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Alcohol Consumption Patterns in Young Adults with Type 1 Diabetes: the SEARCH for Diabetes in Youth Study

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Abstract

Aims: The objective of this study is to describe alcohol consumption behaviors of young adults with T1D and to examine associations between alcohol consumption and diabetes-related clinical markers

Methods: Data from 602 SEARCH for Diabetes in Youth Study participants age ≥18 yrs. with T1D were collected from 12/2011 to 6/2015 (50% female, mean age 21.3(SD 2.4), 22% race/ethnic minority). Participants were characterized as alcohol non-drinkers (n=269), drinkers but non-binge drinkers (n=167), or binge drinkers (n=166) based on reported consumption in the past

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Conflict of interest
None.

Sites
Kaiser Permanente Southern California (U18DP006133, U48/CCU919219, U01 DP000246, and U18DP002714), University of Colorado Denver (U18DP006139, U48/CCU819241-3, U01 DP000247, and U18DP000247-06A1), Cincinnati's Children's Hospital Medical Center (U18DP006134, U48/CCU519239, U01 DP000248, and 1U18DP002709), University of North Carolina at Chapel Hill (U18DP006138, U48/CCU419249, U01 DP000254, and U18DP002708), Seattle Children's Hospital (U18DP006136, U58/CCU019235-4, U01 DP000244, and U18DP002710-01), Wake Forest University School of Medicine (U18DP006131, U48/CCU919219, U01 DP000250, and 200-2010-35171)

30 days. Analyses were conducted using one-way ANOVAs, chi-square tests, and logistic regression modeling to examine associations between drinking and clinical markers.

Results: Fifty-five percent of participants reported alcohol consumption; 27.6% of participants reported binge drinking. After adjusting for demographic characteristics, neither binge drinking nor non-binge drinking were associated with HbA1c or severe hypoglycemic events relative to non-drinkers. Binge drinking was associated with higher HDL (p=0.008), lower systolic blood pressure (p-=0.011), and a lower waist:height ratio compared to non-drinkers (p=0.013).

Conclusions: Young adults with T1D in the SEARCH cohort reported similar alcohol use but higher rates of binge drinking compared to the general United States population and previously reported rates in adults with T1D.

Keywords

type 1 diabetes; alcohol; binge drinking

Introduction

Type 1 diabetes (T1D) is a chronic disease caused by the autoimmune disruption of endogenous insulin secretion. Typically diagnosed in childhood, T1D requires careful management during adolescence and emerging young adulthood, as deterioration of metabolic control is common during this life stage. Data from the T1D Exchange demonstrates a sharp incline in HbA1c after the age of 10, peaking at the age of 19 years, and then slowly declining to reach a plateau at age 30 years[1]. Hormonal changes compounded by increasing desire for autonomy and the strict requirements of proper self-management make adolescence a uniquely difficult time to maintain good glycemic control[2]. As a result, complications and comorbidities of T1D are prevalent in adolescents and young adults diagnosed with T1D in childhood[3].

Alcohol use, is common in young adults.[4] Data suggests that adults with type 1 diabetes consume alcohol at similar rates to the general population[5]. In a recent report from the T1D Exchange study, 79% of adult participants with T1D (average age of 38 years), reported using alcohol in the past year, 63% in the past month, and 9% reported daily use[5]; 19% of participants were classified as binge drinkers in this cohort.

In the current study, we aimed to describe the drinking behaviors of young adults with T1D, and the associations of drinking, including non-binge and binge drinking, on clinical parameters such as HbA1c, severe hypoglycemia events, and cardiovascular (CV) risk markers including lipid profile, blood pressure, BMI and waist-to-height ratio (WHTR). Glycemic control and cardiovascular risk factors (lipid profile, blood pressure, BMI, WHTR) were examined as they relate to development of microvascular and macrovascular complications of T1D[3]. Severe hypoglycemia was chosen as a clinical variable given the association of alcohol use with acute and subacute hypoglycemia[6].

Materials and Methods

SEARCH for Diabetes in Youth (SEARCH) is an ongoing multicenter population-based study of physician-diagnosed diabetes mellitus in youth <20 years of age. Participants were identified in geographically defined populations in Colorado, Ohio, South Carolina, and Washington, among health plan enrollees in California, and Indian Health Service beneficiaries from American Indian populations. A detailed description of the SEARCH study and methods has been published[7].

Institutional review boards for each site approved the study protocol. Informed consent and assent were obtained from participants at the start of the visit. SEARCH participants with type 1 diabetes diagnosed in 2002–2006 and 2008 who had a baseline study visit and at least 5 years duration of diabetes were invited to participate in a follow up in-person study visit (Cohort visit). Individuals with incident diabetes in 2007 were not eligible for an in-person visit, and thus were excluded from analysis.

Research visits

Self-report demographic data was collected, including Race, ethnicity, education and income. Race/ethnicity was categorized into non-Hispanic white (NHW) and other racial/ethnic groups which combined Hispanic (regardless of race), African American, American Indian and Asian/Pacific Islander into one category[8]. Diabetes self-management and number of severe hypoglycemia episodes in the prior 6 months were obtained at the Cohort visit. Anthropomorphic measurements were taken and BMI was defined as weight (kilograms) divided by height (meters^2) and converted to a Z score[9]. Waist-to-height ratio (WHTR) was measured using National Health and Nutrition Examination Survey (NHANES) methodology. Three resting systolic and diastolic blood pressure levels were taken and an average was calculated. Blood was drawn after an 8-h overnight fast, and medications, including short-acting insulin, were withheld until after the blood was drawn on the morning of the visit.

Laboratory measures

Specimens were analyzed for GAD-65 antibodies (GAD_{65})[10] and insulinoma-associated-2 antibodies (IA-2A) as well as Fasting lipids, HbA1c, and glucose[11] at the Northwest Lipid Metabolism and Diabetes Research Laboratory (Seattle, WA) and Zinc-Transporter 8 autoantibody[12] was analyzed at the Eisenbarth laboratory (University of Colorado, Aurora, CO).

Surveys

Participants filled out a series of questionnaires at the cohort visit. The alcohol use survey included alcohol-related questions from the 2011 CDC behavior risk factor surveillance system (BRFSS) questionnaires[13]. On the alcohol use survey, participants were classified as drinkers if they responded “yes” to the question “During the past 30 days, have you had at least one drink of any alcoholic beverage such as beer, wine, a malt beverage or liquor?” If participants gave a response of “no” to this question, then they were classified as non-drinkers. Those who responded “don’t know” or “I don’t want to answer” were excluded

from these analyses. Per the standard National Institute on Alcohol Abuse and Alcoholism binge drinking definition, binge drinking was based on the largest number of drinks on any occasion within the past 30 days; with a threshold of 5 or more for males and 4 or more for females[14].

Participants who had smoked within the past 30 days were categorized as current tobacco users, with former tobacco users being defined as not having smoked within the past 30 days but having ever tried smoking a cigarette. Participants were categorized as physically active if they exercised or participated in a physical activity for at least 20 minutes that made them sweat and breathe hard at least 3 days per week. Sedentary behavior was defined separately and was classified as watching 2 or more hours of television or electronic screens per weekday. Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D)[15,16]. Quality of life was assessed using the PedsQL Generic Core, with scores ranging from 0–100, higher scores indicating higher quality of life[17]. Participants were categorized as having one or more episodes of severe hypoglycemia if they responded “yes” to the question “In the past 6 months, have you had any severe hypoglycemia, that is, very low blood sugar that required you to get help?” and “If yes, how many times?”.

Data Analysis

These analyses were restricted to the following inclusion criteria: participants in the cohort visit who had type 1 diabetes, had a positive GAD65, ZnT8 and/or IA2 result at their baseline visit and were at least 18 years of age and taking insulin at the time of their cohort visit. Initial analysis included participants ages 12–18 at the cohort visit but this age group was not included in final analyses due to the low prevalence of drinking (5.7%).

Descriptive analyses present means and standard deviations for continuous measures and counts and percentages for categorical variables. Bivariate tests were conducted using one-way ANOVAs and chi-square tests. Multivariable multinomial logistic regression was conducted using a generalized logit function to compute odds ratios and 95% confidence intervals for drinkers vs. non-drinkers and binge drinkers vs. non-drinkers. General linear models and logistic regression models, both unadjusted and adjusted, were constructed in order to describe the relationship between drinking status and HbA1c (as a continuous variable), number of severe hypoglycemic events over the past 6 months, and CVD risk markers. Covariates not significant in univariate models were not included in multivariable models. All analyses were conducted using SAS v 9.4 and use a 0.05 level of significance.

Results

Of the 3863 individuals eligible for the SEARCH cohort visit, 2777 (71.9%) participated. A total of 602 participants met inclusion criteria as described above, and were included in these analyses. Of these participants, 269 (44.7%) were non-drinkers, and 167 (27.7%) were non-binge drinkers, and 166 (27.6%) were binge drinkers (Table 1). The mean number of days per month at least 1 drink was consumed was 3.29 (SD 5.2) and mean number of drinks per drinking occasion was 2.07 (SD 3.4). The study sample was evenly split between males and females with an average age of 21.3 years at the time of the first cohort visit. A majority

of the study sample was non-Hispanic white (78.1%), came from a two-parent household (68.8%) with at least one parent having education beyond high school (81.8%). Almost a third (28.8%) of participants came from households earning USD $75,000 or greater, while the remainder of participants were split fairly evenly across the lower household income divisions. Less than half of participants reported healthy lifestyle habits, including never having used tobacco (48.8%) and being physically active (49.5%), watching less than 2 hours of television on weekdays (41.0%) and engaging in diabetes self-management, including checking blood sugar four or more times daily (48.2%); 46.2% used an insulin pump. Overall glycemic control of study participants was suboptimal, with a mean HbA1c of 9.1% (SD 2.0).

There was no sex differences for overall rate of drinkers vs. non-drinkers. However, males consumed alcohol more frequently (7.3 days v. 4.5 days, $p<0.0001$) and consumed more alcoholic drinks per occasion (4.7 drinks vs. 3.0 drinks, $p=0.0001$) compared to females. Additionally, males were more likely to be binge drinkers as compared to females (34.2% vs. 20.9%, $p= 0.0003$). Additionally, males were more likely than females to be smokers (current or former) than non-smokers (OR 1.6, 95% CI=1.1–2.2).

Participants who were 21 years old or older were more likely to have consumed alcohol in the past 30 days (77.1% vs. 36.5%, $p<0.0001$) and drank more frequently (7.0 days vs. 4.0 days out of the last 30 days, $p<0.0001$) compared to those participants ages 18–20 years. The 21 and older age group was also more likely to be binge drinkers (41.6% vs. 15.5%, $p<0.0001$), but average number of drinks consumed per occasion did not differ between age groups. A small number of participants reported use of other medications (in addition to insulin); no significant differences were seen when looking at alcohol consumption behaviors by medication use.

In the adjusted models, comparing binge drinkers to non-drinkers (Table 2), binge drinkers were older (OR 1.4, 95% CI = 1.2–1.6), had higher parental education (OR 2.6, 95% CI = 1.4–4.8), and were more likely to be current (OR 10.5, 95% CI =5.8–19.2) or former (OR 5.8, 95% CI = 3.3–10.1) tobacco users compared to nondrinkers.

In adjusted models comparing non-binge drinkers to non-drinkers, non-binge drinkers were older (OR 1.3, 95% CI = 1.1–1.5), had a higher parental education (OR 2.2, 95% CI =1.2–4.0), and were more likely to be current (OR 2.4, 95% CI =1.3–4.3) or former (OR 2.5, 95% CI = 1.5–4.2) tobacco users compared to non-drinkers.

When comparing binge drinkers to non-binge drinkers, binge drinkers were more likely to be male (OR 2.0, 95% CI =1.3–3.2) and current (OR 4.5, 95% CI = 2.4–8.2) or former (OR 2.3, 95% CI = 1.3–4.0) tobacco users compared to non-binge drinkers.

Relationships between alcohol consumption and clinical markers were examined and the model was adjusted for sex, age at diagnosis, age at cohort visit, race/ethnicity, highest parental education, and tobacco use (Table 3). Binge drinking was associated with higher HDL compared to non-drinkers (B = 4.16, SE = 1.57, $p=0.0082$) or non-binge drinkers (B=4.14, SE=1.56, $p=0.0081$), lower systolic blood pressure (SBP) compared to non-drinkers (B=−0.34, SE=0.14, $p=0.0113$) or non-binge drinkers (B=−0.30, SE=0.14,

p=0.0259), and a lower weight-to-height ratio (WHTR) compared to non-drinkers (B=−0.02, SE=0.01, p=0.0134). Binge drinking was not associated with adverse glycemic outcomes (HbA1c) or severe hypoglycemic events. There were no differences in alcohol consumption behaviors by SEARCH site, nor were there site differences in associations of alcohol use with clinical markers.

When stratified by physical activity, among the physically active, binge drinkers were more likely to have higher SBP than non-drinkers (B=0.89, SE=0.27, p=0.001) with no relationship in the physically inactive. WHTR was lower in binge drinkers compared to non-drinkers in the physically inactive group (B=−0.03, SE=0.01, p=0.016) with no relationship in the physically active. HDL differences were not significant when stratified by physical activity.

When stratified by insulin pump use, among pump users, non-binge drinkers had a higher HbA1c than non-drinkers (B=0.48, SE=0.22, p=0.032), but binge drinkers had a lower HbA1c than non-binge drinkers (B=−0.70, SE=0.25, p= 0.006). Among non-pump users, binge drinkers had a higher HDL compared to non-binge drinkers (B=5.47, SE=2.20, p=0.014). SBP was lower in binge drinkers vs. non-drinkers (B=−0.43, SE=0.19, p=0.023) and non-binge drinkers (B=−0.41, SE=0.20, p=0.040).

Discussion

This report from the SEARCH study demonstrates that alcohol consumption and binge drinking are common behaviors among young adults with T1D. The legal age for alcohol consumption in the USA is 21 years, which likely explains the low prevalence of drinking in the 12–18 year old SEARCH participants who were excluded from final analysis. Rates of binge drinking were especially high in this young adult cohort compared to rates found in other adult (older) T1D cohorts: in T1D Exchange (mean age of participants was 38 years), 19% reported binge drinking[5], while we found a substantially higher rate of binge drinking (27%) with participants' mean age of 21.4 years. This is the first study that we know of that examined alcohol consumption rates in this young adult T1D population. Our findings are consistent with trends seen in the non-T1D young adult USA population, in that college-age rates of binge drinking are high in the USA, quoted as 30–40%[18]. Binge drinking rates are higher in those who attend college and in males[18]. This is consistent with our findings that males with T1D consumed alcohol more frequently, more alcohol per occasion, and were more likely to be binge drinkers than females with T1D. The legal age for alcohol consumption in the USA is 21 years, which likely explains the low prevalence of reported drinking in the 12–18 year old SEARCH participants who were excluded from final analysis.

We were unable to examine how employment and educational status may impact these findings, for instance, if participants who attended college were more likely to report binge drinking. We did find that binge drinkers had a higher parental education level compared to non-drinkers, and college attendance status could explain this association. Reported household income was not significantly different between drinking status groups, thus socio-

economic status does not explain the associations we found with higher parental education level.

Among USA college students, non-Hispanic Whites demonstrate higher rates of binge drinking, compared to Hispanic or African American students[18]. We did not find associations with drinking patterns and race/ethnicity in our T1D population.

Alcohol consumption and binge drinking were more often observed in current or former tobacco users in our T1D population. This association of alcohol use with tobacco use has been well-described in the general USA population[19].

The literature is mixed on the association of alcohol and glycemic control. While some studies have demonstrated that both liberal and moderate consumption of alcohol by individuals with T1D had no significant effect on serum glucose levels,[20,21] others have shown increased hypoglycemic response to alcohol consumption, though no severe hypoglycemic events were observed.[6,22] In a multicenter analysis of the German/Austrian DPV registry of youth and young adults with T1D, any alcohol use was associated with worse glycemic control, more severe hypoglycemia, and increased DKA rates[23]. However, in our study we did not observe any significant associations between alcohol consumption and HbA1c or self-reported number of severe hypoglycemic events over the past 6 months in adjusted models. The DPV registry study included a younger cohort- ages 12–29 years, average age 17.0 years, compared to our young adult, ≥18 year old cohort. Only 10.8% of their younger cohort reported alcohol use, representing a small subset of young patients who likely had other risk factors for DKA and poor glycemic control. Thus, it is difficult to compare our findings to their study given the very different age distribution and developmental stages. A recent study in Italy demonstrated that among youth (age 13–19 years) with T1D alcohol use was associated with increased abdominal adiposity, dyslipidemia, and poor adherence to the Mediterranean diet, as well as higher HbA1c[24]. Similar to the DPV registry study, only 10% of youth in the Italian study reported alcohol consumption, thus making their findings difficult to compare with our study for the reasons mentioned above.

Alcohol consumption by individuals with T1D can be associated with acute concerns, mainly increased hypoglycemia risk during, and for 24 hours following consumption[6]. In our study, the rate of severe hypoglycemia was similar to that reported in other studies of young adults with T1D[25], but low (overall 9.0%) and thus we were not adequately powered to detect associations between severe hypoglycemia with alcohol use. Alcohol use also may be associated with more chronic concerns such as risk for CV disease or microvascular complications, though these relationships remain unclear. Light to moderate alcohol consumption (one to three drinks a day) has been associated with favorable cardiovascular risk profile and reductions in cardiovascular death and nonfatal myocardial infarction[26]. Binge drinking, however, demonstrates an increase in mortality, hypertension[27], alcoholic cardiomyopathy, cancer, and cerebrovascular events[26]. When looking specifically at adults with T1D, no association was found between alcohol consumption and coronary artery calcification as a marker of cardiovascular risk[28].

In earlier studies of individuals with T1D, alcohol consumption has either not been associated with microvascular disease or has been protective. Some studies show that moderate consumption is associated with no change in risk of proliferative retinopathy[29], neuropathy[30], and macroalbuminuria[29,31] while other studies show a decreased risk in these complications with moderate consumption[31].

In our cohort, we found that binge drinking was associated with favorable cardiovascular markers including higher HDL, lower SBP, and lower WHTR. This may be related to the young age of our cohort in that the detrimental effects of binge drinking on CV risk factors may take time to develop, as well the lack of ability to control for college/occupational status in this study. When stratified by age, the 21–23 year old age group was found to drive the binge drinking association with SBP and WHTR. When stratified by physical activity, physical activity did not drive the associations found in the adjusted model.

However, regardless of direct relationships between alcohol use and diabetes specific complications, alcohol is a high-risk activity that can contribute to morbidity and mortality in this population. A Norwegian nationwide mortality study looking at deaths in those with T1D, found 20% of deceased misused alcohol and 15% of those with T1D that died had alcohol related ICD-10 codes on their death certificate[32]. The cause of death was associated with alcohol in 21.8% of those who died with less than 20 years' diabetes duration.

There are some limitations to this study. Since data on drinking behavior was dependent on self-report, there is a potential for response bias and recall bias, especially considering that drinking behavior can often be perceived as a sensitive topic by participants. Other self-report variables are subject to response bias as well. Self-report is also limited by recall bias when asking participants to recall drinking behaviors over the prior 30 days. The effect of this bias would likely be toward the null, yet statistically significant findings did emerge in our study. Another limitation is the relatively short duration of follow-up for our participants, such that we can only report the short-term effects. As mentioned previously, we did not have employment or student status for our participants to be able to control for this as a variable. An important strength of this study is that while drinking patterns may vary by geographic region and demographic groups, this research benefits from being able to draw from the large, diverse SEARCH for Diabetes in Youth cohort.

Conclusions

This study demonstrates that young adults with T1D engage in alcohol consumption in a pattern that is similar to other individuals in their age group without diabetes, and many engage excessively. While there were no measurable adverse association between alcohol consumption in the short-term and glycemic control and CVD risk factors in the SEARCH cohort, the German/Austrian DPV registry data[23] and Norwegian mortality study[32] suggest that there are substantial acute and long-term risks of alcohol consumption in T1D. Given these previously reported risks, and the high alcohol consumption and binge-drinking rates in young adults with T1D, counselling and education around alcohol use and its potential consequences should be incorporated into the care of young adults with T1D.

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Table 1:

Characteristics of 602 Adult Participants in the SEARCH Cohort Visit

		Overall n=602	Binge drinkers n=166	Non-binge drinkers n=167	Non-drinkers n=269	Chi Square P-value
Male N(%)		301 (50.0)	103 (62.0)	71 (42.5)	127 (47.2)	0.001
Age at diagnosis Mean(SD)		12.9 (2.6)	13.4 (2.3)	13.7 (2.8)	12.0 (2.4)	< 0.001
Age at cohort visit (years) Mean(SD)		21.3 (2.4)	22.1 (2.2)	22.1 (2.7)	20.3 (2.0)	< 0.001
Duration (years) Mean(SD)		8.4 (1.8)	8.6 (1.7)	8.4 (1.9)	8.2 (1.8)	0.093
Race/ethnicity N(%)	Hispanic and/or nonwhite	132 (21.9)	24 (14.5)	31 (18.6)	77 (28.6)	0.001
	Non-hispanic white	470 (78.1)	142 (85.5)	136 (81.4)	192 (71.4)	
Highest parental education N(%)	<= High school	108 (18.2)	23 (14.0)	22 (13.4)	63 (23.9)	0.006
	> High school	484 (81.8)	141 (86.0)	142 (86.6)	201 (76.1)	
Household income N(%)	<$25K	95 (15.9)	28 (17.0)	25 (15.1)	42 (15.7)	0.864
	$25–49K	96 (16.1)	27 (16.4)	26 (15.7)	43 (16.1)	
	$50–74K	84 (14.0)	22 (13.3)	25 (15.1)	37 (13.9)	
	$75K+	172 (28.8)	52 (31.5)	51 (30.7)	69 (25.8)	
	DK/Ref	151 (25.3)	36 (21.8)	39 (23.5)	76 (28.5)	
Tobacco use N(%)	Current	137 (23.0)	69 (42.1)	34 (20.6)	34 (12.7)	< 0.001
	Former	168 (28.2)	63 (38.4)	59 (35.8)	46 (17.2)	
	Never	291 (48.8)	32 (19.5)	72 (43.6)	187 (70.0)	
Physically active N(%)[a]		298 (49.5)	90 (54.2)	81 (48.5)	127 (47.2)	0.349
Sedentary behavior N(%)[b]		354 (59.0)	103 (62.4)	93 (55.7)	158 (59.0)	0.459
Household N(%)	2 Parents / 1 Household	411 (68.8)	114 (68.7)	116 (69.9)	181 (68.3)	0.941
	Other	186 (31.2)	52 (31.3)	50 (30.1)	84 (31.7)	
How often blood sugar checked N(%)	Less than 4 times per day	310 (51.8)	96 (57.8)	88 (52.7)	126 (47.5)	0.111
	4 or more times per day	288 (48.2)	70 (42.2)	79 (47.3)	139 (52.5)	
Insulin regimen N(%)	Pump	278 (46.2)	61 (36.7)	90 (53.9)	127 (47.2)	0.156
	Long + short/rapid insulin, 3 or more times a day	137 (22.8)	42 (25.3)	33 (19.8)	62 (23.0)	
	Long + any other combination, 2 or more times a day	132 (21.9)	47 (28.3)	30 (18.0)	55 (20.4)	
	Any combination of insulins excluding long, 3 or more times a day	37 (6.1)	12 (7.2)	9 (5.4)	16 (5.9)	
	Any insulins taken once a day, or any	18 (3.0)	4 (2.4)	5 (3.0)	9 (3.3)	

		Overall n=602	Binge drinkers n=166	Non-binge drinkers n=167	Non-drinkers n=269	Chi Square P-value
	insulin combination except long 2 times a day					
Continuous Glucose Monitor Use N(%)		93 (15.8)	25 (15.5)	27 (16.5)	41 (15.6)	0.965
HbA1c Mean(SD)		9.1 (2.0)	8.8 (2.0)	9.1 (2.0)	9.2 (2.0)	0.103
Severe Hypoglycemia N(%)		54 (9.0)	21 (12.7)	15 (9.0)	18 (6.7)	0.107
CESD score Mean(SD)		10.6 (9.1)	10.6 (9.5)	9.8 (9.0)	11.0 (9.1)	0.431
PQOL total score (child) Mean(SD)		83.3 (12.9)	82.7 (13.2)	83.6 (12.7)	83.4 (12.9)	0.799
SBP z-score Mean(SD)		0.2 (1.9)	0.3 (1.8)	0.7 (2.1)	−0.2 (1.6)	< 0.001
DBP z-score Mean(SD)		−0.2 (2.9)	−0.8 (3.1)	0.1 (3.6)	−0.0 (2.1)	0.007
total cholesterol (mg/dL) Mean(SD)		171.8 (38.5)	169.5 (35.2)	171.7 (35.7)	173.3 (42.0)	0.617
HDL cholesterol (mg/dL) Mean(SD)		54.5 (14.1)	55.8 (15.0)	53.9 (13.9)	54.1 (13.6)	0.411
LDL cholesterol (mg/dL) Mean(SD)		97.7 (29.7)	93.7 (25.9)	98.8 (29.2)	99.3 (32.0)	0.135
triglycerides (mg/dL) Mean(SD)		100.0 (93.5)	101.6 (81.2)	95.7 (74.9)	101.8 (109.7)	0.783

[a] Physically active defined as: participating in a physical activity for ≥20 minutes a day, ≥3 days a week

[b] Sedentary behavior defined as: ≥2 hours of screen time per weekday

Table 2:

Adjusted odds ratio (aOR) and 95% confidence interval (CI) for alcohol consumption by demographic and clinical characteristics

		Binge drinker vs. Non-drinker		Non-binge drinker vs. Non-drinker		Binge drinker vs. Non-binge drinker		
		aOR (95% CI)	P Value	aOR (95% CI)	P Value	aOR (95% CI)	P Value	P value (overall test)
Male Gender		1.4 (0.9–2.2)	0.159	0.7 (0.5–1.1)	0.104	2.0 (1.3–3.2)	0.003	0.012
Age at diagnosis (years)		1.0 (0.9–1.2)	0.817	1.1 (1.0–1.3)	0.114	0.9 (0.8–1.1)	0.220	0.249
Age at cohort visit (years)		1.4 (1.2–1.6)	< 0.001	1.301	<0.001	1.1 (0.9–1.2)	0.489	< 0.001
Race/ethnicity: Other		0.8 (0.4–1.5)	0.476	0.8 (0.5–1.4)	0.412	1.0 (0.5–1.9)	0.983	0.648
Parent with > High school education (ref: High school or less)		2.6 (1.4–4.8)	0.003	2.2 (1.2–4.0)	0.010	1.2 (0.6–2.3)	0.647	0.004
Tobacco use (ref: Never)	Current	10.5 (5.8–19.2)	< 0.001	2.4 (1.3–4.3)	0.005	4.5 (2.4–8.2)	< 0.001	< 0.001
	Former	5.8 (3.3–10.1)	< 0.001	2.5 (1.5–4.2)	<0.001	2.3 (1.3–4.0)	0.004	

Table 3:

Relationship between alcohol consumption and clinical characteristics

*Adjusted for sex, age at diagnosis, age at cohort visit, race/ethnicity, parental education, and tobacco use

		Unadjusted			Adjusted*		
Outcome	**Drinking**	**Beta (SE)**	**P Value**	**P Value (Overall)**	**Beta (SE)**	**P Value**	**P Value (Overall)**
HBA1C	Binge drinker vs. non-drinker	−0.42 (0.20)	0.034	0.103	−0.27 (0.21)	0.201	0.158
	Non-binge drinker vs. non-drinker	−0.12 (0.20)	0.526		0.13 (0.20)	0.506	
	Binge drinker vs. non-binge drinker	−0.29 (0.22)	0.179		−0.40 (0.21)	0.057	
Total cholesterol	Binge drinker vs. non-drinker	−3.78 (3.85)	0.327	0.617	−2.07 (4.31)	0.631	0.884
	Non-binge drinker vs. non-drinker	−1.62 (3.82)	0.671		−1.37 (4.04)	0.735	
	Binge drinker vs. non-binge drinker	−2.16 (4.27)	0.614		−0.70 (4.28)	0.871	
HDL cholesterol	Binge drinker vs. non-drinker	1.65 (1.41)	0.243	0.411	4.16 (1.57)	0.008	0.011
	Non-binge drinker vs. non-drinker	−0.21 (1.40)	0.883		0.020 (1.47)	0.989	
	Binge drinker vs. non-binge drinker	1.85 (1.56)	0.236		4.14 (1.56)	0.008	
LDL cholesterol	Binge drinker vs. non-drinker	−5.67 (3.00)	0.056	0.135	−5.60 (3.38)	0.098	0.204
	Non-binge drinker vs. non-drinker	−0.52 (2.94)	0.860		−0.63 (3.17)	0.842	
	Binge drinker vs. non-binge drinker	−5.15 (3.29)	0.117		−4.97 (3.36)	0.140	
Triglycerides	Binge drinker vs. non-drinker	−0.21 (9.35)	0.983	0.783	−4.41 (10.80)	0.683	0.868
	Non-binge drinker vs. non-drinker	−6.09 (9.28)	0.512		−4.99 (10.13)	0.622	
	Binge drinker vs. non-binge drinker	5.88 (10.37)	0.571		0.58 (10.74)	0.957	
Systolic blood pressure	Binge drinker vs. non-drinker	0.50 (0.18)	0.006	< 0.001	−0.34 (0.14)	0.011	0.025
	Non-binge drinker vs. non-drinker	0.98 (0.18)	< 0.001		−0.04 (0.13)	0.741	
	Binge drinker vs. non-binge drinker	−0.48 (0.20)	0.017		−0.30 (0.14)	0.026	
Diastolic blood pressure	Binge drinker vs. non-drinker	−0.77 (0.28)	0.007	0.007	−0.10 (0.26)	0.698	0.720
	Non-binge drinker vs. non-drinker	0.12 (0.28)	0.672		0.11 (0.24)	0.655	
	Binge drinker vs. non-binge drinker	−0.89 (0.31)	0.005		−0.21 (0.26)	0.420	
BMI	Binge drinker vs. non-drinker	−0.17 (0.09)	0.074	0.151	−0.13 (0.11)	0.214	0.459
	Non-binge drinker vs. non-drinker	0.00 (0.09)	0.983		−0.05 (0.10)	0.620	
	Binge drinker vs. non-binge drinker	−0.17 (0.10)	0.103		−0.08 (0.11)	0.435	
NHANES WHTR	Binge drinker vs. non-drinker	−0.02 (0.01)	0.005	0.015	−0.02 (0.01)	0.013	0.043
	Non-binge drinker vs. non-drinker	0.00 (0.01)	0.641		−0.01 (0.01)	0.123	
	Binge drinker vs. non-binge drinker	−0.02 (0.01)	0.033		−0.01 (0.01)	0.302	