larger effect size for depressive symptoms across these five studies (ES=0.60, $p<0.01$).

sample sizes were sufficiently diminished to rule out testing multiple moderators at the same time.

Correlations among the moderator variables revealed only a few significant relations. Average age of the diabetes groups was associated with the average time since diagnosis (r=0.75, p<0.01), and year of publication was associated with HbA1C (r=−0.68, p<0.05) such that more recent articles reported better metabolic control among children with diabetes.

Year of Publication—Year of publication moderated several of the effect sizes, almost always in the direction of more recent studies reporting smaller effect sizes. Child-reported differences in depressive symptoms and clinical depression were smaller in more recent studies. Although the overall effect size was not significant for self-esteem or peer difficulties in initial analyses (see Table 2), the effect sizes did show changes over time: earlier studies of self-esteem indicated that children with diabetes experienced worse self-esteem than comparison groups, but later studies found smaller differences or evidence that children with diabetes experienced better self-esteem than comparison groups. Similarly, the earliest study of peer difficulties indicated that children with diabetes experienced more problems, whereas the two more recent studies indicated that children with diabetes experienced fewer problems than comparison groups.

Age of Child—The average age of the diabetes group did not moderate any of the findings. As discussed previously, it may be difficult to detect moderation effects of age when individual studies have wide age ranges, as the *mean* age for each study is used in the moderation analysis.

Sex—Sex moderated a few of the effects. For adolescent reports of depressive symptoms and psychological distress, group differences became larger when a greater percentage of the diabetes sample was female.

Time since Diagnosis—Time since diagnosis moderated a single child-reported outcome. Group differences in depressive symptoms became smaller as time since diagnosis increased.

Average Hemoglobin A_{1C}—Only half of the studies included in the meta-analysis reported the average metabolic control of participants with diabetes. Thus, moderation analyses could be conducted for only four effects (child-rated depressive symptoms, anxiety, psychological distress, and self-esteem). Of the four effects, two were affected by the average metabolic control of children with diabetes. Group differences in child-rated anxiety and psychological distress became larger when children with diabetes had worse metabolic control (i.e., higher average HbA_{1C}).

Comparison Group Equivalence—The index of comparison group equivalence moderated several of the effect sizes. In the case of child-rated depressive symptoms and anxiety, group differences were smaller in studies with more equivalent comparison groups. Although the overall effect size for peer difficulties was not significant in the initial analyses (see Table 2), the effect size did vary by comparison group equivalence. The study with the most comparable comparison group ([56]; received a 2 on a 5-point scale, which is still low) found that children with diabetes experienced more peer difficulties than the comparison group, whereas the other two studies found that children with diabetes experienced fewer peer difficulties than the comparison group. The overall effect for psychopathology also was not significant in the initial analyses (see Table 2), but moderator analysis found that the size of the effect varied according to comparison group equivalence. The study with the most

equivalent comparison group ([6]; rating of 4) had a negative effect size (d= −0.35) suggesting that the comparison group had more psychopathology than those with diabetes, and the study with the least equivalent comparison group [54] suggested that those with diabetes had more psychopathology than the comparison group (d=0.43), with the two studies with mid-level comparison group equivalence (rated 3) reporting effect sizes near 0 ([45], d=0.06; [46]: d=0.12).

Publication Bias

Because this meta-analysis focused exclusively on peer-reviewed publications, it is important to consider the effect of publication bias. To assess potential bias, we created a funnel plot for each psychological well-being construct, plotting sample size against effect size. Plots should form the shape of a funnel, with smaller studies demonstrating greater variability in effect size [25, 26]. Upon examination, many of the funnel plots showed the expected distribution, some constructs had too few studies to assess the shape of the underlying distribution, and some constructs (e.g., anxiety) showed an asymmetric distribution suggesting that the publication of smaller studies may have been skewed toward reporting larger differences between diabetes and comparison groups (in the direction of children with diabetes experiencing worse outcomes). Thus, it is possible that publication bias may cause effect sizes based on smaller numbers of studies to appear larger than the "true" underlying effect size (i.e., some of the small to medium size differences between children with diabetes and comparison groups may actually be smaller than the current analyses suggest). This issue is partly addressed in the current meta-analysis by weighting larger studies more heavily using inverse variance weighting. This partially attenuates the impact of a skewed distribution among smaller studies by giving them less weight in the analysis. Funnel plots for each of the variables in this meta-analysis are available upon request from the first author.

Discussion

Prior work has often suggested that children and adolescents with diabetes may be at risk for poor psychological well-being when compared to healthy peers. The current meta-analysis supports the idea that children with diabetes experience somewhat elevated levels of depression, anxiety, and psychological distress. Nonetheless, these differences are small to medium in magnitude, and are moderated by several factors.

Especially important was the effect of publication date on the magnitude of effect sizes. Diabetes treatment regimens have changed substantially over the past 15 years, including both technological advancements (e.g., more efficient blood glucose monitors, new types of insulin) and new clinical standards (e.g., more intensive insulin regimens). However, it has previously been unclear whether these changes have improved psychological well-being or contributed to psychological distress. The current study demonstrates that differences between children with diabetes and comparison groups on clinical depression and depressive symptoms were smaller in more recent studies. Though it was not possible for the current analysis to assess the relation between specific aspects of the diabetes care regimen and outcomes, the analysis suggests that children with diabetes currently experience levels of distress that are more similar to their peers than had previously been the case. This finding complements work that examined the psychological well-being of adolescents in the intensive treatment management and control conditions of the Diabetes Control and Complications Trial, which found that adolescents assigned to intensive treatment management did not differ from those assigned to the less intensive conventional treatment in diabetes-related quality of life over a 3-year follow-up period. That study did, however, find a marginally significant interaction between age, treatment, and time, that indicated older adolescents (age 16–18) assigned to intensive treatment experienced small increases in

psychological distress over time compared to an age-matched comparison group, whereas younger adolescents (age 13–15) experienced similar levels of distress over time regardless of treatment condition [14]. As children increasingly begin to use intensive insulin regimens at younger ages, differences in psychological well-being may continue to diminish.

Comparability of the comparison and diabetes groups also played a role in determining the magnitude of differences between the groups. Although there were a few exceptions, in general, studies with more comparable comparison groups found smaller group differences, or demonstrated that children with diabetes experienced better outcomes than peers. Thus, it will be essential for future studies to recruit and retain well-matched comparison groups to better understand the similarities and differences between children with diabetes and their peers.

While the current study suggests that children with diabetes may be at risk for slightly elevated levels of psychosocial difficulties compared to peers, we are not able to identify which children with diabetes may be at the highest risk. Poor metabolic control among diabetes groups was linked to larger differences in anxiety and psychological distress, suggesting that this may be an important starting point in identifying children at risk for psychosocial difficulties. The current analysis did not find that poor metabolic control was linked to differences between groups on depression. Nonetheless, studies conducted solely with children with diabetes have demonstrated a link between metabolic control and depression (e.g., [23]).

It is likely that a small percentage of children with diabetes experience severe problems, while most adjust to the illness and maintain psychological well-being at levels similar to their peers. Identification of children who may be at highest risk for adjustment problems may be best investigated in studies that examine differences within samples of children with diabetes rather than studies that employ case–control designs. Our identification of a group of teens with deteriorating metabolic control over the course of adolescence through trajectory analysis [60] is one such effort. Further exploration in this area may assist clinicians in connecting families to appropriate psychological services so that intervention can begin before minor issues escalate into severe problems. Future work should also focus on identifying factors that promote resilience among some children with diabetes.

The current study is affected by several limitations. First, as a meta-analysis, the data are constrained by the information published in prior reports. We elected to exclude unpublished reports to ensure a minimum level of study quality. Nonetheless, studies that fail to find significant differences are less likely to be published, and as such, it is possible that the current analysis may overestimate differences between children with diabetes and their peers. Furthermore, some published studies did not include sufficient detail to enable inclusion in our analysis. We attempted to contact authors to retrieve relevant information, but it was not always possible to obtain this information. Second, the results of any meta-analysis are limited by the quality and sensitivity of the instruments used to conduct the underlying original research studies. Some constructs have well-developed instruments with proven reliability and validity; other constructs may be more difficult to accurately assess or do not yet have well-developed measurement tools. Third, there were a limited number of studies that assessed and reported findings for certain psychological outcomes (e.g., only three studies compared groups on peer difficulties). These limitations in the underlying literature may render effect sizes for these outcomes less reliable. There were also insufficient studies to examine multiple moderators simultaneously. As the literature in this area progresses, it may be possible to better determine these effects. Fourth, demographic variables, including both the moderating variables that we examined and others (e.g., family structure, ethnicity) were often under-reported. Inclusion of this information in published

reports will help to provide a better context for understanding the determinants of psychological well-being. Finally, for many of the studies examined in this meta-analysis, comparison groups were poorly matched to diabetes groups. Although the majority of studies screened comparison groups for health status, a minority of studies employed a comparison group of children without providing any information on their health status. Overall, there was some variability in the comparison groups utilized that likely contributed to the heterogeneity of the effect sizes we obtained. Using an index that included one point each for matching on age, race, sex, and socioeconomic status and one additional point for targeted recruitment of a comparison group rather than a convenience sample, more than a third of studies scored a 0 or 1. Thus, it will be especially important for future work to focus on recruiting well-matched comparison groups of healthy children in order to obtain a more accurate assessment of similarities and differences between children with diabetes and their peers.

Despite these limitations, the current study offers evidence that there are some differences between children with diabetes and their peers on psychological well-being, while suggesting that these differences may be diminishing over time and may be less likely to appear in methodologically stronger studies. Future work should employ longitudinal designs, obtain specific information about diabetes treatment regimens, and utilize well-matched comparison groups in order to more fully understand the challenges faced by children with diabetes, as well as their resilience to the psychological effects of this lifelong chronic illness.

Acknowledgments

This study was supported by two grants from the National Institute of Diabetes and Digestive and Kidney Diseases (F32 DK071471-01; R01 DK060586-06). The authors would like to extend their thanks to Jamie Vance and Lindsey Lopez for their assistance in preparing materials relevant to the project.

References

*Note that references indicated by an asterisk are those that were included in the meta-analysis

1. Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications of insulin-dependent diabetes mellitus. The New England Journal of Medicine. 1993; 329(14):977–86. [PubMed: 8366922]

2. Lavigne JV, Faier-Routman J. Psychological adjustment to pediatric physical disorders: A meta-analytic review. Journal of Pediatric Psychology. 1992; 17:133–57. [PubMed: 1534367]

3. Bennett DS. Depression among children with chronic medical problems: A meta-analysis. Journal of Pediatric Psychology. 1994; 19(2):149–69. [PubMed: 8051600]

4. Dantzer C, Swendsen J, Maurice-Tison S, Salamon R. Anxiety and depression in juvenile diabetes: A critical review. Clinical Psychology Review. 2003; 23:787–800. [PubMed: 14529698]

5. Wysocki, T.; Greco, P.; Buckloh, LM. Childhood diabetes in psychological context. In: Roberts, MC., editor. Handbook of pediatric psychology. Third. New York, NY: The Guilford Press; 2003. p. 304-20.

6*. Frank RG, Hagglund KJ, Schopp LH, et al. Disease and family contributors to adaptation in juvenile rheumatoid arthritus and juvenile diabetes. Arthritus Care and Research. 1998; 11:166–76.

7*. Hamlett KW, Pellegrini DS, Katz KS. Childhood chronic illness as a family stressor. Journal of Pediatric Psychology. 1992; 17:33–47. [PubMed: 1545320]

8*. Helgeson VS, Snyder PR, Escobar O, Siminerio L, Becker D. Comparison of adolescents with and without diabetes on indices of psychosocial functioning for 3 years. Journal of Pediatric Psychology. 2007; 32:794–806. [PubMed: 17426042]

9*. Overstreet S, Goins J, Chen RS, et al. Family environment and the interrelation of family structure, child behavior, and metabolic control for children with diabetes. Journal of Pediatric Psychology. 1995; 20:435–47. [PubMed: 7666287]

10*. Grey M, Lipman TH, Cameron ME, Thurber FW. Psychosocial status of children with diabetes in the first 2 years after diagnosis. Diabetes Care. 1995; 18:1330–6. [PubMed: 8721933]

11. Hauser, ST.; Jacobson, AM.; Benes, KB.; Anderson, BJ. Psychosocial aspects of diabetes mellitus in children and adolescents: Implications and interventions. In: Alessi, N., editor. Handbook of child and adolescent psychiatry, volume IV: Varieties of development. New York, NY: Wiley; 1997. p. 340-54.

12. Delamater AM. Quality of life in youths with diabetes. Diabetes Spectrum. 2000; 13:42–7.

13. Kliewer, W. Children's coping with chronic illness. In: Wolchik, SA.; Sandler, IN., editors. Handbook of children's coping: Linking theory and intervention. New York, NY: Plenum Press; 1997. p. 275-300.

14. Madsen SD, Roisman GI, Collins WA. The intersection of adolescent development and intensive intervention: Age-related psychosocial correlates of treatment regimens in the Diabetes Control and Complication Trial. Journal of Pediatric Psychology. 2002; 27:451–9. [PubMed: 12058009]

15. Greening L, Stoppelbein L, Konishi C, Jordan SS, Moll G. Child routines and youths' adherence to treatment for type 1 diabetes. Journal of Pediatric Psychology. 2007; 32:437–47. [PubMed: 17030526]

16. Holmes CS, Chen R, Streisand R, et al. Predictors of youth diabetes care behaviors and metabolic control: A structural equation modeling approach. Journal of Pediatric Psychology. 2006; 31:770–784. [PubMed: 16221954]

17. Leonard BJ, Jang Y-P, Savik K, Plumbo MA. Adolescents with type 1 diabetes: Family functioning and metabolic control. Journal of Family Nursing. 2005; 11(2):102–21. [PubMed: 16287821]

18. Kovacs M, Iyengar S, Goldston D, Stewart J, Obrosky DS, Marsh J. Psychological functioning of children with insulin-dependent diabetes mellitus: A longitudinal study. Journal of Pediatric Psychology. 1990; 15(5):619–32. [PubMed: 2283571]

19. La Greca AM, Swales T, Klemp S, Madigan S, Skyler J. Adolescents with diabetes: Gender differences in psychosocial functioning and glycemic control. Children's Health Care. 1995; 24:61–87.

20. Wichstrom L. The emergence of gender difference in depressed mood during adolescence: The role of intensified gender socialization. Developmental Psychology. 1999; 35(1):232–45. [PubMed: 9923478]

21. Grey M, Whittemore R, Tamborlane W. Depression in type 1 diabetes in children: Natural history and correlates. Journal of Psychosomatic Research. 2002; 53:907–11. [PubMed: 12377302]

22. Helgeson VS, Siminerio L, Escobar O, Becker D. Predictors of metabolic control among adolescents with diabetes: A four-year longitudinal study. Journal of Pediatric Psychology. 2009; 34:254–70. [PubMed: 18667479]

23. Hood KK, Huestis S, Maher A, Butler D, Volkening L, Laffel LM. Depressive symptoms in children and adolescents with type 1 diabetes: Association with diabetes-specific characteristics. Diabetes Care. 2006; 29(6):1389–91. [PubMed: 16732028]

24. Weissberg-Benchell J, Glasgow A. The role of temperament in children with insulin-dependent diabetes mellitus. Journal of Pediatric Psychology. 1997; 22(6):795–809. [PubMed: 9494318]

25. Lipsey, MW.; Wilson, DB. Applied Social research methods series. Thousand Oaks, CA: Sage; 2001. Practical meta-analysis.

26. Borenstein, M.; Hedges, LV.; Higgins, JPT.; Rothstein, HR. Introduction to meta-analysis. West Sussex, United Kingdom: Wiley and Sons, Ltd; 2009.

27. Kovacs M. The Children's Depression Inventory (CDI). Psychopharmacology Bulletin. 1985; 21:995–8. [PubMed: 4089116]

28. Chambers W, Puig-Antich J, Hirsch M, et al. The assessment of affective disorders in children and adolescents by semistructured interview: Test–retest reliability of the schedule for affective disorders and schizophrenia for school age children, present episode version. Archives of General Psychiatry. 1985; 42:696–702. [PubMed: 4015311]

29. Radloff LS. A CES-D scale: A self-report depression scale for research in the general population. Applied Psychological Measurement. 1977; 1:385–401.

30. Castaneda A, McCandless BR, Palermo DS. The children's forms of the manifest anxiety scale. Child Development. 1956; 27:317–26.

31. Reynolds CR, Richmond BO. What I think and feel: A revised measure of children's manifest anxiety. Journal of Abnormal Child Psychology. 1978; 6:271–80. [PubMed: 670592]

32. Varni JW, Seid M, Kurtin PS. PedsQL 4.0: Reliability and validity of the pediatric quality of life inventory version 4.0 generic core scales in healthy and patient populations. Medical Care. 2001; 39:800–12. [PubMed: 11468499]

33*. Hutchings HA, Upton P, Cheung W-Y, et al. Adaptation of the Manchester–Minneapolis Quality of Life Instrument for use in the UK population. Archives of Disease in Childhood. 2007; 92:855–60. [PubMed: 17522166]

34. Achenbach, T. Manual for the child behavior checklist/4–18. Burlington, VT: University of Vermont Department of Psychiatry; 1991.

35. Reynolds, CR.; Kamphaus, RW. Behavior assessment system for children. Circle Pines, MN: American Guidance Service; 1992.

36. Harter, S. Manual for the self-perception profile for children. Denver, CO: University of Denver; 1985.

37. Rosenberg, M. Society and the adolescent self-image. Princeton, NJ: Princeton University Press; 1965.

38. Crick NR, Grotpeter JK. Children's treatment by peers: Victims of relational and overt aggression. Development and Psychopathology. 1996; 8:367–80.

39. Hodges K, Kline J, Fitch P, McKnew D, Cytryn L. The child assessment schedule: A diagnostic interview for research and clinical use. Catalog of Selected Documents in Psychology. 1981; 11:56.

40. de Boer AGEM, Taskila T, Ojajarvi A, van Dijk FJH, Verbeek JHAM. Cancer survivors and unemployment: A meta-analysis and meta-regression. The Journal of the American Medical Association. 2009; 301:753–62.

41. Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. Methodological index for non-randomized studies (minors): Development and validation of a new instrument. ANZ Journal of Surgery. 2003; 73:712–6. [PubMed: 12956787]

42. Cohen J. A power primer. Psychological Bulletin. 1992; 112:155–9. [PubMed: 19565683]

43. Hedges LV. Estimation of effect size from a series of independent experiments. Psychological Bulletin. 1982; 92(2):490–9.

44*. Ausili E, Tabacco F, Focarelli B, et al. Multidimensional study on quality of life in children with type 1 diabetes. European Review for Medical and Pharmacological Sciences. 2007; 11:249–55. [PubMed: 17876960]

45*. Blanz BJ, Rensch-Riemann B, Fritz-Sigmund DI, Schmidt MH. IDDM is a risk factor for adolescent psychiatric disorders. Diabetes Care. 1993; 16:1579–87. [PubMed: 8299453]

46*. Engstrom I. Mental health and psychological functioning in children and adolescents with inflammatory bowel disease: A comparison with children having other chronic illnesses and with healthy children. Journal of Child Psychology and Psychiatry. 1992; 33:563–82. [PubMed: 1577899]

47*. Gowers SG, Jones JC, Kiana S, North CD, Price DA. Family functioning: A correlate of diabetic control? Journal of Child Psychology and Psychiatry. 1995; 36:993–1001. [PubMed: 7593406]

48*. Graue M, Wentzel-Larsen T, Hanestad BR, Batsvik B, Sovik O. Measuring self-reported, health related, quality of life in adolescents with type 1 diabetes using both generic and disease-specific instruments. Acta Paediatrica. 2003; 92:1190–6. [PubMed: 14632337]

49*. Hanson CL, Rodrigue JR, Henggeler SW, Harris MA, Klesges RC, Carle DL. The perceived self-competence of adolescents with insulin-dependent diabetes mellitus: Deficit or strength? Journal of Pediatric Psychology. 1990; 15:605–18. [PubMed: 2283570]

50*. Hutchings HA, Upton P, Cheung W-Y, et al. Development of a parent version of the Manchester–Minneapolis Quality of Life Survey for use by parents and carers of UK children: MMQL-UK (PF). Health and Quality of Life Outcomes. 2008:8. [PubMed: 18211701]

51*. Kokkonen J, Taanila A, Kokkonen E-R. Diabetes in adolescence: The effect of family and psychologic factors on metabolic control. Nordic Journal of Psychiatry. 1997; 51:165–72.

52*. Laffel LMB, Goebel-Fabbri A, Connell A, Mansfield A, Vangsness L, Anderson BJ. General quality of life in youth with type 1 diabetes. Diabetes Care. 2003; 26:3067–73. [PubMed: 14578241]

53*. Liakopoulou M, Korvessi M, Dacou-Voutetakis C. Personality characteristics, environmental factors and glycemic control in adolescents with diabetes. European Child and Adolescent Psychiatry. 1992; 1:82–8.

54*. Liakopoulou M, Alifieraki T, Katideniou A, et al. Maternal expressed emotion and metabolic control of children and adolescents with diabetes mellitus. Psychotherapy and Psychosomatics. 2001; 70:78–85. [PubMed: 11244388]

55*. Seigel WM, Golden NH, Gough JW, Lashley MS, Sacker IM. Depression, self-esteem, and life events in adolescents with chronic diseases. Journal of Adolescent Health Care. 1990; 11:501–4. [PubMed: 2262397]

56*. Storch EA, Lewin A, Silverstein JH, et al. Peer victimization and psychosocial adjustment in children with type 1 diabetes. Clinical Pediatrics. 2004; 43:467–71. [PubMed: 15208752]

57*. Sultana S, Oommen A, Shanmugham V. Psychological adjustment in juvenile diabetics. Journal of the Indian Academy of Applied Psychology. 2007; 33:39–46.

58*. Tercyak KP, Beville KW, Walker LR, et al. Health attitudes, beliefs, and risk behaviors among adolescents and young adults with type 1 diabetes. Children's Health Care. 2005; 34:165–80.

59*. Varni JW, Limbers CA, Burwinkle TM. Impaired health-related quality of life in children and adolescents with chronic conditions: A comparative analysis of 10 disease clusters and 33 disease categories/severities utilizing the PedsQL 4.0 generic core scales. Health and Quality of Life Outcomes. 2007:15. [PubMed: 17352831]

60. Helgeson VS, Snyder PR, Seltman H, Escobar O, Becker D, Siminerio L. Brief report: Trajectories of glycemic control over early to middle adolescence. Journal of Pediatric Psychology. 2010; 35:1161–1167. [PubMed: 20189951]

Table 1

Studies used in the meta-analysis

Authors (date; ref #)	N (dm/comp)	Average age (dm/comp)	Age range (dm/comp)	% Female (dm/comp)	% White (dm/comp)	Time since diagnosis (average and range in years)	HbA_{1C} (average and range)	Nature of comparison group	List of outcomes
Ausili et al. (2007; [44])	33/50	10.3/11.3	6–14/5–15	45/42		6.2 (1−11)	8 (5.8−12)	Unspecified, normative health population	Behavioral problems (p), Psychological distress (p)
Blanz et al. (1993; [45])	93/93	18.1/18.6	17–19	42		8.7(1−17)	25%<7.5 48% 7.6−9.5 27%>9.5	Other study, somatically healthy	Psychopathology
Engstrom (1992; [46])	20/20	16.4	9–18	55		6.8(1−16.1)		Schools, no chronic illness	Depression
									Anxiety
									Psychological distress
									Psychological distress (p)
									Internalization (p)
									Externalization (p)
									Psychopathology
Frank et al. (1998; [6])	114/88	9.48/8.27	0–17	45/49	98/96	1.78		Physician office, no chronic illness	Psychological distress
									Behavioral problems (p)
									Psychopathology
Gowers et al. (1995; [47])	60/38	13.7 dm good control 14.1 dm poor control/14.4 comp	12–16	40/55		>1	8.76 good control 11.60 poor control	Physician office, no diabetes	Depression
Graue et al. (2003; [48])	63/38		15–18	?/42		6.99 (1−16)	9.3 (6.2−14)	Hospital registry, healthy	Psychological distress
									Self-esteem
Grey et al. (1995; [10])	89/53	11.3	8–14	58	59/66	5.2 wks (2–8 wks)		Friends, no chronic illness	Depression
									Anxiety
									Self-esteem
									Physical health (p)
Hamlett et al. (1992; [7])	30/30	9.4/9.6	6–14	37	87/?			Physician office, schools, parent contacts, no significant physical illness	Internalization (p)
									Externalization (p)
Hanson et al. (1990; [49])	104/32	13.44/14.6		50/75	79	4.22		Newspaper, healthy	Self-esteem
Helgeson et al. (2007; [8])	126−132/129−131	12.08	11–14	53/51	93/91	4.91(1−13)	8.04	Physician office, area malls, no chronic illness	Depression
									Anxiety

Authors (date; ref #)	N (dm/comp)	Average age (dm/comp)	Age range (dm/comp)	% Female (dm/comp)	% White (dm/comp)	Time since diagnosis (average and range in years)	HbA_{1C} (average and range)	Nature of comparison group	List of outcomes
									Self-esteem
									Internalization (p)
									Externalization (p)
Hutchings et al. (2007; [33])	73/563		8–18					Schools, no information on health status	Psychological distress
									Self-esteem
									Peer difficulties
Hutchings et al. (2008; [50])	70/296		8–18/?					Schools, healthy	Psychological distress (p)
Kokkonen et al. (1997; [51])	31/145	14.3/?	12–16/15–16	42/?		5.6 (.8−14)	10.5 (7.1−14)	Schools, no information on health status	Depression
									Anxiety
Laffel et al. (2003; [52])	100/399−401	12.1/?	8–17/?	47/?	93/?	2.7 (.5−6)	8.4	Norms, healthy	Psychological distress
									Psychological distress (p)
Liakopoulou et al. (1992; [53])	40/39		11–18	58/56		5.51	11.47	Schools, no information on health status	Depression
									Anxiety
									Psychological distress
Liakopoulou et al. (2001; [54])	55/54	12.9/9.8		51/44		3.9	10.44	Acute illness, outpatient clinic	Depression
									Anxiety
									Psychopathology
Overstreet et al. (1995; [9])	90/89	11.8/12.1	8–16/?	41/44	90/94	3.6	9.7	Schools, no major illness or trauma	Behavioral problems (p)
Seigel et al. (1990; [55])	20/100		12–18			>2		Schools, no information on health status	Depression
									Self-esteem
Storch et al. (2004; [56])	32/32	12.9	8–18	72	69			Past studies, no medical diagnosis	Peer difficulties
Sultana et al. (2007; [57])	30/13	?/13	6–15/?	83/?				Other study, no information on health status	Self-esteem
Tercyak et al. (2005; [58])	53/53	15.6/15.9	13–21	49/55	53/47		8.8	Physician office, no chronic illness	Depression
Varni et al. (2007; [59])	209/5480	?/9.79	8–18/?	?/48.5				Physician office, healthy or no chronic illness	Psychological distress
									Peer difficulties

A single listed number (e.g., Engstrom average age) indicates that the mean is equivalent for the two groups. Only those outcomes included in the meta-analysis are depicted (*p*) the outcome was reported by the parent, *dm* diabetes group, *comp* comparison group, *?* unreported

Table 2

Effect sizes for meta-analysis of psychological well-being

Respondent	Variable	*k*	Mean ES (fixed)	Significance	Homogeneity
Parent	Psychological distress	4	0.62	0.00	ns
	Behavioral problems	6	0.25	0.00	ns
	Internalizing problems	3	0.25	0.02	ns
	Externalizing problems	3	0.05	ns	ns
Child	Depressive symptoms	9	0.26	0.00	Q=62.58, p<0.01
	Depression (clinical)	5	0.40	0.00	Q=13.15, p=0.01
	Anxiety	6	0.18	0.02	Q=15.77, p<0.01
	Psychological distress	7	0.17	0.00	Q=14.09, p<0.05
	Self-esteem	8	−0.09	ns	Q=32.05, p<0.01
	Peer difficulties	3	−0.09	ns	Q=6.18, p<0.05
	Psychopathology	4	0.04	ns	Q=8.77, p<0.05

This table depicts overall effect sizes (Cohen's *d*), significance values and results of homogeneity testing. Note that significant values for the *Q* statistic indicate that there is more variability than would be expected by chance, which allows for moderation analyses

Table 3

Results of moderator analyses for child-reported outcomes

ES variable	Moderating variable	*k*	*B*	Beta	Significance
Depressive symptoms	Year of publication	9	−0.03	−0.33	$p<0.01$
	Mean age—diabetes	7	−0.03	−0.10	n.s.
	% Female—diabetes	8	0.05	0.71	$p<0.01$
	Time since diagnosis	6	−0.09	−0.64	$p=0.01$
	Mean HbA_{1C}	6	0.05	0.14	n.s.
	Comparison group equivalence	9	−0.11	−0.37	$p<0.01$
Depression (clinical)	Year of publication	5	−0.04	−0.65	$p<0.05$
	Mean age—diabetes	4	−0.07	−0.90	n.s.
	% Female—diabetes	4	0.00	0.15	n.s.
	Time since diagnosis	3	−0.03	−0.70	n.s.
	Comparison group equivalence	5	−0.06	−0.26	n.s.
Anxiety	Year of publication	6	−0.02	−0.44	n.s.
	Mean age—diabetes	5	0.09	0.38	n.s.
	% Female—diabetes	6	−0.01	−0.12	n.s.
	Time since diagnosis	6	0.01	0.10	n.s.
	Mean HbA_{1C}	4	0.20	0.81	$p<0.01$
	Comparison group equivalence	6	−0.13	−0.84	$p<0.01$
Psychological distress	Year of publication	6	−0.02	−0.47	n.s.
	Mean age—diabetes	5	−0.01	−0.10	n.s.
	% Female—diabetes	4	0.04	0.79	$p<0.01$
	Time since diagnosis	5	0.05	0.42	n.s.
	Mean HbA_{1C}	3	0.22	0.99	$p<0.01$
	Comparison group equivalence	7	0.06	0.36	n.s.
Self-esteem	Year of publication	8	0.03	0.54	$p<0.01$
	Mean age—diabetes	6	−0.06	−0.23	n.s.
	% Female—diabetes	5	−0.01	−0.38	n.s.
	Time since diagnosis	5	−0.03	−0.39	n.s.
	Mean HbA_{1C}	3	0.01	0.16	n.s.

ES variable	Moderating variable	*k*	*B*	Beta	Significance
	Comparison group equivalence	8	0.00	0.01	n.s.
Peer difficulties	Year of publication	3	−0.19	−0.89	$p<0.05$
	Comparison group equivalence	3	0.58	0.89	$p<0.05$
Psychopathology	Year of publication	4	0.02	0.20	n.s.
	Mean age—diabetes	4	0.03	0.43	n.s.
	% Female—diabetes	4	0.03	0.50	n.s.
	Time since diagnosis	4	0.03	0.35	n.s.
	Comparison group equivalence	4	−0.25	−0.96	$p<0.01$

This table shows the moderating effect of each listed variable on the overall effect size. Moderation analyses were conducted only for effects that had sufficient heterogeneity (*Q* statistic; see Table 2). Potential moderating variables that had insufficient sample size for analysis (i.e., fewer than three studies) are not depicted in the table