Title: Adherence to gender-typical behavior and high frequency substance use from adolescence into young adulthood

Authors:
Andra L. Wilkinson[1,2]
Paul J. Fleming[2,3]
Carolyn Tucker Halpern[1,2]
Kathleen Mullan Harris[2,4]

[1] Department of Maternal and Child Health, University of North Carolina at Chapel Hill
[2] Carolina Population Center, University of North Carolina at Chapel Hill
[3] Department of Health Behavior, University of North Carolina at Chapel Hill
4 Department of Sociology, University of North Carolina at Chapel Hill

Corresponding author:
Andra L. Wilkinson
Department of Maternal and Child Health
University of North Carolina, Chapel Hill, NC USA
Chapel Hill, NC 27599-7440
(tel) 720-394-1660
wilkina@live.unc.edu

Short Abstract
Objectives: Explore associations between adherence to gender-typical behavior and substance use from adolescence into adulthood.
Method: Using data from the National Longitudinal Study of Adolescent to Adult Health, we used multinomial logistic regression of high frequency substance use on adherence to gender-typical behavior.
Results: Cross-sectional relationships show that adherence to gender-typical behavior is associated with greater risk of high frequency substance use for males in adolescence, emerging and young adulthood and less risk of substance use for females in emerging and young adulthood. Longitudinal relationships indicate that adolescent adherence to gender-typical behavior is associated with adult substance use but adherence in emerging adulthood is not.
Conclusions: Males who adhere to male-typical behavior are at higher risk of high frequency substance use and females who adhere to female-typical behavior are at a lower risk of high frequency substance use. The results indicate that adolescence is a more sensitive period than emerging adulthood for the salience of gender norms in relation to later substance use behaviors.

Introduction

Most substance use is initiated in adolescence and peaks in emerging adulthood.[1–3] The substance use pattern often begins with alcohol and tobacco use before or early in high school, then may escalate to illegal drug use during high school.[1] According to the 2013 Youth Risk Behavior Survey (YRBS), more than one-third of high school students reported current alcohol use, and smoking marijuana (23.4%) is now more common than smoking cigarettes (15.7%) among adolescents.[4] The quantity and frequency of alcohol and drug use typically peak between 18-25 years of age in the U.S.[1] Substance use in adolescence can have deleterious effects on a wide range of developmental outcomes (e.g., brain development, educational attainment, etc.).[1]

On average, adolescent males use more substances and use them more frequently than females.[1,4] The gender difference starts in middle to late adolescence, with males appearing more likely to engage in regular substance use although females are more likely to accelerate faster than males from initiating use to experiencing problems from use.[1,5] There are numerous potential contributors to this gender difference in sensation seeking and substance use patterns, reflecting complex interactions of biological factors (e.g., brain development, genetic influences, hormonal change) and gender-related socialization processes.[6–9] This paper will focus on socialization.

Risk taking is a key form of demonstrating masculinity for adolescent males. From the constructionist perspective of gender, individual behavior is guided by and continually reinforces gender norms. In this way, male behavior is a tool for demonstrating and reifying the masculine norm that emphasizes dominance, denial of vulnerability, emotional and physical control, etc.[10,11] While this norm is fairly constant over the life course for men, men's behavior to demonstrate their adherence to this norm changes over the life course.[11,12] Where work and economic success are dominant masculine behaviors in adulthood, in adolescence, masculinity is often performed through risk taking.[12] This may be a function of the different expectations for and opportunities available to older and younger men. The former can emphasize dominance by filling the provider role, while the younger man must do this through other means like risk taking. As adolescent males transition to adulthood, there is also evidence that their overall adherence to the masculine gender norm may become more diffuse as their ideological norms about manhood diversify with maturity.[13] Femininity contrasts masculinity by emphasizing general risk aversion, and substance use is in general less relevant for feminine norms than it is for masculine norms.[14]

Indeed, young men are less likely than women to wear bike helmets, more likely to drive recklessly, have more sexual partners, and are less likely to seek health care.[12,15] Further, though men generally perceive they are less susceptible to risk than women, adolescent males have higher rates of unintentional injury and infectious disease compared to adolescent females.[10,12,15] Of course these patterns are not only observed at the individual level but at the social level as well. In prime time television, the male characters are three to seven times more likely to smoke and the publication *Sports Illustrated* – which has a predominantly male readership – has more alcohol and tobacco ads than any other magazine.[15] The pervasiveness of the male risk taking norm at both the social and individual levels could help explain why in one study men ages 19 to 30 reported positive drinking motives such as social and internal reinforcement, whereas females, especially younger ones, reported negative drinking motives such as coping and conformity.[16]

There are also racial and ethnic differences in adolescent substance, gender norms, and risk perceptions. Generally Native Americans report the highest lifetime use of substances, followed

by, in order from most to least, White, Hispanic, Black, and Asian adolescents.[1] However, racial and ethnic differences in substance use can differ substantially by age. A recent study examining racial/ethnic differences in substance use from ages 14 to 32 found substance use prevalence was higher for White respondents than Hispanic and Black respondents and this gap increased from age 16 to 20.[17] Though, the gap narrowed in the 20's as the prevalence of smoking peaked later for Botherlack and Hispanic respondents.[17] Studies of masculine gender norms in men of color have traditionally focused on negative deviance from the norm, for example African American young men exhibiting hypermasculinity through violence.[18] However, a qualitative survey of African American men in the U.S. found masculine beliefs that positively deviated from the norm by valuing responsibility, spirituality, and family.[18] Similarly, studies of risk perceptions have found men of color report higher risk perceptions compared to White men, indicating masculine norms for men of color may be less tied to risk taking.[19]

Prior studies have demonstrated connections between gender measures and substance use patterns. Peralta et al. used the Bem Sex Role Inventory to measure masculine/feminine traits among college students and found support for masculine traits was positively associated with binge drinking, controlling for the sex of the respondent.[20] Similarly, Iwamoto and Smiler, with a small sample of rural youth, found youth support for masculine ideologies using the Conformity to Masculine Norms Inventory were associated with alcohol use for both males and females, though the association was stronger for males.[21,22] Expanding to other substances, Kulis et al. found endorsing masculine dominance as an ideology was associated with drugs use in male middle school students, especially marijuana.[23] Finally, Lengua and Stormshak, using the Bem Sex Role Inventory, found masculinity, as measured, predicted higher substance use problems and femininity predicted lower substance use problems among college students.[24] Some limitations of these studies are cross-sectional designs, non-representative samples, no examination of racial/ethnic differences and using trait or ideology gender measures.

Historically, gender has been frequently conceptualized as a trait (e.g., masculine personality characteristics) or as an ideology (e.g., beliefs and attitudes about the roles of men and women). [25] Trait measures ignore the social dimensions of gender that emphasize that it is not something that individuals *are,* but rather something that they *do* in relation to other people.[26] Ideology measures only capture one aspect of gender – beliefs – and do not always correspond to how individuals behave. While these measures are valuable, they do not necessarily capture developmental and historical changes in gender norms, and may fail to capture how gender influences behavior at an individual level.[12,18] Two prior studies have demonstrated the value of empirically-derived measures of gender based on individual behavior and preferences relative to peers.[27,28] The present study builds on that work by using an empirically-derived behavioral (rather than ideological or trait) measure of gender and testing cross-sectional and longitudinal associations between adherence to gender-typical behavior and high frequency substance use in a diverse, nationally representative U.S. sample. Specifically, we will test four hypotheses: greater adherence to male-typical behavior will be positively associated with high frequency substance for males (1), though the magnitude of the association will decrease at later stages of the life course (2); greater adherence to female-typical behavior will be negatively associated with substance use for females (3); the relationship between adherence to gender-typical behavior and high frequency substance use will be moderated by race (4).

Methods

Sample

Data are from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a nationally representative and racially diverse sample of more than 20,745 adolescents who

were in grades 7-12 in the 1994-95 school year (Wave I). The analysis sample is restricted to the 10,277 respondents subsequently interviewed at ages 18 to 26 (Waves III, 2001-2002) and ages 24 to 32 (Wave IV, 2008-2009), and who had complete data on all variables of interest. Details of the Add Health study and design have been described elsewhere.[29]

Measures

Substance use: We used measures of substance use frequency for alcohol, cigarettes, and marijuana. Answers were continuous or ordinal, and the time frame varied across substances. Binge drinking frequency was assessed as the number of occurrences in the past year, cigarette smoking was the number of days in the past 30, and marijuana use was number of occurrences (Waves I and III) and days (Wave IV) in the past 30 days. To simplify comparisons between substances, we created binary measures of non-normative high frequency use at each wave. To do so, the 'high frequency' threshold for each substance was defined as habitual use (compared to infrequent) and/or where fewer than 20% of respondents reported the frequency, meaning their use was non-normative relative to their peers. For binge drinking, the binary measure captures binge drinking two to three times per month or more in the last year, coded as '1.' For cigarette smoking (referred to in this paper as 'smoking'), the measure captures smoking on five to 30 days in the past 30 days, or once per week or more, coded as '1.' For marijuana use, the measure captures using marijuana twice or more in the past 30 days, coded as '1.' Our ability to capture habitual marijuana use was limited by the relative rarity of this behavior, especially at earlier waves. These measures were consistent between males and females and across all three waves of data. We additionally created a measure of overall substance use that integrated the three high-frequency measures described above. This measure was a categorical variable with eight categories for all possible patterns of high frequency use of one or more substances: (1) none/low frequency, (2) binge drinking, (3) smoking, (4) marijuana, (5) binge drinking and smoking, (6) binge drinking and marijuana, (7) smoking and marijuana, and (8) all three.

Gender-typicality: Using data from respondents interviewed at all four waves of Add Health, we created an empirical measure of adherence to gender-typical behavior (AGB).[30] This captures the degree to which respondents' reported behaviors are concordant with those of other Add Health respondents of their same biological sex within a given interview wave (and thus life stage of the Add Health cohort) based on a large pool of behaviors measured at that wave. 'Behaviors' included a range from individual actions (e.g., exercising) to states of being (e.g., getting sad) that were shown to be highly correlated with biological sex. These variables were then used in a logistic regression model to create predicted probabilities of being a biological sex (e.g., for prediction of being a male, a predicted probability of 0.99 indicates a 99% chance of being male and a 1% chance of being female). We excluded behaviors that are unique to one sex, for example experiencing menstruation. None of the substance use measures we use in these analyses were included as items in the AGB measure. The process of developing the measure is similar to the methods used by Cleveland et al. in analyses based on Add Health data, but we included Waves III and IV and a wider range of variables.[27] Additionally, rather than relying on the predicted probabilities, which were extremely skewed, we ranked males and females separately by their adherence scores and used their rank percentile score in our analyses. A higher percentile means greater adherence to the behavior typical of one's own biological sex at a given wave. For example, males with a percentile of 0.95 exhibited strong adherence to male-typical behavior at that wave and females with a percentile of 0.95 exhibited strong adherence to female-typical behavior at that wave.

Controls: From Wave I, respondent's self-identified race/ethnicity (Hispanic and non-Hispanic White, Black, Asian, Native American, and Other) was included as a control in the model, as

was both respondent's (at Waves III and IV) and their mother's (at Wave IV) educational attainment (less than high school, high school graduate, some college, or college graduate or higher) as proxy measures for socioeconomic status. The respondent's age during the wave at which the dependent variable was measured was also included as a control, as the age ranges are fairly wide within waves.

Analysis: We use multinomial logistic regression to obtain relative risk ratios of engaging in high frequency substance use when the AGB score changes from one standard deviation (SD) below the mean to one SD above the mean (i.e., those less adherent to gender-typical behavior compared to those more adherent). To model this meaningful change in the AGB percentile score, we divided the original measure by two standard deviations (0.50) and used this scaled measure in the regression analysis. We tested these associations both within a given wave (cross-sectional associations) and over time--between the AGB percentile in a baseline prior wave with substance use at later waves, or developmental life stages (longitudinal associations), controlling for the baseline wave substance use in a lagged dependent variable design. We also tested moderation of the association between degree of gender typical behavior and substance use frequency by race by interacting race with AGB percentile scores. Regression post-estimation was used to obtain predicted probabilities of high frequency substance use for two SD increases in AGB percentile scores. For all analyses, we stratified by biological sex as we hypothesized the associations would go in opposite directions and this maximized the interpretability of the AGB percentiles. The analyses were weighted to adjust for unequal probability selection into the sample and nonresponse over time. Additionally, we adjusted our variance estimates for clustering at the primary sampling unit and stratification by region. Longitudinal analyses included longitudinal weights so that the model included only individuals with observations at all three data collection time points. We used Stata, version 13.0 (Stata Corp, College Station TX, 2013).

Results

Table 1 outlines the characteristics of the analysis sample. Approximately one third of the analysis sample identifies as non-White. Parent's educational attainment is fairly evenly split with approximately 30% reporting graduating from high school, attending some college, and graduating from college, with the remaining parents not completing high school. Respondent education at ages 24-32 was concentrated at higher educational attainment levels with over 40% reporting some college and an additional 30% roughly reporting graduating from college with about 20% reporting graduating high school and the remaining not completing high school. The mean ages for both males and females were 15 years at Wave I, 21 at Wave III and 28 at Wave IV.

Table 1
Characteristics of the analysis sample

Characteristic	Males (n=4617) n (weighted %)	Females (n=5660) n (weighted %)
Race/Ethnicity (Wave I)		
Hispanic[a]	753 (11.0)	801 (9.5)
Black	778 (11.3)	1251 (14.8)
Asian	355 (3.8)	359 (3.4)
Native American	103 (2.6)	93 (1.8)
Other	42 (0.9)	47 (0.8)
White	2586 (70.4)	3109 (69.8)
Parent Education (Wave I)		
Less than high school	481 (9.1)	692 (10.5)
High school graduate	1073 (25.8)	1424 (27.8)

Some college	1374 (30.7)	1619 (29.1)
College graduate or higher	1689 (34.5)	1925 (32.5)
Respondent Education (Wave IV)		
Less than high school	327 (7.2)	265 (5.6)
High school graduate	778 (18.8)	675 (12.0)
Some college	2021 (42.0)	2490 (44.7)
College graduate or higher	1491 (32.0)	2230 (37.7)
Age (mean (standard error))		
Wave I	15.4 (0.12)	15.2 (0.12)
Wave III	21.9 (0.12)	21.7 (0.12)
Wave IV	28.4 (0.12)	28.1 (0.12)

[a] All other race/ethnicities are non-Hispanic

The prevalence of high frequency substance use behaviors across all waves for males and females are summarized in Table 2. Across all waves, for males and females, low frequency or no substance use was the most common pattern and the second most common pattern is smoking, with the exception of binge drinking for males at Wave III. For males, at Wave I, the next most common pattern was binge drinking (4.5%), at Wave III binge drinking was the most common pattern (13.4%), followed by smoking (11.6%), and at Wave IV, binge drinking falls behind smoking in prevalence (11.3%). For females, the next most common substance use pattern after no/low frequency use and smoking is smoking and marijuana use at both Wave I (4.0%) and Wave III (5.6%), and at Wave IV the second most common pattern becomes binge drinking (6.4%).

Table 2

Weighted percentages of high frequency substance use patterns over time

Use Pattern	Wave I (Adolescence)		Wave III (Emerging Adulthood)		Wave IV (Young Adulthood)	
	Males	Females	Males	Females	Males	Females
None/Low Frequency	71.8	74.6	41.3	57.6	45.7	60.2
Binge drinking	4.5	1.9	13.4	5.4	11.2	6.4
Smoking	9.1	11.6	11.6	18.0	15.0	18.3
Marijuana Use	2.3	2.1	4.9	3.2	3.9	2.6
Binge drinking & Smoking	3.8	2.6	9.2	4.7	9.1	5.6
Binge drinking & Marijuana	1.7	0.9	5.2	2.2	3.1	1.1
Smoking & Marijuana	2.9	4.0	6.5	5.6	6.5	3.9
All Three	3.9	2.3	7.9	3.4	5.6	2.0

The distributions of males and females in the sample at different predicted probabilities of being male at Wave I are presented in Figure 1. In general we see both males and females are present at all predicted probabilities indicating there is variation in the adherence to gender-typical behaviors. Also, the trends for males and females operate in different directions, with the distribution for males skewed towards a higher predicted probability of being male and the distribution for females skewed to lower predicted probabilities of being male.

Figure 1
Distribution of males and females by predicted probability of being male, Wave I

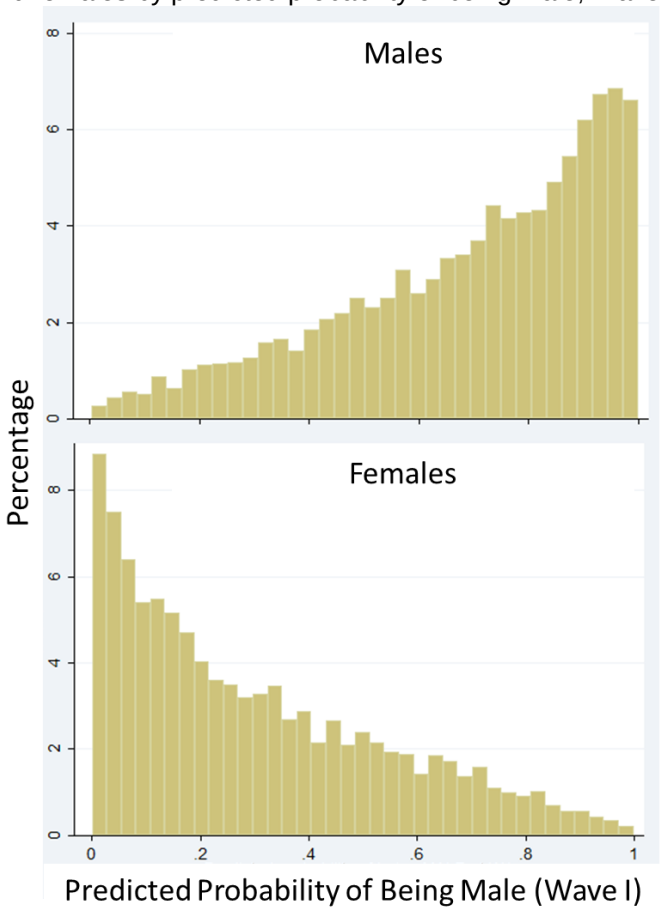

Table 3 outlines the cross-sectional results from multinomial logistic regressions of high frequency substance use patterns on AGB percentiles within the same wave, stratified by biological sex. The cross-sectional associations reveal different patterns for males and females. For males, at all waves, higher percentile scores (i.e., greater adherence to male-typical behavior) are associated with greater relative risk of high frequency substance use. For example, at Wave IV, a man whose percentile score is one SD above the mean of male-typical behavior, compared to a man whose percentile score is one SD below the mean of male-typical behavior, is 123% more likely to report high frequency binge drinking. By comparison, for females, only the cross-sectional associations at Waves III and IV are significant and for nearly all substance use patterns, a higher AGB percentile score (indicating more gender-typical behavior for females) is associated with a lower relative risk of substance use. For example, at Wave IV, a woman whose percentile score is one SD above the mean of female-typical behavior, compared to a woman whose percentile score is one SD below the mean of female-typical behavior, is 50% less likely to report high frequency binge drinking.

Table 3
Relative risk ratios of high frequency substance use for one SD above mean AGB percentiles within the same wave[a]

	Males			Females		
Same Wave Substance Use	Wave I	Wave III	Wave IV	Wave I	Wave III	Wave IV

None/low frequency	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Binge Drinking	2.33***	2.72***	2.23***	1.06	0.63*	0.50***
Smoking	1.83**	1.26	1.56***	1.12	1.08	0.71**
Marijuana	1.86*	1.48*	1.50	0.78	0.61*	0.72
B. Drinking & Smoking	1.83*	2.06***	2.25***	0.90	0.55**	0.64**
B. Drinking & Marijuana	3.35***	4.02***	2.66***	0.73	0.44*	0.35**
Smoking & Marijuana	1.84*	1.61**	2.01**	1.22	0.57**	0.46**
All Three	3.57***	2.84***	3.10***	1.51	0.51*	0.30***

[a] Control variables: Age, race/ethnicity, maternal and respondent education
*p<0.05; **p<0.01; ***p<0.001

In order to test whether race/ethnicity moderated the relationship between AGB percentile scores and high frequency substance use, we added an interaction term of race and AGB percentile score to the cross-sectional regression models above. After the Bonferroni correction for multiple tests, none of the interaction terms were statistically significant or they lacked a sufficient sample size. The predicted probabilities were estimated for Whites and parental education was held at a modal value (college graduation or higher) as was respondent education (some college) with age held at its mean. Figures 2 and 3 below are illustrative examples and show the predicted probability of engaging in high frequency use of all three substances at Wave IV as the AGB percentile score increases from 0 to 1. Figure 2 shows that an increase in the AGB percentile score from the lowest to highest value for males is associated with an increase in the predicted probability from about 5% to 14% of high frequency use of all three substances. Figure 3 shows the same change in the AGB percentile score for females is associated with a decrease in the predicted probability of high frequency use of all three substances from 7% to approximately 2%. The figure for females also displays that females with low female-typical behavior—and thereby high male-typical behavior—have a higher predicted probability of high frequency use of all three substances compared to females with more female-typical behavior.

Figure 2
Predicted probability of high frequency use of all three substances at Wave IV as AGB percentile score increases from its minimum to its maximum, Males

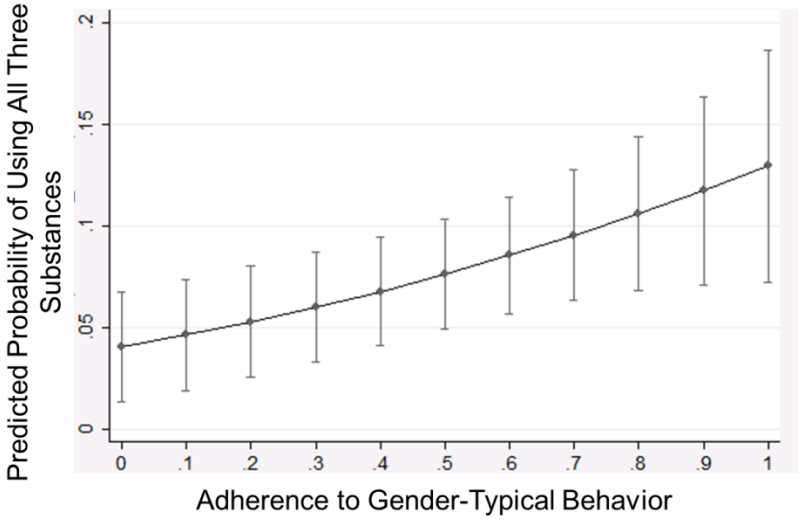

Figure 3
Predicted probability of high frequency use of all three substances at Wave IV as AGB percentile score increases from its minimum to its maximum, Females

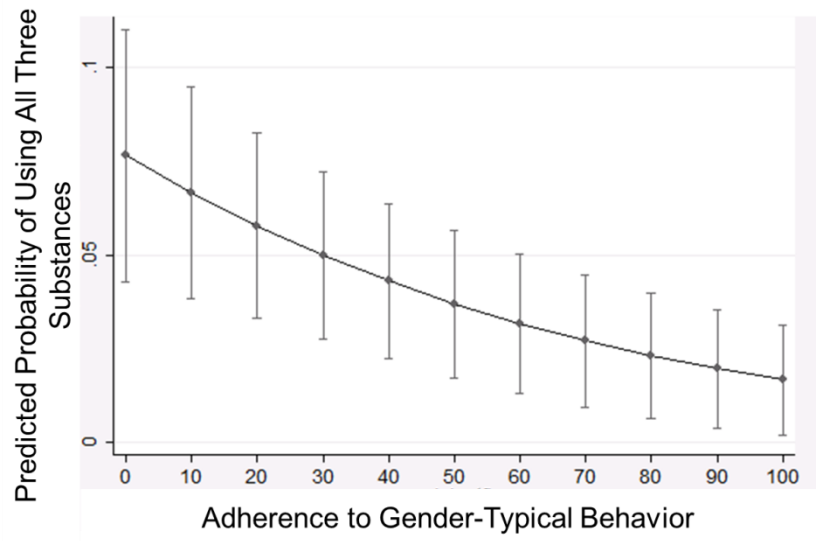

Table 4 presents the longitudinal results from gender-stratified multinomial logistic regressions of high frequency substance use patterns from Wave III regressed on AGB percentiles at Wave I, controlling for substance use at Wave I. Again the patterns vary by biological sex. For males, greater gender-typicality (e.g., an AGB percentile score one SD above the mean) at Wave I is significantly and positively associated with increased risk of all patterns of substance use except high frequency marijuana use and high frequency binge drinking/smoking. By contrast, for females, the Wave I AGB percentile scores are significantly associated only with increased risk of Wave III high frequency binge drinking and marijuana use. This could be a function of the longitudinal models controlling for substance use at a prior wave as the higher risk substance use patterns (e.g., high frequency use of more than one substance), especially at later waves and for females, experience fairly small changes; the relative risk ratios and confidence intervals for these associations are understandably large.

Table 4
Longitudinal relative risk ratios between high frequency substance use at Wave III and AGB percentile scores from Wave I[a]

Wave III Substance Use	AGB (WI)	95% CI	Substance Use[b] (WI)	95% CI
MALES				
None/low frequency	(ref)		(ref)	
Binge Drinking	1.34**	1.02, 1.76	2.31**	1.42, 3.75
Smoking	1.58***	1.17, 2.13	8.63***	5.17, 14.41
Marijuana	1.28	0.86, 1.92	6.91***	3.04, 15.72
B. Drinking & Smoking	1.32	0.94, 1.84	17.11***	7.81, 37.49
B. Drinking & Marijuana	1.82**	1.23, 2.70	26.43***	8.99, 77.74
Smoking & Marijuana	1.95***	1.39, 2.72	22.07***	8.96, 54.36

All Three	1.63*	1.10, 2.41	30.86***	12.81, 74.34
FEMALES				
None/low frequency	(ref)		(ref)	
Binge Drinking	0.83	0.62, 1.12	3.91***	1.90, 8.08
Smoking	0.83	0.66, 1.04	7.68***	5.62, 10.49
Marijuana	0.94	0.64, 1.38	2.29	0.86, 6.13
B. Drinking & Smoking	0.95	0.61, 1.47	10.17***	4.66, 22.17
B. Drinking & Marijuana	0.46*	0.22, 0.95	35.20***	12.76, 97.10
Smoking & Marijuana	0.72	0.49, 1.05	22.75***	11.31, 45.77
All Three	0.78	0.51, 1.18	34.03***	13.88, 83.42

[a] Control variables: Age, race/ethnicity, maternal and respondent education, and prior wave substance use.
[b] These coefficients represent the relationship between use of the same substance at Wave I and Wave III.
*p<0.05; **p<0.01; ***p<0.001

The same longitudinal methods were used to examine relationships between Wave III AGB percentile scores and Wave IV substance use, controlling for Wave III substance use patterns. The results are shown in Table 5. Males who are one SD above the mean AGB percentile score at Wave III, compared to males one SD below the mean, were 54% more likely to engage in high frequency binge drinking at Wave IV. There were no significant relationships for females.

Table 5
Longitudinal relative risk ratios between high frequency substance use at Wave IV and AGB percentile scores from Wave III[a]

Wave IV Substance Use	AGB (WIII)	95% CI	Substance Use WIII)[b]	95% CI
MALES				
None/low frequency	(ref)		(ref)	
Binge Drinking	1.54**	1.14, 2.08	6.03***	4.44, 8.19
Smoking	0.97	0.75, 1.25	17.45***	11.40, 26.70
Marijuana	1.13	0.70, 1.83	26.27***	12.44, 55.47
B. Drinking & Smoking	1.01	0.72, 1.43	30.40***	16.63, 55.56
B. Drinking & Marijuana	1.27	0.70, 2.31	57.89***	26.64, 125.77
Smoking & Marijuana	0.87	0.56, 1.36	118.81***	51.77, 168.2
All Three	1.13	0.70, 1.83	357.54	131.00, 975.80
FEMALES				
None/low frequency	(ref)		(ref)	
Binge Drinking	0.73	0.54, 1.00	4.99***	3.42, 7.29
Smoking	1.20	0.91, 1.58	20.35***	14.70, 28.17
Marijuana	0.99	0.62, 1.60	13.82***	6.79, 28.13
B. Drinking & Smoking	0.80	0.51, 1.24	106.67***	55.23, 206.00
B. Drinking & Marijuana	0.67	0.34, 1.31	210.46***	77.46, 571.82
Smoking & Marijuana	1.13	0.68, 1.89	176.12***	84.69, 366.29
All Three	0.65	0.36, 1.17	282.96***	103.82, 771.22

[a] Control variables: Age, race/ethnicity, maternal and respondent education, and prior wave substance use.
[b] These coefficients represent the relationship between use of the same substance at Wave III and Wave IV.
*p<0.05; **p<0.01; ***p<0.001

Finally, Table 6 displays the results of multinomial logistic regressions testing the longitudinal relationship between Wave I AGB percentile scores and Wave IV high frequency substance use. A male with a Wave I AGB percentile score one SD above the mean, compared to a male who's score is one SD below the mean, has a higher risk of binge drinking and smoking (RRR=1.57, p<0.05), smoking and marijuana (RRR=1.52, p<0.05), and high frequency use of all three substances (RRR=1.75, p<0.05) at Wave IV. Again, there were no significant relationships for females.

Table 6
Longitudinal relative risk ratios between high frequency substance use at Wave IV and AGB percentile scores from Wave I[a]

Wave IV Substance Use	AGB (WI)	95% CI	Substance Use (WI)[b]	95% CI
MALES				
None/low frequency	(ref)		(ref)	
Binge Drinking	1.16	0.88, 1.52	3.80***	2.40, 6.03
Smoking	1.07	0.83, 1.38	7.84***	4.89, 12.57
Marijuana	1.22	0.80, 1.87	7.02***	3.16, 15.59
B. Drinking & Smoking	1.57*	1.10, 2.24	9.65***	4.89, 19.03
B. Drinking & Marijuana	1.05	0.68, 1.64	15.49***	5.92, 40.57
Smoking & Marijuana	1.52*	1.05, 2.20	12.79***	5.36, 30.51
All Three	1.75*	1.14, 2.68	12.18***	5.20, 28.53
FEMALES				
None/low frequency	(ref)		(ref)	
Binge Drinking	1.05	0.77, 1.43	1.64	0.71, 3.76
Smoking	1.05	0.86, 1.28	6.91***	5.16, 9.26
Marijuana	1.33	0.74, 2.39	1.17	0.22, 6.21
B. Drinking & Smoking	0.84	0.57, 1.25	4.33**	1.73, 10.85
B. Drinking & Marijuana	1.38	0.68, 2.79	19.61***	6.30, 61.07
Smoking & Marijuana	0.93	0.58, 1.49	21.33***	9.39, 48.48
All Three	1.07	0.62, 1.85	24.68***	9.01, 67.65

[a] Control variables: Age, race/ethnicity, maternal and respondent education, and prior wave substance use.
[b] These coefficients represent the relationship between use of the same substance at Wave I and Wave IV.
*p<0.05; **p<0.01; ***p<0.001

Discussion

We analyzed the cross-sectional and longitudinal relationships between high frequency substance use and adherence to gender-typical behavior in males and females from a nationally representative longitudinal sample. Broadly, the results indicate increased adherence to gender-typical behavior is associated with an increased risk of high frequency substance use for males

and a decreased risk of high frequency substance use for females, supporting hypotheses one and three. Interestingly, cross-sectional results showed some variation by developmental time period with the association seeming strongest for females during emerging and young adulthood only. For females, there was only one significant longitudinal association from adolescence into young adulthood. This suggests adherence to gender-typical behavior in adolescence (Wave I) is not related to concurrent substance use, but is modestly associated with later substance use in emerging adulthood (Wave III). By comparison, for males, the increased risk associated with male-typical behavior was fairly consistent across the waves, suggesting that – contrary to our second hypothesis – associations are not attenuated as men transition into adulthood. Although the longitudinal association between AGB in emerging adulthood and substance use in young adulthood is smaller in magnitude, some positive and significant associations between adolescent AGB and Wave IV substance use are evident. The significance of these relationships support the salience of Wave I gender adherence on later substance use behavior in young adulthood.[9] Taken together, it appears adolescence is a sensitive period shaping the association between gender adherence and concurrent and later substance use, which makes sense given that gender norms tend to be the most traditional in adolescence and gain fluidity with age.[13,31] Finally, hypothesis four was not supported as there was no significant moderation by race/ethnicity of the relationship between AGB percentile scores and high frequency substance use.

The different results for males and females are supported by gender norms, which seem to have been accurately reflected in the AGB percentile score. Where risk taking, such as substance use, can be an integral part of masculinity, it can be a deviant or coping behavior for females that is misaligned with their gender expression.[12,14–16] The fact that the AGB percentile score generated results similar to past analyses using trait or ideology measures of gender is a testament to its construct validity.[20,21,23,24] The AGB percentile score is also valuable because it captures the dynamic nature of gender and how it can be performed differently as you age and based on your context.[11,12] The items included in the AGB score vary by wave and are included based on the behavior of your same-sex peers in that same wave and so it is capturing gender-typical behavior both at a specific point in development as well as at a point in historical time. This unique feature of AGB allows us to test longitudinal relationships between gender adherence and substance use, which previous studies did not do.

There are two main limitations of the analyses in this study. First, the use of lagged measures of high frequency substance use, the dependent variable, can introduce bias into some models from residual autocorrelation.[32] However, one study using Monte Carlo simulations of several different models demonstrated that lagged dependent variables are usually acceptable in regression models.[32] Also, if bias is introduced into the model by their use, the main result is to bias the effect of the explanatory variables downward, which would decrease our ability to reject the null hypothesis, rather than inflate it. Further, given the addictive nature of many substances, we felt it was critical to include a measure of prior engagement in high frequency use of substances, especially in longitudinal models examining changes in the AGB percentile score predicting changes in substance use. A second limitation of this paper is the insufficient sample of Native Americans and respondents identifying as ‘Other’ races for testing moderation. While Add Health is a large, diverse, and nationally representative sample, our analysis of eight different patterns of high frequency substance use stressed the sample of the smaller racial/ethnic groups. However, we were successfully able to test moderation by Hispanics, African Americans, and Asians, groups which can be under-represented in much research on this topic.

The results of this study inform our understanding of gender and developmental differences in substance use. Substance use seems to be more closely linked to gender expression for males than females, so integrating an understanding of gender norms and their behavioral implications into substance use prevention efforts could help young males navigate the social and peer pressures they may experience to use substances. In a report of evidence-based adolescent drug use prevention strategies, the National Institute on Drug Abuse indeed argues the risk and protective factors influencing individual substance use are unique to the ages, gender, and race/ethnicity of adolescents, and advocates for tailoring prevention strategies accordingly.[33] Though substance use is more prevalent among young males, a trend that may be partially explained by masculine gender norms emphasizing risk taking during adolescence, there is evidence the gender gap in substance use is narrowing.[1,4,12] Further, this study and others have found a relationship between masculine gender role norms and substance use in both male and female adolescents.[20,21] This means integrating an understanding of male gender norms into substance use prevention programs could benefit females who exhibit or endorse masculine behavior as well as males. But, female gender norms would also be a critical addition to the prevention curriculum. Guthrie and Low clearly outlined the dangers of perceiving female gender as solely a protective factor against substance use. Femininity in adolescence is often defined individually and relationally, meaning while a female's own gender ideology may inhibit substance use, the gender norms of her peers or romantic partners may still strongly influence her substance use behavior.[34] There are three main ways to integrate gender into health programming; programs can ignore gender as a unique risk/protective factor (gender-neutral), be sensitive to the differing needs of men and women based on current gender conceptions (gender-sensitive), or aim for gender equality through program activities (gender-transformative).[35] A global review of health programs trying to engage men and boys through differing levels of explicit inclusion and discussion of masculinity found more gender-transformative interventions that directly challenged gender norms were more effective at changing attitudes and behaviors than gender-sensitive programs that simply acknowledged gender norms.[35] In conclusion, adherence to male typical behavior appears to be a risk factor for high frequency substance use from adolescence into young adulthood and prevention efforts should aim to integrate an understanding of gender norms, at a minimum, and ideally aim to break the link between masculinity and substance use, especially during the sensitive adolescent time.

References

1. Chassin L, Hussong A, Beltran I. Adolescent Substance Use. In: Lerner R, Steinberg L, eds. *Handbook of Adolescent Psychology*. John Wiley & Sons, Inc.; 2009:723–764.

2. Chen P, Jacobson KC. Developmental trajectories of substance use from early adolescence to young adulthood: Gender and racial/ethnic differences. *J Adolesc Heal*. 2012;50(2):154–63. doi:10.1016/j.jadohealth.2011.05.013.

3. Arnett JJ. Emerging adulthood: A theory of development from the late teens through the twenties. *Am Psychol*. 2000;55(5):469–480. doi:10.1037//0003-066X.55.5.469.

4. Kann L, Kinchen S, Shanklin S, et al. Youth Risk Behavior Surveillance — United States , 2013. *MMWR*. 2014;63(4).

5. Ridenour T, Lanza S, Donny E, Clark D. Different lengths of times for progressions in adolescent substance involvement. *Addict Behav*. 2006;31:962–983.

6. Romer D. Adolescent risk taking, impulsivity, and brain development: Implications for prevention. *Dev Psychobiol*. 2012;52(3):263–76. doi:10.1002/dev.20442.Adolescent.

7. Campbell BC, Dreber A, Apicella CL, et al. Testosterone exposure, dopaminergic reward, and sensation-seeking in young men. *Physiol Behav*. 2010;99(4):451–6. doi:10.1016/j.physbeh.2009.12.011.

8. Halpern CT, Campbell B, Agnew CR, Thompson V, Udry JR. Associations between Stress Reactivity and Sexual and Nonsexual Risk Taking in Young Adult Human Males. *Horm Behav*. 2002;42(4):387–398. doi:10.1006/hbeh.2002.1831.

9. Rudolph KD. Gender differences in emotional responses to interpersonal stress during adolescence. *J Adolesc Health*. 2002;30(4 Suppl):3–13. Available at: http://www.ncbi.nlm.nih.gov/pubmed/11943569.

10. Courtenay WH. Constructions of masculinity and their influence on men's well-being: a theory of gender and health. *Soc Sci Med*. 2000;50(10):1385–401. Available at: http://www.ncbi.nlm.nih.gov/pubmed/10741575.

11. Connell RW. Hegemonic Masculinity: Rethinking the Concept. *Gend Soc*. 2005;19(6):829–859. doi:10.1177/0891243205278639.

12. Evans J, Frank B, Oliffe JL, Gregory D. Health, Illness, Men and Masculinities (HIMM): a theoretical framework for understanding men and their health. *J Mens health*. 2011;8(1):7–15. doi:10.1016/j.jomh.2010.09.227.

13. Marcell A V, Eftim SE, Sonenstein FL, Pleck JH. Associations of Family and Peer Experiences with Masculinity Attitude Trajectories at the Individual and Group Level in Adolescent and Young Adult Males. *Men Masc*. 2011;14(5). doi:10.1177/1097184X11409363.

14. Byrnes JP, Miller DC, Schafer WD. Gender differences in risk taking: A meta-analysis. *Psychol Bull*. 1999;125(3):367–383. doi:10.1037/0033-2909.125.3.367.

15. Courtenay WH. Key Determinants of the Health and the Well-Being of Men and Boys. 2003:1–27.

16. Cooper ML. Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychol Assess*. 1994;6(2):117–128.

17. Evans-Polce RJ, Vasilenko S a., Lanza ST. Changes in gender and racial/ethnic disparities in rates of cigarette use, regular heavy episodic drinking, and marijuana use: Ages 14 to 32. *Addict Behav*. 2015;41:218–222. doi:10.1016/j.addbeh.2014.10.029.

18. Hammond WP, Mattis JS. Being a Man About It: Manhood Meaning Among African American Men. *Psychol Men Masc*. 2005;6(2):114–126. doi:10.1037/1524-9220.6.2.114.

19. Finucane ML, Slovic P, Mertz CK, Flynn J, Satterfield T a. Gender, race, and perceived risk: The “white male” effect. *Health Risk Soc*. 2000;2(2):159–172. doi:10.1080/713670162.

20. Peralta RL, Steele JL, Nofziger S, Rickles M. The impact of gender on binge drinking behavior among U.S. college students attending a midwestern university: An analysis of two gender measures. *Fem Criminol*. 2010;5(4):355–379. doi:10.1177/1557085110386363.

21. Iwamoto D, Smiler A. Alcohol makes you macho and helps you make friends: The role of masculine norms and peer pressure in adolescent boys’ and girls' alcohol use. *Subst Use Misuse*. 2013;48(5):371–8.

22. Mahalik J, Locke B, Ludlow L, et al. Development of the Conformity to Masculine Norms Inventory. *Psychol Men Masc*. 2003;4(1):3–25.

23. Kulis S, Marsiglia FF, Hecht ML. Gender labels and gender identity as predictors of drug use among ethnically diverse middle school students. *Youth Soc*. 2002;33(3):442–475. doi:10.1177/0044118X02033003005.

24. Lengua LJ, Stormshak E a. Gender, gender roles, and personality: Gender differences in the prediction of coping. *Sex Roles*. 2000;43(11/12):787–820. doi:10.1023/A:1011096604861.

25. Smiler A, Epstein M. Measuring Gender: Options and Issues. In: Chrisler J, McCreary D\, eds. *Handbook of Gender Research in Psychology: Gender Research in General and Experimental Psychology*. New York: Springer; 2010.

26. West C, Zimmerman D. Doing gender. *Gend Soc*. 1987;1(2):125–151.

27. Cleveland HH, Udry JR, Chantala K. Environmental and genetic influences on sex-typed behaviors and attitudes of male and female adolescents. *Personal Soc Psychol Bull*. 2001;27(12):1587–1598. doi:10.1177/01461672012712003.

28. Lippa R, Connelly S. Gender diagnosticity: A new bayesian approach to gender-related individual differences. *J Pers Soc Psychol*. 1990;59(5):1051–1063.

29. Harris KM. *Design Features of Add Health*. Chapel Hill, NC; 2011.

30. Fleming P, Halpern CT. The Role of Adherence to Gender-Typical Behavior in Adult Intimate Partner Violence Perpetration: A Nationally Representative Longitudinal Data Analysis. In: *Population Association of America*. Boston, MA; 2014.

31. Halfon N, Hochstein M. Life course health development: An integrated framework for developing health, policy, and research. *Mibank Q*. 2002;80(3):433–479.

32. Keele L, Kelly N. Dynamic models for dynamic theories: The ins and outs of lagged dependent variables. *Polit Anal*. 2006;14:186–205. doi:10.1093/pan/mpj006.

33. National Institute on Drug Abuse. *Preventing Drug Use among Children and Adolescents*. Washington, DC; 2003. Available at: http://www.drugabuse.gov/publications/preventing-drug-abuse-among-children-adolescents/acknowledgments.

34. Guthrie BJ, Low LK. A substance use prevention framework: Considering the social context for African American girls. *Public Health Nurs*. 2000;17(5):363–373.

35. Barker G, Ricardo C, Nascimento M. *Engaging men and boys in changing gender-based inequity in health: Evidence from programme interventions*. Geneva, Switzerland; 2007. Available at: http://www.who.int/gender/documents/Engaging_men_boys.pdf.