



## Individual-, peer-, and parent-level substance use-related factors among 9- and 10-year-olds from the ABCD Study: Prevalence rates and sociodemographic differences

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### ABSTRACT

**Background:** Although a relatively large body of research has identified multiple factors associated with adolescent substance use, less is known about earlier substance-related factors during preadolescence, including curiosity to use substances. The present study examined individual-, peer-, and parent-level domains pertaining to substance use and how these domains vary by sociodemographic subgroups and substance type.

**Methods:** Participants were 11,864 9- and 10-year-olds from the baseline sample of the Adolescent Brain Cognitive Development (ABCD) Study. Youth-reported measures were curiosity to use substances and perceived peer substance use. Parent-reported measures were availability of and rules about substances. Generalized logistic mixed models (GLMM) were used to compare these measures across alcohol, nicotine, and marijuana and across sociodemographic subgroupings (sex, race/ethnicity, household income, and family history of alcohol problems). GLMM was then used to examine predictors of curiosity to use by substance type.

**Results:** The most striking descriptive differences were found between race/ethnicity and income categories (e.g., positive associations between greater income and greater availability of alcohol). In multivariable analyses, greater curiosity to use alcohol was associated with being male, higher household income, perceived peer alcohol use, and easy alcohol availability; greater curiosity to use nicotine was associated with being male, perceived peer cigarette use, easy availability of cigarettes, and no parental rules about cigarette use.

**Conclusions:** This study identified substance use-related individual-, peer-, and parent-level factors among a diverse, national sample. Findings highlight the importance of considering sociodemographic and substance-specific variability and may help identify risk and protective factors preceding adolescent substance use.

### 1. Introduction

Drug and alcohol experimentation typically begins during adolescence. Among U.S. 8th grade respondents from the Monitoring the Fu-

ture (MTF) survey, 20.5% used alcohol, 11.2% used a nicotine product, and 11.4% used marijuana within the past year (Miech et al., 2020). Although some low-level, experimental substance use is typical during this age, early substance use (i.e., before age 14) is particularly problematic, as it can have detrimental effects on brain development and neuropsychological functioning (Gray and Squeglia, 2018; Nguyen-Louie et al., 2017; Silveri et al., 2016). Identifying early risk factors for substance use in preadolescence, when youth are just beginning to show curiosity

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to use substances and a greater awareness of others' substance use, is an important step in preventing later problematic drug and alcohol use.

Bronfenbrenner's Ecological Systems Theory is a useful developmental framework to examine the multiple systems that have direct and indirect influences on substance use attitudes and behaviors (Bronfenbrenner and Morris, 2006). At the center of this theoretical model is the individual, including their sociodemographic characteristics (e.g., age, sex). In terms of individual-level factors, non-Hispanic White (hereafter referred to as White) males tend to show the highest rates of use (Miech et al., 2020). Sex differences in substance use, however, have diminished in recent years and may vary by substance type. In the 8th grade MTF survey, few sex differences were observed in alcohol use, but females had slightly higher rates of marijuana use, and males had greater nicotine use (Miech et al., 2020). Lower socioeconomic status (SES) youth typically engage in greater illicit drug and nicotine use, while higher SES youth have greater alcohol use (Jang et al., 2017; Miech et al., 2020). Racial/ethnic differences in substance use also may vary by substance type (Alvanzo et al., 2011; Wu et al., 2011). Among the three largest racial/ethnic groups in the U.S., Black/African American (hereafter referred to as Black) youth typically report lower levels of drug and alcohol use compared to White and Latinx/Hispanic (hereafter referred to as Latinx) youth, but Black youth have shown increasing rates of marijuana use. White youth tend to report the highest levels of alcohol and nicotine use (Miech et al., 2020).

Related to individual-level factors, adolescence coincides with a developmental mismatch between the brain's reward and cognitive control systems that contributes to heightened risk-taking (Casey and Jones, 2010; Shulman et al., 2016; Smith et al., 2013). Adolescents' predispositions toward risk-taking contribute, in part, to attitudes about substance use. Cognitions such as curiosity and openness to engage in risky behaviors typically precede risk-taking behaviors (Andrews et al., 2008; Silveira et al., 2020). Indeed, curiosity to use substances is prospectively associated with experimentation (Guo et al., 2012; Lee et al., 2007; Nodora et al., 2014). To our knowledge, only one existing study has examined factors specifically associated with curiosity to use alcohol in preadolescents, and no existing studies have examined curiosity to use other substances (e.g., nicotine, marijuana) in this age group Wade et al. (2021). showed that both low perception of alcohol-related harm and low peer disapproval of alcohol use were predictors of curiosity to use alcohol in a substance naïve sample of 9- to 11-year-olds from the Adolescent Brain Cognitive Development (ABCD) Study®.

These findings provide support for the importance of social contexts in relation to substance use attitudes (Trucco et al., 2011). From a developmental perspective, the peer context becomes increasingly important from childhood to adolescence. As such, substance use occurs most frequently in the context of peers, and perceptions about peer use can have an influence on one's own use Jackson et al. (2014). found that greater personal willingness (i.e., curiosity about engaging in a behavior either with or without intentions to act) to use alcohol was associated with perceived peer norms about drinking among a sample of early adolescents. In a large sample of middle- and high-school aged youth, Schuler et al. (2019) documented positive associations between adolescent and best friend use of alcohol, cigarettes, and marijuana. The authors noted that these associations were strongest among younger adolescents, indicating the need for examining associations between perceptions of peer use and substance use related attitudes in preadolescence.

Parent-level factors, such as availability of substances within the home and substance-related rule setting, also contribute to substance use attitudes and behaviors among youth (Abar et al., 2014). Furthermore, youth whose parents have substance use problems are more likely to develop substance use problems themselves (Cservenka, 2016; Dodge et al., 2009; Zucker, 2014). Linkages between parent and peer influences on substance use have been observed (Van Ryzin et al., 2012). In a sample of 14- to 17-year-olds, Kiesner et al. (2010) found an association between lower parental monitoring and higher rates of us-

ing substances with peers. In one of the few longitudinal studies to investigate multiple sociocontextual influences across substance types, D'Amico et al. (2020) examined predictors of alcohol, tobacco, and marijuana use (and co-use) across individual, peer, family, and neighborhood domains. Accounting for the other domains, spending time with substance using peers in adolescence had an influence on substance use in young adulthood. According to Bronfenbrenner's Ecological Systems Theory, peers and parents are both located within the microsystem, which is the most proximal sociocontextual system to the individual (Bronfenbrenner and Morris, 2006). Additional work is needed that disentangles these multi-level influences during preadolescence, when substance use experimentation is just beginning.

In sum, examining multi-level factors associated with substance use attitudes may provide important information about which youth are most likely to engage in early substance use. Focusing on interactions within and across multiple sociocontextual systems, the goal of the present study was to examine individual-, peer-, and parent-level factors associated with substance use attitudes in 9- and 10-year-olds from the ABCD Study. Although ABCD Study participants have reported minimal substance use at baseline, limited primarily to low-level alcohol, marijuana, and nicotine use, the ABCD Study has valuable data on early, substance-related attitudes that precede substance use behavior (Lisdahl et al., 2018). The present study used data from the ABCD Study to: (1) examine prevalence rates descriptive differences in preadolescents' curiosity to use substances, perceived peer use of substances, availability of substances, and parental rules about substance use by sex, race/ethnicity, household income, and family history of alcohol problems (FH); and (2) investigate individual-, peer-, and parent-level factors as predictors of curiosity to use alcohol, nicotine, and marijuana. These substances were targeted, as they are the most commonly used substances among youth (Miech et al., 2020).

## 2. Materials and methods

### 2.1. Participants

Participants were 11,864 9- and 10-year-olds from the baseline cohort of the ABCD Study. The ABCD Study cohort was recruited from 21 data collection sites across the U.S. (Garavan et al., 2018). A probability sampling approach was used to target schools within the communities surrounding each data collection site. Participants were assessed on multiple psychosocial, neurocognitive, and behavioral domains, including a substance use module (see Lisdahl et al., 2018 for further details). See additional information pertaining to recruitment sites and general project information at <http://abcdstudy.org>. Participants and their parent or legal guardian provided assent and informed consent, respectively, and all study procedures were approved by a central Institutional Review Board.

### 2.2. Measures

#### 2.2.1. Demographics

*Biological sex at birth, race/ethnicity, and household income* were included in the PhenX toolkit portion of the ABCD Study (Stover et al., 2010). Race/ethnicity was categorized as 1 = White, 2 = Black, 3 = Latinx, or 4 = other (all other racial/ethnic groups, including multi-racial). Household income was categorized as 1 = less than \$50,000 ("low-income"), 2 = \$50,000-\$100,000 ("middle-income"), or 3 = greater than \$100,000 ("high-income"). *Family history of alcohol problems* was measured by parents' reported problems attributable to alcohol use for themselves, the participant's other biological parent, siblings, maternal and paternal aunts, uncles, and grandparents. 1 = one or both parents met the threshold for being family history positive (FH+) and 0 = neither parent met the threshold for being family history negative (FH-; Family History Assessment; Barch et al., 2018)

### 2.2.2. Substance use measures

Youth-administered substance use-related measures were *curiosity to use substances* and *perceived peer substance use*. For curiosity to use substances, participants were asked the extent to which they are curious about using alcohol, nicotine, and marijuana, with response options ranging from 1 = "very curious" to 4 = "not at all curious". For perceived peer substance use, participants were asked how many of their friends drink alcohol, use cigarettes, use other nicotine, and use marijuana, with response options spanning from 1 = "none" to 5 = "all". Parent-administered substance use-related measures were *availability of substances* and *parent rules about substance use*. For availability of substances, parents were asked how easy it would be if their child wanted to get alcohol, cigarettes, other nicotine, or marijuana, with response options ranging from 1 = "very hard" to 4 = "very easy". For parent rules about substance use, parents were asked about the rules for their child's use of alcohol, cigarettes, and marijuana, with response options ranging from "my child is not allowed to drink/use marijuana/smoke cigarettes under any circumstances" to "I do not set rules about my child's drinking/marijuana use/smoking cigarettes". Parents were also given the response option of "I have not made rules yet about my child drinking/using marijuana/smoking cigarettes." Detailed information on these measures are described in Lisdahl et al. (2018). Due to low endorsement of substance use in the baseline cohort of the ABCD Study, and thus to better interpret findings, responses were recoded as shown in Supplemental Table 1.

### 2.3. Data analysis plan

Analyses were performed using Stata (version 15.1). Frequencies for both sets of youth- and parent-reported items were examined by substance type and by sex, race/ethnicity, household income, and FH. Bivariate generalized logistic mixed models (GLMM) were used to test for significant differences in youth- and parent-reported items by substance type and by sex, race/ethnicity, household income, and FH. These models were comprised of a single, binary outcome variable (e.g., curiosity to use alcohol) and a single, binary predictor variable (e.g., male versus female). Due to low endorsement rates of "Some use allowed" for parental rules about substance use (alcohol:  $n = 186$ , 1.57%; cigarettes:  $n = 92$ , 0.78%; marijuana:  $n = 47$ , 0.40%), and thus insufficient variance to compute multinomial GLMMs with three outcome variables, GLMMs were computed with 1 = "No use allowed" versus 0 = "No rules". Multivariable GLMMs were then used to examine predictors of curiosity to use alcohol, nicotine, and marijuana in three separate models. For each multivariable GLMM, fixed effects were sex, race/ethnicity, household income, FH, perceived peer use, parent-reported availability of substances, and parental rules about their child's substance use. Each model included substance-specific predictors (i.e., the model with any curiosity to use alcohol as the outcome variable included perceived peer alcohol use, availability of alcohol, and parental rules about alcohol use as predictor variables). The nicotine model included only cigarette use-related predictors due to relatively lower endorsement of other nicotine use items and considering that the parental rules question only asked about parental rules for cigarette use. In exploratory analyses, a nicotine model was tested with other nicotine use predictors except for parental rules, but the model did not converge. Random effects for all GLMMs were site and family identifiers, the latter capturing the impact of sibling correlations. Nesting by family ID was not used in models where parental rules about substances were the outcome variable, since these questions were asked about rules for their family and not each individual child.

## 3. Results

### 3.1. Prevalence rates

Among youth-reported items in the full study sample, 10.62% reported any curiosity to use alcohol, 9.72% reported any curiosity to use

nicotine, and 2.42% reported any curiosity to use marijuana; 2.87% reported any perceived peer alcohol use, 2.10% reported any perceived peer cigarette use, 1.28% reported any perceived peer other nicotine use, and 1.09% reported any perceived peer marijuana use. Among parent-reported items in the full study sample, 33.53% reported easy availability of alcohol, 7.07% reported easy availability of cigarettes, 3.45% reported easy availability of other nicotine, and 2.98% reported easy availability of marijuana; 81.90% reported having made rules prohibiting their child's use of alcohol, 75.35% reported having made rules prohibiting their child's use of nicotine, and 74.44% reported having made rules prohibiting their child's use of marijuana. Prevalence rates by sex, race/ethnicity, household income, and FH subgroups across substance types are shown in Table 1.

### 3.2. Bivariate GLMM regression analyses

Results of significant bivariate GLMMs showing sociodemographic subgroup comparisons by substance type are presented in Supplemental Table 2.

*Curiosity to use substances.* Compared to females, males had a greater likelihood of curiosity to use alcohol, nicotine, and marijuana. White youth had greater curiosity to use alcohol versus Black youth, and Latinx youth had greater curiosity to use alcohol compared to Black youth. There were no significant differences in curiosity to use nicotine by race/ethnicity. Black youth had greater curiosity to use marijuana versus White, Latinx, and other race/ethnicity youth. High-income youth had greater curiosity to use alcohol versus middle- and low-income youth. Middle-income youth had greater curiosity to use alcohol compared to low-income youth. There were no significant differences in household income by curiosity to use nicotine or marijuana, and no significant differences between FH groups by curiosity to use alcohol, nicotine, or marijuana.

*Perceived peer substance use.* Males reported greater perceived peer alcohol, cigarette, other nicotine, and marijuana use than females. Compared to White, Latinx, and other race/ethnicity youth, Black youth reported greater perceived peer alcohol, cigarette, other nicotine, and marijuana use. Latinx youth had greater perceived peer cigarette and other nicotine use than White youth. Other race/ethnicity youth had greater perceived peer cigarette use compared to White youth. Low-income youth reported greater perceived peer alcohol use compared to high-income youth and had greater perceived peer use of cigarettes versus high- and middle-income youth. Low-income youth also had greater perceived peer use of other nicotine and marijuana versus high- and middle-income youth. Middle-income youth had greater perceived peer cigarette and other nicotine use compared to high-income youth. There were no significant differences between FH groups for perceived peer alcohol use, but FH+ youth had greater perceived peer cigarette, other nicotine, and marijuana use.

*Availability of substances.* There were no significant sex differences. Compared to parents of Black youth, parents of White, Latinx, and other race/ethnicity youth reported easier alcohol availability. Parents of White youth reported easier alcohol availability versus Latinx and other race/ethnicity youth. Parents of other race/ethnicity youth reported easier alcohol availability compared to Latinx youth. There were no significant differences by race/ethnicity for cigarette availability. For other nicotine, parents of White, Latinx, and other race/ethnicity youth reported easier availability compared to Black youth. Parents of Latinx youth reported easier availability of other nicotine compared to White youth and easier marijuana availability compared to White and Black youth. Parents of high-income families reported easier alcohol availability versus those of middle- and low-income; middle-income parents reported easier alcohol availability than low-income. Compared to high-income parents, low-income parents reported easier availability of cigarettes, other nicotine, and marijuana. Parents of FH+ youth had less alcohol availability but greater availability of cigarettes, other nicotine, and marijuana compared to parents of FH- youth.

**Table 1**  
Within-group percentages by substance type and sociodemographic group.

	Sex		Race/Ethnicity				Household Income			Family History of Alcohol Problems	
	Male	Female	White	Black	Latinx	Other	< 50K	50 K–100 K	> 100 K	FH-	FH+
	n = 6182	n = 5682	n = 6172	n = 1777	n = 2405	n = 1495	n = 3218	n = 3068	n = 4562	n = 9690	n = 1730
<b>Curiosity to use substances (any curiosity)</b>											
Alcohol	11.94	9.26	11.84	7.88	10.16	10.02	7.42	10.61	13.55	10.60	10.11
Nicotine	10.79	8.57	9.80	9.44	8.85	10.97	9.20	10.45	9.62	9.44	10.61
Marijuana	3.04	1.62	2.13	4.23	2.15	1.83	2.70	2.35	2.28	2.44	2.09
<b>Perceived peer use (any peer use)</b>											
Alcohol	3.47	2.21	2.64	3.92	2.60	3.08	3.46	2.81	2.46	2.72	3.53
Cigarettes	2.50	1.65	1.20	6.03	1.82	2.04	4.19	1.44	0.74	1.86	3.26
Other nicotine	1.77	0.74	0.80	3.18	1.29	1.27	2.54	1.17	0.38	1.11	2.09
Marijuana	1.41	0.69	0.65	3.66	0.61	0.58	2.01	0.53	0.49	0.87	1.89
<b>Availability of substances (easy availability)</b>											
Alcohol	33.29	33.79	45.38	8.99	23.06	30.83	10.98	31.29	54.21	34.90	27.53
Cigarettes	7.51	6.60	7.92	4.70	6.61	7.20	9.39	8.60	4.55	5.92	13.87
Other nicotine	3.73	3.14	3.31	1.65	4.68	4.15	4.17	3.59	3.00	3.01	5.78
Marijuana	3.20	2.74	2.73	2.18	4.03	3.21	3.59	2.94	2.50	2.65	5.19
<b>Parental rules</b>											
Some use allowed											
Alcohol	1.60	1.53	1.34	2.64	1.04	2.07	1.74	1.37	1.53	1.64	1.33
Cigarettes	0.83	0.72	0.28	2.31	0.91	0.80	1.49	0.36	0.28	0.71	0.87
Marijuana	0.44	0.35	0.18	0.84	0.62	0.40	0.71	0.29	0.15	0.41	0.17
No use allowed											
Alcohol	75.99	74.57	70.77	87.51	78.42	74.58	81.79	76.37	68.76	75.34	75.03
Cigarettes	81.07	81.22	79.31	88.35	80.91	80.74	83.65	81.19	79.02	81.69	78.44
Marijuana	74.28	74.53	70.32	87.34	76.05	73.38	80.11	75.00	69.11	74.61	73.47
No rules											
Alcohol	22.39	23.81	27.85	9.85	20.42	23.28	16.41	22.26	29.68	22.98	23.53
Cigarettes	18.08	17.97	20.38	9.34	18.05	18.39	14.79	18.45	20.67	17.55	20.58
Marijuana	25.27	25.03	29.47	11.82	23.20	26.15	19.11	24.71	30.71	24.93	26.24

*Parent rules about substance use.* There were no significant sex differences. Parents of Black youth were more likely than all other racial/ethnic groups to have rules for not using alcohol, cigarettes, and marijuana. Compared to parents of White youth, parents of Latinx and other youth were more likely to have rules about not using alcohol and marijuana. Parents of Latinx youth were also more likely to have rules about not using cigarettes compared to White youth. Compared to parents of other race/ethnicity youth, parents of Latinx youth were more likely to have rules about not using alcohol and marijuana. Low-income parents were more likely than middle- and high-income parents to have rules about not using alcohol, cigarettes, and marijuana. Middle-income parents were more likely than high-income parents to have rules about not using alcohol, cigarettes, and marijuana. There were no significant differences in having substance use rules for alcohol and marijuana by FH, but parents of FH+ youth were less likely to have rules about not using cigarettes.

3.3. Multivariable GLMM regression analyses

The multivariable GLMM predicting curiosity to use alcohol is shown in Table 2 and the GLMM predicting curiosity to use nicotine is shown in Table 3. In the alcohol model, females were less likely to report curiosity to use. Youth who reported having any alcohol-using peers were significantly more likely to be curious about using alcohol, as were youth whose parents reported easy alcohol availability. There were no significant differences by race/ethnicity, FH, or parental rules about alcohol.

In the nicotine model, females were less likely to report curiosity to use. Youth who reported having any cigarette-using peers, have parents reporting easy availability of cigarettes, and have parents with no rules about their child's cigarette use were significantly more likely to be curious about using nicotine. There were no significant differences by race/ethnicity, household income, FH, or parental rules about cigarette use.

Results from the multivariable GLMM for marijuana indicated that being male (OR = 1.97, 95% CI = 1.18, 3.32,  $p = 0.01$ ), Black (vs. White

**Table 2**  
Multivariable generalized logistic mixed model predicting any curiosity to use alcohol.

Variable	Odds Ratio	95% Confidence Interval	p-value
Female	<b>0.74</b>	<b>0.62–0.88</b>	<b>0.001</b>
Race/ethnicity			
Black	0.98	0.74–1.30	0.895
Latinx	1.23	0.99–1.54	0.065
Other	0.89	0.68–1.15	0.359
Household income			
\$50,000 – \$100,000	<b>1.47</b>	<b>1.15–1.88</b>	<b>0.002</b>
>\$100,000	<b>1.82</b>	<b>1.39–2.39</b>	<b>&lt; 0.001</b>
Family history of alcohol problems	1.07	0.85–1.36	0.569
Any perceived peer alcohol use	<b>3.33</b>	<b>1.85–6.00</b>	<b>&lt; 0.001</b>
Easy availability of alcohol	<b>1.46</b>	<b>1.19–1.78</b>	<b>&lt; 0.001</b>
No parental rules about alcohol use	1.12	0.93–1.36	0.230
<i>Random Effects: Site and Family ID</i>			

Note: Bolded values are significant. Reference categories: male; White; less than \$50,000; no parent with a history of alcohol problems; no perceived peer alcohol use; hard availability of alcohol; any parental rules about their child's alcohol use; model fit: Wald  $\chi^2 = 38.68, p < 0.001$ .

OR = 2.41, 95% CI = 1.20, 4.86,  $p = 0.01$ ), and having easy availability of marijuana (OR = 2.97, 95% CI = 1.13, 7.78,  $p = 0.03$ ) were associated with a significantly greater likelihood of having curiosity to use marijuana. However, this model showed inadequate fit ( $\chi^2 = 11.34, p = 0.33$ ), and thus, low confidence in the predictor variables having a true effect on the outcome variable. This is likely attributable to the relatively lower endorsement of marijuana use variables compared to alcohol and nicotine variables.

4. Discussion

Findings from the present study provide a big-picture snapshot of individual-, peer-, and parent-level factors associated with alcohol,



**Table 3**  
Multivariable generalized logistic mixed model predicting any curiosity to use nicotine.

Variable	Odds Ratio	95% Confidence Interval	p-value
Female	<b>0.76</b>	<b>0.64–0.90</b>	<b>0.002</b>
Race/ethnicity			
Black	0.99	0.76–1.29	0.952
Latinx	0.89	0.72–1.11	0.316
Other	1.19	0.94–1.51	0.143
Household income			
\$50,000 – \$100,000	1.24	0.99–1.54	0.057
>\$100,000	1.12	0.91–1.39	0.283
Family history of alcohol problems	1.03	0.84–1.28	0.837
Any perceived peer cigarette use	<b>2.78</b>	<b>1.56–4.96</b>	<b>0.001</b>
Easy availability of cigarettes	<b>1.42</b>	<b>1.08–1.88</b>	<b>0.013</b>
No parental rules about cigarette use	<b>1.23</b>	<b>1.01–1.50</b>	<b>0.040</b>
<i>Random Effects: Site and Family ID</i>			

Note: Bolded values are significant. Reference categories: male; White; less than \$50,000; no parent with a history of alcohol problems; no perceived peer cigarette use; hard availability of cigarettes; any parental rules about their child's cigarette use; model fit: Wald  $\chi^2 = 23.25$ ,  $p < 0.01$ .

nicotine, and marijuana use in a national, diverse preadolescent sample. Results highlight the prominent role of peers and parents on substance use attitudes and provide novel insights among youth at an earlier age and in a larger national sample than has been examined in existing literature. Identifying these factors and their associations across sociodemographic subgroups and multiple substance types, when substance use attitudes and behaviors are just beginning to emerge, may help identify important early precursors to substance use.

A key finding from the present study was that perceived peer use and parent-reported availability of substances in the home were associated with significantly greater likelihoods of curiosity to use for both alcohol and nicotine multivariable models. It has been well-documented that youth tend to overestimate the extent to which their peers are using substances (e.g., Eisenberg et al., 2014; Olds and Thombs, 2001). At a developmental stage when youth strive for acceptance and belonging, perceptions of peer norms can influence substance use attitudes and behaviors (Petit et al., 2013). Although peers are a strong social influence within the microsystem during preadolescence, parental influences remain (Bronfenbrenner and Morris, 2006; Kiesner et al., 2010; Van Ryzin et al., 2012). In line with results from the present study, the availability of substances in the home may set expectations about parental norms for substance use (Abar et al., 2014; Zucker et al., 2008). Children whose parents report easy availability of substances in the home are likely aware of the presence of those substances at home and observe their parent's consumption. In turn, this may pique a child's curiosity to use themselves.

Findings from both bivariate and multivariable GLMMs suggest that certain individual-, peer-, and parent-level factors related to substance use attitudes vary by substance type, whereas others are more substance-specific. For example, the nicotine multivariable GLMM indicated that not having parental rules about cigarette use was associated with significantly greater odds of curiosity to use nicotine, but this association was not found in the alcohol model. Results from bivariate analyses examining significant subgroup differences in relation to curiosity to use, perceived peer use, and availability by substance type provide additional evidence for substance-specific and substance non-specific associations. There was consistency in bivariate comparisons for race/ethnicity and household income for parental rules across alcohol, cigarette, and marijuana use. Sex differences for all youth- and parent-reported items showed consistent findings across substance types as well. Being male was associated with greater curiosity to use alcohol and nicotine in both multivariable and bivariate models examined in the present study. Males were also more likely to have curiosity to use marijuana in bivariate comparisons. Given comparable rates of substance use among

male and female adolescents (Miech et al., 2020) and evidence showing that both sexes begin substance use at similar ages (Kuhn, 2015), sex differences in curiosity to use substances was unexpected. It is important for future longitudinal work using the ABCD Study sample to examine if males who report greater curiosity to use alcohol go on to initiate use at higher rates than females. Considering that peers tend to have a stronger influence on substance use in males compared to females (Kiesner et al., 2010), future studies should also assess potential sex differences in peer effects on curiosity to use substances and use behavior.

Our findings on household income and substance use attitudes, both in bivariate and multivariable analyses, are consistent with prior research. In bivariate models, high-income parents had significantly greater odds of reporting easy availability of alcohol compared to low-income parents, but low-income parents reported easier availability of cigarettes, other nicotine, and marijuana. Furthermore, there was a positive association between curiosity to use alcohol and higher household income, which is in line with studies documenting relatively high rates of substance use, especially binge drinking, among higher income youth (Luthar et al., 2018). Interestingly, although higher income youth reported greater curiosity to use alcohol, lower income youth were more likely to report perceived peer substance use across substance types; and although lower income households reported greater availability of cigarettes and marijuana, lower income was associated with a greater likelihood of having made rules prohibiting substance use across all substance types.

Bivariate comparisons between race/ethnicity groups were similar to comparisons by household income. Parents of White youth reported easier availability of alcohol compared to parents of Black youth and also had the highest rates of having not made rules about alcohol use. Parents of Black youth were more likely to report having made rules about their child's alcohol, nicotine, and marijuana use compared to all other race/ethnicity groups. White youth had the highest percentage of curiosity to use alcohol. Taken together, these results may reflect family norms about alcohol use and generally higher rates of alcohol use among White adolescents (Patrick et al., 2013) and White adults (Chartier and Caetano, 2010), especially in contrast to Black individuals (Patrick et al., 2021). These findings may be attributable, at least in part, to families of color displaying a greater extent of substance use-related protective strategies in response to community exposure to substances and disproportionate experiences of negative consequences of substance use (Molina et al., 2012; Schwinn and Schinke, 2014). Black youth in the present study were more likely to report perceived peer use across substance types (except Black versus Other race/ethnicity for alcohol). It is important to note the possible intersecting impact of household income, neighborhood poverty and race/ethnicity. In the U.S., the average White family has eight times the wealth of the average Black family, due in part to disparities in inherited wealth, education, housing, and employment (Bhutta et al., 2020). Additional research that tests direct and indirect effects of race/ethnicity and household income, and social determinants of health impacted by institutionalized racism (e.g., neighborhood, school, and healthcare access factors; National Academies of Science, Engineering, and Medicine, 2017) on substance use attitudes is warranted.

In terms of parental history of alcohol problems, FH+ youth had greater likelihoods of perceived peer cigarette, other nicotine, and marijuana use; parents of FH+ youth reported easier availability of cigarettes, other nicotine, and marijuana. It is interesting to note that neither of these set of findings were significant for alcohol. It is possible that restricting access to alcohol was a protective strategy used by parents who were aware of their family's vulnerability to alcohol. Future studies examining protective strategies in FH+ families, including longitudinal analyses examining the extent to which FH+ parents limit availability of and enforce rules about substance use, may provide useful information on protective factors against substance use.

#### 4.1. Strengths and limitations

A strength of the present study is its focus on 9- and 10-year-old preadolescents. Although some participants from the baseline ABCD Study sample reported early use (e.g., sipping alcohol, taking a puff of a nicotine product or marijuana) and even fewer reported consuming a full drink or more than a puff of a nicotine product or marijuana, the majority were substance naïve (Lisdahl et al., 2021). Results from the present study set the stage for future work that will take a deeper dive into a wider array of dimensions within individual-, peer-, and parent-level influences on substance use once youth in this study begin to display increasing levels of drug and alcohol use. Another strength of the present study is its use of a large, diverse, national dataset that allowed for the statistical power to detect relatively small effects across multiple sociodemographic groups and substance types. A limitation of such large data, however, is determining which effects are not only significant but also clinically meaningful. Further, analyses conducted in the present study did not specifically examine differences by gender identity; as youth enrolled in the ABCD Study transition into adolescence, examining the impact of both sex and gender identity on substance use attitudes and patterns of use is an important future direction (Fish et al., 2021). Furthermore, differences by race/ethnicity should be interpreted with the understanding that race is a social construct and that racial/ethnic categories are heterogeneous on many dimensions (Kaplan and Bennett, 2003).

#### 4.2. Conclusions

The current findings on individual-, peer-, and parent-level domains related to substance use attitudes and behaviors among a diverse, national sample may help to identify risk and protective factors of early substance use. Considering that substance-related curiosity prior to the onset of use is an important risk factor for later experimentation (Guo et al., 2012; Lee et al., 2007), and that results from the present study indicate a subset of youth across all included sociodemographic groups are beginning to show curiosity to use substance by age 9 and 10 years old, it may be informative for prevention efforts to focus on supporting and strengthening protective parental monitoring, household rules, and refusal skills in preadolescence. Additionally, findings highlight the importance of educating parents about substance availability in their home and indicate that targeting perceptions of peer substance use, especially educating youth on more accurate rates of peer use, may be a useful prevention strategy. Indeed, prevention and intervention strategies that address the role of family and peers in relation to substance use among youth have been well-validated in prior work (e.g., D'Amico et al., 2005; Schuler et al., 2019). Furthermore, this work supports the need for more individualized prevention and intervention programs that account for possible sociodemographic subgroup differences in substance use attitudes and behaviors.

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#### Declaration of Competing Interest

No conflicts declared

#### CRedit authorship contribution statement

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#### Supplementary materials

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