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Effects of socio-demographic factors on parental monitoring, and regimen adherence among adolescents with type 1 diabetes: A moderation analysis

Liyang Zhang¹, Deborah A. Ellis^{1,*}, Sylvie Naar-King¹, Kathleen Moltz¹, April I. Carcone¹, and Bassem Dekelbab^{2,3}

¹Carman and Ann Adams Department of Pediatrics, Wayne State University School of Medicine, Detroit, MI

²Department of Pediatrics, St. John Hospital and Medical Center, Detroit, MI

³Department of Pediatrics, William Beaumont Hospital, Royal Oak, MI

Abstract

Parental monitoring of adolescent diabetes care is an important predictor of adolescent regimen adherence. To date, no studies have investigated whether socio-demographic factors are associated with low levels of parental monitoring or differences in parental monitoring styles, and their moderating effects in families of adolescents with type 1 diabetes. The purpose of this cross-sectional study was to determine whether youth and family socio-demographic factors moderated the relationship between monitoring and youth regimen adherence (i.e., mean frequency of blood glucose testing [BGT]). Data were collected from 267 adolescents with type 1 diabetes and their parents. Hierarchical multiple regression analyses were employed. Socio-demographic factors accounted for 17.1% of the variance in adherence. After parental monitoring scales were entered, R^2 in all eight equations increased and R^2 change score in six of eight equations were significant. All models were significant after the interaction terms were entered. In the adolescent report models, parent age and family structure were both independently associated with adherence and also moderated the association between adolescent-report parental monitoring and adherence to diabetes care, in particular, adolescent report of parental direct observation/presence during diabetes care. In the parent report models, income was moderated the association between parent-report youth disclosure and adherence. Research should focus on identifying additional modifiable factors that place families at risk for low levels of parental monitoring of diabetes care. Future clinical research is needed to help identify risk factors for low levels of parental monitoring and develop interventions to promote optimal parenting skills that can support youth diabetes care.

Keywords

Adolescents; Parental monitoring; Socio-demographic factors; Adherence; Metabolic control

*Corresponding author: Deborah A. Ellis, Ph.D., Professor, Pediatric Prevention Research Center, Carman and Ann Adams Department of Pediatrics, Wayne State University School of Medicine, Detroit, MI, Old Hutzel Hospital, Suite W534, 4707 St. Antoine, Detroit, MI 48201, Telephone: 313-993-7851, Fax: 313-745-4993, dellis@med.wayne.edu.

Introduction

Type 1 diabetes is one of the leading chronic diseases in children aged <20 years (Pettitt et al., 2014). A recent study reported that the prevalence of type 1 diabetes in this population in the United States increased from 1.48 per 1000 in 2001 to 1.93 per 1000 in 2009, representing an increase of 21.1% in adjusted prevalence (Dabelea et al., 2014). Adolescents with type 1 diabetes are more likely to be engaged in mismanagement behaviors (e.g., diet, missing blood tests, or missing insulin shots); in turn they are more likely to have poorer metabolic control than either their younger or older counterparts (Delamater, Albrecht, Postellon, & Gutai, 1991; Johnson, Silverstein, Rosenbloom, Carter, & Cunningham, 1986; Weissberg-benchell et al., 1995). Poorer metabolic control among adolescents results in risk for severe complications, including retinopathy, kidney failure, and heart disease (Afkarian, 2015; Clement et al., 2004). Therefore, understanding factors that can predict poor adolescent regimen adherence is critical.

One common method of assessing the effectiveness of diabetes management is to determine the frequency of patient self-monitoring of blood glucose (SMBG) (American Diabetes Association, 2015). SMBG is required to be conducted prior to meals and snacks, at bedtime, prior to exercise, when low blood glucose is suspected and after treating low blood glucose (American Diabetes Association, 2014). Although diabetes self-care includes completion of insulin administration and management of diet, SMBG is the regimen adherence behavior that has been most closely linked to metabolic control in pediatric populations (Levine et al., 2001; Miller et al., 2013). Frequency of blood glucose testing can also be obtained directly from the blood glucose meter and therefore is not subject to the typical self-report biases that are present when questionnaire measures of adherence are used.

Family environment plays a critical role in adolescent adherence (Pereira, Berg-Cross, Almeida, & Machado, 2008). A number of family and parenting variables have been found to be related to adolescent adherence and metabolic control (Hanson, Henggeler, Harris, Burghen, & Moore, 1989; Naar-King, Podolski, Ellis, Frey, & Templin, 2006). Parental monitoring and supervision of adolescent diabetes care appears to be one important parenting variable (Ellis et al., 2007; Ellis et al., 2012). Parental monitoring is defined by Dishion and McMahon (1998) as “a set of correlated parenting behaviors involving attention to and tracking of the adolescent’s whereabouts, activities and adaptation” (p.61). In samples of youth with type 1 diabetes, adherence and metabolic control among adolescents have likewise been found to be related to parental monitoring. In cross-sectional studies, Ellis et al. reported that parents who engaged in higher levels of monitoring had adolescents with better adherence, and through adherence, better metabolic control (Ellis et al., 2007; Ellis et al., 2012; Hilliard, Wu, Rausch, Dolan, & Hood, 2013). Longitudinal studies have also indicated that declines in adolescents’ adherence and metabolic control are associated with declines in parental monitoring (King, Berg, Butner, Butler, & Wiebe, 2014; King et al., 2012).

Recent studies have also attempted to disentangle those particular parental monitoring practices that are most closely tied to better adolescent regimen adherence. Parents gather

information about their adolescent's activities in a number of ways, including asking the adolescent, gathering information from other adults or the youth's peers and being present during adolescent activities. A considerable literature also suggests that youths' spontaneous disclosure of their activities to their parents is another important source of information (Eaton, Krueger, Johnson, McGue, & Iacono, 2009; Soenens, Vansteenkiste, Luyckx, & Goossens, 2006). In one paper examining these issues in a sample of chronically ill children, Ellis et al. (2012) showed that while soliciting information from the adolescent (i.e., asking the youth if care was completed) was the most common method by which parents engaged in monitoring of youth diabetes management, only direct observation of diabetes care completion by the parent and youth disclosure about their diabetes (i.e., youth sharing information about care without parental prompting) were predictive of better adherence.

Factors that increase risk for low levels of parental monitoring or use of ineffective parental monitoring practices are not well understood. Studies from the general child development literature have provided mixed evidence that risk for low parental monitoring is related to socio-demographic factors such as minority status, family structure or socioeconomic status (Le et al., 2008; Levine et al., 2001; Li, Feigelman, & Stanton, 2000). No studies have investigated whether socio-demographic factors are associated with low levels of parental monitoring or differences in parental monitoring styles in families of adolescents with type 1 diabetes. Therefore, the purpose of this study was to determine whether child (i.e., age, gender) and family (i.e., parent age, gender, education, minority status, family structure, parent employment status, and family income) socio-demographic characteristics moderated the relationship between parental monitoring and adolescent adherence (i.e., frequency of daily blood glucose testing) in a diverse sample of adolescents with type 1 diabetes and their parents.

Method

Participants

The study used a cross-sectional design with a convenience sample. Participants were recruited from two pediatric diabetes clinics in a large Midwestern city at scheduled clinic visits from December 2007 to September 2009. The first clinic was a university-affiliated clinic in an urban children's hospital. The second clinic was part of a large hospital-affiliated private practice in a suburban area. Recruiting from these two sources increased the representation of minority (African-American) families across a broad range of income levels.

Procedures

Adolescents and their parents were approached for participation if they met the following eligibility criteria: (1) adolescents aged 12–18 years; (2) diagnosed with type 1 diabetes for at least six months; (3) resided in a family setting with a parent or caregiver (i.e., non-biological parent such as an adoptive parent or legal guardian) who was willing to participate in the study; (4) without cognitive impairment, developmental delays or psychosis; (5) without additional chronic conditions that caused atypical diabetes management (e.g., adolescents with cystic fibrosis). All families meeting these criteria who

were seen for a clinic visit during the study period were offered the opportunity to participate. Data collection took place before or after the diabetes clinic visit to maximize convenience for families and took approximately one hour. Sixty-two percent of the 274 families approached in the urban clinic and 65% of the 145 families approached in the suburban clinic agreed to participate. The most frequent reason for non-participation was the extra time required to complete the study. The final sample consisted of 267 participants (94 from the suburban clinic, 173 from the urban clinic). The research was approved by the respective hospital Institutional Review Boards. Participants provided informed consent and assent to participate. Participants were provided with a \$5 gift certificate for completing the study measures. Data were collected by a trained research assistant who was present during the completion of measures to answer questions and ensure that the caregiver and adolescent did not share their responses. If two caregivers were present at the clinic visit, the caregiver that was most involved in the adolescent's diabetes care was asked to complete the measures.

Measures

Parental monitoring—Parental monitoring of diabetes care was measured using the Parental Monitoring of Diabetes Care-Revised (PMDC-R) questionnaire (Ellis et al., 2012). This self-report measure assesses parental monitoring of diabetes management in a number of domains (e.g., insulin administration, blood glucose testing) and via a number of parental monitoring strategies (e.g., watching adolescent complete diabetes care tasks, asking the adolescent about care completion, asking other family members whether the adolescent completed their diabetes care). Responses are on a 5-point Likert scale (i.e., from 1=less than once a week to 5=more than once a day), with higher responses indicating more parental monitoring. Both the adolescent-report version and the parent-report version were administered. Scores for a total parental monitoring scale [(PM, 30 items in parent-report), (PM, 27 items in adolescent-report)]; and three subscales: direct observation/presence [(DOP, 17 items in parent-report), (DOP, 14 items in adolescent-report)]; youth disclosure (YD, 9 items in both parent-report and adolescent-report); and solicit information from youth (SIY, 4 items in both parent-report and adolescent-report) can be calculated. In prior studies, while all three aspects of parental monitoring were related to one another, higher levels of direct observation (parent watching the youth complete their diabetes care) and youth disclosure (youth telling the parent about their diabetes care completion spontaneously without being asked) were found to be related to better youth diabetes management. On the other hand, the degree to which parents solicited information from adolescent (asked the youth whether or not diabetes care had been completed) was unrelated to youth diabetes management (Ellis et al., 2012).

For the present analyses, 3 items from the adolescent report version of the PMDC-R that were not present on the parent version and 1 item from the parent version not found on the adolescent version were not used. In the present study, the total PM scales had high reliability (Cronbach's $\alpha=0.94, 0.87$, for adolescent and parents respectively) as did the three subscales (DOP: Cronbach's $\alpha=0.87, 0.83$ respectively; YD: Cronbach's $\alpha=0.90, 0.95$, respectively; SIY: Cronbach's $\alpha=0.82, 0.83$ respectively).

Metabolic control—Metabolic control was measured by glycosylated hemoglobin (HbA_{1C}). HbA_{1C} was obtained as part of routine care during the clinic visit using the Bayer DCA 2000+; the information was extracted from the medical record by the research staff. HbA_{1C} is commonly used as a clinical and research metric of diabetes health outcomes, as it represents the blood integrated glucose concentration in the preceding 8–12 weeks (Little & Sacks, 2009). According to 2015 American Diabetes Association Standards of Medical Care in Diabetes, the recommended target HbA_{1C} is <7.5% for all pediatric age-groups (American Diabetes Association, 2015). Higher levels of HbA_{1C} represent poorer metabolic control and therefore greater risk of diabetes complications.

Adherence—Adherence was measured by the average frequency of daily blood glucose testing (BGT). BGT was obtained directly from the adolescent's blood glucose (BG) meter during the clinic visit by the research staff. Youth were asked if they used any other meters (such as at schools) and in these instances efforts were made to obtain data from additional meters by phone, FAX or other means. Frequency of testing during the 14-day period immediately preceding data collection was recorded and an average daily testing frequency was subsequently calculated.

Socio-demographic factors—Parents completed a questionnaire regarding socio-demographics, including child and parent age, gender, minority status, family structure, parental education, parental employment status, and family income. Minority status was coded as either African American or White/Other, as there were very few members of other ethnic/racial groups represented in the current data set. Subjects were coded as residing in a two-parent family if their caregiver reported that they were “married or living with a partner”. Subjects were coded as residing in a single-parent family if their caregiver reported that they were “single or widowed” or “separated or divorced”. Other types of family structures (i.e., married to mother/father of this child; married but not to mother/father of this child; single and living with a partner; divorced and living with a partner) were coded as two-parent family. Parent's education and employment status were each recoded into two categories: (*no college*=0 vs. *some college*=1) and (*unemployed*=0 vs. *employed*=1). Family annual income (<9999=1, 10000–19999=2, 20000–29999=3, 30000–39999=4, 40000–49999=5, 50000–59999=6, 60000–69999=7, 70000–79999=8, 80000–89999=9, 90000–99999=10, >100000=11) was recoded as falling into two categories: below poverty level (< \$30,000) and above poverty level (≥ \$30,000) based on the federal poverty guidelines and average family size in Michigan (U. S. Census Bureau, 2010; U.S. Department of Health and Human Services, 2014).

Data analyses

All analyses were conducted using SPSS version 21.0. Analyses were conducted using hierarchical multiple regression with blood glucose testing (BGT) serving as the outcome variable. Separate regressions were conducted using the total PM scale and each the three PM subscales [direct observation/presence (DOP), youth disclosure (YD), and soliciting information from the youth (SIY)] to determine if different relationships emerged when the total PM score or one of the three subscales were used. In Step 1, socio-demographic correlates (child age and gender, parent age and gender, minority status, family structure,

parent education, parental employment status, family annual income) were entered. In Step 2, the parental monitoring total scale or one of the three subscales was entered. In Step 3, all the interaction terms (e.g., child age $\times$ parental monitoring) were entered to test for moderator effects of the socio-demographic variables. Subsequently, for those socio-demographic variables where the interaction term was significant on Step 3 (indicating moderation) the direction of the moderator effect was further explored. In order to do so, the relationship between adherence and monitoring at various levels of the socio-demographic variable was plotted. The percentage of missing data in the current study was lower (e.g., the highest percentage of missing data was 4.5% for income variable). These missing data were treated based on list-wise approach.

Results

The average age of adolescents with diabetes was 14.6 years ($SD=1.96$), and 49.8% were girls (Table 1). The average age of parents was 42.9 years ($SD=7.35$). The majority of parents/caregivers (80.8%) were women. Of 267 participants, 35.7% of adolescent's parents were African American. For approximately two-thirds (68.9%) of families, parents reported that they were "married to mother/father of this child", and a third of parents (31.1%) reported they were single parents (single or widowed, or separated or divorced). The majority of parents attended some college (59.3%), were employed (67.7%), and had a family income above poverty level (67.5%). The mean daily frequency of BGT was 2.75 ($SD=1.54$) and the mean HbA1C was 9.7% ($SD=2.4$). On average, the adolescents in the current study had poor metabolic control (above the standard recommendation of 7.5%) and were testing less frequently than recommended (minimum recommended is typically 3–4 times per day).

Table 2 shows the results of the hierarchical multiple regression equations based on parent-reported monitoring. For Equation 1 using the total PM score, on Step 1 socio-demographic factors accounted for 17.1% of the variance in BGT. On Step 2, the addition of the PM scale to the model was significant [F change (1, 231)=25.78, $p<0.001$]. Higher levels of total PM were associated with higher BGT ($p<.01$). Finally, after the addition of the interaction terms in Step 3, the model explained 27.7% of the variance in BGT ($p<0.001$). However, none of the interaction terms were uniquely associated with BGT.

For Equation 2 using the DOP subscale, the findings were essentially similar. On Step 1, socio-demographic factors were a significant predictor of BGT on Step 1 and accounted for 17.1% of the variance in BGT. On Step 2, the addition of DOP to the model was significant [F change (1, 231)=22.15, $p<0.001$]. Higher direct observation of diabetes care completion by parents was associated with higher BGT frequency ($p<.01$). There was no evidence for a moderating effect of socio-demographics on the relationship between direct observation and BGT frequency based on Step 3.

However, a different pattern emerged in Equation 3 when the YD subscale was used. In this model, within the socio-demographic predictors entered on Step 1, youth age was uniquely associated with BGT, with younger children having higher BGT frequency than older children ($B=-0.28$, $p<0.05$). The addition of the YD scale on Step 2 was significant [F

change (1, 231)=18.17, $p<0.001$]. Higher parent-reported youth disclosure regarding diabetes care completion was associated with higher BGT frequency ($p<0.01$). In addition, on Step 3 there was a significant interaction between youth disclosure about diabetes care completion and family income ($B=0.48$, $p<0.05$). To explore this moderation effect further, plots of the relationship between frequency of BGT and degree of youth disclosure were inspected for families living above and below the poverty line (see Figure 1). For families living below the poverty line, youth disclosure about their diabetes care completion had a weaker positive relationship with BGT (mean test frequency per day =2.08 for lower disclosers and 2.23 for higher disclosers). However, for families living above the poverty line, youth disclosure about diabetes care completion had a stronger positive relationship with BGT, with low disclosers completing a mean of 2.59 tests per day and high disclosers completing a mean of 3.50 tests per day.

For Equation 4 using the SIY scale, only the socio-demographic variables significantly predicted BGT. On Step 2, the addition of the SIY scale was not significant ($p>0.05$), suggesting that soliciting information from the youth about diabetes care completion was unrelated to frequency of BGT. There was no evidence for moderation on Step 3 when interaction terms were added.

Table 3 shows the results of the hierarchical multiple regression equations based on adolescent reports of their parent's monitoring of their diabetes care. For Equation 5 using the total PM score, on Step 1 socio-demographic factors accounted for 17.1% of the variance in BGT. In addition, parent age and family structure were uniquely associated with BGT ($p<0.05$). Older parents and single parent families had adolescents with lower BGT. On Step 2, the addition of the PM scale to the model was significant [F change (1, 231)=8.12, $p<0.01$]. Similar to the data from parent-report, adolescent-reported total PM was positively associated with BGT ($P<0.01$). Finally, after the addition of the interaction terms in Step 3, the overall model explained 24.2% of the variance in BGT ($p<0.001$). For this model, on Step 3, evidence of moderation was found, as the parent age $\times$ total PM interaction term and the family structure $\times$ total PM interaction term were uniquely associated with BGT ($p<0.05$). In order to explore the moderation effects further, plots of the relationship between frequency of BGT and lower and higher parental monitoring total score (PM) were inspected for older versus younger caregivers (Figure 2a) and single-versus two-parent families (Figure 2b). Participants were placed into three categories based on tertiles of caregiver age (≤ 38 years, 39–46 years, ≥ 47 years). For older caregivers, there was a stronger positive relationship between total parental monitoring and BGT such that youth with lower parental monitoring tested 2.2 times per day on average and those with higher parental monitoring tested 3.1 times per day on average. However, for younger caregivers, there was a weaker positive relationship between total PM and BGT, such that youth with lower parental monitoring tested 2.3 times per day on average while those with higher monitoring tested 2.9 times per day on average. For two-parent families, there was a weaker positive relationship between total PM and BGT with youth with low parental monitoring testing 2.5 times per day on average and those with high parental observation testing 3.3 times per day on average. However, for single parent families, there was a stronger positive relationship between total PM and BGT, such that youth with lower

parental monitoring tested 1.8 times per day on average while youth with higher lower monitoring tested 2.8 times per day on average.

For Equation 6 using the DOP subscale, the findings were essentially similar to those for the total PM scale in Equation 5. On Step 1, socio-demographic factors were a significant predictor of BGT, accounting for 17.1% of the variance in BGT; parent age and family structure were uniquely associated with BGT ($p < 0.05$). On Step 2, the addition of DOP to the model was significant [F change (1, 231)=6.08, $p < 0.05$]. Higher direct observation of diabetes care completion by parents was associated with higher BGT frequency ($p < 0.05$). On Step 3, the parental age and family structure $\times$ DOP interaction terms were significant. In order to further explore the moderator effects, we grouped caregivers into three categories based on tertiles of caregiver age (38 years, 39–46 years, 47 years). Although as shown in Figure 3a, the slopes for caregivers in three age groups look similar, there was a slight difference between slopes for younger caregivers and older caregivers such that there was a positive relationship between DOP and BGT in older caregivers than younger caregivers. For younger caregivers, those with lower DOP tested 2.2 times per day on average while those with higher DOP tested 2.9 times per day on average. However, for older caregivers, those with lower DOP tested 2.3 times per day on average while those with higher monitoring tested 3.1 times per day on average although these differences did not show statistical significances. Similar to findings on the adolescent-report total PM scale, among two parent families, there was a weaker positive relationship between direct observation of diabetes care by parents and rates of BGT while for single parent families there was a stronger positive relationship between DOP and BGT (Figure 3b). For two-parent families, adolescents with lower DOP tested 2.6 times per day on average and those with high parental observation tested 3.2 times per day on average. However, for single parent families, there was a stronger positive relationship between DOP and BGT, such that youth with lower DOP tested 1.7 times per day on average while those with higher monitoring tested 2.9 times per day on average.

In Equation 7, using the YD scale, socio-demographic factors were a significant predictor of BGT on Step 1 and accounted for 17.1% of the variance in BGT. On Step 2, the addition of YD to the model was significant [F change (1, 231)=8.51, $p < 0.01$]. Similar to findings for parent-reported YD, higher adolescent-reported YD was associated with higher frequency of BGT ($p < 0.01$). There was no evidence for a moderating effect of socio-demographics on the relationship between youth disclosure and BGT frequency based on Step 3. For Equation 8 using the SIY scale, on Step 1, the socio-demographic variables were a significant predictor of BGT and accounted for 17.1% of variance in BGT. Family structure was an independent predictor of BGT, with youth in two parent families showing higher BGT ($p < 0.05$). However, on Step 2, the addition of the SIY scale was not significant ($p > 0.05$), again suggesting no significant effect of SIY on youth BGT. There was no evidence for moderation on Step 3 when interaction terms were added.

Discussion

The purpose of the present study was to test whether socio-demographic factors moderated the relationship between parental monitoring total scale and sub-scales and youth adherence.

Our findings replicated earlier work regarding the importance of parental monitoring for predicting youth regimen adherence (Ellis et al., 2007). Both parent and adolescent report of total parental monitoring were related to higher frequency of daily blood glucose testing. Also consistent with prior studies (Ellis et al., 2012), particular monitoring practices such as the frequency with which parents observed or were present during diabetes management tasks were related to better regimen adherence, while the frequency with which parents asked the youth about diabetes care was unrelated to regimen adherence.

Based on youth report, adolescents residing in single parent families and with older caregivers reported lower levels of adherence with their diabetes care. The findings that children from single parent families have poorer adherence is well known (Frey, Templin, Ellis, Gutai, & Podolski, 2007; Thompson, Auslander, & White, 2001). Single-parent families not only have more limited resources and access to care which may affect diabetes management, but may also have more limited time to promote optimal diabetes management (Astone & McLanahan, 1991). However, the finding that older parents had children who were less adherent is novel. This finding may be artifactual and simply reflect the fact that younger parents also had younger children; younger children have been repeatedly found to have better adherence than older ones (Burdick et al., 2004; Frey et al., 2007). Alternatively, older parents may encounter other barriers to diabetes management such as fatigue, poor health or having more children in the home to care for. This issue should be further explored in future research.

Importantly, several socio-demographic factors were found to moderate the relationship between adherence and parental monitoring. In adolescent-report models, the number of caregivers in the home was a significant moderator of the relationship between adherence and parental monitoring. While the relationship between adherence and monitoring was positive in both cases, the relationship between parental monitoring and frequency of blood glucose testing was stronger for single parent families. Put another way, within single parent families, the degree to which the adolescent reported high levels of oversight of diabetes care by their caregiver was a stronger predictor of frequent blood glucose testing than was the case for two parent families. In adolescent-report models, caregiver age also moderated the relationship between adherence and parental monitoring. While the relationship between adherence and monitoring was positive in all cases, the strongest relationship were found for older caregivers, with degree of parental oversight of diabetes care a stronger predictor of frequency of blood glucose testing for these families versus families with younger caregivers. This suggests that health care providers may need to be particularly alert for low levels of parental monitoring in single parent families and families with older caregivers, as these appear to be contexts in which low parental monitoring is particularly likely to lead to poor diabetes regimen adherence. Health care providers may need to pay more attention and provide additional interventions to these vulnerable families, such as information regarding the value of parental monitoring or referrals for assistance with parenting.

Results of the moderator analyses also suggest that different types of parental monitoring practices may serve as protective factors in different contexts. Based on adolescent report models, although both relationships were positive, direct observation or presence on the part of parents during diabetes care was more strongly related to regimen adherence for single

parent families than it was for two-parent families. Based on parent report models, youth disclosure to parents about whether they had completed their diabetes care or not was more strongly related to regimen adherence among higher income than among lower income families. Monitoring by direct supervision is a different parenting behavior than monitoring via relationship enhancement and promotion of youth responsibility/ honesty about their diabetes care. Contextual factors associated with low income and/or single parent families (i.e., low resource neighborhoods, low social support, poorer access to medical care) versus high income and/ or two parent families (i.e., high resource neighborhoods, higher social support, better access to medical care) may influence which types of parental monitoring of diabetes care are optimal.

Additional research is clearly needed to explore other factors associated with socio-demographic factors that may predict low levels of parental monitoring of diabetes care. These might include parenting beliefs or skills, parental mental health, social support or other factors not explored in the current study. For example, one recent study showed that depressed parents engaged in lower rates of parental monitoring overall, and that lower monitoring was in turn related to poorer metabolic control (Eckshtain, Ellis, Kolmodin, & Naar-King, 2010). Future research should focus on identifying additional factors that place families at risk for low levels of parental monitoring of diabetes care and how these may relate to the socio-demographic variables identified in the present study.

There are several limitations to the present study. First, the sample used in this study was recruited from two pediatric diabetes clinics in the Midwest. While African American families were well-represented, other minority groups were not. Hence, findings may be not representative of adolescents with diabetes of other ethnic minority status or from other communities/geographic regions. With regard to representativeness, in addition to lack of other minority groups, it may be important to note on average the sample in the current study had poor metabolic control (HbA1C=9.69). Future studies need to be done controlling HbA1C as a covariate to see if it makes a difference in BGT. The response rate was only moderate (62% and 65% in the urban and sub-urban clinics, respectively); although this is not atypical in clinic-based studies of youth with diabetes, it is not known how this may have affected sample representativeness. Second, as the data were cross-sectional; causal conclusions cannot be drawn. Third, our measure of adherence (BGT) assessed only a single domain of adherence to diabetes regimen and did not address adherence with other aspects of care such as insulin administration or dietary adherence. Lastly, our conclusions are limited because data on other factors that might affect parental monitoring, including family factors such as caregiver depression, support or beliefs about parenting, were not collected. Third, we did not differentiate between biological parents and non-biological parents on the survey and in data analyses. Results may differ depending on whether that caregiver was a biological parent or not. Further explorations on the role of family structure when the caregiver is a biological parent are needed in the future.

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Figure 1.

The relationship between parent-reported youth disclosure and daily blood glucose testing by income level.

(a)

(b)

Figure 2.

The relationship between adolescent-reported total parental monitoring score and daily blood glucose testing for younger (< 38 years), middle (39–46 years), and older (≥ 47 years) parents (a); and the relationship between adolescent-reported total parental monitoring score and daily blood glucose by number of caregivers in the family (b).

(a)

(b)

Figure 3.

The interaction relation between adolescent-reported direct observation/presence and daily blood glucose testing for younger (< 38 years), middle (39–46 years), and older (≥ 47 years) parents (a); and the interaction relation between adolescent-reported direct observation/presence and daily blood glucose testing at single-parent family and two-parent family (b).

Table 1

Sample socio-demographic characteristics (N=267)

Variables	Mean (SD)	N (%)
Adolescent Age	14.62 (1.96)	
Adolescent Gender		
Female		133 (49.8)
Male		134 (50.2)
Parents' age	42.92 (7.35)	
Parent's gender		
Female		215 (80.8)
Male		51 (19.2)
Minority		
African American		95 (35.7)
White/Other		171 (64.3)
Family structure		
Single-parent		83 (31.1)
Two-parent		184 (68.9)
Parent's education		
No college		107 (40.7)
Some college		156 (59.3)
Employment status		
Unemployed		86 (32.3)
Employed		180 (67.7)
Family annual income		
<\$30,000		83 (32.5)
\$30,000		172 (67.5)
HbA_{1C}	9.69 (2.39)	
Adherence^a	2.75 (1.54)	
Parent reported parental monitoring scale and subscales		
PM	3.40 (0.78)	
DOP	3.46 (0.82)	
YD	2.81 (1.20)	
SIY	4.31 (0.82)	
Adolescent reported parental monitoring scale and subscales		
PM	3.41 (0.89)	
DOP	3.31 (0.93)	
YD	3.24 (1.13)	
SIY	3.98 (0.99)	

Note:

^a Adherence measured by the average frequency of daily blood glucose testing (BGT).

Table 2

Hierarchical multiple regression analyses of blood glucose testing (parent report monitoring)

	PM (Equation 1)					DOP (Equation 2)					YD (Equation 3)					SIY (Equation 4)				
	B	S.E.	β	R ²	F/ F	B	S.E.	β	R ²	F/ F	B	S.E.	β	R ²	F/ F	B	S.E.	β	R ²	F/ F
Step 1 Socio-demographics				0.17					0.17					0.17					0.17	
Child age	−0.07	0.24	−0.09			0.14	0.24	0.17			−0.28	0.13	−0.35*			0.07	0.30	0.09		
Child gender (τ=girl)	−0.93	0.84	−0.30			−0.59	0.83	−0.19			−0.20	0.47	−0.06			−0.06	1.15	−0.02		
Parent age	−0.03	0.06	−0.13			−0.04	0.06	−0.18			0.01	0.03	0.05			−0.06	0.08	−0.27		
Parent gender (τ=female)	−1.28	1.07	−0.32			−1.21	1.10	−0.30			−0.46	0.60	−0.11			−0.50	1.46	−0.12		
Minority (τ=African American)	0.65	0.96	0.20			1.01	0.93	0.32			1.00	0.58	0.31			1.83	1.25	0.57		
Family structure (τ=single-parent)	0.95	1.01	0.29			0.00	1.05	0.00			0.50	0.52	0.15			0.88	1.29	0.27		
Parent education (τ=<college)	0.58	0.90	0.18			0.66	0.91	0.21			−0.04	0.48	−0.01			1.71	1.19	0.54		
Employment status (τ=unemployed)	−0.34	0.98	−0.10			−0.26	0.96	−0.08			0.17	0.56	0.05			−1.56	1.32	−0.47		
Family annual income (τ=below poverty level)	−0.75	1.07	−0.23			0.00	1.02	0.00			−0.86	0.59	−0.26			−0.44	1.44	−0.13		
F (9, 232)					5.30***					5.30***					5.30***					5.30***
Step 2 Parental monitoring				0.25	0.08				0.24	0.07				0.23	0.05				0.18	0.002
Parental monitoring scale	0.65	0.13	0.33**			0.59	0.27	0.32**			0.33	0.08	0.26**			0.21	0.13	0.11		
F (10, 231)					7.86***					7.42***					6.94***					5.09***
F Change (1, 231)					25.78***					22.15***					18.17***					2.81
Step 3 Interactions				0.28	0.02				0.26	0.02				0.26	0.03				0.20	0.02
Child age × parental monitoring	−0.01	0.07	−0.06			−0.06	0.07	−0.44			0.05	0.04	0.52			−0.06	0.07	−0.45		
Child gender × parental monitoring	0.26	0.24	0.31			0.15	0.23	0.18			0.09	0.16	0.10			0.02	0.26	0.03		
Parent age × parental monitoring	0.01	0.02	0.28			0.01	0.02	0.33			0.00	0.01	0.03			0.01	0.02	0.39		
Parent gender × parental monitoring	0.44	0.34	0.35			0.42	0.33	0.34			0.17	0.22	0.11			0.13	0.36	0.13		
Ethnicity × parental monitoring	−0.03	0.28	−0.04			0.08	0.26	0.09			0.10	0.20	0.10			0.25	0.28	0.34		
Family structure × parental monitoring	−0.23	0.29	−0.25			0.07	0.29	0.08			−0.14	0.18	−0.15			−0.14	0.29	−0.19		
Parent education × parental monitoring	−0.20	0.26	−0.23			−0.21	0.25	−0.25			−0.01	0.17	−0.01			−0.40	0.27	−0.58		
Employment × parental monitoring	0.13	0.27	0.14			0.10	0.26	0.11			−0.03	0.18	−0.03			0.36	0.29	0.49		
Income × parental monitoring	0.35	0.30	0.38			0.10	0.28	0.12			0.48	0.20	0.50*			0.18	0.32	0.25		
F (19, 222)					4.48***					4.14***					4.19***					2.88***

Table 3

Hierarchical multiple regression analyses of blood glucose testing (adolescent report monitoring)

	PM (Equation 5)						DOP (Equation 6)						YD (Equation 7)						SIY (Equation 8)					
	B	S.E.	β	R ²	F/	F	B	S.E.	β	R ²	F/	F	B	S.E.	β	R ²	F/	F	B	S.E.	β	R ²	F/	F
Step 1 Socio-demographics				0.17		0.17				0.17		0.17				0.17		0.17				0.17		0.17
Child age	0.03	0.20	0.03				0.05	0.18	0.06				-0.14	0.16	-0.17				0.04	0.22	0.05			
Child gender (r=female)	0.23	0.81	0.07				0.54	0.76	0.18				-0.47	0.61	-0.15				1.02	0.86	0.33			
Parent age	-0.13	0.06	-0.59*				-0.11	0.05	-0.51*				-0.07	0.04	-0.31				-0.10	0.07	-0.46			
Parent gender (r=female)	-0.35	1.07	-0.09				-1.07	1.05	-0.26				0.54	0.78	0.13				-1.01	1.11	-0.25			
Minority (r=African American)	0.74	0.93	0.23				0.81	0.90	0.25				0.49	0.70	0.16				1.46	1.00	0.46			
Family structure (r=single-parent)	2.22	0.96	0.68*				2.11	0.90	0.64*				1.21	0.70	0.37				2.30	1.06	0.70*			
Parent education (r=<college)	-0.74	0.79	-0.23				-0.95	0.76	-0.30				-0.23	0.59	-0.07				-0.76	0.89	-0.24			
Employment status (r=unemployed)	-0.63	0.87	-0.19				-0.23	0.81	-0.07				-0.90	0.67	-0.27				-0.04	0.98	-0.01			
Family annual income (r=below poverty level)	0.38	1.07	0.12				0.27	1.05	0.08				0.61	0.76	0.19				0.52	1.06	0.16			
F (9, 232)						5.30***						5.30***						5.30***						5.30***
Step 2 Parental monitoring				0.20		0.03				0.19		0.02				0.20		0.03				0.18		0.01
Parental monitoring scale	0.32	0.11	0.18**				0.27	0.11	0.16*				0.25	0.09	.18**				0.16	0.10	0.10			
F (10, 231)						5.73***						5.49***						5.78***						5.05***
F Change (1, 231)						8.12**						6.08*						8.51**						2.46
Step 3 Interactions				0.24		0.04				0.24		0.05				0.23		0.03				0.22		0.04
Child age × parental monitoring	-0.06	0.06	-0.46				-0.07	0.05	-0.58				-0.01	0.05	-0.08				-0.06	0.05	-0.61			
Child gender × parental monitoring	-0.06	0.23	-0.07				-0.16	0.22	-0.19				0.17	0.18	0.20				-0.23	0.21	-0.32			
Parent age × parental monitoring	0.04	0.02	1.03*				0.03	0.02	0.96*				0.02	0.01	0.66				0.02	0.02	0.78			
Parent gender × parental monitoring	0.07	0.32	0.06				0.30	0.32	0.25				-0.23	0.24	-0.18				0.23	0.28	0.23			
Ethnicity × parental monitoring	-0.01	0.26	-0.01				0.00	0.26	0.00				-0.09	0.20	-0.10				0.18	0.24	0.23			
Family structure × parental monitoring	-0.55	0.27	-0.62*				-0.54	0.26	-0.60*				-0.28	0.20	-0.32				-0.49	0.25	-0.64			
Parent education × parental monitoring	0.20	0.22	0.23				0.27	0.22	0.30				0.06	0.17	0.07				0.17	0.21	0.24			
Employment × parental monitoring	0.20	0.24	0.22				0.09	0.23	0.10				0.29	0.19	0.32				0.03	0.23	0.04			
Income × parental monitoring	0.01	0.30	0.01				0.03	0.30	0.04				-0.05	0.22	-0.06				-0.02	0.26	-0.03			

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	PM (Equation 5)					DOP (Equation 6)					YD (Equation 7)					SIY (Equation 8)				
	B	S.E.	β	R ²	F/ F	B	S.E.	β	R ²	F/ F	B	S.E.	β	R ²	F/ F	B	S.E.	β	R ²	F/ F
F (19, 222)					3.73***					3.76***					3.49***					3.31***
F Change (9, 222)					1.41					1.67					0.96					1.31

Note.

* p<0.05,

** p<0.01,

*** p<0.001.

B=unstandardized coefficients in regression analysis; S.E.=Standard Error; Dependent variable=daily blood glucose testing (BGT); PM=Parental monitoring total scale; DOP=direct observation/presence; YD=youth disclosure; SIY=solicit information from youth.