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# Secrecy From Parents and Type 1 Diabetes Management in Late Adolescence

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## Abstract

**Objectives** This study examined (a) associations of parent–adolescent relationship characteristics and adolescent problem behavior with late adolescents' secrecy from parents about type 1 diabetes management, and (b) whether secrecy was associated with diabetes and psychological outcomes independently of these factors. **Methods** Adolescents ( $N = 247$ ,  $M_{\text{age}} = 17.76$  years) completed survey measures of diabetes-related secrecy from parents, disclosure, parental acceptance, parental knowledge, and conduct problems. Mothers and adolescents reported on adolescent adherence to diabetes regimens and adolescents reported their depressive symptoms. Glycemic control was obtained from HbA1c test kits. **Results** Adolescent-reported disclosure to parents was uniquely negatively associated with secrecy from parents. Controlling for relationship variables, conduct problems, and sociodemographic and illness-related variables, secrecy from mothers was uniquely associated with poorer glycemic control and secrecy from both parents was associated with lower adherence. **Conclusions** Secrecy about type 1 diabetes management is uniquely associated with diabetes outcomes independent of other relationship characteristics and problem behaviors.

**Key words:** conduct problems; disclosure; late adolescence; relationship quality; secrecy; type 1 diabetes.

Adolescence is a developmental period when adherence to type 1 diabetes regimens and physiological management of the illness (i.e., metabolic control) deteriorate (Weissberg-Benchell et al., 1995). Patterns of mismanagement in adolescence often extend into adulthood (Bryden et al., 2001), increasing the risk for long-term adverse health outcomes (Diabetes Control and Complications Trial [DCCT], 1993). Because adolescence is a time when individuals are becoming more autonomous and responsible for their own diabetes care (Wiebe et al., 2014), it is important to understand how effective management of the illness is attained. Parental monitoring of diabetes, a construct often measured as parental knowledge about

adolescents' management of type 1 diabetes, is associated with better adherence and metabolic control (Berg et al., 2008; Ellis et al., 2007; King et al., 2012).

Parental knowledge comes not only from parents' efforts to be aware of their adolescents' diabetes, but also through adolescents' information management strategies, including the extent to which they disclose to or keep secret from parents information about daily diabetes management behaviors (Berg et al., 2014; Osborn et al., 2013). In the diabetes context, secrecy is defined as the intentional concealment of information relating to diabetes management. Frijns et al. (2010) demonstrated that disclosure and secrecy are not opposite poles of a single construct, but that they

can occur simultaneously. In the context of diabetes, for example, an adolescent may disclose that blood glucose was high, but keep secret that they skipped an insulin dose. Keeping secrets from parents has been associated with poor psychosocial adjustment in the general developmental literature (Frijns, Finekenauer, Vermulst, & Engels, 2005) and with poorer adherence, metabolic control, and more depressive symptoms in the diabetes context (Osborn et al., 2013). However, the unique associations of parent–child relationship variables and behavioral problems with adolescent secrecy in the diabetes context are not well understood. Furthermore, it is unclear whether secrecy is associated with diabetes management independent of other relationship variables. Finally, much of the research on secrecy has focused on early to middle adolescence. In the present study, we investigated factors that are related to secrecy in the context of type 1 diabetes management during late adolescence and the unique associations of secrecy from parents to diabetes and psychological adjustment outcomes.

Secrecy from parents arises from both poor parent–adolescent relationships as well as adolescent problem behavior. Keeping secrets from parents may develop from a longstanding pattern of problem behavior where parents exhibit inconsistent discipline and low parental warmth and knowledge about adolescents' activities (Frijns et al., 2010; Patterson, DeBarshye, & Ramsey, 1989). In contrast, adolescents are more likely to disclose to and less likely to keep secrets from parents when the parent–adolescent relationship is positive (Smetana, Villalobos, Rogge, & Tasopoulos-Chan, 2010; Tilton-Weaver, 2014). Furthermore, adolescents may withhold information when they are engaged in problem or delinquent behaviors (Frijns et al., 2010; Tilton-Weaver, 2014). These findings suggest that secrecy from parents is influenced by both the parent–adolescent relationship and adolescent problem behavior, associations not yet examined in the diabetes literature.

Secrecy from parents is expected to be detrimental for adolescent diabetes management. Although rarely studied in the diabetes context (for exception, see Osborn et al., 2013), secrecy has been associated with other psychosocial variables in the developmental literature (e.g., less disclosure and parental knowledge, poorer parent–adolescent relationships, and conduct problems) that are related to poorer diabetes adherence and metabolic control (Cohen, Lumley, Naar-King, Partridge, & Çakan, 2004; King et al., 2014). Adolescent secrecy may limit parents' access to accurate knowledge about diabetes management, thereby undermining parental support for their adolescent's disease care. Furthermore, secrecy may create distress for adolescents and undermine their ability to effectively manage their illness and maintain psychological well-being (Hamza & Willoughby, 2011). Secrecy

from parents has been associated with poorer adherence and appears to weaken the positive associations of adolescent disclosure with diabetes outcomes (Osborn et al., 2013). Taken together, secrecy is expected to be associated with poorer psychological adjustment and illness management, but it is important to determine whether these associations occur independent of other factors that are related to secrecy.

Research on secrecy has primarily examined early to middle adolescence, but understanding secrecy during late adolescence is especially important. Late adolescents spend more time away from parents, creating more opportunities for adolescent control over information management to parents (Keijsers, Branje, Frijns, Finkenauer, & Meeus, 2010). Late adolescents also assume more independent responsibility for diabetes management (Wiebe et al., 2014) which, when combined with increased time spent away from home, may alter the role of secrecy in undermining diabetes care. Furthermore, late adolescence is a developmentally appropriate time to examine independent associations of disclosure and secrecy to diabetes outcomes because late adolescents may not engage in much active disclosure, given the degree to which much of their diabetes care is autonomous. Indeed, adolescents disclose less to parents across adolescence (Keijsers, Frijns, Branje, & Meeus, 2009). However, actively keeping secrets may still have detrimental effects on health. Thus, late adolescence is an important developmental period in which to examine predictors of secrecy and how secrecy is associated with health outcomes.

The present study investigated (a) associations of relationship variables (disclosure to parents, parental acceptance, and parental knowledge) and conduct problems with secrecy in the context of type 1 diabetes management among older adolescents, and (b) whether secrecy was associated with diabetes and psychological outcomes above and beyond these factors. We hypothesized that poor relationship quality (low parental acceptance, parental knowledge, and disclosure to parents) and adolescent conduct problems would be associated with higher secrecy from parents. We also hypothesized that higher secrecy would be associated with worse diabetes outcomes (HbA1c, adherence) and depressive symptoms above and beyond other relationship variables and problem behaviors.

## Methods

### Participants

Participants included 247 high school seniors (60% female,  $M$  [ $SD$ ] age = 17.76 [0.39] years) with type 1 diabetes and their mothers who completed baseline assessments as part of a 2-year multisite study of late adolescents managing diabetes into emerging

adulthood. Adolescents and mothers were recruited during visits to their pediatric endocrinology clinic and by phone in two southwestern cities. Mothers ( $N=210$ ,  $M$  [SD] age = 48 [6.68] years) were recruited regardless of whether they lived with the adolescent, but mothers' participation was not mandatory. Youth were eligible if diagnosed with type 1 diabetes for at least 1 year ( $M=7.35$ ,  $SD=3.89$  years), spoke English as their primary language, were in their last year of high school, lived with a parent (70.8% lived at home with two parents [biological/step/adopted], 29.2% with one parent), could have regular contact with parents across 2 years (necessary for the larger study), and had no condition to prohibit study completion (e.g., severe intellectual disability). The gender distribution was affected by the fact that some males at one site were not eligible owing to plans that excluded regular contact with parents across 2 years.

Of the qualifying 507 individuals approached, 301 (59%) agreed to participate. Of those, 247 (82%) were enrolled in the study. Reasons for nonparticipation primarily included lack of interest (33%) and being too busy (34%); 20% declined to give a reason. Consistent with the patient population at participating clinics, 75.2% identified as non-Hispanic White, 14.2% as Hispanic, 4.8% as Black, and the remainder as Asian/Pacific Islander, American Indian, or more than one race. A range of maternal education was reported with 12.9% of mothers having a high school education or less, 37.2% having some college or a vocational degree, and 34% having a bachelor's degree or higher. Forty-two percent of individuals were on an insulin pump.

### Procedure

The study was approved by the appropriate institutional review boards, with parents providing informed consent and teens providing consent or assent. Procedures involved an in-person laboratory session followed by an online confidential survey, with instructions to complete the survey individually. Teens were paid \$50 for completing the laboratory procedures and online survey.

### Measures

#### Conduct Problems

The 6-item Conduct Problems subscale of the Conners-Wells' Adolescent Self Report Scale-Short (Conners et al., 1997) measured adolescents' problems following rules, relating to people in authority, and being easily angered (e.g., "I break rules"). Items were answered using a scale from 0 (*not true at all*) to 3 (*very much true*). Reliability in the present sample was  $\alpha = .73$ . T-scores adjusting for adolescents' age and sex were used in the analyses.

#### Parental Relationship Quality

The 5-item acceptance subscale from the Mother-Father-Peer scale (Epstein, 1983) measured adolescents' perceptions of mothers' and fathers' communication of love, acceptance, and appreciation of them. Adolescents rated acceptance from mothers and fathers separately on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Reliability in the present sample was  $\alpha = .86$  and  $.88$  for mother and father acceptance, respectively.

#### Parental Knowledge

Adolescents reported on parental knowledge by completing the 7-item diabetes parental monitoring scale (Berg et al., 2008). Adolescents reported separately how much their mothers and fathers "*really*" know about aspects of their diabetes care (e.g., blood sugar readings; how much insulin has been taken) using a 1 (*doesn't know*) to 5 (*knows everything*) scale. Reliability in the present sample was  $\alpha = .92$  and  $.96$  for mother and father knowledge, respectively.

#### Diabetes Disclosure and Secrecy

Adolescents completed the diabetes disclosure and secrecy items developed for use with the type 1 diabetes population by Osborn et al. (2013). These items were developed from Stattin and Kerr's (2000) work to capture how much information adolescents voluntarily disclose to or keep secret from parents about their diabetes and thus this measure builds directly on the secrecy measures in the developmental literature (see Keijsers et al., 2009, 2010; Stattin & Kerr, 2000). Separate ratings were conducted for mothers and fathers. Adolescents were instructed to indicate what they tell their mother/father about their diabetes management (e.g., blood sugar readings, how much insulin they have taken, what their pump readings are). Disclosure was measured with three items ("I spontaneously tell my [mother/father] about what is going on with my diabetes management," "I like to tell my [mother/father] about my diabetes management," and "I often want to tell my [mother/father] what is going on with my diabetes management") and secrecy with two items ("I keep a lot of secrets from my [mother/father] about my diabetes management," and "I hide a lot from my [mother/father] about my diabetes management on nights and weekends when I am away from [him/her]"). Items were rated on a 1 (*strongly disagree*) to 5 (*strongly agree*) scale and averaged such that higher scores indicated higher secrecy and disclosure. The diabetes-specific secrecy measure has shown excellent reliability among adolescents with type 1 diabetes, and correlates with diabetes management in younger adolescents (Osborn et al., 2013). Reliability in the present sample was  $\alpha = .83$  and  $.88$  for adolescent disclosure and  $\alpha = .91$

for secrecy from both mothers and fathers, respectively. A factor analysis of these items in the present sample revealed two distinct factors—a three-item disclosure factor and a two-item secrecy factor. Given this pattern and that disclosure and secrecy were only moderately correlated with each other ( $r = -.47$  for both mothers and fathers), disclosure and secrecy were analyzed as separate variables in the analyses.

### Adherence

An adapted version of the Self-Care Inventory (La Greca, Follansbee, & Skyler, 1990; Lewin et al., 2009) measured adherence to various diabetes tasks (e.g., checking blood glucose, eating proper foods). In consultation with a certified diabetes educator and pediatric endocrinologist, items were selected that would be expected to occur daily. Mothers and adolescents reported adherence to the regimen over the past month (1 = *never did it* to 5 = *always did this as recommended without fail*); average scores were analyzed (adolescent report:  $\alpha = .82$ , mother report:  $\alpha = .91$ ).

### Metabolic Control

Metabolic control was indexed using glycosylated hemoglobin (HbA1c) obtained from mail-in HbA1c assay kits obtained from and processed by CoreMedica Laboratories. HbA1c represents the average blood glucose over the prior 2 or 3 months, with higher levels indicating poorer metabolic control. Blood samples were obtained during the laboratory session, and mailed to the laboratory for analysis, allowing us to closely match the timing of survey and HbA1c measure.

### Depressive Symptoms

Adolescents completed the Center for Epidemiologic Studies Depression Scale (Radloff, 1977) to measure depressive symptoms. Respondents rated the experience of 20 common symptoms of depression over the past week on a 0 (*rarely or none of the time*) to 3 (*most or all of the time*) scale. Reliability in the present sample was good ( $\alpha = .93$ ).

### Data Analysis Plan

SPSS version 22 was used to conduct analyses. First, bivariate correlations among study variables were calculated. Second, we examined whether relationship variables (acceptance, disclosure, and knowledge) and conduct problems were uniquely associated with secrecy from mothers and fathers using mixed linear modeling. This analysis was used to control for the dependency of secrecy from mothers and from fathers, given the correlation between these variables ( $r = .71$ ,  $p < .001$ ). Third, hierarchical multiple regressions were used to test whether secrecy was associated with

diabetes management and depressive symptoms above and beyond relationship variables and conduct problems. Because previous research has found that male adolescents tend to be more secretive than females (Keijsers et al., 2010) and socioeconomic status has been associated with relationship quality variables in the diabetes context (Main et al., 2014), adolescent sex and mother education were included as covariates in all regression analyses. We examined secrecy from mothers and fathers separately, given the importance of father involvement in youth with chronic illness (Wysocki & Gavin, 2006). In analyses with diabetes outcomes as dependent variables, time since diagnosis and diabetes regimen (pump vs. multiple daily injections) were also included as covariates. Because the study was conducted at two sites in different states, interactions between sites were explored for all regression analyses; they were not significant and were dropped from analyses.

### Results

Means, standard deviations, and correlations among study variables are presented in Table I. Adolescents reported higher disclosure to mothers,  $t(222) = 4.81$ ,  $p < .001$ , and higher mother knowledge compared with fathers,  $t(214) = 8.89$ ,  $p < .001$ . There were no differences in secrecy from mothers vs. fathers,  $t(221) = -0.36$ ,  $p = .72$ , or in acceptance,  $t(223) = 0.99$ ,  $p = .33$ . Higher secrecy from mothers and fathers were associated with lower acceptance, diabetes disclosure, and parental diabetes knowledge, and with higher conduct problems. Higher secrecy from mothers and fathers was associated with poorer metabolic control and adherence, and higher depressive symptoms. Parent-adolescent relationship variables and conduct problems were also associated with diabetes management and depressive symptoms in a manner consistent with the broader literature.

We next examined the unique associations of relationship variables and conduct problems with secrecy from parents. Using linear mixed modeling, we first tested a baseline model in which all adolescent-reported relationship variables (mother/father acceptance, disclosure to mothers/fathers, and mother/father knowledge) were allowed to vary across mothers and fathers with secrecy as an outcome. Mother acceptance, mother diabetes knowledge, disclosure to mothers, and conduct problems were all uniquely associated with secrecy from mothers. Only disclosure to fathers was significantly uniquely associated with secrecy from fathers (see Table II).

To determine whether there were differences in the associations between relationship variables and secrecy from parents, we used chi-square tests to compare the fit of three separate models in which each



**Table 1.** Correlations Among Demographic, Illness, and Primary Study Variables

| Variable                          | M (SD)        | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9      | 10      | 11      | 12      | 13   |
|-----------------------------------|---------------|---------|---------|---------|---------|---------|---------|---------|---------|--------|---------|---------|---------|------|
| 1. Mother acceptance              | 4.32 (0.88)   | —       |         |         |         |         |         |         |         |        |         |         |         |      |
| 2. Disclosure to mother           | 3.21 (0.96)   | .34***  | —       |         |         |         |         |         |         |        |         |         |         |      |
| 3. Mother diabetes knowledge      | 3.29 (1.03)   | .26***  | .53***  | —       |         |         |         |         |         |        |         |         |         |      |
| 4. Secrecy from mother            | 2.47 (1.12)   | -.34*** | -.47*** | -.49*** | —       |         |         |         |         |        |         |         |         |      |
| 5. Father acceptance              | 4.30 (0.88)   | .52***  | .22***  | .16*    | -.36**  | —       |         |         |         |        |         |         |         |      |
| 6. Disclosure to father           | 2.96 (1.15)   | .17*    | .59***  | .33***  | -.40*** | .47***  | —       |         |         |        |         |         |         |      |
| 7. Father diabetes knowledge      | 2.76 (1.15)   | .17*    | .35***  | .62***  | -.40*** | .35***  | .57***  | —       |         |        |         |         |         |      |
| 8. Secrecy from father            | 2.45 (1.13)   | -.17*   | -.37*** | -.41*** | .71***  | -.33*** | -.47*** | -.39*** | —       |        |         |         |         |      |
| 9. Conduct problems               | 2.31 (2.18)   | -.14*   | -.26*** | -.17**  | .31***  | -.22*** | -.29*** | -.22*** | .21**   | —      |         |         |         |      |
| 10. HbA1c                         | 8.30 (1.63)   | -.14*   | -.07    | -.10    | .20**   | -.24*** | -.13    | -.12    | .16*    | .21**  | —       |         |         |      |
| 11. Adherence (A)                 | 3.98 (0.60)   | .16*    | .34***  | .41***  | -.42*** | .30***  | .32***  | .30***  | -.42*** | -.18** | -.24*** | —       |         |      |
| 12. Adherence (M)                 | 3.89 (0.63)   | .11     | .12     | .12     | -.24**  | .27***  | .17*    | .13     | -.28*** | -.13   | -.41*** | .43***  | —       |      |
| 13. Depressive symptoms           | 16.72 (12.04) | -.17*   | -.05    | -.17**  | .26**   | -.31*** | -.08    | -.08    | .20**   | .24*** | .24***  | -.30*** | -.30*** | —    |
| 14. Adolescent sex <sup>a</sup>   | 61.20         | -.05    | -.12    | -.01    | -.03    | -.01    | -.07    | .03     | -.02    | .27*** | .15*    | .09     | -.06    | -.05 |
| 15. Mother education <sup>b</sup> | 3.98 (1.35)   | .07     | -.08    | -.03    | -.02    | .07     | .01     | -.01    | -.05    | .13    | -.27*** | -.03    | .09     | -.03 |
| 16. Pump status <sup>c</sup>      | 43.30         | .05     | -.04    | -.06    | -.06    | .03     | .04     | -.03    | -.10    | -.05   | -.28*** | .01     | .10     | -.07 |
| 17. Illness duration (years)      | 7.53 (3.76)   | .06     | -.00    | .00     | -.09    | .09     | .02     | -.08    | -.06    | .07    | .13     | -.09    | -.08    | -.11 |

Notes. M = mean, SD = standard deviation; (M) = mother report; (A) = adolescent report.

<sup>a</sup>0 = female, 1 = male.

<sup>b</sup>Mother education coded as: 1 = some high school or less, 2 = high school graduate or equivalent, 3 = some college, 4 = associates/vocational degree, 5 = bachelor's degree, 6 = master's degree, 7 = MD/PhD/JD.

<sup>c</sup>0 = does not use pump, 1 = uses pump.

\*\*\**p* < .001, \*\**p* < .01, \**p* < .05.

**Table II.** Mixed Linear Models Predicting Secrecy From Mothers and Fathers From Parental Acceptance, Parent Diabetes Knowledge, Adolescent Disclosure to Parents, and Conduct Problems

| Variable                             | Secrecy from mothers | Secrecy from fathers |
|--------------------------------------|----------------------|----------------------|
| <i>Fixed effects</i>                 |                      |                      |
| Adolescent sex(0 = female, 1 = male) | -.35* (.13)          | -.35* (.15)          |
| Mother education                     | .00 (.00)            | .00 (.00)            |
| Acceptance                           | -.21** (.07)         | -.06 (.08)           |
| Diabetes knowledge                   | -.19** (.06)         | -.12 (.06)           |
| Disclosure                           | -.26*** (.07)        | -.21** (.08)         |
| Conduct problems                     | .15*** (.03)         | .06 (.04)            |
| Intercept variance                   | .97*** (.10)         |                      |
| Residual variance                    | .78*** (.08)         |                      |
| Error covariance                     | .56*** (.08)         |                      |

Note. Estimates and standard errors (in parentheses).

\*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$ .

independent variable was fixed across mothers and fathers compared with the baseline model in which all variables were allowed to vary across mothers and fathers. None of these tests were significant, suggesting that the associations between relationship variables and secrecy did not differ across mothers and fathers, ( $\chi^2(1) = 3.28, p > .05$ ,  $\chi^2(1) = 0.93, p > .10$ , and  $\chi^2(1) = 0.37, p > .10$ , for acceptance, knowledge, and disclosure, respectively).

We then examined the unique associations of conduct problems, relationship variables (acceptance, parental knowledge, and disclosure), and secrecy to outcomes (HbA1c, mother- and adolescent-reported adherence, and depressive symptoms). Though mother and adolescent reports of adherence were correlated ( $r = .43, p < .001$ ), we analyzed them separately owing to differential correlations with study variables (see Table I). For all regressions, in Step 1, the covariates (adolescent sex, mother education, illness duration, and pump status) were entered. In Step 2, conduct problems and relationship variables (acceptance, parental knowledge, and disclosure) were entered. In Step 3, secrecy was entered, allowing us to examine its unique association with each outcome. For regressions with mother relationship factors and conduct problems as independent variables, in Step 2, mothers' diabetes knowledge was uniquely associated with better adolescent-reported adherence and fewer depressive symptoms, and conduct problems were uniquely associated with lower adolescent-reported adherence and more depressive symptoms (see Table III). In Step 3, secrecy from mothers was associated with poorer metabolic control and lower adolescent- and mother-reported adherence independently of relationship variables and conduct problems. Contrary to hypotheses, secrecy from mothers was not uniquely associated with depressive symptoms. For regressions with father relationship variables and conduct problems as

independent variables, in Step 2, father acceptance was uniquely associated with better metabolic control, higher mother-reported adherence, and fewer depressive symptoms, and conduct problems were uniquely associated with more depressive symptoms. In Step 3, secrecy from fathers was uniquely associated with lower adolescent- and mother-reported adherence and more depressive symptoms.

To determine whether differences in mother and father secrecy predicting HbA1c were significantly different from each other, we conducted an R-square change test (Cohen, Cohen, West, & Aiken, 2003). First, a sum of secrecy from each parent was computed. Then, we compared the R-square values from a regression model predicting HbA1c based on the summed variable as a predictor to a model predicting HbA1c from secrecy from mothers and fathers as simultaneous predictors. The R-square values were not significantly different from one another,  $F(3, 178) = 1.25, p > .05$ , suggesting that the findings for mothers and fathers were not significantly different from one another.

## Discussion

The present study investigated the (a) unique associations of parent-adolescent relationship variables (disclosure to parents, parental acceptance, and parental knowledge) and adolescent conduct problems with secrecy from parents, and (b) whether secrecy was related to diabetes and psychological outcomes above and beyond these other factors. Findings suggest that diabetes-related secrecy may be a unique risk factor for poor diabetes management in late adolescence.

Adolescents were less likely to keep secrets when the parent-adolescent relationship was positive and they had few problem behaviors. This is consistent with the general developmental literature (Frijns et al., 2010; Smetana et al., 2010; Tilton-Weaver, 2014). In the diabetes context, parental knowledge is key to successful health outcomes (King et al., 2014). Our study suggests that adolescents are less likely to keep secrets about diabetes when they feel accepted by their parents, are willing to disclose their diabetes management activities, when their parents are knowledgeable about their diabetes, and when they do not engage in problem behaviors. It is important to note that secrecy from mothers and fathers were correlated, and while there were some differential associations between relationship variables and conduct problems and secrecy from mothers and fathers, the differences across mothers versus fathers were not statistically significant. These findings highlight the complex interpersonal context in which secrecy occurs, and demonstrate that such relations are important to consider in adolescent diabetes management.

**Table III.** Multiple Regressions Predicting Glycemic Control, Adherence, and Depressive Symptoms From Secrecy From Parents

| Variable  | DV: HbA1c |              | DV: Adherence (A) |              | DV: Adherence (M) |              | DV: Depressive symptoms |              |
|---|-----------|--------------|-------------------|--------------|-------------------|--------------|-------------------------|--------------|
|   | $\beta$   | $\Delta R^2$ | $\beta$           | $\Delta R^2$ | $\beta$           | $\Delta R^2$ | $\beta$                 | $\Delta R^2$ |
| Regressions using secrecy from mothers as a predictor |           |              |                   |              |                   |              |                         |              |
| Step 1  |           | .19***       |                   | .03          |                   | .04          |                         | .01          |
| Adolescent sex (0 = female, 1 = male)                 | .11       |              | .11               |              | -.05              |              | -.05                    |              |
| Mother education                                      | -.31***   |              | -.02              |              | .16*              |              | .01                     |              |
| Pump status   | -.26***   |              | -.04              |              | .10               |              | -.03                    |              |
| Illness duration                                      | .22***    |              | -.10              |              | -.10              |              | -.08                    |              |
| Step 2  |           | .02          |                   | .23***       |                   | .04          |                         | .15***       |
| Mother acceptance                                     | -.05      |              | .03               |              | .07               |              | -.11                    |              |
| Disclosure to mothers                                 | -.06      |              | .21**             |              | .04               |              | .09                     |              |
| Mother knowledge                                      | -.04      |              | .26***            |              | .08               |              | -.20*                   |              |
| Conduct problems                                      | .06       |              | -.15*             |              | -.11              |              | .29***                  |              |
| Step 3  |           | .02*         |                   | .03**        |                   | .04*         |                         | .01          |
| Mother acceptance                                     | -.02      |              | .00               |              | .04               |              | -.10                    |              |
| Disclosure to mothers                                 | -.01      |              | .16               |              | -.01              |              | .12                     |              |
| Mother knowledge                                      | .02       |              | .19*              |              | .01               |              | -.17                    |              |
| Conduct problems                                      | .02       |              | -.09              |              | -.06              |              | .25**                   |              |
| Secrecy from mothers                                  | .20*      |              | -.23**            |              | -.24**            |              | .13                     |              |
| Regressions using secrecy from fathers as a predictor |           |              |                   |              |                   |              |                         |              |
| Step 1  |           | .20***       |                   | .04          |                   | .05          |                         | .02          |
| Adolescent sex (0 = female, 1 = male)                 | .10       |              | .15               |              | .00               |              | -.07                    |              |
| Mother education                                      | -.33**    |              | .03               |              | .17*              |              | -.02                    |              |
| Pump status   | -.27***   |              | .00               |              | .14               |              | -.04                    |              |
| Illness duration                                      | .23**     |              | -.13              |              | -.10              |              | -.08                    |              |
| Step 2  |           | .06*         |                   | .17***       |                   | .09**        |                         | .13***       |
| Father acceptance                                     | -.24**    |              | .16               |              | .23**             |              | -.24**                  |              |
| Disclosure to fathers                                 | -.02      |              | .13               |              | .09               |              | .14                     |              |
| Father knowledge                                      | -.01      |              | .16               |              | -.01              |              | -.05                    |              |
| Conduct problems                                      | -.01      |              | -.09              |              | -.05              |              | .25**                   |              |
| Step 3  |           | .01          |                   | .06**        |                   | .04**        |                         | .02          |
| Father acceptance                                     | -.22**    |              | .13               |              | .19*              |              | -.21*                   |              |
| Disclosure to fathers                                 | -.00      |              | .06               |              | .05               |              | .18                     |              |
| Father knowledge                                      | .01       |              | .10               |              | -.05              |              | -.02                    |              |
| Conduct problems                                      | -.01      |              | -.08              |              | -.05              |              | .24**                   |              |
| Secrecy from fathers                                  | .09       |              | -.29***           |              | -.23**            |              | .16*                    |              |

Note. In all steps of the model, covariates (adolescent sex, mother education, pump status, and illness duration) were entered. (M) = mother report; (A) = adolescent report. \*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$ .

Adolescents who kept diabetes-related secrets from parents had poorer adherence according to both mother and adolescent report, and adolescents who kept secrets from mothers also had poorer glycemic control. These findings are largely consistent with Osborn et al. (2013) and with a large literature suggesting that secret keeping is associated with poorer well-being in both adolescents and adults (Finkenauer, 1999; Frijns et al., 2005). Notably, these associations were independent of parent-adolescent relationship variables and adolescent problem behaviors—variables that were associated with secrecy in the present study and have been associated with diabetes management in prior research (Cohen et al., 2004; King et al., 2014; Osborn et al., 2013). Taken together, our findings indicate there may be something quite maladaptive about keeping secrets from parents even in late adolescence when adolescents are transitioning into a

more autonomous role in the family (Smetana, Campione-Barr, & Daddis, 2004).

It is important to consider why secrecy is so problematic even in late adolescence. Secrecy during adolescence is problematic partly because it deprives parents of information that is necessary to respond effectively to their children's needs (Finkenauer et al., 2002; Smetana, Metzger, Gettman, & Campione-Barr, 2006). Despite their increasing independence in diabetes management, late adolescents often continue to rely on parents as important sources of support, advice, and tangible aid (Hanna et al., 2014; Hilliard et al., 2014), and parental support has been associated with better diabetes management among late adolescents and emerging adults (Helgeson et al., 2014). While secrecy can serve as a barrier to parental support, it is important to note that the associations of secrecy to outcomes were independent of parental



knowledge. It may be that keeping secrets requires adolescents to actively monitor, inhibit, or suppress thoughts, emotions, and behaviors to protect their secrets (Frijns et al., 2005), which can be psychologically and physically taxing.

There are several limitations in the present study that warrant mentioning. First, the cross-sectional nature of the data precludes determination of directionality of the associations among the variables. It is possible that adolescents are more likely to keep secrets about their diabetes when their adherence is poor. A longitudinal investigation examining how secrecy may derive from relationship and behavioral problems and link to diabetes outcomes over time would better address this question. Additionally, alternative methodologies, such as daily diary measures (see Smetana et al., 2010), may better capture day-to-day fluctuations in associations between secrecy and diabetes management. Second, self-report measures may not accurately assess adherence or relationship variables. Future research using interviews and observational methodologies may elucidate why adolescents keep secrets in the diabetes context, and glucometer downloads could be used to provide a more objective index of adherence. Third, the secrecy measure used in the present study only consisted of two items. Although this is a commonly used measure in secrecy research (see Keijsers et al., 2010), future work is warranted that validates the measure in this population, such as by tracking adolescents' diabetes management and verifying this information with what adolescents report they do in regard to their diabetes management. Fourth, the sample was primarily White. Although type 1 diabetes most commonly develops among European Americans, there are ethnic disparities in type 1 diabetes management (Gallegos-Macias, Macias, Kaufman, Skipper, & Kalishman, 2003). Future research with ethnically diverse samples is warranted to better understand how families from various socioeconomic and cultural backgrounds manage chronic illness across adolescence. Fifth, we did not have objective measures of parental involvement. Such information would illuminate how parents continue to be involved in diabetes care in late adolescence. Finally, secrecy from parents explained a small portion of the variance in diabetes outcomes. It is important to note that we conducted a fairly conservative test of these associations. That is, secrecy was uniquely associated with diabetes outcomes after controlling for multiple other relationship and behavioral factors that were associated with secrecy in the present study and are commonly associated with diabetes management. This underscores the importance of considering other variables that might be important in understanding adherence and metabolic control including other relationship variables such as conflict (Hilliard, Wu, Rausch, Dolan, & Hood,

2013) and individual factors such as self-regulation (Berg et al., 2014).

Despite these limitations, the present study makes important contributions to the literature. Although the amount of unique variance in diabetes outcomes explained by secrecy after controlling for other relationship and behavioral variables is small, correlations between secrecy and HbA1c were almost as large as the correlation between adolescent-reported adherence and HbA1c. Such findings suggest that secrecy has detrimental associations with diabetes management even when considering multiple interpersonal and individual factors that influence adolescent diabetes and psychological outcomes. Despite previous theorizing that secrecy during adolescence could have positive functions (see Finkenauer et al., 2002), our findings show that secrecy from parents, even in late adolescence, has harmful associations with adolescent physical health and psychological outcomes. This research holds implications for clinicians and physicians who are working with families managing type 1 diabetes. Specifically, clinicians should alert families to the importance of information sharing about adolescents' diabetes management and encourage parents to solicit information from adolescents about their diabetes in a supportive manner.

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