### Title

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### Journal

Children's Health Care, 48(3)

### ISSN

0273-9615



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### Publication Date

2019-07-03

### DOI

10.1080/02739615.2018.1531758

Peer reviewed

Published in final edited form as:

*Child Health Care*. 2019 ; 48(3): 285–300. doi:10.1080/02739615.2018.1531758.

# Health-risk Behaviors and Type 1 Diabetes Outcomes in the Transition from Late Adolescence to Early Emerging Adulthood

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## Abstract

This study examined within- and between-person associations between health-risk behaviors (smoking, drinking, insulin withholding) and type 1 diabetes (T1D) outcomes (adherence and HbA1c) during the high-risk transition from late adolescence to early emerging adulthood utilizing a 2-year longitudinal study. Beginning in the senior year of high school, participants ($n$ = 197) with T1D completed measures of health-risk behaviors, adherence, and HbA1c annually at three time points. Health-risk behaviors were associated with poorer diabetes outcomes during the transition from late adolescence to early emerging adulthood. These results highlight the importance of monitoring health-risk behaviors regularly and intervening to reduce health-risk behaviors during this important developmental transition.

### Keywords

diabetes; health-risk behaviors; glycemic control; adolescents; emerging adults

Late adolescence and early emerging adulthood are risky developmental periods for adherence and glycemic control among youth with type 1 diabetes (T1D; Weissberg-Benchell & Shaipro, 2017; Helgeson, 2014). Glycemic control deteriorates longitudinally across adolescence and early emerging adult years (Helegson, 2017; Schwandt et al., 2017), and individuals display the poorest diabetes management behaviors compared to other age cohorts (Miller et al. 2015). In addition, only 17 percent of emerging adults between 18 and 26 years old with T1D meet the recommendations for hemoglobin A1C (≤ 7.0%) (Beck et al., 2012; Monaghan, Helgeson, & Wiebe, 2015). Late adolescents and early emerging adults with T1D become increasingly independent and experience less direct guidance and support from parents, often leading to poor self-management (Buhl, 2008; Helgeson et al., 2014; Rassart et al., 2016). In addition, early emerging adulthood is a critical developmental period to integrate lifelong diabetes management skills, which have significant implications

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for long-term health and well-being (Monaghan, Helgeson, & Wiebe, 2015). At the same time, late adolescence and early emerging adulthood are times when youth are increasingly vulnerable to health-risk behaviors (e.g., smoking cigarettes, drinking alcohol; Arnett, 2000; Palladino et al., 2013), behaviors that may potentially undermine T1D management (Peters & Laffel, 2011). Thus, it is important to understand how health-risk behaviors are related to diabetes outcomes during this vulnerable transitional period.

Two general health-risk behaviors, smoking and drinking alcohol, are prevalent during late adolescence and early emerging adulthood, and may be particularly problematic among individuals with T1D. Cigarette smoking is a serious public health issue that causes more than 480,000 deaths a year in the United States (U.S. Department of Health and Human Services, 2014). Most (90 percent) cigarette smokers first experiment with smoking before the age of 18 and many become habitual smokers (U.S. Department of Health and Human Services, 2014). Smoking cigarettes is a high health-risk behavior for those with T1D due to its negative health effects on T1D outcomes (Tyc & Throckmorton-Belzer, 2006), in addition to its well-known negative health effects more generally including cardiovascular and respiratory disease (Garey et al., 2018). Among adolescents, early emerging adults, and middle-aged adults with T1D, smoking is associated with higher HbA1c, cardiovascular disease, and diabetic nephropathy (Feodoroff et al., 2016; Hofer et al., 2009; Reynolds et al., 2017).

Alcohol consumption is one of the most frequently performed risky health behaviors in the transition from late adolescence to early emerging adulthood (Borsari, Murphy, & Barnett, 2007) and may have detrimental implications for T1D. Drinking alcohol during emerging adulthood is a critical public health problem, with rates of binge drinking being around 40 percent among those aged 18 to 25 years (Substance Abuse and Mental Health Services Administration [SAMHSA], 2012). In the context of T1D, drinking alcohol is also inversely associated with adherence to diabetes self-care behaviors, such as self-monitoring blood glucose (Ahmed, Karter, & Liu, 2006). Among young adults and middle-aged adults with T1D, drinking alcohol is linked to short-term diabetes-related complications, such as higher risk for hypoglycemia and ketoacidosis (Barnard, Sinclair, Lawton, Young, & Holt, 2012; Richardson, Weiss, Thomas, & Kerr, 2005). Furthermore, symptoms of hypoglycemia and alcohol intoxication can often appear similar (Richardson, Weiss, Thomas, & Kerr, 2005), thereby compounding risk because the individual with T1D, as well as people nearby, may have difficulty distinguishing between the two (Richardson, Weiss, Thomas, & Kerr, 2005).

Patients with T1D may not only engage in general health-risk behaviors, but may also engage in diabetes-specific health-risk behaviors, such as insulin withholding (Hackworth et al., 2013). Taking appropriate doses of insulin is a critical component of effectively managing diabetes, while insulin withholding is linked to negative diabetes outcomes (Crow, Keel, & Kendall, 1998; Peveler et al., 2005). One common reason to engage in insulin withholding is to lose weight (Neumark-Sztainer et al., 2002; Pinhas-Hamiel et al., 2013), and insulin withholding is often seen with diabetes-specific disordered eating patterns, such as ‘diabulemia’ (Falcão & Francisco, 2017; Wisting et al., 2017). Other reasons for insulin withholding include stigma (unwilling to inject insulin in public) or giving lower priority to diabetes in one’s life (Brazeau et al., 2018; Jeong, Quinn, Kim, & Martyn-Nemeth, 2018).

Insulin withholding places individuals with T1D at risk for poorer glycemic control and experiencing diabetes-related complications (e.g., ketoacidosis, retinopathy) earlier in life (Crow, Keel, & Kendall, 1998; Peveler et al., 2005). For example, a longitudinal study of women (mean age at follow up =45 years) with T1D found that insulin withholding increased the risk for microvascular complications, such as retinopathy and nephropathy, by three-fold mortality across an 11-year period (Goebel-Fabbri et al., 2008).

Although a growing body of evidence has pointed to the negative association between health-risk behaviors and adolescents' or emerging adults' diabetes outcomes, there is a dearth of research examining associations longitudinally from late adolescence to early emerging adulthood. Given that late adolescence and early emerging adulthood are marked by major changes in the development of health-risk behaviors (Arnett, 2000; Palladino et al., 2013), it is important to examine variability in health-risk behaviors, both between-person (inter-individual variability) and within-person (intra-individual variability; Boker & Nesselroade, 2002). Health behaviors are time-varying constructs that include both between-person and within-person variability (Hoffman, 2015; Hoffman & Stawski, 2009). For example, some people tend to engage in more health-risk behaviors than others (i.e., between-person variation). In addition, an individual may engage in health-risk behaviors more than he or she does at other times (i.e., within-person variation). This represents a deviation from the specific mean associated with that individual (Hoffman, 2015; Hoffman & Stawski, 2009). Previous studies have examined between-person variability in health-risk behaviors (Barnard, Sinclair, Lawton, Young, & Holt, 2012; Crow, Keel, & Kendall, 1998; Peveler & Bryden, 2005; Richardson, Weiss, Thomas, & Kerr, 2005; Tyc & Throckmorton-Belzer, 2006). However, identifying within-person variability in health-risk behaviors is critical to understanding the link between health-risk behaviors and diabetes outcomes during this vulnerable transitional period.

Health-risk behaviors are highly interrelated during late adolescence and early emerging adulthood (Chung & Chun, 2010; Huang, Lanza, Murphy, & Hser, 2012), but previous studies on health-risk behaviors and diabetes management have examined each specific health-risk behavior in isolation. Engaging in any one health-risk behavior can be a risk factor for engaging in other health-risk behaviors, so it is critical to control for other health-risk behaviors when examining the effect of a specific health-risk behavior (McDonnell, Northam, Donath, Werther, & Cameron, 2007). Further, specific health-risk behaviors may be indicative of a broader behavioral pattern that underlies the co-occurrence of health-risk behaviors. For instance, externalizing problems including oppositional behaviors are associated with a host of health-risk behaviors such as smoking and alcohol use (Cheetham et al., 2018; Steele, Forehand, Armistead, & Brody, 1995). However, previous research on the effects of health-risk behaviors on diabetes outcomes has not controlled for this possible confounding factor (e.g., Reynolds et al., 2011).

To address these gaps in previous research, the current study examined the within- and between-person associations of general health-risk behaviors (smoking and drinking alcohol) and diabetes specific health-risk behaviors (insulin withholding), and diabetes outcomes across three time points during the transition from late adolescence to early emerging adulthood. To account for a broader underlying behavioral pattern associated with

multiple health-risk behaviors, all analyses controlled for oppositional behaviors and other health-risk behaviors in order to assess the unique contribution of each specific health-risk behavior to diabetes outcomes. For example, when assessing smoking, drinking and insulin withholding were controlled. We predicted that diabetes outcomes would be poorer for those with higher mean level of each health-risk behavior relative to peers (between-person effect), and in years when each health-risk behavior was higher than an individual's own mean (within-person effect).

## Methods

### Participants

Participants in the current study were 197 high school seniors with T1D recruited for a 2-year longitudinal study on how self-regulation and social relationships are associated with T1D diabetes management during late adolescence and early emerging adulthood. We focused on ages 17–18 as youth in this age were expected to experience many changes in the subsequent year that would make diabetes management challenging: 1) transition from pediatric to adult care provider, 2) change in living situation, and/or 3) move from the structured high school environment to either college or work. Participants were recruited in clinic, or by mail and phone from three pediatric endocrinology clinics in two southwestern U.S. cities. Eligibility criteria included being diagnosed with T1D for at least one year (*M* illness duration at Time 1 = 7.35 years, *SD* = 3.88), speaking English as the primary language (due to the cognitive assessments done as part of the larger study), being in the final year of high school, living with a parent (68.4% lived at home with both biological parents, 27.1% with one biological parent, 4.5% with adoptive parents or grandparents), being able to have regular contact with parents over the subsequent two years (consistent with objectives of the broader longitudinal study), and having no condition that would prohibit study completion (e.g., severe intellectual disability, blindness, etc.). Adolescents who had dropped out of high school were eligible if they met all other criteria. Of the qualifying 507 individuals approached, 301 (59%) initially agreed to participate. Reasons for not participating included lack of interest (44.2%), being too busy in their senior year to participate (34.0%), and 21.8% declined to give a reason. Of those who agreed to participate, 247 high school seniors (*M* age = 17.76 years, *SD* = 0.39; 61.5% Female; 81 % White, 14.2% Latino) completed baseline assessments. Data for the primary study variables were gathered at each of three time points: during the senior year of high school (Time 1; late adolescence), and on two additional occasions (Time 2 and Time 3; early emerging adulthood). Measurements were approximately 1 year apart. For the current secondary data analysis, 197 participants who completed all times 1, 2, and 3 surveys were included and had valid cognitive data (N=236). Participants in the current study and all participants who completed at least one time point did not differ on adherence, time since diagnosis, pump status, ethnicity, or age (*ps* > .05). However, participants in the current study were lower in glycated hemoglobin (HbA1c) than all participants, *M* (*SD*) = 8.13 (1.59) versus 9.01 (1.63), $t(232) = 3.11$, $p = .001$, and were more likely to be female ($\chi^2(1) = 12.39$, $p < .001$).

## Procedures

The study was approved by the Institutional Review Boards from universities in two southwestern states, with parents providing informed consent, and teens providing consent or assent. During an initial laboratory session, adolescents completed a battery of neurocognitive and behavioral measures, as well as an HbA1c home test kit, and were trained on online survey measures to be completed at home. These surveys included the following measures.

## Measures

**Smoking and alcohol consumption behaviors.—**Two questions from the Center for Disease Control and Prevention (CDC) 2009 National Youth Risk Behavior Survey (Eaton et al., 2009) assessed adolescents' smoking and alcohol consumption ("Have you smoked a cigarette in the last 6 months?" and "Have you consumed alcohol in the last 6 months?") responding 0 = No and 1 = Yes. Dichotomized variables were used because a large majority of participants responded that they were not involved in smoking and drinking (see Table 1 for descriptive statistics).

**Insulin withholding.—**Adolescents completed one item to assess taking less insulin than recommended ("How often do you take less insulin than you should?"), responding on a 0 (*never*) to 5 (*always*) Likert-type scale (see Table 1 for descriptive statistics). Insulin withholding has been shown to increase the risk of microvascular complications and mortality (Goebel-Fabbri et al., 2008).

**Diabetes outcomes.—**Adolescent adherence to the T1D management regimen was measured by the Diabetes Behavior Rating Scale (Iannotti et al., 2006; higher values denote better management, range 0–1). This 37-item scale is associated with a more time-intensive interview measure of adherence to T1D management regimens (Iannotti et al., 2006) (see Table 1 for descriptive statistics). Glycemic control was indexed using HbA1c home test assay kits (higher values denote poorer management). We used HbA1c home test assay kits instead of obtaining HbA1c information from medical records, as we wanted to use the same procedures to measure HbA1c across time points, and ensure that HbA1c measures could be obtained even from those who were not under routine medical care. At baseline, the kit was completed by the teen after receiving instructions from a trained research assistant who observed test completion. HbA1c home test assay kits at baseline were strongly correlated with HbA1c obtained from point-of-care assays in medical records at baseline ($r = .74$, $p < .001$) (see Table 1 for descriptive statistics).

**Oppositional behavior.—**Parents completed the Conners' Parent Rating Scales-Revised (Short Form) as part of the online survey (Conners, 2001). We utilized only the subscale for oppositional behavior.

**Covariates.—**All analyses controlled for mothers' report of oppositional behaviors as a between-person (Level-2) covariate (grand mean-centered). In addition, the following between-person (Level-2) covariates were included in models: gender (−0.5 = *male*, 0.5 =

*female*), initial pump status (−0.5 = *not using pump*, 0.5 = *using pump*), race (−0.5 = *white*, . 0.5 = *nonwhite*), and years since T1D diagnosis (grand mean-centered).

### Analytic Plan

Multilevel modeling was conducted to simultaneously examine within- and between-person variability in health-risk behaviors as they relate to diabetes adherence and glycemic control (Hoffman, 2015; Hoffman & Stawski, 2009). We followed guidelines for separating within-person and between-person effects (Hoffman, 2015) to better understand the effect of a person's fluctuations (intra-individual variability) in health-risk behaviors on their diabetes outcomes while accounting for their average level of health-risk behaviors (individual variability).

**Predicting adherence and glycemic control from health-risk behaviors.—**We estimated within- and between-person variations of health-risk behaviors using a series of multilevel models. Data from all three time points were included in these models, with adherence and HbA1c at each time point predicted by health-risk behaviors at each time point. Equations for the multilevel models are listed below:

Level 1 (within-person):

$$\text{Diabetes outcomes} = \pi_{0i} + \pi_{1i}(\text{Health-risk behaviors})_{ti} + r_{ti}$$

Level 2 (between-person):

$$\pi_{0i} = \beta_{00} + \beta_{01}(\text{Mean of health-risk behaviors})_i + r_{0i}$$
$$\pi_{1i} = \beta_{10}$$

Health-risk behaviors were group (person) mean-centered at Level 1, and mean of health-risk behaviors at Level 2 was each person's average health-risk behaviors score across the three time points, which then was grand mean-centered. The slope ($\beta_{10}$) represents the within-person health-risk behavior effect and $\beta_{01}$ represents the between-person health-risk behavior effect. All within- and between-person effects of health-risk behaviors were estimated using the MIXED command in SPSS (version. 25; 2017) with a two-tailed alpha of .05.

## Results

### Associations of Smoking with Diabetes Outcomes

Within-person fluctuations in smoking were not associated with adherence, however, smoking was significantly associated with adherence at the between-person level. Individuals with higher mean levels of smoking relative to peers had poorer adherence on average across the three time points ($B = -.08$, $SE = .03$, $p = .004$). Neither within-person fluctuations nor between-person associations of smoking were associated with glycemic control (see Table 2).

### Associations of Drinking with Diabetes Outcomes

Neither within-person fluctuations nor between-person effects in drinking were associated with adherence. However, within-person fluctuations in drinking alcohol were significantly associated with poorer glycemic control (i.e., higher HbA1c): in years of higher alcohol use (relative to an individual's own average) poorer glycemic control occurred ($B = .94$, $SE = .23$, $p < .001$). In contrast, between-person effects of alcohol consumption were not associated with glycemic control, and (see Table 2).

### Associations of Insulin Withholding with Diabetes Outcomes

Insulin withholding was associated with poorer adherence, both within- ($B = -.03$, $SE = .005$, $p < .001$) and between-persons ($B = -.03$, $SE = .01$, $p = .002$). In addition, insulin withholding was significantly associated with poorer glycemic control at the within-person level ($B = .24$, $SE = .09$, $p = .01$). However, insulin withholding was not significantly associated with poorer glycemic control at the between-person level ($B = .26$, $SE = .14$, $p = .06$; see Table 2).

## Discussion

The current study adds to the small extant literature examining health-risk behaviors during the vulnerable transitional period from late adolescence to early emerging adulthood (Hackworth et al., 2013; Palladino et al., 2013). The findings of this study support that smoking cigarettes, drinking alcohol, and insulin withholding appear to be detrimental for adherence and HbA1c during the transition from late adolescence to emerging adulthood. As such, this study contributes to, and expands, previous research in meaningful ways. First, this study focused on the understudied developmental period of emerging adulthood when vulnerability is heightened for both health-risk behaviors and poor diabetes management. Second, this study utilized a longitudinal design across the transition from late adolescence to emerging adulthood, in particular by examining both between-person (i.e., individual variability) and within-person (i.e., intra-individual variability) effects of health-risk behaviors on diabetes outcomes. Third, the current study included both general health-risk behaviors (smoking and drinking alcohol) and diabetes-specific behaviors (insulin withholding). Finally, the study represented a conservative estimate of longitudinal effects of health-risk by controlling for oppositional behaviors (McDonnell et al., 2007), other associated health-risk behaviors, and demographic and illness characteristics in a large sample. Overall, both general health-risk behaviors, and diabetes-specific health-risk behaviors, seem to be related to poorer diabetes outcomes during this vulnerable developmental period, above-and-beyond factors known to associate with health-risk behaviors.

The hypothesis that between-person differences and within-person fluctuations in health-risk behaviors would predict adherence and glycemic control was partially supported. Participants with higher mean levels of smoking relative to peers (between-person association) had poorer adherence on average. Smoking might be a marker of lifestyle choices, which are reflected in poorer adherence (Leroux et al., 2014). Although smoking was not related to glycemic control during this developmental period, smoking may have

more distal effects on glycemic control later in adulthood, given that a significant portion of those who smoke at this time may become long-term smokers. The current study also found that drinking alcohol was negatively associated with diabetes outcomes. Within-person fluctuations of drinking alcohol on glycemic control imply that the HbA1c levels of individuals with T1D during this developmental period seem to be sensitive to fluctuations of alcohol use from one year to the next. Finally, this study found that insulin withholding, which is a diabetes-specific health-risk behavior, has the most consistent negative implications for both adherence and glycemic control. We found significant between-person associations, such that those with higher levels of insulin withholding relative to their peers reported poorer adherence. Further, within-person fluctuations in insulin withholding were associated with both adherence and glycemic control, such that individuals experienced poorer adherence and glycemic control in years when their levels of insulin withholding were higher than their average level.

In general, within-person fluctuations in health-risk behaviors occurred during the transition from late adolescence to early adulthood, suggesting that within-person associations matter for individuals with T1D. Thus, changes in reported engagement in risk behaviors predict similar changes in diabetes management. We found between-person associations with some, but not all, outcomes. It may be that the relative absence of between-person associations, such as with the relationship between smoking and HbA1c, is due to controlling for factors known to associate with health-risk behaviors. Whereas researchers have demonstrated that health-risk behaviors are associated with worse adherence and glycemic control (Barnard, Sinclair, Lawton, Young, & Holt, 2012; Crow, Keel, & Kendall, 1998; Peveler & Bryden, 2005; Richardson, Weiss, Thomas, & Kerr, 2005; Tyc & Throckmorton-Belzer, 2006), we are the first to examine repeated measurements of health-risk behaviors during the transition from late adolescence to early emerging adulthood while examining both within-person fluctuations and between-person associations.

The results of the current study should be interpreted in the context of limitations. First, the current study relied solely on single-item self-report measures. Although, only a minority of the late adolescents and emerging adults in our sample engaged in health-risk behaviors, such behaviors can have significant short-term and possible long-term effects. Future research should use more detailed assessments of frequency and intensity of health-risk behaviors. Second, participants in this study were primarily Non-Hispanic White. While the ethnic composition of our sample closely resembles large-scale studies with T1D (e.g., Shah et al., 2014), the findings of the current study may not generalize to other pediatric chronic illnesses. Third, the individuals in this study who completed three time points had better A1c levels than participants who completed at least one time point. Thus, we were not able to capture individuals with the poorest diabetes outcomes. Individuals with the poorest diabetes outcomes might have vulnerable family factors, more internal or external problems, or more biological risk factors, leading them to engage in more risk health behaviors or be more vulnerable to the effects of health risk behaviors (Gu, 2017; Rechenberg, Whittemore, Grey, & Jaser, 2016; Stranberg, Graue, Wentzel-Larsen, Peyrot, & Rokne, 2014). Therefore, future research should attempt to replicate these findings with samples that are more diverse, and that include individuals with the poorest T1D outcomes. Future research may wish to

examine other measures of health-risk behaviors such as risk perception, duration, intensity, and quantity of health-risk behaviors (Bhatt et al., 2018; Weber, Blais, & Betz, 2002).

## Implications for Practice

Overall, the findings support the need for education, prevention, and intervention efforts aimed at curbing smoking, drinking, and insulin withholding during the transition from late adolescence to early emerging adulthood. Between-person associations for smoking and insulin withholding suggest that these health-risk behaviors should be assessed and cessation support should be offered as needed. The within-person fluctuations in health-risk behaviors and poor diabetes outcomes suggest that that even for those who don't generally engage in health-risk behaviors, uptake of these behaviors across time appears to negatively affect diabetes outcomes. In contrast, decreases in health-risk behaviors across years are linked to improvements in diabetes outcomes, even among those who generally exhibit high health-risk behaviors. These findings provide compelling evidence of the importance of reducing health-risk behaviors and recording the uptake of health-risk behaviors so that clinicians can use these records to monitor reduced health-risk behaviors. Clinicians may want to carefully and regularly assess insulin withholding and alcohol consumption, including binge drinking, specifically during the transition from late adolescence to early adulthood (Engler, Ramsey, & Smith, 2013). It is important to understand the factors that put individuals with T1D at heightened risk of engaging in health-risk behaviors (Neumark-Sztainer et al., 2002). For example, some adolescents engage in smoking and insulin withholding so as to lose weight (Audrain-McGovern & Benowitz, 2011; Fulkerson & French, 2003; Neumark-Sztainer et al., 2002; Pinhas-Hamiel et al., 2013). Thus, both psychological factors (e.g., pressure to lose weight) and behavioral factors (e.g., oppositional behavior) should be assessed and treated to minimize health-risk behaviors. These findings warrant future research on the factors that protect against health-risk behaviors during this transition (Jaser & Yates, Dumser, & Whittemore, 2011).

## Acknowledgements

This work was supported by the National Institute of Diabetes and Digestive and Kidney Diseases at the National Institutes of Health (grant number R01DK092939, MPIs Berg and Wiebe). No author had any conflicts to disclose.

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**Table 1.**

Descriptive Statistics of Primary Variables

| | Time 1 | | Time 2 | | Time 3 | |
|---|---|---|---|---|---|---|
| | % | Mean (SD) | % | Mean (SD) | % | Mean (SD) |
| Smoking | 10.2% | | 15.2% | | 16.2% | |
| Alcohol use | 21.2% | | 33% | | 39.1% | |
| Insulin withholding | | 1.68(.98) | | 1.57(1.07) | | 1.53(1.03) |
| Glycemic control | | 8.13(1.59) | | 8.96(1.88) | | 9.12(2.00) |
| Adherence | | .61(.12) | | .59(.13) | | .59(.15) |

*Notes*. Results are based on 197 individuals with T1D.

**Table 2.**

Longitudinal Prediction of Adherence and Glycemic Control from Health-Risk Behaviors

| | **Adherence** | **HbA1c** |
|---|---|---|
| Smoking | Beta (*SE*) | Beta (*SE*) |
| Intercept | .64(.02)*** | 8.63(.21)*** |
| Within person effect | −.02(.02) | .21(.34) |
| Between person effect | −.08(.03)** | .59(.38) |
| Alcohol consumption | −.01(.01) | .41(.19) |
| Insulin withholding | −.03(.005)*** | .25(.08)** |
| Illness Duration | .002(.002) | .004(.03) |
| Oppositional Behaviors | −.003(.002) | .11(.03)** |
| Gender | .004(.02) | −.24(.23) |
| Race | −.01(.03) | 1.20(.35)** |
| Pump | −.01(.01) | −.36(.19) |
| Alcohol consumption | Beta (*SE*) | Beta (*SE*) |
| Intercept | .65(.02)*** | 8.69(.21)*** |
| Within person effect | −.01(.01) | .94(.23)*** |
| Between person effect | −.02(.02) | −.41(.30) |
| Smoking | −.04(.02)* | .57(.26)* |
| Insulin withholding | −.03(.005)*** | .23(.08)** |
| Illness duration | .002(.002) | .01(.03) |
| Oppositional behaviors | −.004(.002) | .12(.03)*** |
| Gender | .01(.02) | −.27(.22) |
| Race | −.004(.03) | 1.12(.34)** |
| Pump | −.01(.01) | −.44(.19)* |
| Insulin withholding | Beta (*SE*) | Beta (*SE*) |
| Intercept | .60(.01)*** | 8.97(.18)*** |
| Within person effect | −.03(.005)*** | .24(.09)* |
| Between person effect | −.03(.01)** | .26(.14) |
| Alcohol consumption | −.01(.01) | .43(.19)* |
| Smoking | −.04(.02)* | .38(.26) |
| Illness Duration | .002(.002) | .01(.03) |
| Oppositional Behaviors | 0.04(.002) | .11(.03)*** |
| Gender | .01(.02) | −.25(.23) |
| Race | −.01(.03) | 1.19(.35)** |
| Pump | −.01(.01) | −.37(.19) |

*Notes.* Results are based on 197 individuals with T1D.

* $p < .05$

** $p < .01$

*** $p < .001$.

Coding of Level-2 was: gender (−0.5 = *male*, 0.5 = *female*), initial pump status (−0.5 = *not using pump*, 0.5 = *using pump*), race (−0.5 = *white*, .0.5 = *nonwhite*), years since T1D diagnosis (grand mean centered), and oppositional behaviors (grand mean centered).