Published in final edited form as:

Drug Alcohol Depend. 2016 July 1; 164: 172–178. doi:10.1016/j.drugalcdep.2016.05.006.

Childhood weight status and timing of first substance use in an ethnically diverse sample

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Abstract

Background—We examined associations between weight status during childhood and timing of first cigarette, alcohol, and marijuana use in an ethnically diverse sample.

Methods—Data were drawn from child respondents of the 1979 National Longitudinal Survey of Youth, including 1448 Hispanic, 2126 non-Hispanic Black, and 3304 non-Hispanic, non-Black (White) respondents aged 10 years and older as of last assessment. Cox proportional hazards regression was conducted predicting age at first use from weight status (obese, overweight, and underweight relative to healthy weight) assessed at ages 7/8, separately by substance class, sex, and race/ethnicity. Tests of interactions between weight status and respondent sex and race/ethnicity were also conducted.

Results—Compared to healthy-weight females of the same race/ethnicity, overweight Hispanic females were at increased likelihood of alcohol and marijuana use and overweight White females were at increased likelihood of cigarette and marijuana use. Compared to healthy-weight males of the same race/ethnicity, obese White males were at decreased likelihood of cigarette and alcohol use and underweight Hispanic and Black males were at decreased likelihood of alcohol and marijuana use. Significant differences in associations by sex and race/ethnicity were observed in tests of interactions.

Conclusions—Findings highlight childhood weight status as a predictor of timing of first substance use among Hispanic and Non-Hispanic Black and White female and male youth. Results suggest that collapsing across sex and race/ethnicity, a common practice in prior research, may obscure important within-group patterns of associations and thus may be of limited utility for informing preventive and early intervention efforts.

Keywords

First substance use; Childhood weight status; Sex/gender; Race/ethnicity

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Contributors: Author Duckworth conducted literature searches and authors Duckworth, Doran, and Waldron conducted the statistical analyses. Author Duckworth wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest: None.

1. Introduction

According to recent data (Johnston et al., 2015), approximately 14% of 8th graders (ages 13–14 on average) smoked a cigarette, 27% consumed alcohol, and 16% used marijuana at some point in their lives. Although substance use is increasingly normative over the course of adolescence, consequences of early-onset use are far-reaching. Early drinking and drug use are associated with increased risk of accidental falls, burns, and drownings (Bass et al., 1985; Spirito et al., 1997), physical fighting (Dukarm et al., 1996; Hingson et al., 2001), and risky sexual activities (Tapert et al., 2001). Among longer term consequences, early drinking and drug use are predictive of later problem use, including elevated risk of substance dependence (Grant and Dawson, 1997; Hingson et al., 2006; Robins and Przybeck, 1985).

Identifying predictors of early-onset substance use is critical to inform preventive efforts. However, much literature on predictors of early use predates more recent attention to the obesity epidemic in the U.S. (Ogden et al., 2014), ignoring weight status as a potential risk-factor. This is especially true of research on racial/ethnic minorities, whose rates of smoking, drinking, and marijuana use during adolescence are fast approaching or have surpassed those of Whites (Johnston et al., 2014) and for whom prevalence of obesity is comparatively high. Indeed, current estimates suggest that 22% of Hispanic and 20% of non-Hispanic Black children meet criteria for obesity, relative to 14% of non-Hispanic White children (Ogden et al., 2014).

Although associations between concurrently assessed obesity and use of cigarettes, alcohol, and marijuana are reported in adolescent samples (e.g., Farhat et al., 2010; Fonseca et al., 2009; Ratcliff et al., 2011; Sanderson et al., 2015), few longitudinal analyses have been conducted where temporal primacy of weight status relative to substance use can be achieved. Compared to findings from cross-sectional studies, longitudinal findings suggest small to moderate effects of obesity or overweight status on subsequent smoking with largely nonsignificant effects on later use of alcohol and marijuana (Huang et al., 2013; Lanza et al., 2014; Pasch et al., 2008, 2012). In the single study to predict *timing* of first substance use from weight status, Caria and colleagues (2009) found that girls who were obese or overweight in 5th grade were more likely to initiate smoking through age 18, compared to healthy-weight peers. For males, no significant effect of weight status was observed.

Findings by Caria et al. (2009) highlight sex as a potential moderator of risk associated with weight status, although pooling of data from males and females is typical of analyses published to-date. Such pooling, regardless of reason (e.g., reduced statistical power or desire to generalize more broadly), may obscure important within-group patterns of associations given differences by sex related to substance use and weight status. For example, compared to females, males report earlier use of cigarettes (Harrell et al., 1998), alcohol (Alvanzo et al., 2011), and marijuana (Kosterman et al., 2000). Males also report heavier and more frequent use across most substance classes (Johnston et al., 2014) and demonstrate higher lifetime prevalence of substance use disorder (Brady and Randall, 1999; Kessler et al., 2005). Additionally, in the U.S., males are more likely than females to be

obese or overweight as children, although this pattern is reversed for Black children (Ogden et al., 2014; Wang and Beydoun, 2007).

It is also common for studies linking weight status and adolescent substance use to pool across racial/ethnic group, which may likewise obscure important differences in observed relationships. Compared to non-Hispanic Whites, Black youth report later use of cigarettes (Harrell et al., 1998) and alcohol (Blum et al., 2000) and are at overall reduced risk of substance dependence (Breslau et al., 2006; Muthén and Muthén, 2000). Historically, Hispanic adolescents had lower rates of substance use than non-Hispanic Whites (Blum et al., 2000), but higher than Black youth (Johnston et al., 2010). More recent data suggest that rates of substance use by Hispanic adolescents now exceed those of both non-Hispanic White and Black youth, especially during early adolescence (Johnston et al., 2014). Regarding weight status, as noted, non-Asian minorities account for a disproportionate number of obese children (Ogden et al., 2014).

Preliminary evidence that associations between weight status and substance use differ by race/ethnicity was reported in a recent analysis of the Youth Risk Behavior Survey of high school students. In the only study to stratify by race/ethnicity, Sanderson et al. (2015) reported a number of cross-group variations, although formal tests of differences were not performed. Compared to healthy-weight White females, for example, overweight and obese White females were at increased odds of lifetime smoking and current smoking. Odds of ever smoking and current smoking were also elevated among obese but not overweight White males, relative to healthy-weight White males. Among Hispanic and Black youth, findings were nonsignificant with two exceptions: obese Hispanic females were at increased odds of current smoking with overweight status predictive of early (before age 13) use of marijuana.

In the present study, we extend prior research by examining associations between *childhood* weight status and *timing* of first cigarette, alcohol, and marijuana use, the latter prospectively assessed from early adolescence. Consistent with Sanderson and colleagues (Sanderson et al., 2015), analyses were conducted separately for Hispanic, Black, and White females and males. In addition to testing for differences by sex and race/ethnicity, we examined outcomes associated with obese, overweight, and underweight statuses. Although obese and overweight statuses are often examined as a single category of “obese or overweight” (e.g., Caria et al., 2009; Lanza et al., 2014), stronger negative effects of obesity relative to overweight status have been reported for a number of outcomes associated with early-onset substance use, including peer victimization (Pearce et al., 2002; Sullivan et al., 2006), diminished self-esteem (Franklin et al., 2006; Strauss, 2000), and academic difficulties (Ary et al., 1999; Falkner et al., 2001). To our knowledge, the present study is the first to examine underweight status in the context of adolescent substance use, and the first to examine the moderating roles of sex and race/ethnicity.

2. Material and methods

2.1. Participants

Data were drawn from child samples of the 1979 National Longitudinal Survey of Youth (NLSY79) or *Children of the NLSY* (CNLSY; Bureau of Labor Statistics, 2012b). NLSY79 is a large, nationally-representative sample of 12,686 male and female individuals aged 14–22 years at baseline interview (Bureau of Labor Statistics, 2012a). NLSY79 surveys were conducted annually through 1994 and biennially since 1996. In 1986, biennial assessment of biological children of female participants began. By 2010, 11,504 offspring had participated in at least one of 13 waves of CNLSY. Present analyses were limited to children aged 10 or older as of last survey, when assessments of substance use commenced. Of 8692 offspring aged 10 or older, 6878 (79%) had data available to code onset of substance use and weight status at age 7/8, including 1448 Hispanic, 2126 non-Hispanic Black (Black), and 3304 non-Hispanic, non-Black (White) offspring composing our final sample. Average age at last assessment, when offspring last participated in any of the 13 waves of CNLSY, ranged from 10 to 33 years. Additional sample characteristics are provided in Table 1.

2.2. Measures

2.2.1. Onset of substance use—Cigarette, alcohol, and marijuana use were assessed as part of the Child Self-Administered Supplement (CSAS) and the Young Adult Self-Report (YASR) administered biennially to offspring aged 10–14 and 15 or older, respectively. Offspring completing the CSAS and YASR assessments reported if they had ever used cigarettes, alcohol, and marijuana and if so, their age at first use. For each substance class, offspring reporting prior use were coded positive for ever using and offspring denying use were coded negative. For offspring with multiple reports of age at first use, youngest reported age was coded.

2.2.2. Childhood weight status—Offspring height and weight were assessed as part of Child and Mother Supplement interviews administered biennially through offspring age 14. Body mass index (BMI) was calculated at age 7 or 8 and thus prior to pubertal onset for most children (Lee et al., 2001). Mother report was analyzed for approximately 14% of offspring whose height and/or weight were not directly assessed. Age- and sex-specific BMI percentiles were based on CDC 2000 growth charts (Kuczmarski et al., 2002). Consistent with CDC designations, three dummy variables were coded for obese (BMI at/above 95th percentile for age and sex), overweight (at/above 85th and below 95th percentiles for age and sex) and underweight (below 5th percentile for age and sex), with healthy-weight children (at/above 5th and below 85th percentiles for age and sex) comprising the reference group.

2.2.3. Control variables—Socio-demographic characteristics predictive of both childhood obese/overweight statuses and early substance use were modeled in covariate-adjusted analyses. Dummy variables were coded for mothers who dropped out of high school and mothers completing any college, with high school only comprising the reference group. Dummy variables for maternal first childbirth prior to age 20 and after age 34 were coded, with mothers giving birth between ages 20 and 34 comprising the reference group.

Because family disruption has been identified as a risk factor for early-onset substance use (Hoffmann and Johnson, 1998; Waldron et al., 2014) and childhood obesity (Chen and Escarce, 2010), dummy variables for offspring residing with one biological parent and offspring residing with neither biological parent were coded in reference to offspring residing with both parents at ages 7/8.

2.3. Analytic strategy

Survival analysis was conducted to predict both likelihood and timing of first substance use, separately by substance class (cigarettes, alcohol, and marijuana). Survival analyses were performed in STATA version 13 (StataCorp, 2013). As part of preliminary analyses, cumulative failure curves of substance use were estimated using the Kaplan-Meier (KM) survivor function (Kaplan and Meier, 1958), with log-rank tests of differences by sex and race/ethnicity. Multinomial logistic regression was employed to examine differences in weight status by sex and race/ethnicity.

Cox proportional hazards (PH) regression (Cox, 1972) was conducted predicting onset of substance use from childhood weight status. For each substance class, Cox models were estimated separately for Hispanic, Black, and White females and males, without and with adjustment for covariates. Thus, for each substance class, 12 Cox models were estimated—6 each for females and males. In subsidiary analyses, interactions between weight status and sex and race/ethnicity were modeled without covariate adjustment. Interactions with sex were modeled pooling across sex, stratified by racial/ethnic group; interactions with race/ethnicity were modeled pooling across race/ethnicity, stratified by offspring sex.

For all Cox models, the Huber-White estimator was used to control for non-independent family data, with the Efron approximation (Efron, 1977) applied for survival ties. The Grambsch and Therneau test of Schoenfeld residuals (Grambsch and Therneau, 1994) was employed to examine potential violation of the PH assumption. A PH violation would be evidenced if the effect of weight status on timing of substance use varied for different age or risk periods. Following Cleves et al. (2004), interactions between age and predictor variables were modeled to correct observed PH violations. Where there was no violation in PH, risk periods were collapsed.

3. Results

There were significant differences in timing of first substance use by offspring sex and race/ethnicity (see Table 1). Within racial/ethnic group, earlier initiation of all substance classes was observed for Hispanic and Black males compared to females (log-rank tests, $p < 0.05$); earlier marijuana use was observed for White males compared to females (log-rank tests, $p < 0.000$). Relative to White females, Hispanic females reported earlier use of marijuana (log-rank tests, $p = 0.003$) with Black females reporting later cigarette, alcohol, and marijuana use (log-rank tests, $p < 0.05$). Relative to White males, Hispanic males reported earlier use of both cigarettes and marijuana (log-rank tests, $p < 0.05$), with Black males reporting later alcohol but earlier marijuana use (log-rank tests, $p < 0.05$).

Differences in weight status by offspring sex and race/ethnicity were also observed (see Table 1). Within racial/ethnic group, proportionally more Black females were obese at ages 7/8 compared to males ($X^2_1 = 4.57, p = 0.03$), whereas more White males were obese compared to females ($X^2_1 = 8.62, p = 0.003$). Compared to White females ages 7/8, Hispanic females were more likely to be obese ($X^2_1 = 13.32, p = 0.0003$) as were Black females ($X^2_1 = 52.54, p < 0.001$). Similarly, compared to White males ages 7/8, Hispanic males were more likely to be obese ($X^2_1 = 7.99, p = 0.005$) as were Black males ($X^2_1 = 5.20, p = 0.02$). Differences by race/ethnicity in likelihood of overweight status were nonsignificant.

3.1. Cox proportional hazards analyses

Results of Cox analyses predicting timing of first substance use from childhood weight status are presented in Tables 2 and 3 for females and males, respectively. Results are presented as Hazard Ratios (HR), with $HR > 1$ indicating an increased likelihood of use or *earlier* first use associated with a given weight status relative to healthy-weight peers, and $HR < 1$ indicating a reduced likelihood of use or *delayed* first use. $HR = 1$ indicates no difference in timing of first substance use. Below we summarize findings by substance class.

3.1.1. Cigarette use—Associations between childhood weight status and timing of first cigarette use were nonsignificant among Hispanic and Black females and males. Among White females, overweight status was associated with a 24% increased likelihood of cigarette use, compared to healthy-weight peers; controlling for maternal education, maternal age at first birth, and family structure, overweight status predicted a 21% increased likelihood of cigarette use. Obesity did not predict cigarette use among White females. However, among White males, through age 13, obesity was associated with a 26% decreased likelihood of cigarette use in adjusted analysis. Note that separate risk periods of birth through age 13 and from age 14 onwards were modeled to correct a PH violation.

In subsidiary analyses modeling interactions between weight status and respondent sex, a significant interaction was observed among White youth. Compared to healthy-weight peers, overweight status predicted earlier smoking by White females relative to males ($HR = 1.43$ [95% CI: 1.09–1.88]). Interactions between weight status and race/ethnicity, examined separately for males and females, were nonsignificant.

3.1.2. Alcohol use—Effects of weight status on timing of first drink were nonsignificant for females with one exception: among Hispanic females, overweight but not obese status was predictive, associated with a 45% and 29% increased likelihood of using alcohol in unadjusted and adjusted analyses, respectively, compared to healthy-weight peers. Through age 12, underweight status was associated with a 46% decreased likelihood of drinking by Hispanic males, an effect that reduced only slightly in adjusted analyses. Among Black males, underweight status was associated with a 22% decreased likelihood of alcohol use in covariate-adjusted analyses, again through age 12. Among White males, obesity predicted an 18% decreased likelihood of alcohol use, compared to healthy-weight peers, with a similar pattern observed in adjusted analyses.

In subsidiary analyses, significant interactions between weight status and respondent sex were observed. Compared to healthy-weight peers, obesity predicted earlier drinking by White females relative to males ($HR = 1.48$ [95% CI: 1.16–1.90]). Through age 10, underweight status predicted earlier drinking by Hispanic females relative to males ($HR = 2.41$ [95% CI: 1.03–5.66]); the same pattern was observed among Black youth, but without age interaction ($HR = 1.35$ [95% CI: 1.03–1.77]). A significant interaction between race/ethnicity and weight status was also found. Compared to healthy-weight peers, overweight status predicted earlier drinking by Hispanic females relative to White females ($HR = 1.45$ [95% CI: 1.09–1.41]).

3.1.3. Marijuana use—Among Hispanic females, through age 11, overweight status was associated with a 2.43 times and 2.16 times increased likelihood of using marijuana relative to healthy-weight peers in unadjusted and adjusted analyses, respectively. Among White females, overweight status was associated with a 32% increased likelihood of using marijuana, reducing only slightly in adjusted models. For neither females nor males was obesity predictive of marijuana use. Through age 14, underweight status was associated with a 49% and 46% decreased likelihood of using marijuana among Hispanic males and Black males, respectively. In analyses adjusting for socio-demographic variables, underweight status was associated with a 26% decreased likelihood of using marijuana by Hispanic males.

In subsidiary analyses, we observed a number of significant interactions between weight status and sex. Compared to healthy-weight peers, overweight status predicted earlier use of marijuana by White females relative to males ($HR = 1.54$ [95% CI: 1.14–2.07]). Through age 12, underweight status predicted earlier use of marijuana by Hispanic females relative to males ($HR = 2.27$ [95% CI: 1.22–4.20]). Significant interactions between weight status and race/ethnicity were observed among males. Compared to healthy-weight peers, overweight status predicted earlier use of marijuana among Black relative to White males ($HR = 1.40$ [95% CI: 1.01–1.95]). Underweight status predicted later marijuana use among Hispanic relative to White males ($HR = 0.65$ [95% CI: 0.46–0.94]).

4. Discussion

The present study is the first to examine *timing* of first substance use as a function of *childhood* weight status and the potential moderating roles of sex and race/ethnicity. With data drawn from a national longitudinal sample, we predicted age at first cigarette, alcohol, and marijuana use from obese, overweight, and underweight statuses assessed at ages 7 or 8. Although we found the overall effects of weight status on first substance use were relatively small in magnitude, different patterns of risk emerged for females and males of Hispanic, Black, and White race/ethnicity.

For Hispanic and Whites females, overweight but not obese status predicted *earlier* onset substance use compared to healthy-weight peers of the same race/ethnicity. Being overweight as a child was associated with earlier alcohol and marijuana use among Hispanic females, and earlier smoking and marijuana use among White females. A significant interaction between race/ethnicity and overweight status suggested further increased risk to

Hispanic relative to White females for early drinking. For Black females, we found little to no effect of obesity or overweight status on timing of first substance use. Effects of underweight status were nonsignificant for all groups and across all substance classes.

A different pattern of findings was observed for males, where unhealthy weight status appeared protective against initiation, that is, associated with *delayed* onset of substance use. Among White males, obesity predicted later cigarette and alcohol use compared to healthy-weight peers. Among minority males, underweight status was especially predictive of delayed initiation. Underweight status was associated with later use of alcohol and marijuana among both Hispanic and Black males, compared to healthy-weight males of the same race/ethnicity. Significant interactions by race/ethnicity were also found specific to marijuana use, such that overweight status predicted earlier use by Black males, and underweight status predicted later use among Hispanic males, relative to White males.

Given that Hispanic, Black, and White youth differ in risks related to adolescent substance use (e.g., Harrell et al., 1998; Johnston et al., 2014) and childhood weight status (Ogden et al., 2014; Wang and Beydoun, 2007), it is perhaps not surprising that we observed wide variation in associations across groups. In the only study to examine weight status and adolescent substance use separately by sex and race/ethnicity, Sanderson et al. (2015) found, in a cross-sectional sample, that unhealthy weight status predicted increased odds of substance use primarily among White males and females. In our study, significant effects of weight status were also observed for Hispanic females and both Hispanic and Black males, although direction of effects differed as a function of weight status and offspring sex.

While underlying mechanisms are unknown, observed differences by sex might reflect variable associations with pubertal timing. Although early-onset puberty increases risk for substance use by female and male adolescents (Costello et al., 2007; Lanza and Collins, 2002; Westling et al., 2008), obesity predicts earlier puberty among females but not males (Ahmed et al., 2009; Biro et al., 2006). Thus it's possible that early-onset puberty helps to explain associations between overweight status and early substance use observed of females only. Future research that includes measures of pubertal timing represents an important extension of our work and will be the focus of follow-up studies.

Differential patterns in peer relationships associated with unhealthy weight in childhood might also play a role. Among the more immediate psychosocial consequences of childhood obesity are peer teasing, rejection, and victimization (Strauss and Pollack, 2003), which may limit social opportunities for males of unhealthy weight to access and engage in substance use. Limited opportunities may in turn result in a pattern of delayed use, especially for males at the extreme end of the weight spectrum (i.e., obese and underweight) who may be more vulnerable to negative psychosocial outcomes.

Among females, increased risk of substance use was observed for overweight but not obese females. Although obese and overweight females are also at increased risk for peer rejection and bullying (Pearce et al., 2002), it is possible that overweight girls are more vulnerable to negative peer influences, including affiliation with delinquent peers, who may provide increased opportunities for substance use. Because obese females are more likely to report

negative psychosocial outcomes than overweight females (Janssen et al., 2004), overweight females may experience (relatively) less social distress, more peer acceptance, and therefore increased opportunities to affiliate with delinquent peers compared to their obese peers.

Differences likely also arise from complex socio-cultural attitudes about health behavior. Among Hispanic youth in the U.S., positive associations between levels of acculturation and adolescent substance use (Szapocznik and Coatsworth, 1999) as well as childhood obesity (Caprio et al., 2008) are well-documented. Recent research also suggests that the impact of acculturation on adolescent substance use may be more pronounced for Hispanic females than males (Lara et al., 2005), placing overweight Hispanic females at potentially greater risk. At the same time, attitudes toward obese and overweight peers are generally less negative among Black females than other groups (Latner et al., 2005) and, unlike Hispanic and White females, self-esteem shows little to no association with weight status (Strauss, 2000).

Additionally, differences by sex and race/ethnicity may be specific to certain substance classes. For example, cigarette smoking as a weight-loss strategy has been reported by adolescents in several studies (e.g., Harakeh et al., 2010), with more females than males endorsing weight-loss motives (Paxton et al., 1991), but fewer Black than White females (Fulkerson and French, 2003). Research examining the roles of correlated health-risk behaviors, including diet and exercise, may provide additional insight into mechanisms linking weight status and early-onset substance use.

Clearly, there is a need for additional research to elucidate underlying processes, pubertal, social, and otherwise. Incorporating a culturally sensitive framework, such as the Ecodevelopmental Theory (Szapocznik and Coatsworth, 1999) to examine how attitudes and behaviors are impacted over time by sex, race/ethnicity, and their interaction with weight status may help to shed light. While the present study is primarily descriptive, research on causal mechanisms, which may operate differently for females and males of different racial/ethnic groups, is a research priority.

4.1. Limitations and conclusion

Although ours is the only study of childhood weight status and timing of first substance use, findings should be considered in light of limitations beyond currently unmeasured causal mechanisms. First, our measure of BMI (from which weight status was derived) was limited to a single assessment at age 7 or 8. Weight status at first substance use was not examined, nor was change in weight status across childhood (c.f., Huang et al., 2013). Analyses that incorporate change in weight status through adolescence would advance this line of research. Regarding substance use, we did not examine substance *misuse*, focusing instead on risk associated with first use. Weight status has been linked to substance use disorder but in predominantly adult samples (Barry and Petry, 2009; Duncan et al., 2009). Unfortunately, CNLSY has limited assessment of age at onset of problem use regardless of substance class.

Our study also does not address potential differences *within* racial/ethnic groups, particularly among Hispanic youth whose risk of obesity and of early-onset substance use might vary widely as a function of acculturation and nativity. Findings are thus broadly representative of

American-born Hispanic, Black and White youth. Additionally, although our overall sample size was relatively large, power for modeling interactions between weight status and both sex and race/ethnicity was limited given more moderately sized sub-samples of Black and Hispanic female and male respondents.

Despite limitations, our study addresses a gap in the literature, namely the influence of childhood weight status on timing of first substance use. Our findings thus contribute to a growing literature on the relationship between these two important health-risk behaviors. Results underscore the importance of taking both sex and race/ethnicity into account, with implications for preventative efforts. Given that Hispanics represent the fastest growing minority group in the U.S. (Ennis et al., 2011), increased risk of early substance use among Hispanics is especially concerning. Females, particularly Hispanic females, who were overweight as children may especially benefit from early screening and education with the goal of delaying substance use and ultimately reducing risk of problem use.

Acknowledgments

Role of funding sources: Funding for this study was provided by NIDA grant DA023696. NIDA had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication.

Acknowledgements We wish to thank the NLSY respondents and their families.

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Table 1

Sample characteristics, by offspring sex and race/ethnicity.

	Female				Male			
	Hispanic <i>n</i> = 689	Black <i>n</i> = 1079	White <i>n</i> = 1637		Hispanic <i>n</i> = 759	Black <i>n</i> = 1047	White <i>n</i> = 1667	
Age at last interview, <i>M</i> (<i>SD</i>)	22.23 (5.44)	23.17 (5.26)	20.88 (5.67)		22.39 (5.19)	22.79 (5.38)	20.75 (5.59)	
<i>Substance use</i>								
Alcohol use, <i>n</i> (%)	570 (82.7)	892 (82.7)	1248 (76.2)		644 (84.9)	857 (81.9)	1271 (76.3)	
Age at onset, <i>M</i> (<i>SD</i>)	14.32(3.36)	14.70 (4.09)	13.90 (3.39)		13.65 (3.46)	13.89 (4.15)	13.33 (3.82)	
Cigarette use, <i>n</i> (%)	381 (55.3)	504 (46.7)	845 (51.6)		503 (66.3)	621 (59.3)	919 (55.1)	
Age at onset, <i>M</i> (<i>SD</i>)	14.13 (3.47)	14.05 (4.40)	13.36 (3.44)		13.87 (3.97)	13.75 (4.05)	13.42 (3.87)	
Marijuana use, <i>n</i> (%)	331 (48.0)	420 (38.9)	645 (39.4)		484 (63.8)	600 (57.3)	790 (47.4)	
Age at onset, <i>M</i> (<i>SD</i>)	15.04(2.85)	15.80 (3.15)	15.29 (2.57)		14.65 (3.02)	14.90 (3.23)	15.18 (2.80)	
<i>Childhood weight status, n (%)</i>								
Obese	108 (15.7)	223 (20.7)	176 (10.8)		138 (18.2)	181 (17.3)	235 (14.1)	
Overweight	101 (14.7)	138 (12.8)	219 (13.4)		97 (12.8)	149 (14.2)	222 (13.3)	
Healthy weight	402 (58.4)	600 (55.6)	1074 (65.6)		434 (57.2)	623 (59.5)	1042 (62.5)	
Underweight	78 (11.3)	118 (10.9)	168 (10.3)		90 (11.9)	94 (9.0)	168 (10.1)	
<i>Control variables</i>								
<i>Maternal education, n (%)</i>								
Less than high school	296 (43.2)	340 (31.6)	307 (18.8)		322 (42.7)	321 (31.7)	318 (19.1)	
High school only	188 (27.4)	351 (32.6)	619 (38.0)		243 (32.2)	355 (34.0)	611 (36.8)	
Some college	202 (29.5)	386 (35.8)	705 (43.2)		189 (25.1)	369 (35.3)	733 (44.1)	
<i>Maternal age at first birth, n (%)</i>								
19 and younger	316 (45.9)	568 (52.6)	399 (24.4)		322 (42.4)	543 (51.9)	405 (24.3)	
20–34	362 (52.5)	506 (46.9)	1194 (72.9)		430 (56.7)	488 (46.6)	1229 (73.7)	
34 and older	11 (1.6)	5 (0.5)	44 (2.7)		7 (0.9)	16 (1.5)	33 (2.0)	
<i>Childhood family structure, n (%)</i>								
One parent	261 (37.9)	630 (58.4)	546 (33.4)		291 (38.3)	612 (58.5)	476 (28.6)	
Both parents	424 (61.5)	432 (40.0)	1074 (65.6)		458 (60.3)	416 (39.7)	1167 (70.0)	
Neither parent	4 (0.6)	17 (1.58)	17 (1.0)		10 (1.3)	19 (1.8)	24 (1.4)	

Table 2

Hazard Ratios [and 95% Confidence Intervals] from unadjusted and adjusted models predicting onset of substance use from childhood weight status among females, separately by race/ethnicity.

	Hispanic		Black		White	
	Unadjusted <i>n</i> = 759	Adjusted ^a <i>n</i> = 755	Unadjusted <i>n</i> = 1047	Adjusted ^a <i>n</i> = 1046	Unadjusted <i>n</i> = 1637	Adjusted ^a <i>n</i> = 1634
<i>Cigarettes</i>						
Obese	1.19 [0.87–1.62]	1.24 [0.94–1.64]	0.99 [0.78–1.26]	0.98 [0.79–1.22]	1.12 [0.88–1.43]	1.14 [0.90–1.43]
Overweight	1.16 [0.86–1.57]	1.17 [0.89–1.54]	1.02 [0.74–1.40]	1.02 [0.77–1.36]	1.24 [1.01–1.52]	1.21 [1.00–1.47]
Healthy weight	1.00	1.00	1.00	1.00	1.00	1.00
Underweight <13	0.80	1.28 [0.81–2.02]	1.20	1.04	1.08	1.02
Underweight 13	[0.55–1.18]	0.65 [0.40–1.04]	[0.88–1.65]	[0.78–1.38]	[0.85–1.37]	[0.83–1.25]
<i>Alcohol</i>						
Obese	1.08 [0.84–1.39]	1.20 [0.97–1.48]	1.07 [0.91–1.25]	1.03 [0.89–1.20]	1.08 [0.88–1.31]	1.11 [0.92–1.34]
Overweight	1.45 [1.14–1.83]	1.29 [1.04–1.60]	0.94 [0.76–1.16]	0.85 [0.70–1.04]	1.02 [0.86–1.20]	1.05 [0.90–1.22]
Healthy weight	1.00	1.00	1.00	1.00	1.00	1.00
Underweight	1.02 [0.75–1.37]	1.04 [0.79–1.37]	1.12 [0.89–1.41]	1.06 [0.87–1.29]	1.03 [0.86–1.23]	1.04 [0.89–1.21]
<i>Marijuana</i>						
Obese	1.09 [0.80–1.49]	1.13 [0.85–1.51]	1.04 [0.79–1.36]	1.10 [0.86–1.41]	1.09 [0.82–1.44]	1.11 [0.85–1.45]
Overweight <12	2.43 [1.21–4.86]	2.16 [1.11–4.24]	1.28	1.13	1.32	1.29
Overweight 12	1.19 [0.82–1.72]	1.15 [0.82–1.60]	[0.94–1.73]	[0.84–1.51]	[1.07–1.65]	[1.05–1.58]
Healthy weight	1.00	1.00	1.00	1.00	1.00	1.00
Underweight	0.89 [0.61–1.31]	1.01 [0.71–1.42]	0.95 [0.69–1.24]	0.81 [0.57–1.14]	0.92 [0.69–1.24]	0.90 [0.70–1.17]

Note. Bold indicates statistical significance. Where brackets are shown, reported risk is equivalent across risk periods (age in years).

^aControlling for maternal educational attainment, maternal age at first birth, and childhood family structure.

Table 3

Hazard Ratios [and 95% Confidence Intervals] from unadjusted and adjusted models predicting onset of substance use from childhood weight status among males, separately by race/ethnicity.

	Hispanic		Black		White	
	Unadjusted <i>n</i> = 759	Adjusted ^a <i>n</i> = 755	Unadjusted <i>n</i> = 1047	Adjusted ^a <i>n</i> = 1046	Unadjusted <i>n</i> = 1667	Adjusted ^a <i>n</i> = 1664
<i>Cigarettes</i>						
Obese <14	0.95	0.89	0.87	0.87	1.02	0.74 [0.57–0.96]
Obese 14	[0.73–1.24]	[0.70–1.13]	[0.67–1.13]	[0.68–1.10]	[0.84–1.25]	1.03 [0.80–1.33]
Overweight	1.10 [0.81–1.50]	1.01 [0.78–1.31]	0.93 [0.73–1.19]	1.03 [0.82–1.30]	0.88 [0.71–1.09]	0.82 [0.67–1.01]
Healthy weight	1.00	1.00	1.00	1.00	1.00	1.00
Underweight	0.86 [0.64–1.15]	0.84 [0.64–1.10]	1.06 [0.77–1.45]	1.11 [0.85–1.44]	1.07 [0.86–1.35]	1.00 [0.82–1.22]
<i>Alcohol</i>						
Obese	1.06 [0.86–1.31]	0.96 [0.80–1.16]	0.87 [0.70–1.07]	0.88 [0.74–1.05]	0.82 [0.69–0.98]	0.72 [0.61–0.85]
Overweight <12	1.21	1.08	0.96	0.99	0.98	0.86 [0.65–1.13]
Overweight 12	[0.94–1.55]	[0.86–1.35]	[0.78–1.18]	[0.81–1.22]	[0.93–1.15]	1.06 [0.88–1.27]
Healthy weight	1.00	1.00	1.00	1.00	1.00	1.00
Underweight <13	0.54 [0.37–0.78]	0.56 [0.36–0.88]	0.79	0.78	0.94	0.92
Underweight 13	1.32 [0.95–1.84]	0.96 [0.77–1.18]	[0.62–1.00]	[0.64–0.95]	[0.78–1.14]	[0.78–1.08]
<i>Marijuana</i>						
Obese	0.94 [0.71–1.25]	0.90 [0.70–1.17]	0.85 [0.65–1.10]	0.86 [0.68–1.08]	0.88 [0.70–1.12]	0.82 [0.66–1.02]
Overweight	1.18 [0.89–1.58]	1.04 [0.80–1.35]	1.16 [0.92–1.48]	1.19 [0.95–1.51]	0.83 [0.66–1.04]	0.81 [0.66–1.00]
Healthy weight	1.00	1.00	1.00	1.00	1.00	1.00
Underweight <15	0.51 [0.32–0.82]	0.74	0.54 [0.30–0.95]	0.89	1.15	1.09
Underweight 15	1.14 [0.78–1.67]	[0.57–0.96]	1.26 [0.83–1.90]	[0.68–1.17]	[0.92–1.45]	[0.89–1.33]

Note. Bold indicates statistical significance. Where brackets are shown, reported risk is equivalent across risk periods (age in years).

^aControlling for maternal educational attainment, maternal age at first birth, and childhood family structure.