Parent and Adolescent Distribution of Responsibility for Diabetes Self-care: Links to Health Outcomes

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Objective To examine the relation of adolescent and parent responsibility distribution for diabetes self-care to psychological and physical health. **Methods** We interviewed children (mean age 12 years) annually for 3 years and asked parents to complete a questionnaire. Both reported how diabetes self-care was distributed in the family. Amount of responsibility held by the child only, the parent only, and shared between child and parent was calculated. Psychological distress, competence, and diabetes outcomes were assessed at each wave. **Results** In both cross-sectional and longitudinal (lagged) analyses, multilevel modeling showed that shared responsibility was consistently associated with better psychological health, good self-care behavior, and good metabolic control, whereas child and parent responsibility were not. In some cases, links of shared responsibility to health outcomes were stronger among older adolescents. **Conclusions** These findings highlight the importance of shared responsibility for diabetes self-care through early to middle adolescence.

Key words adolescence; diabetes; responsibility.

Diabetes is a chronic illness that requires individuals to engage in frequent self-care behavior, in order to stay alive and healthy. Over the course of an average day, an individual with type 1 diabetes must monitor the kind and amount of food consumed, frequently test blood glucose levels, administer the correct amount of insulin throughout the day, and estimate the effect of physical activity on blood glucose levels. The diabetes regimen is complicated and demanding, even for individuals who are well-prepared for its challenges.

Adolescents with diabetes have more difficulty maintaining optimal blood glucose levels than do children or adults (Amiel, Sherwin, Simonson, Lauritano, & Tamborlane, 1986; Kovacs, Kass, Schnell, Goldston, & Marsh, 1989). This is problematic because poor blood glucose control is linked to a variety of serious complications, including damage to eyes, kidneys, nerves, and blood vessels (DCCT, 1993). Adolescents' difficulties in maintaining optimal blood glucose levels are partly due to the difficulty in keeping up with increasing insulin requirements caused by hormonal changes associated with puberty (Goran & Gower, 2001; Moran et al., 1999) and partly to the fact they perform poorer self-care behavior compared to adults and younger children (Anderson, Auslander, Jung, Miller, & Santiago, 1990; Jacobson et al., 1987).

There are many possible reasons why self-care behavior declines during adolescence. Adolescents may place a greater value on areas of life other than health (e.g., peer interaction), may believe that they are not vulnerable to long-term effects of the disease, or may be less skilled than adults at performing diabetes-related tasks. Given the complexity of managing the disease, a great deal of skill is required. It is during early adolescence that responsibility for diabetes self-care is beginning to be transferred from parent to child. Whereas parents take primary responsibility for managing diabetes during childhood, adolescents take on increasing levels of responsibility for diabetes care as they mature (Anderson, Ho, Brackett, Finkelstein, & Laffel, 1997; La Greca, Follansbee, & Skyler, 1990). The implications of this responsibility shift for diabetes health as well as overall psychological well-being are not completely clear.

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Journal of Pediatric Psychology 33(5) pp. 497–508, 2008
doi:10.1093/jpepsy/jsm081
Advance Access publication September 10, 2007
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There are a number of studies that have examined links between the distribution of responsibility for diabetes self-care and diabetes outcomes, but findings are not consistent. Some studies have demonstrated that greater parent involvement (typically implying less child involvement) is associated with better self-care behavior [Anderson et al., 1990 (6 to 21-year-olds); Anderson et al., 1997 (10 to 15-year-olds)] and good metabolic control [McKelvey et al., 1993 (7 to 18-year-olds); Waller et al., 1986 (7 to 17-year-olds)], whereas other studies have failed to find a relation between parent responsibility and self-care behavior [Miller & Drotar, 2003 (11 to 17-year-olds); Wiebe et al., 2005 (10 to 15-year-olds)] or metabolic control (Anderson et al., 1990, 1997; Miller & Drotar, 2003; Wiebe et al., 2005). One limitation of these studies is that they have examined wide age ranges of children and adolescents, and parent involvement may have different implications for health at different ages. Because these studies are cross-sectional, it is difficult to know if the distribution of responsibility is leading to diabetes outcomes or whether diabetes outcomes are influencing who is involved in diabetes self-care. However, two longitudinal studies—both interventions—showed benefits of parental involvement in diabetes care, specifically improved metabolic control [Anderson, Brackett, Ho, Laffel, 1999 (10 to 15-year-olds); Grey et al., 2001 (12 to 20-year-olds)].

Whereas the majority of past work on responsibility distribution in the family has examined implications for diabetes outcomes, fewer studies have examined the impact of responsibility distribution for psychological outcomes. Because one of the major goals of adolescence is to achieve a sense of autonomy (Allen, Hauser, Bell, & O'Connor, 1994; Collins, Gleason, & Sesma, 1997), it is important to consider the impact that parent involvement in diabetes care may have on the child's psychological well-being. Although parental involvement in diabetes self-care may have a positive impact on diabetes outcomes, over-involvement of parents in diabetes self-care could be linked with distress or a threat to self-esteem among adolescents. Developmental research has shown that as children age, they began to view adult assistance—even when well-intentioned—as a reflection of their own incompetence (Pomerantz & Eaton, 2000). It is not clear whether these same problems would emerge in families with a child with diabetes. Two studies of adolescents with diabetes examined psychological outcomes, one finding a link between parent involvement and greater psychosocial problems (e.g., difficulties with peers, negative affect, and academic difficulties; Palardy, 2000) and the other finding no relation of parental involvement to overall quality of life (Laffel et al., 2003). In sum, given the central task of adolescence to establish a sense of autonomy, the implications of the distribution of responsibility for psychological health is an issue worthy of investigation.

Concerns with Past Research

There are two limitations of past research that the present study seeks to address. First, many of the previous studies examined wide age ranges of children and adolescents (e.g., ages 11–17 years in Miller & Drotar, 2003; ages 8–17 years in Laffel et al., 2003) making it difficult to know whether parent involvement is more or less beneficial for some ages but not others. There is some suggestion that greater parent involvement and less child involvement is linked to better metabolic control for children and early adolescents, but not necessarily middle adolescents (La Greca et al., 1990). In the present study, we examined a relatively homogenous group of adolescents with respect to age (the majority were ages 11 and 12 years at study start) and followed them over a 2-year period with three waves of data enabling us to examine the relation of responsibility distribution to health over the course of early to middle adolescence.

A second concern with much of the past research is that the distribution of responsibility between parents and adolescents was examined as a single continuum, with one end representing sole adolescent responsibility and the other end representing sole parent responsibility. Shared responsibility would be reflected as the midpoint of the scale. It is possible that shared responsibility rather than sole adolescent responsibility or sole parent responsibility is optimal for both psychological and physical health. The previous scoring scheme would not be able to detect this, given that only linear analyses have been reported. In the present study, we examine the implications of adolescent only, parent only, and shared responsibility for health by calculating the percentage of tasks that are assumed by each.

There is a good reason to believe that shared responsibility is optimal for adolescent health. First, because diabetes is a complicated illness to manage and places a burden on families, it may be beneficial to have more people involved in care. Second, sharing responsibility provides the parent with the opportunity to model appropriate self-care behavior to adolescents.

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Third, the positive impact of shared responsibility would be consistent with recent developmental research that has suggested adolescent autonomy is best achieved in the context of parental support (Allen, Aber, & Leadbeater, 1990). Sharing responsibility may be viewed as teamwork—as a way for adolescents to achieve autonomy for self-care in the context of support. The clinic at Children's Hospital aims for a gradual transition of responsibility from parent to child during adolescence, with the goal of shared responsibility throughout this transition.

The Present Study

Our goal was to examine the implications of the distribution of responsibility for psychological adjustment, self-care, and metabolic control. We focused on early adolescents because it is the period of time during which self-care begins to decline and metabolic control begins to deteriorate. It also is a period of time during which responsibility begins to be shifted from parent to adolescent. Finally, there is some evidence that the implications of responsibility distribution for outcomes changes over the course of early to middle adolescence (La Greca et al., 1990). We hypothesized that shared responsibility would be associated with the best health outcomes. We did not expect age to influence the relations of shared responsibility to outcomes, meaning that shared responsibility would be equally important for older and younger adolescents. However, we did expect that adolescent-only responsibility would be more harmful, in terms of diabetes outcomes for the younger (early) adolescents as they would not have the skills and the maturity to be completely responsible for their medical regimen. We also hypothesized that parent-only responsibility would be more harmful for older (middle) adolescents, in terms of psychological outcomes as this would conflict with their emerging sense of autonomy. We examined both cross-sectional and longitudinal relations.

To further support links between responsibility and health, we also sought to examine reverse causality—that is, the extent to which psychological and physical health predicted changes in responsibility. It is possible that the distribution of responsibility in the family could be a response to good or poor health behavior.

The present study improves upon past research by: (a) examining links of responsibility distribution to psychological outcomes as well as diabetes outcomes, (b) examining shared responsibility as a construct that is distinct from child and parent responsibility, (c) examining a more homogenous age group of early adolescents at study start, and (d) following those adolescents over time as they transition to middle adolescence.

Method

Participants

Participants were 132 adolescents with diabetes (70 girls, 62 boys). Age at study start ranged from 10.73 to 14.21, with a mean of 12.10. The majority of the children (80%) were ages 11 and 12 years. Males and females were of a similar age. Length of illness ranged from 1 to 13 years ($M = 4.91$, $SD = 2.96$). The percentage of children using an insulin pump was 26% at study start, 35% 1 year later, and 44% the following year; the rest of the children were using injections. The majority of participants were white (93%), 2% were African American, 1% were Asian, 1% were American Indian, and 3% were mixed races. These figures are consistent with the diabetes population seen at Children's Hospital, which draws from a largely suburban and partly rural area. The four factor Hollingshead index (1975) of social status (mother and father education and occupation) revealed an average family score of 41.97 ($SD = 11.05$), which reflects the lower end of technical workers, medium business, and minor professionals.

Procedure

The study was approved by the appropriate Institutional Review Boards. Letters of invitation were sent to all adolescents with diabetes who were ~11–13 years of age and attending Children's Hospital ($n = 307$). Families could return a postcard indicating that they did not want to be contacted by phone about the study. Twenty families returned these postcards, refusing contact about the study without us being able to determine eligibility. We were able to reach 261 of the remaining 287 families by phone and determined that 90 were not eligible, meaning that they no longer went to Children's Hospital; had been diagnosed with diabetes for <1 year; they were not in 5th, 6th, or 7th grade; or they had another major chronic illness (e.g., cancer and rheumatoid arthritis). Of the 171 eligible families, 39 refused and 132 agreed. Thus, our effective response rate was 77%.

For families who agreed, we set up an appointment immediately before or after the next clinic visit. Interviews were conducted in the General Clinical Research Center, which is separate from and not associated with the diabetes clinic. Parent consent and child assent were obtained at that time. Interviews with children were

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conducted aloud.[1] Research assistants unaffiliated with Children's Hospital conducted interviews that measured the distribution of responsibility, psychological distress, perceived competence, and self-care behavior. Children were provided with response cards (i.e., 1 = not at all; 2 = a little; and 3 = a lot) for standardized instruments. Children were paid for their participation in the study. One parent completed a questionnaire in a separate room, while the child was being interviewed. When two parents accompanied their child to the appointment, we asked the parent who was most involved in diabetes care to complete the questionnaire. This was typically the mother (92%).

One year later [Time 2 (T2)], we interviewed 127 of the 132 (96%) children, and 124 (94%) parents completed a questionnaire. The following year [Time 3 (T3)], we interviewed 126 (95%) of the children, and 119 (90%) parents completed a questionnaire.

Instruments

Responsibility

The Diabetes Family Responsibility Questionnaire (DFRQ; Anderson et al., 1990) was administered to both children and parents to examine the distribution of diabetes-related responsibilities in the family. The DFRQ consists of 17 items that reflect diabetes-related responsibilities. For each item, respondents indicate whether parents take responsibility almost all of the time, whether the adolescent takes responsibility almost all of the time, or whether responsibility is shared about equally between adolescents and parents. In the present study, we also added a fourth option to each question, which was that no one took responsibility for the task. Because this option was rarely endorsed for any item (average was 2% of the time for child report), it will not be discussed. We viewed the three responses as distinct kinds of responsibility rather than a single continuum of responsibility. We calculated the percentage of the 17 tasks for which the adolescent was solely responsible, the percentage for which the parent was solely responsible, and the percentage for which responsibility was shared.

The correlations between parent and shared responsibility ranged from −0.46 to −0.68; the correlations between parent and child responsibility ranged from −0.16 to −0.39; and the correlations between child and shared ranged from −0.39 to −0.75 across the three waves of assessment for child and parent reports. Because of some empirical overlap, we examined the implications of parent, child, and shared responsibility separately in our analyses.

Psychological Distress

We examined three indicators of psychological distress: depressive symptoms, anxiety, and anger. We used the abbreviated form of the Children's Depression Inventory (CDI) to assess depressive symptoms (Kovacs, 1985, 2001). The CDI is a self-report measure designed for children and adolescents. The abbreviated form consists of 10 items that are comprehensible at a first-grade reading level. Reliability of the CDI has been established through administration to psychiatric and medical-outpatient populations. The α's were .76 at T1, .59 at T2, and .78 at T3.

We measured anxiety with the 7-item scale developed by Stark and Laurent (2001), in response to concerns about the overlap between depressive symptoms and anxiety. These were the 7 items from the Revised Children's Manifest Anxiety Scale found to be unique to anxiety, when the instrument was factor analyzed with the CDI. The authors provided convergent and discriminate validity for this scale. To increase variability in our scale and make the response format consistent with other items, we changed the true/false format to 3-point scales (not at all true, sort of true, and very true of me). The internal consistency was .68 at T1, .72 at T2, and .73 at T3, which are comparable to the alphas reported by Stark and Laurent (2001).

We used the 3-item anger subscale of the Differential Emotions Scale (Izard, Libero, Putman, & Haynes, 1993). This is a self-report scale of different emotions that has been used with children. Test–retest reliability is high and validity with comparable scales has been reported. We mixed these items with the 7 anxiety items. For consistency, we changed the response format to a 3-point scale. The internal consistency was .76 at all three times of assessment. Because depressive symptoms, anxiety, and anger were only modestly related (r's ranged from .27 to .37 at T1), we examined them separately.

Self-Perceived Competence

We administered two subscales from the Self-Perception Profile for Children (Harter, 1985) to assess children's judgments of their perceived competence. We selected two domains we thought most relevant to adolescents—social competence and global self-worth. The internal consistencies for the two subscales were marginal in the

[1]The Children's Depression Inventory was completed in private due to the sensitive nature of the items.

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present study at T1, T2, and T3 (social competence .73, .60, and .67; global self-worth .75, .74, and .76).

Diabetes Outcomes

We measured self-efficacy with the self-efficacy subscale from the Multidimensional Diabetes Questionnaire (Talbot, Nouwen, Gingras, Gosselin, & Audet, 1997). Participants are asked to estimate their confidence on a 0–100% scale that they can carry out each of 7 diabetes-specific behaviors. The internal consistency was adequate at each assessment, α's = .79, .80, and .78 at T1, T2, and T3, respectively.

We measured self-care behavior with the 14-item Self-Care Inventory (La Greca, Swales, Klemp, & Madigan, 1988). This instrument asks respondents to indicate how well they followed their physician's recommendations for glucose testing, insulin administration, diet, exercise, and other diabetes-related behaviors. Each item is rated on a 1 (never do it) to 5 (always do this as recommended) scale. This scale reflects domains of self-care that have been regarded as important by the American Diabetes Association, and it has been associated with metabolic control among adolescents in a number of studies (Delamater, Applegate, Eidson, & Nemery, 1998; La Greca et al., 1990). We updated this scale by adding 8 more contemporary items: 3 negative behaviors from Weissberg-Benchell et al. (1995: made up blood tests results because numbers were too high, made up blood test results because did not really test, took extra insulin because ate inappropriate food); three negative behaviors of our own (skipping meals, skipping injections, and eating foods that should be avoided); and two positive behaviors (rotating injection sites and measuring food). The positive behaviors used the above-mentioned scale; the negative items were scored on a similar scale ranging from 1 (never do it) to 5 (very often). We reverse scored negative items, summed across items, and took the average. The internal consistency was adequate at all times (α = .78, .82, and .80, respectively). Our revised measure was correlated .94 with La Greca's original 14-item scale.

Metabolic control was measured with hemoglobin A_{1C} (HbA_{1C}) obtained at the clinic appointment measured by HPLC (Tosoh Instruments) with normal range of 4.6–6.1%. HbA_{1C} values indicate the average blood glucose level over the past 1–2 months. The average HbA_{1C} at T1 for our sample was 8.04 (SD = 1.31). Current recommendations for 13 to 19-year-old adolescents are that their HbA_{1C} should be below 8% (American Diabetes Association, 2006).

Overview of Statistical Analyses

We used longitudinal growth modeling or multilevel modeling (Singer & Willett, 2003) to examine the extent to which responsibility predicted changes in outcomes over time.[2] The application of growth curve modeling to pediatric psychology is relatively new and discussed in depth by DeLucia and Pitts (2006) in the Special Issue of *Journal of Pediatric Psychology* on longitudinal research. Because this is an emerging technique in this field, we have briefly delineated the most important strengths of this technique for the current work.

Multilevel modeling has numerous advantages over ordinary least squares (OLS) regression. First, with multilevel modeling, one is able to take advantage of all available data, including data from participants who have not completed all assessments. Second, multilevel modeling can be used when one expects variables to be correlated across time, a substantial improvement over OLS, which assumes that this autocorrelation is zero. Finally, and most importantly, multilevel modeling allows one to examine individual variability in rates of change. The rate of change is calculated for each individual and then aggregated across individuals. One can examine the relation of individual characteristics that change over time (i.e., time-varying predictors) to outcomes that change over time. In this article, both responsibility and age are considered to be time-varying predictors. We examine the relation of responsibility at each wave of assessment to the outcome measured at the same time. We also examine how the age of the child at each wave of assessment is associated with the outcome at the same time, and determine whether age at each wave of assessment influences the relation of responsibility to outcomes. That is, we were able to examine whether the relation of responsibility to outcomes was moderated by age at each time of assessment.

We present three sets of analyses. First, we used multilevel modeling to examine the concurrent relations of the responsibility distribution variables to health outcomes. We computed three multilevel models. In the first model, we examined the relations of child report and parent report of shared responsibility; in the second, child report and parent report of

[2]We used an unstructured covariance matrix for these analyses. Because the correlations among responsibility measures were stronger at times that were closer together (e.g., T1 and T2 vs. T1 and T3), we also ran the multilevel models using autoregressive covariance matrices. The results were the same as those presented in the text. Thus, for simplification we retained the unstructured covariance matrix.

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child responsibility; and in the third, child report and parent report of parent responsibility. In this way, we could compare child and parent reports of responsibility to outcomes. Responsibility was uncentered in the analyses, as 0 was a meaningful number. Age was centered at the youngest age of the participant, so that 0 represented the youngest participant in the study. As an example, the growth curve model equation that we used to predict depression with parent and child reports of child responsibility was:

$$\begin{aligned}\text{Depressive symptoms}_{ti} &= \beta_{00} + \beta_{10}(\text{child responsibility} - \text{child report}_{ti}) \\ &+ \beta_{20}(\text{child responsibility} - \text{parent report}_{ti}) \\ &+ \beta_{30}(\text{age}_{ti}) \\ &+ \beta_{40}(\text{age} \times \text{child responsibility} - \text{child report}_{ti}) \\ &+ \beta_{50}(\text{age} \times \text{child responsibility} - \text{parent report}_{ti}) \\ &+ r_{01} + r_{31} \times \text{age}_{ti} + e_{ti}\end{aligned}$$

The intercept, β_{00}, represents the depressive symptoms score for the youngest child in the study because age is scored so that 0 represents the youngest person in the study at the initial wave of data collection. The second and third parameters, β_{10}, and β_{20}, are the slopes of the relation between child responsibility (child report and then parent report) to depressive symptoms. The fourth parameter, β_{30}, reflects the relation of age to depressive symptoms. The fifth and sixth parameters, β_{40} and β_{50}, reflect the interaction between age and child responsibility (child and then parent reports) in predicting depressive symptoms. The remaining three parameters reflect various error terms: r_{01} reflects the between-person residual in initial rate of depressive symptoms; $r_{31} \times$ age reflects the between-person residual in the rate of change associated with age; and e_{ti} represents the within-person residual.

Second, we examine longitudinal or lagged relations of responsibility to outcomes. That is, we examined the relations of responsibility at t_n to outcomes measured at t_{n+1}. The lagged analyses take into consideration two lags: T1 to T2 and T2 to T3. In the lagged analyses, we examine the relation of responsibility at T_n to outcomes measured at T_{n+1} controlling for outcomes measured at T_n. Thus, we are examining the links of responsibility to *changes in outcomes* over time. These analyses reflect both the T1–T2 change as well as the T2–T3 change. Although we examined the interactions of the responsibility variables with the lag (T1–T2 vs. T2–T3), none of these interactions were significant implying that all relations held across the two lags. We continued to examine age as a moderator of responsibility in these analyses. The equation was similar to the one reported earlier, except that the prior measure of the outcome is included in the equation and the predictor reflects t_n and the outcome reflects t_{n+1}.

Finally, we tested reverse causality by examining the relation of each of the health outcomes at t_n to responsibility at t_{n+1}. For example, we used depressive symptoms to predict child responsibility with the following equation:

$$\begin{aligned}\text{Child responsibility} - \text{child report}_{ti} &= \beta_{00} + \beta_{10}(\text{depressive symptoms}_{ti}) \\ &+ \beta_{20}(\text{age}_{ti}) + \beta_{30}(\text{age} \times \text{depressive symptoms}_{ti}) \\ &+ r_{01} + r_{31} \times \text{age}_{ti} + e_{ti}\end{aligned}$$

In the analyses, presented subsequently, we report the unstandardized beta (β) and *p*-value of significant parameters. We used the HLM software to plot age by responsibility interactions.

Results

Prior to the analyses, we examined whether any background variables needed to be statistically controlled. Parent and child distribution of responsibility were unrelated to social status, household structure, child ethnicity, pubertal status, or time since diagnosis. Treatment with injections versus insulin pumps was related to only one responsibility variable, child report of parent responsibility, at each time of assessment ($\beta = -0.05$, $p < .05$), such that those who were on insulin pumps said that parents assumed less responsibility than those who were on injections. However, treatment delivery method did not influence the relations of responsibility to outcomes, so it will not be discussed further. Therefore, we did not need to include covariates in any of our models.

Relations of Responsibility to Outcomes: Cross-sectional Analyses

We used multilevel modeling to examine the concurrent relations of responsibility to health outcomes. We developed three multilevel models, one for child and parent reports of shared responsibility, one for child and parent reports of parent responsibility, and one for child and parent reports of child responsibility.

Psychological Distress

Child report of shared responsibility was associated with less depressive symptoms ($\beta = -0.12$, $p < .05$), but child

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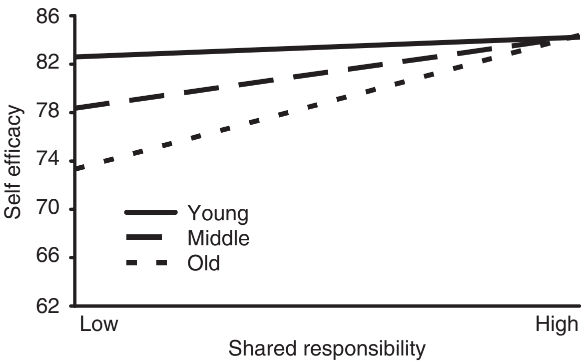

Figure 1. The relation of parent report of shared responsibility to self-efficacy among children of three different age groups: young (25th percentile; average age 12.3 years), middle (50th percentile, average age 13.0 years), and old (75th percentile, average age 13.9 years).

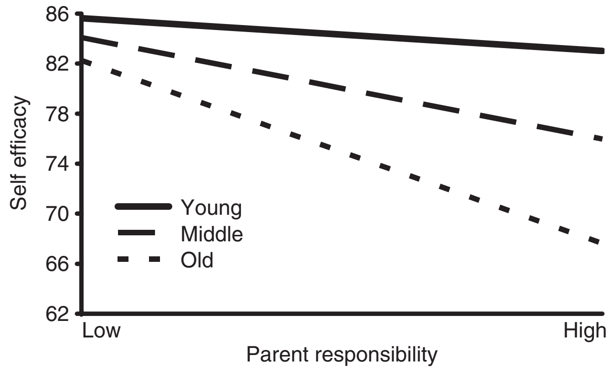

Figure 2. The relation of parent report of parent responsibility to self-efficacy among children of three different age groups: young (25th percentile; average age 12.3 years), middle (50th percentile, average age 13.0 years), and old (75th percentile, average age 13.9 years).

report of child or parent responsibility was not associated with depressive symptoms. None of the responsibility variables interacted with age to predict depressive symptoms. None of the responsibility variables were associated with anxiety or interacted with age to predict anxiety. Child report of shared responsibility was associated with less anger ($\beta = -0.39$, $p < .05$), and child report of child responsibility was associated with greater anger ($\beta = .52$, $p < .05$). Child report of parent responsibility interacted with age to predict anger ($\beta = -0.42$, $p < .01$), such that parent responsibility was associated with more anger for younger children but less anger for older children. Parent reports of responsibility were not associated with any of these outcomes, nor did they interact with age to predict outcomes.

Competence

None of the responsibility indices were associated with self-worth but child report of parent responsibility was associated with less social competence ($\beta = -0.36$, $p < .05$). There was no moderation by age.

Diabetes Outcomes

Both child and parent reports of shared responsibility were associated with more diabetes self-efficacy ($\beta = 8.90$, $p < .05$; $\beta = 9.30$, $p = .05$, respectively). In addition, parent report of shared responsibility interacted with age to predict self-efficacy ($\beta = 8.24$, $p < .01$). As shown in Fig. 1, the relation of shared responsibility to higher self-efficacy became stronger with increased age. Note that the lack of shared responsibility is especially associated with low self-efficacy for older adolescents. Child report of parent responsibility was associated

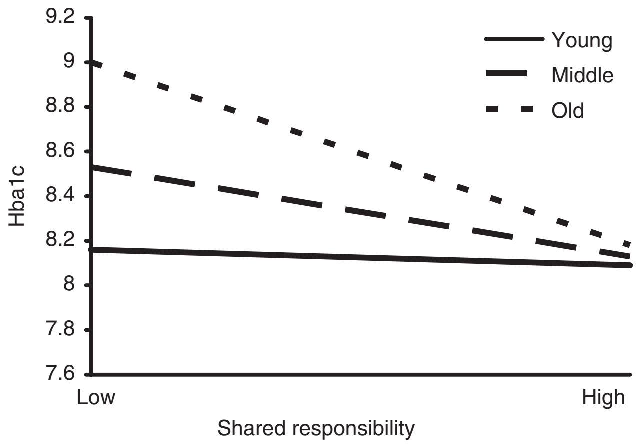

Figure 3. The relation of child report of shared responsibility to metabolic control (HbA1c) among children of three different age groups: young (25th percentile; average age 12.3 years), middle (50th percentile, average age 13.0 years), and old (75th percentile, average age 13.9 years).

with less diabetes self-efficacy ($\beta = -16.93$, $p < .01$), and parent report of parent responsibility interacted with age to predict self-efficacy ($\beta = -10.47$, $p < .05$). As shown in Fig. 2, the relation of parent responsibility to reduced self-efficacy was stronger for older adolescents, a mirror-image of the findings shown in Fig. 1.

In terms of self-care, both child and parent report of shared responsibility was associated with better self-care behavior ($\beta = 0.47$, $p < .001$; $\beta = 0.35$, $p < .05$, respectively). By contrast, both child and parent report of parent responsibility was associated with poorer self-care behavior ($\beta = -0.55$, $p < .001$; $\beta = -0.37$, $p < .05$, respectively).

Child report of shared responsibility interacted with age to predict metabolic control ($\beta = -0.61$,

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$p < .05$). As shown in Fig. 3, shared responsibility was associated with better metabolic control for older adolescents but unrelated to metabolic control for younger adolescents. That is, low shared responsibility was associated with the highest hbA1c (or worst metabolic control) for older adolescents. With high shared responsibility, older adolescents had the same metabolic control as younger adolescents. None of the other responsibility variables were associated with metabolic control.[3]

Relations of Responsibility to Changes in Outcomes: Longitudinal (Lagged) Analyses

We used multilevel modeling to predict outcomes over time by controlling for the previous wave of the outcome in the equation. These models reflect the combination of T1 responsibility predicting T2 outcomes and T2 responsibility predicting T3 outcomes.

Psychological Distress

None of the responsibility variables predicted changes in depressive symptoms, anxiety, or anger over time. Age did not interact with any of the responsibility indices to predict changes in psychological distress indices over time.

Competence

Child report of child responsibility predicted declines in global self-worth over time ($\beta = -0.37$, $p < .05$). None of the responsibility variables predicted changes in social acceptance, and there was no moderation by age.

Diabetes Outcomes

Child report of shared responsibility predicted an increase in self-efficacy ($\beta = 9.38$, $p < .05$), and child report of child responsibility predicted a decrease in self-efficacy ($\beta = -19.34$, $p < .001$). Parent report of shared responsibility predicted an improvement in self-care behavior ($\beta = 0.33$, $p < .05$). Child report of parent responsibility also predicted an improvement in self-care behavior ($\beta = 0.38$, $p < .05$). Child report of shared responsibility predicted an improvement in metabolic control ($\beta = -1.11$, $p < .01$), whereas child report of child responsibility predicted a deterioration in metabolic control ($\beta = 1.46$, $p < .001$).

Relation of Health to Changes in Responsibility: Reverse Causality

In the previous set of analyses, we examined whether child and parent reports of responsibility predicted changes in outcomes over time. We also thought it prudent to examine the reverse direction of causality—whether psychological and physical health predicted changes in the distribution of responsibility over time as perceived by children and parents. Few relations were detected in these reverse lagged analyses, and none involved parent reports. Among the psychological distress variables, only one relation emerged: depressive symptoms predicted an increase in child reports of parental responsibility over time ($\beta = 0.09$, $p < .01$). None of the other distress variables predicted changes in either child or parent reports of responsibility. Competence variables did not predict changes in child or parent reports of responsibility. Neither self-efficacy nor metabolic control predicted changes in reports of responsibility. However, good self-care behavior was associated with an increase in shared responsibility ($\beta = 0.06$, $p < .01$) and a decrease in child responsibility ($\beta = -0.05$, $p < .01$) as reported by children.

Discussion

The goal of the study was to examine the implications of the distribution of responsibility from both the child's perspective and the parent's perspective for both diabetes outcomes and psychological health. As one would expect, the child's perception of responsibility was linked to psychological outcomes, whereas the parent's perception was not. For diabetes outcomes, however, there were times when both child's and parents' perceptions were predictive.

As hypothesized, shared responsibility appeared to be most adaptive for both psychological and physical health. The child's perception of shared responsibility was associated with less depression and less anger. The child's and the parent's perception of shared

[3]We reran the analyses presented in this article using the responsibility measure as a continuous variable to predict outcomes, where one end reflected parent responsibility and the other end reflected child responsibility, with shared responsibility falling in the middle. Neither the child nor the parent measure predicted any of the psychological outcomes, nor did they predict self-care behavior or metabolic control. There also was no moderation by age. The continuous measure of responsibility predicted only one outcome—self-efficacy, such that high parent responsibility (or low child responsibility) predicted greater self-efficacy ($\beta = 8.42$, $p < .05$). Because we had already examined the unique relations of child, parent, and shared responsibility to self-efficacy, we know that the finding for the continuous measure is misleading. It was actually shared responsibility that was associated with higher self-efficacy and parent responsibility was associated with lower self-efficacy.

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responsibility were associated with higher diabetes self-efficacy and better self-care. In addition, the child's perception of shared responsibility was associated with better metabolic control for older adolescents. Importantly, in longitudinal analyses, the child's perception of shared responsibility predicted an increase in diabetes self-efficacy and less deterioration in metabolic control over time, and parents' perceptions of shared responsibility predicted an improvement in self-care behavior. These findings suggest that sharing responsibility for diabetes care not only remains important as youth transition from early to middle adolescence, but that shared responsibility may take on even greater importance among the older adolescent.

Parent responsibility revealed few relations to outcomes, most of which were negative. The child's perception of parent responsibility was associated with lower social competence and less diabetes self-efficacy. Parents' report of their own responsibility also was associated with less diabetes self-efficacy but only for older adolescents.

Child responsibility also revealed few relations to outcomes, and those relations were uniformly negative. In cross-sectional analyses, child responsibility was associated with more anger. In longitudinal analyses, child responsibility predicted declines in self-worth, declines in self-efficacy, and a deterioration in metabolic control over time. The negative relations to diabetes outcomes could be a consequence of adolescents not knowing how to properly execute these behaviors. The negative relations to psychological health could be the result of adolescents feeling overwhelmed by having to assume responsibility for diabetes care—perhaps before they feel prepared to do so.

We also examined whether psychological and physical health outcomes predicted changes in the distribution of responsibility. There was no evidence that psychological health or metabolic control led to an increase in shared responsibility, but good self-care behavior predicted an increase in shared responsibility. One might have expected *poor* self-care behavior to lead parents to increasingly share responsibility with adolescents. However, that may not be the way that families operate. Instead, parents may be more likely to be involved when children are taking good care of themselves.

Psychological and physical health did not predict changes in child responsibility. Child depressive symptoms predicted an increase in parent only responsibility over time. Thus, parent responsibility could be a response to poor child mental health.

The fact that shared responsibility was associated with better metabolic control among older adolescents and predicted less deterioration in metabolic control as children grew older merits special attention. Metabolic control has been linked to long-term health outcomes (DCCT, 1993). These findings have implications for the treatment of youth with diabetes and their families as they transition through the teenage years. Although families may assume that this is the period of time during which responsibilities should be shifted from adults to children, families need to know that parents should remain involved in diabetes care (but not by taking sole responsibility) while the shift is occurring. Thus, more interventions along the lines of the one conducted by Anderson et al. (1999) should be implemented. They developed a teamwork intervention aimed at parents and adolescents sharing responsibility for diabetes care. The intervention was successful in preventing the expected deterioration in parent involvement with self-care and showed trends toward having a positive impact on metabolic control. The precise nature of future teamwork interventions depends on *why* shared responsibility is adaptive.

One explanation has to do with the complexity and burden of diabetes care. Shared responsibility may be beneficial because there are so many aspects of diabetes care to implement that having two or more people involved makes it more likely that care will take place. Or, when responsibility is shared, parents have the opportunity to teach and model good self-care behavior that can be assumed by adolescents on their own in the future. The fact that shared responsibility was increasingly associated with adolescent self-efficacy is consistent with this possibility.

One also needs to know *how* responsibility is shared. If adolescents and parents are jointly engaging in diabetes care activities, shared responsibility is addressing both complexity and burden and providing an opportunity to teach and model good self care. This would be consistent with the collaborative style of care that Wiebe et al. (2005) found to be adaptive. However, if shared responsibility implies that adolescents execute the behaviors some of the time and parents execute the behaviors at other times, shared responsibility may be reducing burden without addressing complexity or modeling self care. Future research needs to distinguish among these possibilities.

Before concluding, we must acknowledge a number of study limitations. First, we only asked one parent, typically the mother, to participate in the study, largely

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for feasibility reasons. Although some research has shown that fathers are less involved than mothers in diabetes care (Dashiff, 2003), future research should include fathers. Second, the sample was largely Caucasian and middle class, limiting the generalizability of the findings. Third, the reliabilities of some scales were low at some times of assessment. Finally, we made slight changes to some of the instruments used. Although we justified these changes, we acknowledge that we do not know their full impact on the reliability of the findings without further study.

Despite these limitations, there are several methodological strengths of this study. We collected multiple waves of data enabling us to conduct longitudinal analyses; we had excellent retention across three waves of data collection; we examined a relatively homogenous age group of adolescents; and we included both child and parent reports of responsibility. We also contributed both conceptually and methodologically to the area of responsibility distribution for diabetes care by examining shared responsibility as conceptually distinct from a single continuum of responsibility ranging from child to parent. Our findings suggest that some previous research may have failed to detect relations of responsibility to outcomes because scales were used ranging from child responsibility to parent responsibility and both of these may be maladaptive. Our work suggests that the midpoint of previous scales (theoretically reflecting shared responsibility) is the most adaptive.

Taken collectively, across a variety of outcomes—psychological, behavioral, and physical, shared responsibility was uniformly adaptive, and its adaptive significance seemed to increase with time as children got older. Future research should investigate how responsibility is shared in families, determine which method of sharing is most adaptive, and design interventions to optimize shared responsibility in families of children with diabetes during adolescence.

Acknowledgments

The authors acknowledge the support of grant R01 DK60586 from the National Institutes of Health to conduct this work and the support of the Pediatric Clinical and Translational Research Center at Children's Hospital (GCRC grant, 5MO1 RR00084). The authors extend their appreciation to Pamela Snyder for her management of the day-to-day aspects of the project as well as for the statistical analyses that she conducted. The authors are grateful to Samantha Bushman, Merrie Cousins, Ashley Episcopo, Ta'Sharee Grant, Abigail Kunz Vaughn, Michelle Merriman, Elizabeth Muia, Erin Nowak-Vache, Vivian Rodriguez, Laura Viccaro, and Heather Whitman for their assistance with this research. We also acknowledge the support of the clinic staff of Children's Hospital of Pittsburgh.

Conflicts of interest: None declared.

Received January 25, 2007; revisions received August 14, 2007; accepted August 15, 2007

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