Parent-Adolescent Communication about Health Risk Behaviors Among Adolescents with type 1 diabetes mellitus

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PARENT-ADOLESCENT COMMUNICATION ABOUT HEALTH RISK BEHAVIORS AMONG ADOLESCENTS WITH TYPE 1 DIABETES MELLITUS

By

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ABSTRACT
PARENT-ADOLESCENT COMMUNICATION ABOUT HEALTH RISK BEHAVIORS AMONG ADOLESCENTS WITH TYPE 1 DIABETES MELLITUS

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Health risk behaviors, like drinking alcohol or using tobacco, are a common problem among adolescents in the United States. For healthy adolescents, health risk behaviors may be hazardous to their health; for adolescents with chronic illnesses, the risks associated with these types of behavior are compounded and may further impact their health status. This is particularly true for adolescents with type 1 diabetes mellitus (T1DM), whose blood sugar may be directly impacted by consumption of alcohol or use of tobacco. Parent-child communication has been found to act as a protective factor against adolescent engagement in health risk behaviors; however, this relationship has not been explored within the context families raising an adolescent with T1DM. As such, the present study will examine the relationships among health risk behavior of adolescents with T1DM, aspects of maternal caregiver-female adolescent communication, diabetes management, and metabolic control.

Fifty-four female caregivers and fifty-two female adolescents (ages 14-19) diagnosed with T1DM completed the study. Parents and adolescents completed questionnaires assessing adolescent lifetime and previous 12 month use of alcohol and cigarettes or tobacco, various aspects of communication, and adherence to diabetes management tasks. Additionally, adolescents' medical records were reviewed to collect most recent hemoglobin A1C (HbA_{1C} values), which represent metabolic control during the past 2-3 months.

In general, adolescents reported low rates of engagement in health risk behaviors. Results generally supported our hypotheses in that adolescents who reported lifetime or previous 12 month engagement in health risk behaviors had poorer parent- and self-reported treatment adherence; however, health risk behavior engagement was not associated with metabolic control. Additionally, parent- and adolescent-reported open and problem communication and parent-reported comfort with discussing risk behaviors were associated with and predicted adolescent-reported lifetime use of alcohol and cigarettes and previous 12 month use of alcohol. Together, aspects of parent- and adolescent-reported communication and adolescent health risk behavior engagement predicted parent- and adolescent-reported adherence to diabetes management tasks.

Overall, present findings suggest that diabetes health care providers should discuss the potential impact of health risk behavior engagement on diabetes management and how the quality of parent-adolescent communication may influence adolescent health risk behaviors.

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Adolescence, a period from age 12 to 21 used to describe individuals in the transition from childhood to adulthood (DiNapoli & Murphy, 2002; Koenig & Gladstone, 1998), is a time marked by emotional, physical, and psychological growth; risk taking; and for many, a time that involves taking part in different behaviors that may be detrimental to their health including engaging in unprotected sex and using alochol, tobacco, and illicit drugs (Jaser, Yates, Dumser, & Whittemore, 2011; Sawyer, Drew, Yeo, & Britto, 2007; Suris, Michaud, & Viner, 2004). Although rates of substance use have decreased over time, drug and alcohol use are common problems among adolescents in the United States (Eaton et al., 2010).

Health risk behaviors may occur at high rates in adolescence because adolescents may not necessarily be capable of understanding or appreciating the impact that their risky behaviors have on their health (Jaser, et al., 2011). Adolescence is a time when individuals struggle to find their own identity that is distinct from their families (Silverstein et al., 2005) and when independence and autonomy are sought (McConnell, Harper, Campbell, & Nelson, 2001). DiNapoli and Murphy (2002) suggest that adolescence is a time when individuals are marginalized by society because society ignores the needs of adolescents, which may result in acts of rebellion, like risk taking behavior.

Prevalence of health risk behaviors among adolescents has been established through the use of surveys using nationally representative samples of high school students in the general population. Using data from the National Longitudinal Study of

Adolescent Health, which is a representative sample of high school students in the United States, Blum, Beuhring, Shew, Bearinger, Sieving, and Resnick (2000) reported that 32.11% of 9-12th graders endorsed smoking at least one cigarette or more during the previous 30 days. Additionally, 56.96% of adolescents reported drinking any alcohol during the previous year (Blum et al., 2000). Data from the Youth Risk Behavior Surveillance (YRBS) 2001 (Grunbaum et al., 2002), another school-based nationally representative sample of high school students, indicated that 78.2% of adolescents had had at least one alcoholic drink throughout their lives, and 47.1% had had at least one drink during the past 30 days. Twenty-two percent of the adolescents surveyed reported trying their first cigarette before age 13 years. Approximately 34% of youth reported using tobacco products at least once during the past 30 days (Grunbaum, et al., 2002). Fifty percent of youth reported having ever tried a cigarette in the 2007 version of the YRBS. Additionally, 20% of students reported smoking at least 1 day during the 30 days prior to the survey. Prevalence of lifetime alcohol use was 75%, while current use (i.e. one drink during the past 30 days) was 44.7% (Eaton et al., 2008). Similarly, Eaton et al. (2010) found that lifetime rates of adolescents having ever tried alcohol was 72.5%, and cigarettes was 46.3% in analysis of the National Youth Risk Behavior Survey, which included a nationally representative sample of American high school students from both public and private schools. These studies suggest that alcohol and tobacco use among the general population of high school students remains high and continues to be of great concern.

Prevalence of health risk behaviors, including drinking alcohol and using tobacco products, is highly variable. There may be several reasons for the dissimilar rates of

substance use reported across different studies. Notably, studies vary in the operational definitions and time frames for describing frequency of engagement in substance use. For example, "current use" may be defined as using a substance every day during the past 30 days or using a substance nearly every day during the past 30 days. Additionally, type of substance use is often not clearly defined. For example, there is variability in terms of which tobacco products studies are examining: cigarettes, chew, snuff, smokeless tobacco, or only cigarettes.

Although studies examining the prevalence of health risk behaviors in the general population provide us with basic information about overall rates of adolescent tobacco and alcohol use, they may not be representative of behaviors among specific subpopulations with chronic illnesses (CI), like adolescents with type 1 diabetes mellitus (T1DM). The purpose of the present study is to explore health risk behaviors in adolescents with T1DM. Moreover, the present study will be the first to provide detailed prevalence data on use of different substances (i.e., cigarettes, chewing tobacco/snuff, beer, wine/wine coolers, and hard liquor) as well as overall use of alcohol and tobacco products across different time frames (i.e. lifetime use and previous 12 month use including last 30 days) among adolescents with T1DM.

Risk Behaviors and Adolescents with Chronic Illness

Traditionally, adolescents with chronic illnesses have been viewed as less likely to engage in health risk behaviors when compared to their healthy peers (Sawyer, et al., 2007); indeed, having a chronic medical condition itself was once considered to be a protective factor against adolescents becoming involved in different health risk behaviors, such that CI was thought to restrict the number of opportunities for youth to

engage in health risk behaviors (Suris & Parera, 2005). When compared to their healthy peers, adolescents with CI have been found to engage in health risk behaviors at similar or greater rates (Sawyer, et al., 2007; Suris & Parera, 2005); however, there is great variability in existing published data (see Table 1). Erickson and colleagues (2005) propose that the normative challenges associated with adolescence are compounded in youth with CI, and the additional stress associated with having a CI may contribute to increased health risk behavior involvement.

In a study of high school adolescents from Spain (ages 14-19 years) who reported a history of either diabetes, allergy, asthma, scoliosis, epilepsy, cancer, arthritis, kidney disease, or ocular conditions, lifetime prevalence for having ever tried alcohol was 91.3% and for ever trying tobacco was 82.2% (Suris & Parera, 2005). In a study of adolescents in 7^{th}-12^{th} grades who self-identified as having a CI, Erickson, Patterson, Wall, and Neumark-Sztainer (2005) found that 38.5% smoked at least one cigarette in the past year, and 40.2% reported having drank alcohol in the past year. Among healthy adolescents in this study, 30.7% reported smoking at least one cigarette during the past year, and 38.6% reported having at least one drink during the past year. Although the rates of smoking a cigarette and drinking alcohol in the past year were similar in this study, prevalence for both of these risk behaviors was greater among youth with chronic illness (Erickson, et al., 2005).

Given that adolescents may see engagement in health risk behaviors as socially normative, Suris and Parera (2005) suggest that adolescents with CI may feel inclined to participate in health risk behaviors to feel more similar to their healthy peers. Additionally, adolescents with CI may be marginalized by society and further stigmatized

and disempowered by their families, school, and health-care providers and may feel negatively valued by their peers (DiNapoli & Murphy, 2002). The rejection and marginalization that youth with CI may experience from their peers occurs at a time when identity is largely dependent upon conformity (Boice, 1998). Lacking peer acceptance may result in a very different school experience for youth with CI, compared to their healthy peers (DiNapoli & Murphy, 2002). The risk of peer rejection may influence adolescents with CI to compensate by engaging in health risk behaviors.

Among healthy adolescents, engaging in risk behaviors may be hazardous to their health and well-being and increases the likelihood of negative health and social outcomes as adults (Hair, Park, Ling, & Moore, 2009). For adolescents with CI, engaging in health risk behaviors is likely to have a significant impact on their health status and increases the potential for adverse health outcomes (Sawyer, et al., 2007). Specifically, involvement in health risk behaviors, particularly the use of alcohol and tobacco products, among adolescents with T1DM can have serious negative implications for their health (Hanna & Outhrle, 1999).

T1DM in Adolescence

T1DM involves impaired glucose metabolism due to insulin deficiency and involves adherence to a complex regimen including administering several daily insulin injections, self-monitoring of blood glucose four to six times daily, regulating diet and daily exercise, and preventing hyper- and hypoglycemia. T1DM is associated with long-term risks to the heart, kidneys, eyes, and nerves (Wysocki, Buckloh, & Greco, 2009). In an overview of the results of the work done by the Diabetes Control and Complications Trial Research Group (DCCT), Erickson et al. (2005) discuss that the DCCT showed that

maintaining near-normal hemoglobin A_{1C} (HbA_{1C}) through adherence to diabetes management tasks (i.e. the extent to which the behavior of a person coincides with the medical or health advice they receive; Modi, et al., 2012) reduces these health risks substantially. During adolescence, youth should aim for an HbA_{1C} value of < 7.5-7.0 or less (American Diabetes Association, 2012).

Adolescence is associated with significant deterioration of glycemic and metabolic control, which may be the result of hormonal changes around the time of puberty that cause insulin resistance (Dabadghao, Vidmar, & Cameron, 2001; Moran, 2002) and non-compliance to diabetes management tasks (Du Pasquier-Fediaevsky et al., 2005). Poor adherence may also result from adolescents' relatively poor executive functioning abilities, which includes the ability to plan for different situations and to envision the future consequences of their behavior (Suris, et al., 2004). Additionally, as reviewed by Descrocher and Rovet (2004), diabetes is associated with various potential neurocognitive deficits, which may be related to age of onset, history of hypo- and hyperglycemia, puberty, and duration of T1DM. Diagnosis of T1DM prior to age five may be related to variable motor and visuo-spatial abilities. Hypoglycemia may have detrimental effects on individuals between birth and 12 years of age while the brain is undergoing its most rapid myelination. Hypoglycemia during this time is associated with deficits in attention and memory. Executive functioning deficits may result from hyperglycemia during puberty, which may further impact the ability of adolescents with T1DM to consider the consequences associated with engaging in risk behaviors. The complexity and difficulty associated with proper care of T1DM is compounded in

adolescence because of hormonal changes, non-compliance, and possible executive functioning deficits.

T1DM Management in Adolescence

During adolescence, diabetes management is often the responsibility of multiple individuals within a family (Wysocki, et al., 2009). Although adolescents may depend on their families for management help and support, as they become more independent and autonomous, family involvement and parental supervision associated with diabetes care may result in resentment and the development of problems within parent-child relationships (Anderson, Auslander, Jung, Miller, & Santiago, 1990; Du Pasquier-Fediaevsky, et al., 2005; Kakleas, Kandyla, Karayianni, & Karavanaki, 2009; Wysocki, et al., 2009). Having a diagnosis of T1DM may act to hinder critical aspects of development associated with adolescence because it limits the amount of freedom allowed by adults and imposes lifestyle restrictions (Kyngas & Barlow, 1995). Resentment may manifest itself as defiance and rebellion (Kakleas, et al., 2009) against the restrictive nature of their diabetes management. Although greater parental involvement in diabetes care tasks is associated with better treatment adherence (La Greca et al., 1995) and subsequently better metabolic control (Guo, Whittemore, & He, 2011), greater parental involvement is also associated with greater diabetes-related family conflict (Miller-Johnson et al., 1994), which is in turn associated with diabetes-specific family conflict. Greater diabetes-specific family conflict is further related to poorer glycemic control (Hood, Butler, Anderson, & Laffel, 2007).

Like other adolescents with CI, youth with T1DM begin to turn towards their peers and others outside the family for support as they become more independent

(Dovey-Pearce, Doherty, & May, 2007). They may experience a significant amount of pressure to fit in with their peers and may disregard the care required to maintain their diabetes (Court, Cameron, Berg-Kelly, & Swift, 2009; McConnell, et al., 2001). Although they have similar needs as healthy adolescents, adolescents with T1DM may be at greater risk of giving in to peer pressure (Suris, et al., 2004), which may detrimentally affect their ability to properly manage their illness. Furthermore, research indicates that adherence to illness management regimens is more problematic for adolescents when their regimen interferes with daily activities that involve their peers (La Greca, 1990). Similarly, Helgeson, Siminerio, Escobar, and Becker (2009) suggest that adolescents with T1DM who are more involved with their peers may have more metabolic control difficulties.

Parents and peers may each play important and unique roles in the lives of adolescents with T1DM. In a study of adolescents 13-17 years of age, Kyngas (2004) found that parents and peers play distinct supportive roles in the lives of adolescents with T1DM and juvenile rheumatoid arthritis. Support from parents was found to be generally oriented towards different aspects of their adolescents' everyday lives, like disease management, while peer support comes from the shared experience associated with growing up (Kyngas, 2004). As a result, adolescence represents a time in which youth with T1DM attempt to strike a balance between family support and autonomy (Dovey-Pearce, et al., 2007), peer relationships (Court, et al., 2009), and compliance to their diabetes management regimen.

Health Risk Behaviors and Adolescents with T1DM

Although research on youth with chronic illness suggests they may engage in health risk behaviors at similar or greater rates compared to their healthy peers, there is a paucity of research that has been conducted on health risk behaviors among adolescents with T1DM (Jaser, et al., 2011). Youth with T1DM may be particularly at risk for engaging in health risk behaviors because they may tend to underestimate the risk to themselves associated with these behaviors. In a study examining health attitudes, beliefs, and behaviors of adolescents and emerging adults with T1DM (ages 13-21 years), Tercyak and colleagues (2005) found that adolescents with T1DM saw smoking as less addictive when compared to their healthy peers. Additionally, Frey, Guthrie, Loveland-Cherry, Park, and Foster (1997) found that youth with T1DM evaluated certain behaviors, like drinking alcohol or using tobacco, as being high risk behaviors; however, adolescents with T1DM perceived these behaviors as posing greater risk to their peers than to themselves. Although adolescents with T1DM may recognize that drinking alcohol and using tobacco can be risky, Millstein and Halpern-Felsher (2001) suggest that the perception of risk may not be sufficient to prevent youth with T1DM from engaging in these types of behaviors. Since maintaining adequate metabolic control is essential for all adolescents with T1DM, it is important to understand how alcohol and tobacco use may impact adolescents' diabetes management and metabolic control (Jaser, et al., 2011).

Alcohol Use Among Adolescents with T1DM

Notably, alcohol use has potentially negative short and long-term consequences. Short-term risks associated with consuming alcohol for individuals with diabetes include delayed hypoglycemia, particularly when alcohol is not accompanied by the intake of food (Franz et al., 2004), metabolic dysregulation, and acidosis. Long term effects may

include hypertension, weight gain, and neuropathy (van de Wiel, 2004). Despite the serious negative effects of alcohol consumption on blood glucose and the detrimental effect alcohol use may have on metabolic control (Peveler, Davies, Mayou, Fairburn, & Mann, 1993), there is very little research on the patterns of alcohol use among adolescents with T1DM and how this health risk behavior affects adherence to diabetes management regimen and glycemic control (Jaser, et al., 2011). In fact, the current literature examining alcohol use among adolescents with T1DM primarily addresses prevalence of use. In a study of adolescents (12-20 years of age) with T1DM, approximately 52% of participants reported having tried alcohol (Glasgow, et al., 1991). Those individuals who reported having ever tried alcohol did not have significantly higher HbA_{1C} values compared to those who had not. The majority of adolescents (89%) reported that their alcohol use had not altered their ability to adhere to their diabetes management tasks. In a sample of 155 children and adolescents with T1DM ages 10-20 years, 39% reported drinking alcohol at least one time, and 42% reported having ever used tobacco products (Frey, et al., 1997). Although the rates of having ever tried alcohol or tobacco are significantly less among adolescents living with a CI in the U.S. adolescents with a CI living in Spain (82.2% reported having ever tried cigarettes, 91.3% reported having ever tried alcohol; Suris & Parera, 2005), the prevalence rates of having ever smoked a cigarette among adolescents with T1DM are similar to those of healthy adolescents from the National Youth Risk Behavior Survey (i.e. 46.3%; Eaton, et al., 2010). As noted in Table 2, lifetime use of alcohol does appear to be significantly less frequent among adolescents with T1DM (Frey, et al., 1997; Glasgow, et al., 1991) in

comparison to their healthy counterparts (Grunbaum, et al., 2002; Eaton, et al., 2008; Eaton, et al., 2010).

Smoking Among Adolescents with T1DM

Research suggests that smoking directly affects metabolic control such that it causes abnormal secretions of growth hormone and cortisol, which may lead to higher blood glucose levels and poorer HbA_{1C} levels (Hofer et al., 2009; Lundman, Asplund, & Norberg, 1990; Nilsson, Gudbjörnsdottir, Eliasson, & Cederholm, 2004). Individuals with diabetes who smoke may also be at increased risk for developing micro- and macrovascular complications (Hofer, et al., 2009) cardio-vascular disease, and premature death (American Diabetes Association, 2012). Among young adults, smoking is associated with a greater risk of abnormal glucose tolerance (Houston et al., 2006). In a medical record review of 27,561 patients with T1DM (≤ 20 years old) in Germany and Austria, 28.4% of 15-20 year olds reported smoking one or more cigarettes a day. Among those participants who smoked at least 1 cigarette a day, HbA_{1C} levels were significantly higher (i.e. poorer metabolic control) when compared to those who did not smoke (Hofer, et al., 2009). Additionally, in a study of individuals with T1DM and type 2 diabetes who were younger than 20 years of age, Reynolds et al. (2011) found that current smokers (8.1% of all participants with T1DM) had significantly poorer glycemic control and higher HbA_{1C} levels than non-smokers with T1DM. Prevalence of lifetime history of having ever smoked a cigarette for those with T1DM in this study was 22% and more specifically 14.9% among adolescents ages 15-19 with T1DM (Reynolds, et al., 2011). Reynolds et al. (2011) also found that current cigarette smokers with T1DM were more likely to have high triglyceride levels, be more physically inactive, and have an elevated

risk for cardiovascular disease. Taken together, these results suggest that using tobacco products poses significant diabetes-specific risks, as well as general health risks, to individuals with diabetes. However, very little is known about the use of tobacco products among youth with T1DM (Ford & Newman, 1991) and the relationship between using tobacco products, adherence, and metabolic control (Tyc & Throckmorton-Belzer, 2006).

Given the small number of published studies, the only data available on alcohol and tobacco use in adolescents with T1DM is limited to prevalence data for current smokers and lifetime use of alcohol and cigarettes (Frey, et al., 1997; Glasgow, et al., 1991; Hofer, et al., 2009; Reynolds, et al., 2011). No data is available on tobacco use (other than cigarettes) and alcohol use during the past 30 days and previous year.

Improved knowledge of health risk behaviors among adolescents with T1DM can inform clinical care. Diabetes physicians and educators need to have an understanding of how health risk behaviors impact adolescents' diabetes care and need to provide appropriate resources to reduce the risk that adolescents may experience as a result of engaging in these activities. Additionally, examining parental influence on health risk behavior engagement will provide the opportunity to develop new and effective interventions to decrease the likelihood of adolescents with T1DM taking part in health risk behaviors.

Family Influences on Risk Behaviors

Family factors like family environment and quality of relationships have been explored as risk and protective factors for adolescent substance use, but parent-child communication about risk behaviors has received little attention in research with

adolescents with CI (Ennett, Bauman, Foshee, Pemberton, & Hicks, 2001) and more specifically T1DM. Ennett and colleagues (2001) suggest that parent-child communication about risk behaviors has been assumed to affect children's risk behavior decisions, but few studies have directly examined this relationship. Among healthy females, parent-adolescent communication about health risk behaviors has been found to be a protective factor against health risk behavior engagement (Lerand, Greenley, & Raboin, 2009). An aspect of parent-adolescent relationships that has been well researched is mother-adolescent communication, which is most commonly studied in the context of adolescent sexual risk behavior (DiClemente et al., 2001; Hutchinson, Jemmott, Jemmott, Braverman, & Fong, 2003; McNelly et al., 2002; Wilson & Donenberg, 2004), and has also been associated with reduced risk in other areas of functioning (Blum, Kelly, & Ireland, 2001).

Communication

Communication can be considered one of the more direct and fundamental ways in which parents can express how they feel about their adolescents' behaviors, like smoking (Otten, Harakeh, Vermulst, van den Eijnden, & Engels, 2007) or alcohol use. Parent-child communication is a multifaceted construct (Miller-Day & Kam, 2010) that includes, but is not limited to, **frequency, openness, problem communication, parent comfort with communicating, and parent communication self-efficacy**. Research suggests that each of these aspects influence healthy adolescents' involvement and attitudes towards risk taking behaviors, like alcohol and tobacco use, and sexual behaviors. Because parent-child communication processes are modifiable, they may

provide a unique opportunity for interventions to mediate health risk behaviors among adolescents (Riesch, Anderson, & Grueger, 2006).

Frequency of communication (i.e. how often parents and their children communicate during a given time period) about drinking alcohol or using tobacco products among parents and healthy adolescents has been found to be associated with both higher and lower levels of adolescent involvement in those health risk behaviors (Guilamo-Ramos, Jaccard, Dittus, & Bouris, 2006; Otten, et al., 2007; van der Vorst, Engels, Meeus, Dekovic, & van Leeuwe, 2005; van Zundert, van der Vorst, Vermulst, & Engels, 2006) and lower adolescent self-efficacy to resist peer pressure (Engels & Willemsen, 2004). The relationship between frequency of communication and adolescent involvement in health risk behaviors appears to be inconsistent among healthy adolescents. Inconsistent findings about the relationship between frequency of communication and higher levels of health risk behavior involvement may be due to measurement of communication taking place at different time points throughout adolescence or at different times in the health risk behavior timeline (i.e. before vs. after an adolescent has begun to engage in a given health risk behavior). It is unknown how frequency of communicating about alcohol and tobacco use will be associated with engagement in risk behaviors among adolescents with T1DM.

Open communication (i.e. environment that fosters the freedom to exchange ideas and discuss problems; Barnes & Olson, 1982) between parents and female adolescents (ages 13-16) has been found to be marginally associated with less alcohol use over time (Yang et al., 2007). Research has also shown that frequent and open communication in general and about alcohol use specifically are negatively related to

positive expectancies about alcohol (i.e. positive consequences associated with alcohol consumption) among healthy adolescents in 5th-6th grade (Miller-Day & Kam, 2010). Open communication between mothers and daughters has also been found to act as a protective factor against adolescent girls' involvement in drinking alcohol and giving into peer pressure associated with the use of alcohol (Fang, Schinke, & Cole, 2009). Currently the relationship between open communication and involvement in health risk behaviors among adolescents with T1DM is unknown.

Problem communication (i.e. environment characterized by hesitancy to share information, negative interaction styles, and selectivity or caution about what is shared with children; Barnes & Olson, 1982) may also influence risk behavior engagement during adolescence. Among African-American girls (ages 13-16), the probability of engaging in sex did not increase between baseline and two years later for those who perceived low levels of problem communication with their parents. The probability of engaging in sex increased greatly (0.3-0.6) for girls who perceived high levels of problem communication with their parents (Yang, et al., 2007). Although parent-adolescent problem communication and the relationship to sexual behaviors is not the focus of the present study, the findings of Yang and colleagues (2007) are informative about the importance of examining how problem communication may be related to future risk of adolescents becoming engaged in health risk behaviors. How parent-adolescent problem communication is related to alcohol and tobacco use in general and in adolescents with T1DM is unknown.

Parent self-efficacy to communicate effectively with their adolescents may play a key role in influencing adolescents' decisions to engage in different risk behaviors.

Parent self-efficacy for communicating about the effects of smoking cigarettes is related to whether or not children try smoking, such that parents who report lower levels of communication self-efficacy have children who report being more likely to try cigarettes. Parent self-efficacy for communicating about different health risk behaviors, like smoking, may depend on parents' previous experience with engaging in those behaviors (Kodl & Mermelstein, 2004). Parents' perception about having enough knowledge is also related to parents feeling more confident that they have enough information to be able to effectively discuss topics with their children, like sexual intimacy (Miller & Whitaker, 2001). Although parent-adolescent communication about sexual behaviors is not the focus of the present study, the findings of Miller and Whitaker (2001) are informative about the importance of examining the role of parent self-efficacy in parent-adolescent communication. How parent self-efficacy to communicate is related to health risk behaviors in adolescents with T1DM remains unknown.

Research shows there is a strong relationship between parent **comfort with communicating** and whether, how often, and how much parents discuss risk behaviors, like sex, with their children (Jerman & Constantine, 2010). Among mothers of 14-17 year olds, Miller and Whitaker (2001) found that the more comfortable mothers felt discussing topics like sexual activity with their children, the more likely they were to engage in those conversations (Miller & Whitaker, 2001). Additionally, greater parent perceived comfort and knowledge about sex, has been found to predict greater number of topics associated with sex discussed (Jerman & Constantine, 2010). Greater comfort with discussing sexual topics is also associated with more frequent communication about sex (Kaljee et al., 2011). Although studies have examined the relationship among parents'

comfort with communicating about sexuality, frequency, and breadth, it is unclear how parent comfort with communicating relates to health risk behavior engagement in general, and alcohol and tobacco use in particular, especially among adolescents with T1DM.

Mother and Female Adolescent Relationships

Among healthy adolescents, research suggests that different processes may operate in mother-male adolescent, mother-female adolescent, father-female adolescent, and father-male adolescent relationships. For example, mothers are more likely to discuss issues that reflect a wider range of values with their daughters as opposed to their sons (Nolin & Petersen, 1992), and in general mothers are more likely to obtain more monitoring knowledge (e.g. activities, location, and whom activities are being done with) than fathers (Waizenhofer, Buchanan, & Jackson-Newsom, 2004). The discrepancy between mother and father knowledge is most likely due to adolescents' willingness to disclose information (Kerr, Stattin, & Trost, 1999). Given the unique relationship that may exist between mother and female adolescents, the current study will focus solely on mother-female adolescent dyads in order to explore the issues specific to their communication about alcohol and tobacco use. To examine the different dyad combinations (i.e. father-female adolescent, father-male adolescent and mother-male adolescent) in depth would require a considerably larger sample size and is beyond the scope of the present study.

Present Study

The relationship between maternal caregiver-female adolescent communication in general and about health risk behaviors, like alcohol and tobacco use, has yet to be explored among female adolescents with T1DM. Studying family influences on health risk behavior among adolescents with T1DM may be particularly important given some evidence that suggests adolescents with T1DM may be more reliant on parental support and may see themselves as less at risk to the detrimental effects of engaging in health risk behaviors compared to their peers.

The proposed study will provide an unique opportunity to clarify how often and to what extent female adolescents with T1DM engage in health risk behaviors (i.e. using alcohol and tobacco products) and how these behaviors are associated with female adolescents' ability to manage their diabetes and maintain metabolic control. Additionally, the proposed study aims to improve upon our understanding of the role that maternal caregivers play in the health-related behaviors of female adolescents. In particular, this study is the first to examine how maternal caregiver communication about health risk behaviors is associated with alcohol and tobacco use behaviors among female adolescents with T1DM. Establishing these relationships is important for informing and improving clinical care for adolescents with T1DM.

The hypotheses that were tested in the current study are as follows:

1. Parent and adolescent ratings of adolescent **adherence** to diabetes management regimen will be negatively related to **metabolic control** (i.e., most recent HbA_{1C} value), such that better adherence will be associated with lower HbA_{1C} values, which represent better metabolic control.
2. Parent and adolescent reports of adolescent involvement in **health risk behaviors** (i.e. previous 12 months and lifetime use of alcohol and tobacco products) will be negatively related to **adherence** to diabetes management

regimen, such that greater involvement in health risk behaviors will be associated with poorer adherence to diabetes management tasks.

3. Parent and adolescent reports of adolescent involvement in **health risk behaviors** (i.e. previous 12 months and lifetime use of alcohol and tobacco products) will be positively related to **metabolic control** (i.e., most recent HbA_{1C} value), such that greater involvement in health risk behaviors will be associated with higher HbA_{1C} values, which represent poorer metabolic control.
4. a. Parent and adolescent ratings of **communication** (i.e. **frequency, openness, parent comfort, and parent self-efficacy**) will be negatively related to parent and adolescent ratings of adolescent's involvement in **health risk behaviors** (i.e. previous 12 months and lifetime use of alcohol and tobacco products), such that greater communication frequency, openness, parent comfort, and parent self-efficacy will be associated with less adolescent involvement in health risk behaviors.
4. b. Parent and adolescent ratings of **problem communication** will be positively related to adolescent's involvement in **health risk behaviors** (i.e. previous 12 months and lifetime use of alcohol and tobacco products), such that greater problem communication will be associated with greater involvement in health risk behaviors.
5. Dimensions of parent-adolescent **communication** (i.e. **frequency, openness, problem, parent comfort, and parent self-efficacy**) will account for a significant amount of unique variance in predicting parent and adolescent reports of adolescent involvement in **health risk behaviors** (i.e. previous 12 months and lifetime use of alcohol and tobacco products).
6. Parent and adolescent reports of adolescent involvement in **using alcohol** (i.e. previous 12 months and lifetime use) and **aspects of communication** (i.e. frequency, openness, problem, parent comfort, and parent self-efficacy) will account for a significant amount of unique variance in predicting **adherence** to diabetes management regimen and **metabolic control**.

7. Parent and adolescent reports of adolescent involvement in using **tobacco** (i.e. previous 12 months and lifetime use) and aspects of **communication** (i.e. frequency, openness, problem, parent comfort, and parent self-efficacy) will account for a significant amount of unique variance in predicting **adherence** to diabetes management regimen and **metabolic control**.

Research Design and Methods

Participants

Eligible participants in the current study included female adolescents, ages 14-19 years old, and their maternal caregivers. Inclusionary criteria for adolescents included adolescents who 1) were fluent in English, 2) were diagnosed with T1DM for at least one year prior to recruitment, 3) had a female parent/guardian who was available to participate, and 4) did not report a history of mental retardation or developmental disorder that would preclude their ability to read or understand study questionnaires. Parents/guardians were eligible to participate if they were 1) female and 2) fluent in English. Participants were recruited from Children's Hospital of Wisconsin (CHW) Department of Endocrinology (i.e., Diabetes Clinic).

Procedures

This study was an extension of an ongoing investigation at CHW entitled "Parent-Adolescent Communication about Health Risk Behaviors Among Adolescents with Chronic Medical Conditions" (CHAT; CHW IRB 07/76, GC 418). Data collection has been completed in the Adolescent Health and Medicine, Rheumatology, Immunology, Pulmonary, Cardiology, and Gastroenterology clinics at CHW. An amendment was submitted and approved on March 27, 2012 to add participant recruitment in the Diabetes Clinic and diabetes-specific questionnaires.

Eligible participants were recruited from the Diabetes Clinic at CHW. For recruitment purposes, demographic information (i.e. patient name, age, sex, medical diagnosis, address, phone number, and parent/guardian name) were obtained from clinic

databases/medical records prior to obtaining informed consent via a waiver of initial consent to screen records for potential participants. Authorized personnel, including staff members of the Diabetes Clinic and study personnel, identified potential participants who met eligibility criteria. Participants were informed of the study before, during, or after a regularly scheduled appointment in the Diabetes Clinic or through mailings. Another method of participant recruitment was making phone calls to families who had previously agreed to be part of the Registry Project in the Diabetes Clinic at CHW. By taking part in the Registry Project, these families previously agreed to be contacted directly to learn about research studies being conducted in the Diabetes Clinic for which they may be eligible. Maternal caregivers and adolescents were provided with a brief overview of the study and given the opportunity to complete consent in clinic or consent over the phone. Participation was possible either in clinic or at home using paper-pencil questionnaires or online via SurveyMonkey. Most families who participated completed the study via paper-pencil questionnaires at home or in the clinic (68.52% of parents and 70.59% of adolescents). If questionnaires were not completed within two weeks from the date study material was distributed, a follow-up phone call was placed.

Maternal caregivers and adolescent females were provided with an overview of the study and were given an opportunity to consent and assent to participate in the study and ask questions. During the consent process, parents authorized the research team to access adolescents' medical records during the previous year. Because all participants were 14 years of age and older, written consent was obtained from a parent and the adolescent.

After adolescents and parents provided their individual consent to participate in the study, each were given a packet of questionnaires to complete. Questionnaires were completed before or after scheduled appointments in the Diabetes Clinic or at home via SurveyMonkey or paper-pencil questionnaire. To ensure parents and adolescents completed their questionnaires separately and to maximize privacy of reporting, parents and adolescents completed their questionnaires separately. When they completed the questionnaires at CHW, they were seated apart from one another and asked not to speak while participating. Participants who completed questionnaires online were required to provide a unique email address for each member of the dyad. Separate packets and postage paid envelopes were provided to parents and adolescents who opted to complete the paper-pencil questionnaires at home and were reminded to complete their questionnaires independently. Medical record reviews were conducted after parents and adolescents completed the consent process. The current study took approximately 45 minutes to complete, and each participant (i.e., parent and adolescent) was given a $5 gift card to Target for participation.

Measures

Table 2 lists measures that were used in the present study, including assessed constructs and reporter information. Additional measures were given to the parents and adolescents to complete as part of the full protocol that are not discussed here.

Demographic characteristics (parent and adolescent report).

Parents and adolescents completed demographic questionnaires that included general demographic and illness-related information. Parents reported on their

relationship to the adolescent, age, race/ethnicity, marital status, education, occupation status, demographic information regarding their spouse if applicable (e.g. relationship to child, age, race/ethnicity), and information about their household (e.g. number of people in the home, number of siblings, annual income). Adolescents reported their age, race/ethnicity, which adults they live with, and grade in school.

Parent-adolescent communication (parent and adolescent report).

To assess aspects of general communication within the family, separate versions of the Parent-Adolescent Communication Scale (PAC; Barnes & Olson, 1982) were administered to parents and adolescents. This measure consists of twenty items about general communication. Each item includes a five-point Likert rating scale ranging from 1=*strongly disagree* to 5=*strongly agree*. The measure yields two subscale scores: Open Family Communication (PAC Openness) and Problem Family Communication (PAC Problem). Scores for the PAC Openness and PAC Problem subscales are calculated by summing the items that belong to each subscale, which generate two total scores.

The first subscale, Openness, measures positive aspects of parent-child communication. The Problem subscale focuses more on the negative aspects of parent-child communication like hesitancy to share, negative interaction styles, and selectivity or caution about what is shared with children. Higher scores on the PAC Openness subscale indicate more open communication between parents and adolescents; whereas higher scores on the PAC Problem subscale indicate greater levels of problem communication.

Internal consistency ratings (Cronbach's alpha) for a sample of 1,841 (sample information is not provided) was .87 for Open Family Communication, and .78 for Problem Family Communication (Barnes & Olson, 1982). The current study found good

internal consistency for parent-reported openness (α = .86) and excellent internal consistency for adolescent-reported openness (α = .95). Good internal consistency was found for parent- (α = .82) and adolescent- (α = .87) reported problem communication.

Parent-adolescent communication about health risk behaviors (parent and adolescent report).

DiIorio's Parental Communication with Adolescent Questionnaire (DiIorio, et al., 1999) and DiIorio's Adolescent Communication with Mother/Father/Friends Questionnaire (DiIorio, et al., 1999) were modified to assess parent-adolescent communication about health risk behaviors (i.e. alcohol, tobacco, and general substance use). Because the original measure emphasizes discussions about sexual activity, parents completed a modified version of the Parental Communication with Adolescent Questionnaire (PCAQ) as it pertains to other health risk behaviors relevant to this study. Parents reported on nine items related to alcohol, tobacco, and general substance use and rated how often they discussed these various topics with their adolescent over the past three months on a five-point Likert scale ranging from 1=*not at all* to 5=*a lot*. Parents indicated how comfortable they felt discussing these topics with their adolescent on a five-point Likert scale ranging from 1=*very uncomfortable* to 5=*very comfortable*. Adolescents completed a parallel questionnaire in which they rated their frequency of communication on the same nine items as their parent. Only parents reported on comfort of communication. For both parent and adolescent versions, higher scores reflect greater frequency of communication. With regards to parent comfort, higher scores indicate greater comfort in communicating about health risk behavior topics. Average scores were computed for frequency and comfort based on the nine relevant items.

The current study found good internal consistency for parent-reported frequency of discussing adolescent alcohol, tobacco, and general substance use ($\alpha = .89$), and excellent internal consistency for parent reported comfort associated with discussing these topics ($\alpha = .94$). The internal consistency for adolescent reported frequency of discussing these topics was also excellent ($\alpha = .90$). Internal consistency reliability for mother-daughter discussions about sex has previously found to be at a high level ($\alpha = 0.91$; DiIorio, McCarty, Denzmore, & Landis, 2007).

Parent self-efficacy (parent report).

Parent self-efficacy related to discussing health risk behaviors (i.e. alcohol, tobacco, and general substance use) was measured using a modified version of a 16-item measure developed by DiIorio et al. (2001) that is designed to measure parents' confidence in talking with their adolescents about sexual issues. The measure was modified to ask about parents' confidence in talking with their adolescents about other health risk behaviors relevant to this study. This measure consists of seven items; three items of which were adapted directly from DiIorio et al.'s (2001) measure by replacing the phrase "sex topics" with "substance use." An additional four items were written for this study based on a literature review of important discussion domains related to adolescent substance use. Parents rated their confidence on a seven-point Likert scale ranging from 1=*not sure at all* to 7=*completely sure*. Total scores are found by summing responses to individual items. Total possible scores ranged from 7 to 49, with higher scores indicating greater self-efficacy to discuss substance use issues with adolescents.

Reliability and validity are available for the original measure of parenting self-efficacy related to discussions about sex (DiIorio et al., 2001). Internal consistency

reliability was found to be at an acceptable level (Cronbach's alpha = 0.85). Self-efficacy was correlated in the predicted direction with sex-based discussions (r = .33), general communication (r = .37), parenting (i.e. maternal involvement; r = .31) and parent self-esteem (r = .22). The current study found this measure to have excellent internal consistency for parents' reports (α = .92).

Frequency of substance use (parent and adolescent report).

Adolescent report items for assessment of risk behaviors were taken from the National Longitudinal Study of Adolescent Health Survey (Sieving, et al., 2001). Parents and adolescents reported on adolescent lifetime use of alcohol and cigarettes (e.g., engaged in this behavior or not) on two items (e.g. HRB-Lifetime) and on adolescent use of alcohol (e.g. wine, wine coolers, beer, hard liquor) and tobacco products (e.g. cigarettes or tobacco) in the past twelve months on five items (e.g. HRB-12). Parents and adolescents were asked to indicate lifetime use of alcohol products by reporting if the adolescent has drank more than just a sip of someone else's drink more than 2-3 times, and lifetime use of cigarettes by asking if the adolescent has every tried smoking, even just 1 or 2 puffs. For previous 12 months use, parents and adolescents reported on <u>any</u> use of alcoholic beverages (e.g. beer, wine/wine coolers, hard liquor) or tobacco products (cigarettes or tobacco/snuff). Frequency of use of smoking cigarettes, chewing tobacco/snuff, beer, wine/wine coolers, and hard liquor in the past year were reported using a seven-point Likert scale, ranging from 0=*none* to 6=*every day or almost every day*. Frequency of alcohol use in the past 12 months was determined by calculating the mean of use across beer, wine/wine cooler, and hard liquor. Previous 12 months use of cigarettes or tobacco were combined into one variable to create a composite tobacco use

score. Higher scores indicate greater frequency of the health risk behavior. Although Sieving et al. (2001) provide information about this measure, there is no published psychometric information available.

The current study found acceptable internal consistency for parents' reports of the frequency of adolescent use of alcohol during the previous year ($\alpha = .67$). Good internal consistency was found for adolescents' reports of use of alcohol during the previous year ($\alpha = .85$). Internal consistency for parent- and adolescent-reported cigarette or tobacco use during the previous 12 months is unavailable because the variables in based on one question.

Metabolic control.

Hemoglobin A_{1C} (HbA_{1C}) measures blood glucose control during the previous two to three months. A medical record review was conducted to obtain HbA_{1C} values from the clinic visits one year prior to the day adolescents and parents are consented to participate in the present study. Most recent HbA_{1C} values are used for data analyses for the present study.

Diabetes management (parent and adolescent report).

Adolescents and their parents completed the Self-Care Inventory – Revised (Weinger, et al., 2005), which is a 15-item questionnaire that measured participants' reported adherence to a diabetes regimen over the previous two weeks. The items measure various aspects of care including blood glucose monitoring, insulin injections, and maintenance of prescribed diet and exercise recommendations of their physician. Participants responded to each item on a five-point Likert scale 1=*complete*

nonadherence to 5=*complete adherence*, with higher scores indicating better adherence. The SCI-R was scored by calculating the mean of all items for each participant, and, for ease of interpretation, the mean score was converted to a 0 to 100-point scale, higher scores indicate greater level of adherence (Weinger, et al., 2005).

Internal consistency ratings (Cronbach's alpha) for a sample of adults ≥ 18 with T1DM was high (α = .87). Reliability (Cronbach's alpha) was high as well (α = .84) for the same sample. There was evidence of good internal consistency in the current study for parents' reports (α = .74) and good internal consistency for adolescents' reports (α=.82). The SCI-R is sensitive to differences in adherence between individuals with good versus poor metabolic control (Weinger, et al., 2005). When comparing different methods of assessing adherence and glycemic control among youth with T1DM, Kichler and colleagues (2012) found that the adjusted global score on the SCI was a stronger predictor of HbA_{1C} than data from a 24-hour recall and blood glucose meter data.

Results

Data Analytic Plan

All data were screened for skewness and kurtosis. Data were screened for patterns associated with missing data points. Missing data analysis was followed as outlined by Tabacknick & Fidell (2006). Data was dummy coded, such that data that was present was coded as 0 and missing data as 1. T-tests were conducted using most recent HbA_{1C} as the dependent variable to determine if data was missing at random. One parent and one adolescent participant were each missing a unique response to one question on the SCI-R that were not considered missing at random. These values were replaced by calculating each case's average score for the SCI-R and imputing that value. Data was found to be missing at random for all other measures. Composite scores, either sum total scores or average scores, were treated as missing if a case was missing more than 25% of the data points required to calculate a given score. This impacted a small number of cases ($n = 6$) across five measures (i.e., parent-reported PAC Openness, parent-reported PAC Problem communication, parent-reported PCAQ Frequency, parent-reported PCAQ Comfort, and adolescent-reported PCAQ Frequency).

All measures of parent and adolescent reported communication and diabetes-related variables (e.g. SCI-R and HbA_{1C}) were normally distributed. Parents reported lower incidence of adolescent lifetime engagement in alcohol (9.3%) and cigarette (1.9%) use compared to adolescent-reported lifetime use of alcohol (25%) and cigarettes (11.5%). Given the limited variability in parent responses and greater confidence that adolescents' responses reflect their actual behavior, as opposed to the possible perception

of behavior by parents, analyses will only include adolescent reports of their own substance-related health risk behaviors and will exclude parent reports. Adolescent-reported previous 12 month use of alcohol and cigarettes or tobacco products were severely skewed and could not be normalized using transformations. Therefore, non-parametric analyses were conducted for hypotheses that included adolescent reports of previous 12 month use of alcohol and cigarette or tobacco products, where applicable.

The impact of outliers was also assessed. Due to the differential impact of outliers on the distribution of parent reported comfort (i.e., PCAQ Comfort) and parent reported self-efficacy to discuss health risk behaviors (i.e., PSE), two outliers, one for each measure, were truncated to 3 standard deviations from the mean of each respective sample's composite score.

The analyses of the first set of hypotheses exploring the relationships among parent- and adolescent-reported adherence to diabetes management tasks and metabolic control were conducted using Pearson correlations. The second, third, and fourth sets of hypotheses examining the relationships among adolescent involvement in health risk behaviors and adherence to diabetes management regimen, metabolic control, and aspects of communication were conducted using Spearman correlations and Mann-Whitney U tests. In particular, Spearman correlations were used to examine relationships among variables of interest and adolescent-reported previous 12 month engagement in health risk behaviors. Mann-Whitney U tests were used to examine the differences among variables of interest and adolescent-reported lifetime involvement in health risk behaviors. For the fifth hypothesis examining how aspects of parent and adolescent reported communication were related to adolescent-reported health risk behavior, logistic

regressions were used to examine the predictors of adolescent-reported lifetime engagement in alcohol and cigarette use. Multiple regressions were conducted to examine how aspects of parent and adolescent communication predicted adolescent-reported health risk behaviors during the previous 12 months and to predict parent- and adolescent-reported adherence to diabetes management tasks. Similarly, the sixth and seventh hypotheses examined how aspects of parent- and adolescent-reported communication and adolescent health risk behaviors combined to predict parent- and adolescent-reported adolescent treatment adherence. Four multiple regressions were conducted examining parent- and adolescent-reported communication and adolescent adherence to diabetes management tasks separately. Only variables associated with parent- and adolescent-reported adolescent treatment adherence at the bivariate level were included in the analyses.

Descriptive Analyses

Analyses were based on a sample of 54 female caregivers and 52 female adolescents, which includes 51 female caregiver-female adolescent dyads, three unpaired female caregivers, and one unpaired female adolescent.

Descriptive statistics for female caregiver demographic and household characteristics are displayed in Table 3. All female caregivers identified as biological mothers. Mothers ranged in age from 32 to 57 years (M = 45.87, SD = 5.81) and were primarily Caucasian (94.4%), married (94.4%), well educated (66.7% had at least a 4-year college degree) and employed (88.9% employed at least part time). More than half (67.2%) reported family earnings of at least $80,000 per year.

Descriptive statistics for female adolescent participants are displayed in Table 4. Adolescents ranged in age from 14 to 19 years (M = 16.03, SD = 1.48). The majority of adolescents who participated in the study identified as Caucasian (90.2%). Just over half of the adolescents reported dosing and administering their insulin using syringes or insulin pens (54.5%) versus insulin pump (45.5%). Most recent HbA_{1C} varied from 6.6% to 12.8% (M = 8.64, SD = 1.46), with higher scores representing poorer metabolic control. Adolescents' mean age at diagnosis was 9.22 years of age (SD = 3.72), and mean length of diagnosis was 6.77 years (SD = 3.54).

The descriptive data for the parent- and adolescent-reported health risk behaviors are presented in Tables 5 and 6. Adolescents reported variable levels of health risk behavior engagement. Approximately 25% of adolescents reported lifetime use of alcohol, and approximately 21% reported any use of alcohol during the past year. The average age of consuming alcohol away from family members was 14.8 years (range = 12-17). Six adolescents (11.8%) reported consuming beer once a month or less, six (11.5%) reported consuming wine or wine coolers 2-3 days per month or less, and 10 (19.2%) reported consuming hard liquor 2-3 days per month or less. Of the adolescents who reported alcohol use, six adolescents reported binge drinking (i.e., consuming 5 or more drinks in a row) at least 1 or 2 days during the past 12 months.

Nearly 12% of adolescents reported lifetime use of cigarettes, and about 10% reported use of cigarettes or tobacco in the past year. Average age of initiation of smoking was 14.8 years (range = 14-17). All adolescents who reported a history of smoking denied cigarette use on a daily basis (i.e., 1 per day for 30 days). One adolescent

(1.8%) reported smoking 4.5 cigarettes over the course of 1.5 days during the previous 30 days.

Five parents (9.3%) reported adolescent lifetime use of alcohol, while approximately 2% reported lifetime use of cigarettes. During the past year, parents reported approximately 6% of adolescents drank beer, 4% drank wine/wine coolers, 6% drank hard liquor, and 2% smoked cigarettes.

Descriptive data for aspects of parent- and adolescent-reported communication and adherence to diabetes treatment regimen are presented in Table 7.

Preliminary Analyses

Preliminary analyses were conducted using parametric (i.e., t-test, Pearson correlation) and non-parametric (i.e., Spearman rho and Mann-Whitney U Test) statistical analyses to examine potential relationships among demographic characteristics (e.g. age, adolescent race/ethnicity, income), diabetes-related variables (e.g. most recent HbA_{1C}, length of diagnosis, type of insulin administration), and study variables (e.g., aspects of parent- and adolescent-reported communication and adolescent health risk behaviors) in order to identify potential covariates. There were three general demographic covariates (i.e., age, adolescent race/ethnicity, and income) and one diabetes-related covariate (i.e., insulin administration type) that were associated with constructs of interest.

Demographic covariates.

Age.

Adolescent age was significantly associated with adolescent-reported frequency of discussing substance use, $r = -.31$, $p < .05$. With regards to engagement in health risk

behaviors, age was positively associated with adolescent reported use of alcohol in the previous 12 months, $r = .28$, $p < .05$. Due to limited variability and skewness of adolescent-reported lifetime use of substances, Mann-Whitney U tests were performed to compare ranks for the adolescent-reported lifetime engagement in risk behaviors ($n = 13$ for lifetime alcohol use, $n = 6$ for lifetime cigarette use); no significant differences were found.

Adolescent race/ethnicity.

Due to the relatively homogenous racial/ethnic composition of the sample, adolescent race/ethnicity was dichotomized into Caucasian and Non-Caucasian to examine the possible differences among study variables of interest and race/ethnicity. Mann-Whitney U tests were conducted and revealed significant differences in most recent HbA_{1C}, $U = 120.5$, $Z = -1.97$, $p < .05$, $r = .27$, with Caucasian adolescents having better metabolic control (Md = 8.1, $n = 46$) than Non-Caucasian adolescents (Md = 9.3, $n = 9$).

Family income.

Bivariate correlations were performed to examine the associations among family income and variables of interest. Family income was not associated with aspects of parent- or adolescent-reported communication. There was a trend found for the association between income and parent-reported adherence to diabetes management regimen, $r = .27$, $p = .054$, which indicates that greater income was associated with better parent-reported adherence behaviors.

Diabetes-specific covariates.

Analyses revealed significant differences in parent-reported comfort discussing substance-related health risk behaviors when comparing participants' method of insulin administration. Parents of adolescents who are treated with conventional insulin (i.e., syringes or insulin pens) reported greater comfort with discussing substance-related health risk behaviors with their adolescent (M = 4.70, SD = .51) than parents of adolescents on an insulin pump (M = 4.31, SD = .62), $t(50) = 2.48$, $p<.05$.

Hypothesis 1: Associations Among Parent- and Adolescent-Reported Adherence to Diabetes Management Regimen and Metabolic Control

To examine associations among the first set of hypotheses, bivariate Pearson correlations were conducted among parent- and adolescent-reported adherence to diabetes management regimen (SCI-R) and metabolic control (as measured by adolescents' most recent HbA_{1C} values). It was hypothesized that better adherence to diabetes management tasks would be associated with lower HbA_{1C} values.

Associations among parent- and adolescent-reported SCI-R scores, and metabolic control.

Higher scores on the SCI-R represent better adherence to diabetes management regimen. Parent, $r = -.28$, $p < .05$, one-tailed, and adolescent, $r = -.28$, $p < .05$, one-tailed, reported diabetes adherence were significantly associated with metabolic control, such that better adherence was associated with lower HbA_{1C} values.

Hypothesis 2: Associations and Differences Among Adolescent-Reported Health Risk Behaviors and Adherence to Diabetes Management Regimen

Bivariate correlations were performed using Spearman correlations

to examine the associations among adolescent-reported previous 12 month use of alcohol and tobacco products and parent- and adolescent-reported adherence to diabetes management tasks. It was hypothesized that greater involvement in health risk behaviors during the previous 12 months would be associated with poorer adherence. Mann-Whitney U tests were performed to examine the differences among parent- and adolescent-reported adherence and adolescent-reported lifetime use of alcohol and cigarettes. It was hypothesized that adolescents who have engaged in health risk behaviors would have poorer adherence behaviors.

Associations and differences among adolescent-reported lifetime and previous 12 month use of alcohol and tobacco products and adherence to diabetes management tasks.

Bivariate associations among adolescent-reported engagement in health risk behaviors during the previous 12 months and adherence are presented in Table 8. Adolescent-reported use of alcohol during the past year was significantly associated with both their own, $r = -.26$, $p < .05$, one-tailed, and parent-reported, $r = -.34$, $p < .01$, one-tailed, adolescent adherence to diabetes management tasks, such that more frequent use of alcohol was related to poorer adolescent adherence behaviors. Additionally, adolescent-reported use of cigarettes or tobacco products was significantly correlated with parent-reported adolescent adherence, $r = -.24$, $p < .05$ one-tailed, such that more frequent use of cigarettes or tobacco was associated with poorer adherence to diabetes management regimen. Previous 12 month use of cigarettes or tobacco was not significantly associated with adolescent-reported adherence, $r = -.19$, ns.

Differences among adolescent-reported lifetime use of alcohol and tobacco and parent- and adolescent-reported adherence to diabetes management tasks are presented in Table 9. With regards to adolescent-reported lifetime use of alcohol, there was a significant difference for adolescent-reported adherence between those who reported engaging in lifetime alcohol use, Md = 65.00, $n = 13$, and those who denied use, Md = 78.33, $n = 39$, $U = 154$, $z = -2.11$, $p < .05$, $r = .29$. This represents a small effect. A trend was found for differences among adolescents who reported lifetime alcohol use, Md = 76.67, $n = 13$, and those who did not, Md = 66.67, $n = 39$, for parent-reported adherence, $U = 158$, $z = -1.93$, $p = .054$, $r = -.27$. This represents a small effect.

Adolescents who reported lifetime use of cigarettes, Md = 55.00, $n = 6$, had significantly poorer self-reported adherence behaviors than adolescents who denied lifetime use of cigarettes, Md = 78.33, $n = 46$, $U = 66$, $z = -2.07$, $p < .05$, $r = .29$. This represents a small effect. Similarly, adolescents who reported lifetime use of cigarettes, Md = 60.83, $n = 6$, had significantly poorer parent-reported adherence to diabetes management tasks than girls who denied lifetime use of cigarettes, Md = 76.67, $n = 45$, $U = 33$, $z = -2.99$, $p < .001$, $r = .42$. This represents a medium effect.

Hypothesis 3: Associations and Differences Among Adolescent-Reported Involvement in Health Risk Behaviors and Metabolic Control

Bivariate correlations were performed using Spearman's rho to examine the associations among adolescent-reported use of alcohol and tobacco products during the previous year and metabolic control. It was hypothesized that greater involvement in health risk behaviors during the previous 12 months would be associated with poorer metabolic control. Mann-Whitney U tests were performed to examine the differences

among adolescent-reported lifetime use of alcohol and tobacco and metabolic control. It was hypothesized that adolescents who have engaged in these health risk behaviors would have higher HbA_{1C} values compared to those who denied engagement.

Associations among adolescent-reported lifetime and previous 12 month use of alcohol and tobacco products and most recent HbA_{1C} values.

Bivariate correlations and Mann Whitney U tests revealed that there were no significant associations or differences among adolescent-reported lifetime or previous 12 month use of alcohol and cigarettes/tobacco and metabolic control. Results of these analyses can be found in Table 10.

Hypothesis 4a and 4b: Associations and Differences Among Parent- and Adolescent-Reported Aspects of Communication and Adolescent Involvement in Health Risk Behaviors

Bivariate associations were performed using Spearman's rho to examine the relationships among aspects of parent- and adolescent-reported communication (i.e., openness, problem, frequency, parental comfort, and parental self-efficacy) and adolescent-reported involvement in health risk behaviors during the previous 12 months. Greater communication frequency, openness, parental comfort, and parental self-efficacy and less problem communication were hypothesized to be associated with less adolescent involvement in health risk behaviors. Additionally, Mann-Whitney U Tests were performed to examine differences among adolescent-reported lifetime use of alcohol and cigarettes and the various aspects of communication. It was hypothesized that parent- and adolescent-reported communication frequency, openness, parental comfort, and parental

self-efficacy would be lower for adolescents who have engaged in the use of alcohol and cigarettes, while parent- and adolescent-reported problem communication would be greater for those adolescents who have a history of alcohol and cigarette use.

Associations among adolescent-reported lifetime and previous 12 months use of alcohol and tobacco products and parent- and adolescent-reported aspects of communication.

Bivariate associations among adolescent-reported health risk behaviors during the previous 12 months and aspects of parent- and adolescent-reported communication are reported in Table 11. Greater adolescent-reported use of alcohol during the past 12 months was significantly associated with poorer parent-reported open communication, $r = -.32, p < .05$, higher levels of problem communication, $r = .31, p < .05$, and lower levels of comfort, $r = -.36, p < .01$. Greater adolescent use of alcohol during the past 12 months was also associated with poorer adolescent-reported openness, $r = -.43, p < .001$, and greater problem communication, $r = .43, p < .001$. Greater adolescent-reported open communication, $r = -.37, p < .01$, and lower problem communication $r = .38, p < .01$, were associated with less cigarette or tobacco use during the previous 12 months.

Differences among adolescent-reported lifetime use of alcohol and cigarettes and aspects of parent- and adolescent-reported communication are presented in Tables 12 and 13. Significant differences were found for adolescent-reported lifetime use of alcohol for parent-reported open communication, $U = 147.50, z = -2.06, p < .05, r = .29$, and comfort, $U = 177.50, z = -2.38, p < .05, r = .34$, and a trend for problem communication, $U = 159.00, z = -1.81, p = .07, r = .26$, compared to those who denied lifetime use. These represent small and medium effects. Adolescent-reported openness, $U = 135.00, z$

= -2.42, $p < .05$, $r = .34$, and problem communication $U = 105.00$, $z = -2.87$, $p < .01$, $r = .40$, significantly differed among adolescents who did and did not endorse lifetime alcohol use. These represent medium effects.

Parent-reported comfort associated with discussing health risk behaviors was significantly different for adolescents who reported and denied lifetime use of cigarettes, $U = 46.50$, $z = -2.28$, $p < .05$, $r = .33$. This represents a medium effect. Adolescents who reported lifetime use of cigarettes significantly differed in their self-reported openness, $U = 36$, $z = -2.90$, $p < .01$, $r = .41$, and problem communication, $U = 40.5$, $z = -2.77$, $p < .01$, $r = .39$, compared to adolescents who denied lifetime use of cigarettes. These represent medium effects. Similarly, differences were observed at the trend level for parent-reported problem communication for adolescents who reported lifetime use of cigarettes compared to those who did not report a history of cigarette use, $U = 53.5$, $z = -1.91$, $p = .055$, $r = .27$. This represents a small effect.

Hypothesis 5: Aspects of Parent- and Adolescent-Reported Communication Predicting Adolescent Involvement in Health Risk Behaviors

A series of logistic regression analyses were used to predict adolescent lifetime engagement in health risk behaviors. The first logistic regression examined the contributions of parent-reported openness, problem, and comfort in the prediction of adolescent lifetime use of alcohol. The second logistic regression examined the contributions of parent-reported problem and comfort communication to predict adolescent-reported lifetime use of cigarettes. The third and fourth logistic regressions examined the relative contributions of adolescent-reported open and problem

communication in predicting their own reports of lifetime use of alcohol and cigarettes, respectively.

A series of multiple regressions were performed examining aspects of parent- and adolescent-reported communication to predict frequency of previous 12-month engagement in health risk behaviors. The first regression examined the contributions of parent-reported openness, problem, and comfort communication to predict adolescent use of alcohol during the past 12 months. A second regression examined the predictive ability of parent-reported problem communication for adolescent-reported use of tobacco during the last 12 months. The third and fourth regressions examined the relative contributions of adolescent-reported openness and problem communication in predicting their own reports of 12-month use of alcohol and tobacco.

Parent- and adolescent-reported communication predicting adolescent-reported lifetime and previous 12 month use of alcohol and tobacco.

Parent-reported communication predicting adolescent-reported lifetime use of alcohol.

The results of the first logistic regression indicated that the overall model was significant, $\chi^2(4, N = 48) = 10.44, p < .05$. The model explained 30% (Nagelkerke R squared) of the variance in adolescent-reported lifetime use of alcohol. Insulin dose type was entered in the first step and did not significantly predict adolescent lifetime use of alcohol, $\chi^2(1, N = 48) = 1.42$. Parent-reported openness, problem, and comfort communication were entered as predictors in the second step. No predictor variables accounted for significant amount of unique variance in adolescent lifetime use of alcohol. Results from the first logistic regression are found in Table 14.

Parent-reported communication predicting adolescent-reported lifetime use of cigarettes.

Results from the second logistic regression are presented in Table 15. Controlling for insulin dose type, the final model significantly predicted adolescent lifetime use of cigarettes, $\chi^2(3, N = 48) = 10.17, p < .05$, accounting for 44% of the variance (Nagelkerke R squared). In the final model, parent-reported comfort was the only significant predictor of adolescent-reported lifetime use of cigarettes.

Adolescent-reported communication predicting adolescent-reported lifetime use of alcohol.

Results of the third logistic regression predicting adolescent-reported lifetime use of alcohol from adolescent-reported openness and problem communication are presented in Table 16. The final model was significant, $\chi^2(2, N = 50) = 10.12, p < .01$. Together, adolescent-reported openness and problem communication accounted for 27% of the variance (Nagelkerke R squared) in adolescent-reported lifetime use of alcohol. No predictor variables accounted for significant amount of unique variance in adolescent lifetime use of alcohol.

Adolescent-reported communication predicting adolescent-reported lifetime use of cigarettes.

The results of the final logistic regression predicting adolescent-reported lifetime use of cigarettes from adolescent-reported openness and problem communication are presented in Table 17. The final model was significant $\chi^2(2, N = 50) = 9.50, p < .01$, and accounted for 33% (Nagelkerke R squared) of the variance in adolescent-reported

lifetime use of cigarettes. Individual predictor variables did not contribute a significant amount of unique variance in adolescent lifetime use of cigarettes.

Parent-reported communication predicting adolescent-reported 12 month use of alcohol.

Results from the first linear regression are presented in Table 18. The insulin dosing type was the only demographic characteristic significantly related to predictors included in this model and was entered into the regression first. Aspects of parent-reported communication (i.e., comfort, openness, and problem) were entered second. Although it was initially proposed that the regression model would include parent-reported frequency and self-efficacy to predict adolescent-reported lifetime use of alcohol, these variables were excluded because they were not significantly associated with the outcome variable at the bivariate level.

The results of the first regression indicated that the overall model was significant, $F(4, 44) = 3.31, p < .05$, and predicted 23% of the variance in adolescent-reported previous 12 month use of alcohol. Insulin dosing type did not account for a significant amount of variance in the prediction of adolescent use of alcohol during the past year at step 1, $F(1,47) = .43, p = .52, R^2 = .01$. In the second step, parental openness, problem, and comfort communication were entered and predicted a significant amount of variance in adolescent-reported use of alcohol in the past 12 months, R^2 change = .22. In the final model, parent-reported comfort for discussing substance use was the only significant predictor of adolescent use of alcohol during the last year.

Parent-reported communication predicting adolescent-reported 12 month use of tobacco.

The second multiple linear regression was conducted to examine the parent-reported problem communication in predicting adolescent-reported use of tobacco during the past year. Parent-reported problem communication did not significantly predict adolescent-reported previous 12 month use of tobacco, $F(1, 48) = 2.52$, $p = .12$, and predicted 5% of the variance in adolescent use of cigarettes or tobacco during the previous 12 months. Results are presented in Table 19.

Adolescent-reported communication predicting adolescent-reported 12 month use of alcohol.

The third regression was conducted to examine the contributions of aspects of adolescent-reported open and problem communication in predicting their own engagement in alcohol use during the past year. The results of the regression indicated that the overall model was significant, $F(2, 47) = 7.82$, $p < .001$, and predicted 25% of the variance in adolescent use of alcohol during the past year. Adolescent-reported open communication was the only significant predictor of adolescent use of alcohol during the previous 12 months. Results are presented in Table 20.

Adolescent-reported communication predicting adolescent-reported 12 month use of tobacco.

A fourth multiple linear regression was conducted to examine the prediction of adolescent use of cigarettes or tobacco during the last year by adolescent-reported openness and problem communication. Results from the regression are presented in Table 21. The regression model was found to be significant, $F(2, 47) = 4.66$ $p < .05$, and

predicted 17% of the variance in adolescent use of cigarettes and tobacco during the last 12 months. Adolescent-reported problem communication was the only significant predictor in the final model.

Hypothesis 6 and 7: Aspects of Parent- and Adolescent-Reported Communication and Adolescent Use of Alcohol and Tobacco Predicting Adolescent Adherence and Metabolic Control

Bivariate associations were performed to examine the relationships among aspects of parent- and adolescent-reported communication (i.e., openness, problem, frequency, parental comfort, and parental self-efficacy), parent- and adolescent-reported adolescent adherence to diabetes management tasks, and metabolic control. Pearson correlations among aspects of parent- and adolescent-reported communication and adolescent adherence are presented in Table 22.

In general, aspects of parent- and adolescent-reported communication were not significantly associated with metabolic control (see Table 23). Additionally, adolescent-reports of use of alcohol (e.g., lifetime and previous 12 month use) and tobacco (e.g., lifetime use of cigarettes and previous 12 month use of tobacco) were not associated with HbA_{1C}, therefore, regression analyses examining parent- and adolescent-reported communication and adolescent-reported use of alcohol and tobacco predicting metabolic control were not performed.

A series of multiple linear regression analyses were conducted using only the predictor variables that were significant at the bivariate level to parent- and adolescent-reported adherence to diabetes management tasks. Results from the regressions are presented in Tables 24-27. Age was the only demographic variable that was significantly

associated with a predictor variable (e.g., adolescent-reported 12 month use of alcohol) at the bivariate level. Therefore age was entered first into the regressions in which adolescent-reported 12 month use of alcohol was used as a predictor variable.

Parent- and adolescent-reported communication and adolescent use of alcohol predicting parent- and adolescent-reported adolescent adherence.

Parent-reported communication and adolescent-reported use of alcohol predicting parent-reported adherence.

The results of the regression indicated that the overall model was significant, $F(5, 44) = 4.48$, $p < .01$, and predicted 34% of the variance in parent-reported adolescent adherence to diabetes management regimen. Age did not account for a significant percentage of variance in the prediction of parent-reported adolescent adherence, $F(1, 48) = .09$, $p = .77$, accounting for less than 1% of the variance in parent-reported adolescent adherence. In the final model, parent-reported problem communication accounted for a significant amount of unique variance in predicting parent-reported adolescent adherence after taking into account age, parent-reported openness communication, and adolescent-reported alcohol use. Results from the regression are presented in Table 24 and represent the contributions at each step of the regression and the final regression model.

Adolescent-reported communication and adolescent-reported use of alcohol predicting adolescent-reported adherence.

A second linear regression was conducted to examine the contributions of adolescent-reported communication and adolescent reports of alcohol use in the prediction of adolescent-reported adherence to diabetes management tasks. Results from

the regression model are presented in Table 25 and represent the contributions at each step of the regression and the final regression model. Age was entered into the regression first, and adolescent-reported openness, problem, and frequency of communication, and adolescent-reported alcohol use (e.g., lifetime and previous 12 month use) were entered second. The results of the regression indicated that the overall regression model was significant, $F(5, 44) = 3.94$, $p < .01$, and predicted 36% of the variance in adolescent-reported adherence. Age did not predict a significant amount variance in adolescent-reported adherence. In the second step, age, openness, problem, and frequency of communication, and adolescent-reported alcohol use accounted for a significant amount of unique variance in predicting treatment adherence, R^2 change = .31. Frequency of communication accounted for a significant amount of variance in adolescent-reported adherence to diabetes management tasks.

Parent- and adolescent-reported communication and adolescent use of tobacco predicting parent- and adolescent-reported adolescent adherence.

Parent-reported communication and adolescent-reported use of tobacco predicting parent-reported adherence.

A linear regression was conducted to examine the contributions of parent-reported communication (e.g., openness and problem) and adolescent reports of tobacco use (e.g. lifetime use of cigarettes and 12 month use of tobacco) in the prediction of parent-reported adherence to diabetes management tasks. Results from the regression model are presented in Table 26. The results of the regression indicated that the overall regression model was significant, $F(4, 45) = 7.01$, $p < .001$, and predicted 38% of the variance in parent-reported treatment adherence. Examination of the final model revealed that parent-

reported problem communication and adolescent-reported lifetime use of cigarettes were the only significant predictors of parent-reported adolescent adherence to diabetes management tasks.

Adolescent-reported communication and adolescent-reported use of tobacco predicting adolescent-reported adherence.

A fourth linear regression was conducted to examine the contributions of adolescent-reported communication (e.g., openness, problem, and frequency communication) and adolescent-reported lifetime use of cigarettes in the prediction of adolescent-reported treatment adherence. Results from the regression model are presented in Table 27. The results of the regression indicated that the overall regression model was significant after controlling for age, $F(3, 46) = 4.74$, $p < .001$, and predicted 35% of the variance in adolescent-reported adherence to diabetes management tasks. Frequency of communication accounted for a significant amount of variance in adolescent-reported adherence to diabetes management tasks.

Additional Relevant Post Hoc Analyses

Associations among aspects of parent- and adolescent-reported communication are presented in Table 28. Parent- and adolescent-reported open, $r = .50$, and problem communication, $r = .49$ were significantly correlated, $p < .001$. Parent-reported frequency of communication was not significantly associated with adolescent-reported frequency, $r = .07$, $p > .05$.

Discussion

The current study is the first to explore relationships among health risk behaviors, parent-adolescent communication, and diabetes management among adolescents with T1DM. The present study provides updated prevalence rates of health risk behavior engagement and is the first to report on both lifetime and previous 12 month use of alcohol and tobacco products by adolescents with T1DM. In general, results supported our hypotheses. As predicted, poorer adherence was associated with poorer metabolic control and health risk behavior engagement. Although we initially hypothesized that metabolic control would be poorer among adolescents who endorsed health risk behavior engagement, this hypothesis was not supported. Results also suggest that general aspects of communication (i.e., open and problematic communication), as well as parental comfort discussing risk behaviors, may be primary facets of communication that work together to predict health risk behavior engagement among adolescents with T1DM. Finally, our results suggest that general aspects of communication, frequency of discussing health risk behaviors, and adolescent substance use combine to predict adolescent adherence to diabetes management tasks. Results of the present study indicate that diabetes healthcare providers should be aware of the impact that health risk behaviors may have on adolescents' ability to manage their disease and to help correct distorted beliefs associated with perceived risk associated with engagement among adolescents with T1DM. Although previous research has found that adolescents with T1DM see themselves as less at risk for the adverse side effects of substance use (Frey, et al., 1997) and do not believe health risk behaviors will impact their ability to manage their diabetes (Glasgow, et al., 1991), our results suggest that health risk behavior

engagement may influence disease management. Finally, our results suggest that improving parent-adolescent communication may be a potential avenue for intervention, particularly focusing on the quality of communication, as it may play an important role in decreasing adolescent health risk behavior engagement and improving adherence to diabetes management tasks among adolescents with T1DM.

Health Risk Behaviors in Adolescents with T1DM

In the present study, 25% of female adolescents (14-19 years of age) with T1DM reported lifetime use of alcohol (e.g., ever had a drink of alcohol, not just a taste of someone else's drink more than 2-3 times), which is lower than previously published rates of lifetime alcohol use in adolescent with T1DM. For example, the most recently published data on lifetime use of alcohol among adolescents (10-20 years of age) with T1DM reported that 39% endorsed having ever tried alcohol (Frey, et al., 1997). The disparate rates of lifetime use of alcohol among adolescents with T1DM may be a function of inconsistent operationalization of "lifetime use". The operationalization of "lifetime use" in the current study appears to be more conservative (i.e., the minimum amount of use to meet for "lifetime use" is greater) than other published studies examining alcohol use in adolescents with T1DM and may therefore underestimate the rate of having "ever tried" alcohol in the present sample.

The rate of adolescent-reported lifetime cigarette use (approximately 12%) in the current study is similar to that of the most recent finding that 14.9% of adolescents with T1DM, ages 15-19 years old, have reported having ever smoked a cigarette (Reynolds, et al., 2011). However, this rate is lower than the rate of lifetime use reported by Frey and colleagues (1997; i.e., 34% of 10-20 year olds have ever tried cigarettes). In the present

study, observed rates of having ever smoked a cigarette likely reflects the general decrease in lifetime cigarette use seen among nationwide samples of adolescents (Kann, et al., 2014). The decrease in lifetime use of cigarettes reported by Frey and colleagues (1997), Reynolds and colleagues (2011), and the present study may reflect this general linear decrease in prevalence of having ever tried a cigarette among adolescents with T1DM.

To our knowledge, the present study is the first to measure the prevalence rates of previous 12 month use of alcohol and tobacco among adolescents with T1DM. The current study found that 21% of the adolescents reported previous 12 month use of alcohol, while 9.6% reported using cigarettes or tobacco during the past year. Discrepancies were observed between parent- and adolescent-reported rates of substance us. Few parents reported that their adolescent had ever drank alcohol (9.3%) and even fewer reported lifetime use of cigarettes (1.9%). Yang and colleagues (2006) suggest that discrepancies between parent- and adolescent-reported risk behaviors may be associated with adolescents' limited disclosure of information to their parents, rather than a function of parental monitoring of their child's activities. Future research may examine both adolescent disclosure and parental monitoring to better understand their influences on parent and adolescent reporting of substance use.

Previous 12 month use of alcohol and tobacco are lower than has been reported for adolescents with chronic illnesses. For example, Kunz and colleagues (2014) found that 44% of adolescents with a chronic medical condition (i.e., pulmonary, GI, rheumatologic, hematologic, cardiac, or multiple conditions) drank alcohol during the previous 12 months, while 15% reported using tobacco. In another study examining

health risk behaviors among adolescents with self-identified chronic health conditions (i.e., "[having] a physical or health condition that makes it hard for [a child] to do some things that other kids [their] age would do (like concentrating in school, doing sports, or eating like other teenagers)", p. 184) and otherwise healthy adolescents, Erickson and colleagues (2005) found that nearly 40% of adolescents with chronic health conditions reported using alcohol and cigarettes during the past year. The discrepancies among the findings of the current study and that of Erickson and colleagues (2005) may be a function of the scope of sampling parameters and operationalization. That is, the current study sampled only adolescents with T1DM, whereas Erickson and colleagues (2005) may have sampled adolescents with chronic medical, physical, or other health conditions. It is unclear if "chronic health condition" was operationalized to include adolescents who self-identified with physical, developmental, or psychological conditions, which may have resulted in a sample composed of various types of conditions rather than just chronic medical conditions (i.e., chronic illness).

Relationship Between Adherence and Metabolic Control

The first hypothesis explored the associations between parent- and adolescent-reported treatment adherence and metabolic control. As hypothesized, better parent- and adolescent-reported adherence (SCI-R) was associated with lower HbA_{1C} values, representing better metabolic control. This is consistent with previous literature showing a negative relationship between treatment adherence and metabolic control (Weinger, et al., 2005).

Relationships Among Parent- and Adolescent-Reported Adherence, Adolescent Health Risk Behavior Engagement, and Metabolic Control

The second hypothesis explored the associations and differences among parent- and adolescent-reported adolescent adherence and adolescent lifetime and previous 12 month use of alcohol and tobacco. Results from the current study suggest that greater alcohol and tobacco use during the past year were associated with poorer adolescent adherence to diabetes management regimen. Additionally, parent- and adolescent-reported adolescent adherence was significantly lower among adolescents who reported lifetime use of alcohol and cigarettes. This is consistent with previous research showing that adolescents with T1DM who reported engaging in health risk behaviors (i.e., use of tobacco, cigarettes, marijuana, alcohol, and other drugs) had significantly higher rates of diabetes mismanagement (e.g., missing insulin/bolus shots on purpose, falsifying blood sugar readings, and missing a meal or snack; Scaramuzza, De Palma, Mamelim Spiri, Santoro, & Zuccotti, 2010).

Although adolescent health risk behavior engagement was associated with treatment adherence, results from the current study show that adolescent health risk behaviors were not significantly associated with most recent HbA_{1C} values. Previous research examining the relationships among lifetime use of cigarettes, previous 12 month use of tobacco, and metabolic control is inconsistent (Hofer, et al., 2009; Reynolds, et al., 2011; (Tercyak, et al., 2005). The inconsistent relationship between cigarette and tobacco use and HbA_{1C} may be associated with dissimilar timeframes across each measure. Specifically, the relationship between HbA_{1C} and adolescent health risk behavior may be a function of time; only when the timeframe associated with most recent HbA_{1C} assay (i.e., glycemic control during the previous 2-3 months) overlaps use of tobacco products,

would the relationship between these two variables be observed. Additionally, frequency of engagement in risk behaviors may impact the relationship between glycemic control and tobacco use. Previous research has shown that adolescents who smoked cigarettes on a more regular basis (i.e., smoked at least one cigarette per day or more during the past 30 days) had significantly poorer HbA_{1C} levels (Hofer, et al., 2009; Reynolds, et al., 2011); however, this relationship has not been found for lifetime use of cigarettes and HbA_{1C} (Tercyak, et al., 2005). Among those who reported previous 12 month use of tobacco products (9.6%), only one adolescent (1.9%) endorsed using cigarettes or tobacco 2-3 times per month. The lack of association between use of cigarettes or tobacco and metabolic control in the present study may also be accounted for by adolescents' rather intermittent use of tobacco products during the past year.

To our knowledge, this is the first study to examine the relationship between metabolic control and use of alcohol during the past year among adolescents with T1DM. Although alcohol use has potentially negative short- and long-term consequences, including delayed hypoglycemia, metabolic dysregulation, acidosis, hypertension, and neuropathy for individuals with T1DM, there is some evidence to suggest that, in moderate amounts, alcohol may actually improve insulin sensitivity. While alcohol consumption seems to have an acute impact on carbohydrate metabolism, which may lead a hypoglycemia episode, in most cases, it does not impact glycemic control (van de Wiel, 2004). Consistent with previous research (Glasgow, et al., 1991), the current study did not find a relationship between lifetime use of alcohol and metabolic control.

Parent- and Adolescent-Reported Communication and Adolescent Health Risk Behavior Engagement

The present study offers a unique contribution to the literature in that it examined the relationship between parent-adolescent communication and adolescent health risk behaviors in adolescents with T1DM. Results demonstrate that greater alcohol use during the past year was associated with less open communication and comfort discussing health risk behaviors, and greater problem communication (parent- and adolescent-report). A similar pattern of results was found for aspects of parent- and adolescent-reported communication and adolescent lifetime use of alcohol.

With regards to adolescent use of tobacco during the past year, greater use was associated with higher levels of parent- and adolescent-reported problem communication. Similarly, adolescents who reported lifetime use of cigarettes had greater levels of problem communication with their parents (parent- and adolescent-reported). Additionally, adolescents who reported greater use of tobacco during the past year and lifetime use of cigarettes also reported less open communication with their parents. Finally, among adolescents who reported lifetime use of cigarettes, parents reported less comfort discussing substance use compared to adolescents who denied lifetime use of cigarettes.

Prediction of Adolescent Health Risk Behavior Engagement

The fifth hypothesis examined what factors explained adolescent health risk behavior engagement. Specifically, analyses examined the contributions of demographic characteristics associated with predictor variables at the bivariate level, and aspects of parent- and adolescent-reported communication. Four logistic regressions predicting adolescent lifetime use of alcohol or cigarettes and four multiple linear regressions predicting previous 12 month use of alcohol or tobacco from parent- and adolescent

reported communication were conducted to examine the influence of aspects of communication on health risk behavior engagement.

For parent reports, open and problematic communication, and comfort communication about health risk behaviors variably predicted adolescent lifetime and previous 12 month use of alcohol and tobacco products. Among adolescent-reports, open and problematic communication predicted their own reports of lifetime and previous 12 month substance use.

These findings suggest that communication, as it relates to adolescent risk behavior, is a multifaceted construct (Miller-Day & Kam, 2010). While certain aspects of communication occasionally accounted for adolescent risk behavior engagement above and beyond that of other areas of communication, analyses associated with hypotheses four and five appear to indicate that open and problematic communication, and parental comfort discussing risk behaviors work together (i.e., final regression model is significant, but no one predictor uniquely accounted for additional variance) and in tandem to predict adolescent risk behavior. As hypothesized, higher levels of openness and comfort were associated with or predicted lower levels of adolescent engagement, whereas higher levels of problem communication was associated with or predicted greater adolescent health risk behavior engagement. Our results are consistent with previous research that has shown that open communication is associated with less alcohol use over time among girls (Yang, et al., 2007) and may act as a more general protective factor against use of alcohol among adolescents (Fang, Schinke & Cole, 2009).

Additionally, comfort may play a key role in promoting parent-adolescent conversations regarding health risk behaviors (Miller & Whitaker, 2001) and may be

related to other parent-specific factors like knowledge about health risk behaviors or reflect dyadic level constructs associated with the parent-child relationship. Findings in the current study suggest that higher levels of problem communication are cross-sectionally associated with greater health risk behavior involvement. This is consistent with previous research that has shown that female adolescents may be at increased risk for engaging in sexual activity as parent-child problem communication increases (Yang, et al., 2007).

Two measures of parent-adolescent communication were not significantly associated with adolescent health risk behavior: frequency of communication and parent-reported self-efficacy to discuss substance use with their adolescent. Previous research has shown there to be an inconsistent relationship between frequency of communication and adolescent health risk behaviors (Guilamo-Ramos, Jaccard, Dittus, & Bouris, 2006; Otten, et al., 2007; van der Vorst, Engels, Meeus, Dekovic, & van Leeuwe, 2005; van Zundert, van der Vorst, Vermulst, & Engels, 2006). Thus, frequency of communication about health risk behaviors, as it is operationalized in the current study, may only be useful in predicting adolescent health risk behaviors that have occurred during the past three months, rather than the past year or lifetime use.

Similar to frequency of communication, parent-reported self-efficacy to discuss health risk behaviors was not related to adolescent health risk behavior. This is inconsistent with previous findings that parental self-efficacy to discuss risk behaviors was associated with lower risk of adolescents trying cigarettes (Kodl & Mermelstein, 2004). In the current study, parents generally reported very high levels of self-efficacy to discuss health risk behaviors with their adolesents, with very little observed variability

across participants. As a result, we were unable to differentiate between girls who have engaged in health risk behaviors and those who have not based on parent-reported self-efficacy. Results suggest there may be a disconnect between parental beliefs in their ability to effectively communicate about health risk behaviors and their adolescent's actual engagement. This may occur because parental self-efficacy to discuss risk behaviors may be more related to other aspects of communication like openness or comfort (see Table 28) and act as more of a precursor to communication rather than represent an actual aspect of communication in and of itself. Specifically, self-efficacy may need to be present for parents to discuss risk behaviors with their adolescents; however, self-efficacy alone does not predict adolescent's actual engagement in risk behaviors.

Parent- and Adolescent-Reported Communication and Adolescent Health Risk Behavior Engagement Predicting Parent- and Adolescent-Reported Treatment Adherence

The sixth and seventh hypotheses examined the prediction of adherence to diabetes management tasks from aspects of communication and adolescent health risk behavior. Controlling for adolescent age, parent-reported open and problem communication and adolescent-reported lifetime and previous 12 month use of alcohol significantly predicted parent-reported adolescent treatment adherence. Parent-reported problem communication accounted for a significant amount of unique variance. Similarly, parent-reported problem communication, as well as adolescent-reported previous 12 month use of tobacco accounted for a significant amount of unique variance in parent-reported adolescent treatment adherence, above and beyond parent-reported

open communication. Controlling for age, adolescent-reported open, problem, and frequency of communication, and adolescent-reported lifetime and previous 12 month use of alcohol together significantly predicted adolescent-reported adherence. Frequency of communication predicted a significant amount of variance in adolescent-reported treatment adherence, such that greater frequency of communication about substance use was associated with better adherence. Similarly, adolescent-reported open, problem, and frequency of communication about substance use, and lifetime use of cigarettes accounted for a significant amount of variance in adolescent-reported adherence to diabetes management tasks. Frequency of communication predicted a significant amount of variance in adolescent-reported treatment adherence, such that greater frequency of communication about substance use was associated with better adherence.

Taken together, these results suggest parent- and adolescent-reported adolescent adherence behaviors may be influenced by the quality of parent-adolescent communication and adolescent risky behavior. Furthermore, this combination of problematic communication and engagement in health risk behavior may make T1DM even more difficult to manage. For example, if an adolescent girl goes out one evening and consumes 2 or 3 drinks with her friends and does not feel well the next day, she may tell her parents she feels sick, but she might not report that she drank alcohol the night before. Her hesitancy may be associated with general problem communication and less overall communication, which has created an environment where caregivers or adolescents are hesitant to openly share information and/or a less open environment in which there is little perceived freedom to exchange ideas and discuss problems (Barnes & Olson, 1982). A lack of open communication and higher levels of problem

communication may further limit parents' ability to understand why their adolescent is struggling with their diabetes treatment adherence. Although the parents may be attuned to changes in adolescent adherence behaviors, a lack of understanding of the antecedents to poor treatment adherence may impact their ability assist their adolescent with their diabetes management. Beyond the impact that health risk behaviors can have on diabetes management, alcohol or tobacco use may introduce a cascade of events that further impact parent-adolescent interactions. These include various psychosocial sequelae like changes in mood, energy, focus, or behavior associated with spikes (i.e., hyperglycemic) or dips (i.e., hypoglycemic) in blood sugar as a result of health risk behavior engagement. Unless parents are aware of adolescent health risk behavior engagement, it can be difficult to understand behavioral or mood changes and why changes in adherence behaviors have occurred.

Limitations and Future Directions

Several limitations in the current study may limit the generalizability of the findings. One limitation of the study was the cross-sectional design, thus only providing us with data from a one point in time representation of parent-adolescent communication, adolescent risk behavior, and diabetes management; therefore, the results provide us with information about relationships among variables, rather than demonstrate causal relationships. For example, it is unclear whether poor adherence behaviors preceded adolescent risk behavior, or if adherence to diabetes management tasks decreased after adolescents began engaging in health risk behaviors. Additionally, it is unclear how the relationships among parent-adolescent communication, adolescent treatment adherence, and health risk behavior change and evolve as a function of time. Examining these

relationships longitudinally may allow for a better understanding and possible development of behavioral trajectories, which would assist in predicting which adolescents are at greatest risk for engagement and complications associated with health risk behaviors.

Additionally, future research should examine between subject agreement, particularly with regards to parent and adolescent perspectives on various aspects of communication, adherence, and adolescent risk behavior. Additional post-hoc analyses for the current study indicated that parent- and adolescent-reported open and problem communication were significantly correlated, suggesting that parents and adolescents perceive their relationship and environment in similar ways.

Given the sensitive nature of the study, the sample may be biased. In some cases, parents and adolescents refused to participate because they felt uncomfortable answering questions associated with their communication about risk behavior or disclosing rates of adolescent use of alcohol or tobacco. As such, the current sample may represent parents and adolescents who are more comfortable and open about these types of discussions and capture a unique subset of adolescents who engage in health risk behaviors at relatively low rates. Therefore, the current sample may be limited in its representation of risk behavior among adolescent females with T1DM. Future research should examine the current constructs in adolescents who are currently engaging in higher rates of health risk behaviors in order to better understand the relationships among adolescent health risk behavior, parent-adolescent communication, diabetes treatment adherence, and metabolic control.

Another limitation of the current study is the discordant time frames used across measures of communication, risk behaviors, adherence to diabetes management tasks, and most recent HbA_{1C}. For example, the most recent HbA_{1C} value represents glycemic control from the date of study participation, whereas engagement in risk behaviors during the past year covers a time span up to six times longer; thus health risk behaviors during the previous year may not necessarily overlap or represent the same time frame captured by the most recent HbA_{1C} assay. The use of measures with similar timeframes may elucidate the relationships among aspects of communication, adolescent health risk behaviors, treatment adherence, and metabolic control in future research.

Another limitation of the present study was the relatively homogenous sample (i.e., Caucasian, highly educated parents). Some differences in most recent HbA_{1C} value were observed, such that Caucasian adolescents had significantly better metabolic control than non-Caucasian adolescents. Therefore, the generalizability of the current findings to populations with greater diversity may be limited. Future research should examine the relationships among variables of interest in more diverse samples with greater variability in racial, ethnic, and socioeconomic characteristics.

As previously noted, research examining adolescent health risk behavior varies greatly in terms of researchers' operational definitions of various substances and time frames associated with frequency of engagement. These difficulties persist as the operational definitions used in the present study are not necessarily equivalent with the operationalization in previously published studies examining risk behaviors among adolescents with T1DM, chronic illness, and otherwise healthy adolescents (e.g., Frey et al., 1997; Kann, et al., 2014; Reynolds et al., 2011).

Finally, the current study examined communication and aspects of diabetes care among female caregivers and adolescents. Previous research suggests that different processes may operate in gender-matched and mismatched parent-child dyads, particularly with regards to mothers, who appear to discuss a wider range of topics with their daughters (Nolin & Petersen, 1992), and are able to obtain more monitoring knowledge associated with adolescent activities than fathers (Waizenhofer, Buchanan, & Jackson-Newsom, 2004). Furthermore, research suggests that the gender of parents and children may differentially impact the relationship between familial relationship quality and health risk behaviors among healthy adolescents (Kelly, et al., 2011). Therefore, future research should explore aspects of communication, health risk behaviors, treatment adherence, and metabolic control among in male and female adolescents in same- and opposite-gender dyads.

Clinical Implications

The present research study findings have several potential clinical implications that may influence illness management among adolescents with T1DM. Despite the low prevalence rates of adolescent health risk behaviors, particularly tobacco use, engagement in health risk behaviors was associated with poorer adherence to diabetes management tasks, which was in turn negatively associated with poorer metabolic control. Therefore, it is vital that diabetes providers have an understanding of how health risk behaviors impact adolescents' ability to care for their diabetes. In light of research suggesting that adolescents with T1DM see themselves as less at risk to the adverse side effects of health risk behaviors (Frey, et al., 1997) and do not believe their use of alcohol or drugs will impact their ability to manage their illness (Glasgow, et al., 1991), diabetes providers

should try to correct distorted beliefs about the relative safety of engaging in risk behaviors and provide appropriate resources to reduce the risk that adolescents may experience as a result of engaging in these activities. Additionally, results suggest that aspects of parent-adolescent communication may be important in predicting risk behavior and diabetes outcomes in adolescents. As such, interventions focused on improving open, problem, and frequency of communication, as well as parental comfort with discussing risk behaviors may be important for decreasing adolescent health risk behaviors, and improving adherence to diabetes management tasks.

Conclusion

The current study provides new insights into the relationships among adolescent health risk behavior, parent-adolescent communication, and disease management among adolescents with T1DM. Observed rates of health risk behavior engagement in the current sample are lower than previously reported among male and female adolescents with T1DM, other chronic illnesses, and otherwise healthy adolescents. Health risk behaviors appear to negatively impact diabetes management among female adolescents with T1DM. Furthermore, parent-adolescent communication may play a protective role against adolescent health risk behavior engagement. Results underscore the importance of considering the role that parent-adolescent relationship quality and health promoting behaviors play in adolescent's adherence behaviors.

Table 1. Prevalence of Tobacco/Cigarette (T/C) and Alcohol Use Across Adolescent Groups Reported in Empirical Literature

	T/C Lifetime	T/C 12 months	T/C 30 days	Alcohol Lifetime	Alcohol 12 months	Alcohol 30 days
Healthy Adolescents						
Blum et al. (2000)			32.11%*		56.96%	
Grunbaum et al. (2002)			34.00%*	78.20%		47.10%
Erickson et al. (2005)		30.70%			38.60%	
Eaton et al. (2008)	50.00%		20.00%*	75.00%		44.70%*
Eaton et al. (2010)	46.30%			72.50%		
Kann et al. (2014)	41.10%		15.70%	66.20%		34.90%
Adolescents with a Chronic Illness						
Kunz et al. (2014)		15.00%			44.00%	
Suris & Parera (2005)	82.20%			91.30%		
Erickson et al. (2005)		38.50%			40.20%	
Adolescents with T1DM						
Glasgow et al. (1991)				52.00%		
Frey et al. (1997)	42.00%/34.00%			39.00%		
Hofer et al. (2009)			28.40%***			
Reynolds et al. (2011)	14.90%**					
Current Study	11.50%	9.60%	1.92%	25.00%	21.15%	

Lifetime: Having ever used at least once
12 months: Frequency of use during previous year
30 days: Frequency of use during previous 1 month
*Smoked at least 1 cigarette or drank at least 1 alcoholic beverage during the previous 30 days
**Lifetime use of cigarettes
***Current use: Smoked at least 1 cigarette/day during the previous 30 days

Table 2. Constructs and Measures Included in the Present Study

Construct	**Measure**	**Information Source**
Demographics	Demographic Characteristics	Parent, Adolescent
Open and problem family communication	Parent-Adolescent Communication (PAC openness, PAC problem)	Parent, Adolescent
Frequency of communication	Parental Communication with Adolescent Questionnaire (PCAQ frequency)	Parent, Adolescent
Comfort with communication	Parental Communication with Adolescent Questionnaire (PCAQ comfort)	Parent
Parent communication self-efficacy	Parent Self-Efficacy (PSE)	Parent
Health risk behavior involvement	Health Risk Behavior (HRB-lifetime, HRB-12)	Parent, Adolescent
Metabolic control	Most recent HbA_{1C}	Medical Record Review
Adherence to diabetes management regimen	Self-Care Inventory-Revised (SCI-R)	Parent, Adolescent

Table 3. Female Caregiver Demographic and Household Characteristics (n = 54)

	Mean	SD	Range	n	%
Age (years)	45.87	5.81	32-57		
Race/Ethnicity					
Caucasian				51	94.4
Latina/Hispanic				2	3.7
Asian/Pacific Islander				1	1.9
Marital Status					
Married/Living with Partner				51	94.4
Divorced				2	3.7
Separated				1	1.9
Education					
High School/GED				6	11.1
Partial College (at least 1 year)				12	22.2
≥ 4-year College Degree				36	66.7
Occupational Status					
Employed Full Time				28	51.9
Employed Part Time				20	37.0
Unemployed				6	11.1
Number of People in Household	4.35	.87	3-7		
Number of Siblings	1.76	1.04	0-4		
Family Income					
≤ $29,999				1	1.9
$30,000-$59,999				6	11.5
$60,000-$89,999				18	34.6
$90,000-$119,999				8	15.4
$120,000-$159,999				8	15.3
≥ $160,000				11	21.1

Table 4. Female Adolescent Demographic Characteristics (n = 52)

	Mean	SD	Range	n	%
Age (years)	16.03	1.48	14.00-18.58		
Grade	10.29	1.45	8.00-13.00		
Race/Ethnicity					
Caucasian				46	90.2
Latina/Hispanic				2	3.9
Asian/Pacific Islander				1	2.0
African American				1	2.0
Biracial				1	2.0
Diabetes Related Information					
Age at Diagnosis (years)	9.22	3.72	1.50-16.92		
Length of Diagnosis (years)	6.77	3.54	1.33-16.08		
Most recent HbA1C value	8.64	1.46	6.60-12.80		
Adolescents who receives insulin via pump				25	45.5

Table 5. Adolescent-Reported Health Risk Behaviors (n = 52)

	Mean	SD	Range	n	%
Alcohol Use					
Age at Initiation (years)	14.8	1.55	12-17		
Lifetime					
Yes				13	25.0
No				39	75.0
Past 12 Months Use					
Beer					
None				45	88.2
1-2 days in last 12 months				3	5.9
Once a month or less				3	5.9
Wine/Wine Coolers					
None				46	88.5
1-2 days in last 12 months				3	5.8
Once a month or less				2	3.8
2-3 days per month				1	1.9
Hard Liquor					
None				42	80.8
1-2 days in last 12 months				6	11.5
Once a month or less				3	5.8
2-3 days per month				1	1.9
Binge Drinking					
None				46	88.5
1-2 days in last 12 months				3	5.8
Once a month or less				2	3.8
2-3 days per month				1	1.9
Cigarettes/Tobacco Use					
Age at Initiation (years; cigarettes only)	14.8	1.30	14-17		
Lifetime (cigarettes only)					
Yes				6	11.5
No				46	88.5
Past 12 Months Use					
Cigarettes					
None				48	92.3
1-2 days in last 12 months				3	5.8
2-3 days per month				1	1.9
Tobacco/Snuff					
None				51	98.1
1-2 days in last 12 months				1	1.9

Table 6. Parent-Reported Health Risk Behaviors (n = 54)

	n	%
Alcohol Use		
Lifetime		
Yes	5	9.3
No	49	90.7
Past 12 Months		
Beer		
None	51	94.4
1-2 days in last 12 months	2	3.7
Once a month or less	1	1.9
Wine/Wine Coolers		
None	52	96.2
1-2 days in last 12 months	1	1.9
Once a month or less	1	1.9
Hard Liquor		
None	51	94.4
1-2 days in last 12 months	3	5.6
Cigarette/Tobacco Use		
Lifetime (cigarettes only)		
Yes	1	1.9
No	52	98.1
Past 12 Months		
Cigarettes		
None	53	98.2
1-2 days in last 12 months	1	1.9

Table 7. Means, Standard Deviations, and Ranges for Parent and Adolescent Report Measures

			Range	
Variable	Mean	SD	Actual	Potential
Openness (PAC Open)				10 - 50
Parent	40.97	6.09	24.00 - 50.00	
Adolescent	36.11	10.70	10.00 - 50.00	
Problem (PAC Problem)				10 - 50
Parent	22.08	7.25	12.00 - 36.00	
Adolescent	26.55	9.16	10.00 - 45.00	
Frequency (PCAQ Frequency)				1 - 5
Parent	3.03	.98	1.44 - 5.00	
Adolescent	2.15	.97	1.00 - 4.67	
Comfort (PCAQ Comfort)				1 - 5
Parent	4.52	.59	3.22 - 5.00	
Self-Efficacy (PSE)				7 - 49
Parent	46.86	3.90	32.81 - 49.00	
Treatment Adherence (SCI-R)				0 - 100
Parent	73.29	11.11	43.33 - 96.67	
Adolescent	73.27	14.02	35.00 - 93.30	

Table 8. Spearman's rho Correlations of Parent- and Adolescent-reported Adherence and Previous 12 Months Engagement in Health Risk Behaviors

Variable	Alcohol	Tobacco
Parent SCI-R	-.34**	-.24*
Adolescent SCI-R	-.26*	-.19

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

Table 9. Mann-Whitney U Tests for Differences Among Parent- and Adolescent-Reported Adherence and Lifetime Engagement in Health Risk Behaviors

	Yes		No				
Variable	Md	n	Md	n	*U*	*z*	*r*
Alcohol							
Parent SCI-R	66.67	13	76.67	38	158	-1.93[a]	.27
Adolescent SCI-R	65.00	13	78.33	39	154	-2.11*	.29
Cigarette							
Parent SCI-R	60.83	6	76.67	45	33	-2.99***	.42
Adolescent SCI-R	55.00	6	78.33	46	66	-2.07*	.29

[a]Indicates trend, $p = .054$
*$p < .05$, ***$p < .001$

Table 10. Mann-Whitney U Tests for Differences for Metabolic Control and Lifetime Engagement in Health Risk Behaviors

	Yes		No				
Variable	Md	n	Md	n	*U*	*z*	*r*
Alcohol							
HbA1C	8.20	13	8.10	39	246.5	-.15	.02
Cigarette							
HbA1C	9.25	6	8.10	46	121	-.49	.07

Table 11. Spearman's rho Correlations of Parent- and Adolescent-reported Communication and Previous 12 Month Engagement in Health Risk Behaviors

Variable	Alcohol	Tobacco
Openness (PAC Open)		
Parent	-.32*	-.09
Adolescent	-.43***	-.37**
Problem (PAC Problem)		
Parent	.31*	.22[a]
Adolescent	.43***	.38**
Frequency (PCAQ Frequency)		
Parent	.02	-.02
Adolescent	.08	.13
Comfort (PCAQ Comfort)		
Parent	-.36**	-.13
Self-Efficacy (PSE)		
Parent	-.06	-.08

[a]Indicates trend, $p = .06$
*$p < .05$, **$p < .01$, ***$p < .001$

Table 12. Mann-Whitney U Tests for Differences Among Parent- and Adolescent-Reported Communication and Lifetime Engagement in Alcohol Use

	Yes		No				
Variable	Md	n	Md	n	*U*	*z*	*r*
Alcohol							
Openness (PAC Open)							
Parent	38.00	13	42.00	37	147.50	-2.06*	.29
Adolescent	32.00	13	42.00	38	135.00	-2.42*	.34
Problem (PAC Problem)							
Parent	26.00	13	19.00	37	159.00	-1.81[a]	.26
Adolescent	33.50	12	24.00	39	105.00	-2.87**	.40
Frequency (PCAQ Frequency)							
Parent	3.33	12	3.17	38	219.50	-.19	.03
Adolescent	1.88	13	2.00	39	240.00	-.29	.04
Comfort (PCAQ Comfort)							
Parent	3.89	11	5.00	38	117.50	-2.38*	.34
Self-Efficacy (PSE)							
Parent	48.00	12	49.00	38	188.50	-1.03	.15

[a]Indicates trend $p = .07$
*$p < .05$, **$p < .01$

Table 13. Mann-Whitney U Tests for Differences Among Parent- and Adolescent-Reported Communication and Lifetime Engagement in Cigarette Use

	Yes		No				
Variable	Md	n	Md	n	*U*	*z*	*r*
Cigarette							
Openness (PAC Open)							
Parent	38.00	5	42.00	45	70.00	-1.38	.20
Adolescent	25.50	6	42.00	45	36.00	-2.90**	.41
Problem (PAC Problem)							
Parent	30.00	5	20.00	45	53.50	-1.91[a]	.27
Adolescent	36.00	6	24.00	45	40.50	-2.77**	.39
Frequency (PCAQ Frequency)							
Parent	3.33	5	3.11	45	106.00	-.21	.03
Adolescent	2.22	6	1.94	46	104.50	-.96	.14
Comfort (PCAQ Comfort)							
Parent	3.89	5	5.00	44	46.50	-2.28*	.33
Self-Efficacy (PSE)							
Parent	47.00	5	49.00	45	87.00	-.95	.13

[a]Indicates trend $p = .06$
*$p < .05$, **$p < .01$

Table 14. Logistic Regression Examining Aspects of Parent-Reported Communication Predicting Adolescent-Reported Lifetime Use of Alcohol

Predictor	b	SE	Wald	*p*	Odds Ratio	95% CI for Odds Ratio Lower	Upper	χ^2	Pseudo R^2
Step 1									
Insulin Type	.83	.71	1.38	.24	2.30	.57	9.22	1.42	.04
Step 2									
Insulin Type	.62	.85	.53	.48	1.86	.35	9.80		
Openness	-.14	.10	1.80	.18	.87	.72	1.07		
Problem	-.10	.09	1.36	.24	.90	.76	1.07		
Comfort	-1.33	.85	2.48	.12	.26	.05	1.39	10.44*	.30

Note. Dependent variable Lifetime Use of Alcohol coded as 0 for *no* and 1 for *yes*
*$p < .05$

Table 15. Logistic Regression Examining Aspects of Parent-Reported Communication Predicting Adolescent-Reported Lifetime Use of Cigarettes

Predictor	b	SE	Wald	*p*	Odds Ratio	95% CI for Odds Ratio		χ^2	Pseudo R^2
						Lower	Upper		
Step 1									
Insulin Type	1.28	1.19	1.15	.28	3.6	.35	37.36	1.33	.06
Step 2									
Insulin Type	.77	1.41	.30	.59	2.15	.14	34.12		
Problem	-.001	.11	<.001	.99	1.00	.80	1.24		
Comfort	-3.14	1.54	4.19	.04*	.04	.002	.88	10.17*	.44

Note. Dependent variable Lifetime Use of Cigarettes coded as 0 for *no* and 1 for *yes*
*$p < .05$

Table 16. Logistic Regression Examining Aspects of Adolescent-Reported Communication Predicting Adolescent-Reported Lifetime Use of Alcohol

						95% CI for Odds Ratio			
Predictor	b	SE	Wald	*p*	Odds Ratio	Lower	Upper	χ^2	Pseudo R^2
Step 1									
Openness	-.04	.05	.53	.47	.97	.88	1.06		
Problem	.10	.06	3.00	.084	1.11	.99	1.25	10.12**	.27

Note. Dependent variable Lifetime Use of Alcohol coded as 0 for *no* and 1 for *yes*
**$p < .01$

Table 17. Logistic Regression Examining Aspects of Adolescent-Reported Communication Predicting Adolescent-Reported Lifetime Use of Cigarettes

Predictor	b	SE	Wald	*p*	Odds Ratio	95% CI for Odds Ratio Lower	Upper	χ^2	Pseudo R^2
Step 1									
Openness	-.06	.07	.68	.41	.95	.83	1.08		
Problem	.13	.01	1.96	.16	1.14	.95	1.37	9.50**	.33

Note. Dependent variable Lifetime Use of Cigarettes coded as 0 for *no* and 1 for *yes*
**$p < .01$

Table 18. Multiple Regression Analyses of Aspects of Parent-Reported Communication Predicting Adolescent-Reported 12 Month Use of Alcohol

Predictor	b	SE	β	F	R^2	Δ R^2
Step 1						
Insulin Type	.08	.15	.10	.43	.01	
Step 2						
Insulin Type	-.04	.14	-.04			
Openness	-.01	.02	-.06			
Problem	.01	.01	.13			
Comfort	-.34	.15	-.38*	3.31	.23	.22*

*$p < .05$

Table 19. Multiple Regression Analyses of Aspects of Parent-Reported Communication Predicting Adolescent-Reported 12 Month Use of Cigarettes or Tobacco

Predictor	b	SE	β	F	R^2
Step 1					
Problem	.02	.01	.22	2.52	.05

Table 20. Multiple Regression Analyses of Aspects of Adolescent-Reported Communication Predicting Adolescent-Reported 12 Month Use of Alcohol

Predictor	b	SE	β	F	R^2
Step 1					
Openness	-.02	.01	-.35*		
Problem	.01	.01	.21	7.82	.25***

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

Table 21. Multiple Regression Analyses of Aspects of Adolescent-Reported Communication Predicting Adolescent-Reported 12 Month Use of Cigarettes or Tobacco

Predictor	b	SE	β	F	R^2
Step 1					
Open	-.004	.01	-.09		
Problem	.02	.01	.35*	4.66	.17*

*$p < .05$

Table 22. Pearson Correlations Among Aspects of Parent- and Adolescent-Reported Communication

Variable	SCI-R	
	Parent	Adolescent
Parent		
Openness (PAC Open)	.41**	-.02
Problem (PAC Problem)	-.52***	-.31*
Frequency (PCAQ Frequency)	-.04	-.001
Comfort (PCAQ Comfort)	.24	-.06
Self-Efficacy (PSE)	.08	-.08
Adolescent		
Openness (PAC Open)	.38**	.41**
Problem (PAC Problem)	-.43**	-.40**
Frequency (PCAQ Frequency)	.03	.34*

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

Table 23. Pearson Correlations Among Aspects of Parent- and Adolescent-Reported Communication

Parent	HbA_{1C}
Openness (PAC Open)	.03
Problem (PAC Problem)	.02
Frequency (PCAQ Frequency)	.25[a]
Comfort (PCAQ Comfort)	.16
Self-Efficacy (PSE)	.13
Adolescent	
Openness (PAC Open)	-.23
Problem (PAC Problem)	-.10
Frequency (PCAQ Frequency)	-.12

[a]Indicates a trend $p = .07$
* $p < .05$

Table 24. Hierarchical Multiple Regression Analyses Examining Aspects of Parent-Reported Communication and Alcohol Use Predicting Parent-Reported Adherence

Predictor	b	SE	β	F	R^2	Δ R^2
Step 1						
Age	-.32	1.09	-.04	.09	.002	
Step 2						
Age	.31	.98	.04			
Openness	.13	.31	.07			
Problem	-.61	.25	-.40*			
Lifetime Alcohol Use	1.46	4.52	.06			
12 Month Alcohol Use	6.32	3.88	-.30	4.48	.34**	.34

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

Table 25. Hierarchical Multiple Regression Analyses Examining Aspects of Adolescent-Reported Communication and Alcohol Use Predicting Adolescent-Reported Adherence

Predictor	b	SE	β	F	R^2	Δ R^2
Step 1						
Age	-2.11	1.34	-.22	2.49	.05	
Step 2						
Age	.29	1.30	.03			
Open	.11	.22	.09			
Problem	-.41	.26	-.27			
Frequency	4.93	1.94	.34*			
Lifetime Alcohol Use	-1.94	5.86	-.06			
12 Month Alcohol Use	-5.46	5.14	0.21	3.94	.36	.31**

*p< .05, **p < .01

Table 26. Hierarchical Multiple Regression Analyses Examining Aspects of Parent-Reported Communication and Cigarette or Tobacco Use Predicting Parent-Reported Adherence

Predictor	b	SE	β	F	R^2
Step 1					
Open	.20	.28	.11		
Problem	-.56	.24	-.36*		
Lifetime Cigarette Use	-13.40	5.40	-.40*		
12 Month Cigarette or Tobacco Use	2.36	3.58	.10	7.01	.38***

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

Table 27. Hierarchical Multiple Regression Analyses Examining Aspects of Adolescent-Reported Communication and Cigarette or Tobacco Use Predicting Adolescent-Reported Adherence

Predictor	b	SE	β	F	R^2	Δ R^2
Step 1						
Age	-.08	1.34	-.22	2.49	.05	
Step 2						
Open	.14	.21	.11			
Problem	-.42	.25	-.27			
Frequency	5.36	1.94	.38**			
Lifetime Cigarette Use	-9.86	5.93	-.23	4.74	.35	.30***

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

Table 28. Pearson Correlations Among Aspects of Parent- and Adolescent-Reported Communication

	Parent					Adolescent		
Variable	1	2	3	4	5	6	7	8
Parent								
1. Openness (PAC Open)		-.64***	.08	.55***	.34*	.50***	-.39**	-.17
2. Problem (PAC Problem)			-.18	-.39**	-.15	-.58***	.49***	-.12
3. Frequency (PCAQ Frequency)				.14	.05	.24	-.13	.07
4. Comfort (PCAQ Comfort)					.38**	.42**	-.47***	-.14
5. Self-Efficacy (PSE)						.01	-.09	.01
Adolescent								
6. Openness (PAC Open)							-.60***	.15
7. Problem (PAC Problem)								.07
8. Frequency (PCAQ Frequency)								

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

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