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Does Adolescent Weight Status Predict Problematic Substance Use Patterns?

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Abstract

Objectives—To identify underlying patterns of cigarette smoking, alcohol use, and marijuana use in young adulthood, and ascertain whether adolescent over-weight or obesity status predicts problematic substance use patterns.

Methods—The study included 15,119 participants from the National Longitudinal Study of Adolescent Health (Add Health) at Wave 1 (11-19 years) and Wave 3 (18-26 years). Latent class analysis was conducted.

Results—Participants were classified into a Low Substance Use (35%), Regular Smokers (12%), High-risk Alcohol use (33%), or High Substance Use (20%) class. Over-weight/obese adolescents had a greater likelihood of belonging to the Regular Smokers class.

Conclusions—Overweight/obese adolescents are at higher risk of engaging in regular cigarette smoking without problematic alcohol or marijuana use.

Keywords

adolescence; alcohol; cigarette smoking; marijuana; obesity; young adulthood

There is a wealth of literature highlighting the negative physical (eg, type II diabetes, cardiovascular problems) and psychosocial (eg, depression, low self-worth) consequences of adolescent obesity.[1-3] However, less attention has been given to the role adolescent weight status plays in future health-risk behaviors, such as problematic substance use. With adolescent overweight and obesity rates remaining high (33.6% overweight, 18.4% obese 12-19 years),[4] and substance use more prevalent in young adulthood than any other developmental period,[5] identification of adolescent weight status as a predictor of future problematic substance use behavior is likely to have a significant impact on research and

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Human Subjects Statement

The following study has been approved by the University of California, Los Angeles Institutional Review Board (#10-001106).

Conflict of Interest Statement

None of the authors have conflict of interests pertaining to this study.

clinical work aimed to reduce multiple health risks in the transition from adolescence to adulthood.

Adolescence is a crucial period for prevention efforts aimed to reduce problematic substance use in young adulthood. According to the National Survey of Drug Use and Health,[5] young adults have the highest rates of current tobacco use (39.5% overall including 33.5% cigarette use) and illicit drug use (21.4%), with 19.0% using marijuana in the past month. Binge drinking has been reported for 39.8% and heavy alcohol use for 12.1% of 18- to 25-year-olds. In the past 30 years, many epidemiological longitudinal studies have identified several key risk factors for problematic substance use, including regular cigarette smoking, binge drinking, and marijuana use, in adolescence and young adulthood. Temperament,[6] behavioral disinhibition,[7] externalizing behaviors,[8] poor parental monitoring,[9] lack of parental support,[10] negative peer interactions,[11] and affiliation with deviant peers[12] have been well-established as critical factors involved in the development of problematic substance use.[13-15] Considering the array of risk factors in adolescence contributing to future problematic substance use, it is likely that other health-risk conditions, such as overweight or obesity status, are linked to problematic substance use behavior.

Little is currently known about the relationship between adolescent weight status and future problematic substance use; however, use of an adolescent developmental framework is likely to increase our understanding of why this relationship may be a significant one to address. One explanation may be that a shared underlying factor like impulsivity may explain co-occurring obesity and problematic substance use. As children learn to self-regulate behaviors, those who have difficulties with self-control are more likely to over-consume energydense food contributing to obesity risk[16,17] and engage in antisocial behaviors leading to substance abuse and dependence.[18,19] Although a shared underlying factor explanation is plausible, understanding adolescent behavior without considering the social context is incomplete.

Critical to the discussion on risk-taking behaviors is the knowledge that social standing among peers is a prominent goal for most adolescents. Taking into consideration the important of self-regulation for risk-taking outcomes, Steinberg's social neuroscience perspective on adolescent risk-taking[20] posits that increases in risk-taking are a result of heightened sensitivity to the social context and its rewards (ie, peer acceptance), as well as slower-developing self-regulatory processes linked to rational decision-making. Both failure to be accepted by peers and desire for higher social status may increase vulnerability to risk behaviors, such as substance use. Earlier work by Tajfel and Turner[21,22] highlights why overweight and obese adolescents may be more likely to experience a negative peer context, which increases vulnerability to later risk-taking. As adolescents derive their self-concept from the social group(s) to which they belong, social status is often achieved by behaving in ways that are normative for the group. Adolescents who do not fit the group norm, such as those who are different in physical appearance (eg, obese adolescents), are less likely to be accepted by peers.[23,24] Overweight and obese adolescents are indeed at higher risk for peer alienation and victimization than normal-weight peers.[25-27] Those deviating from the group norm may try to overcome their poor social status by engaging in behaviors (eg, substance use) that will increase status among certain social groups, like deviant peers.[28] They also

may engage in risky behaviors, like substance use, as a way to cope with the negative feelings stemming from poor social status.[29,30]

It appears that overweight and obese adolescents may be experiencing a social context and lack of self-regulation that increases their risk of engaging in problematic substance use as they transition into adulthood. Prior cross-sectional studies have provided tentative evidence that higher weight status in adolescence is related to problematic cigarette smoking and alcohol use. A positive relationship between cigarette smoking and body mass index (BMI) has been reported among early adolescent Danish boys.[31] In a study of Portuguese adolescents, obese girls and boys were more likely to report daily alcohol consumption and frequent drunkenness compared to non-obese adolescents.[32] A study of Taiwanese adolescents also found that girls and boys with higher BMI were more likely than counterparts to report regular alcohol use and cigarette smoking, but not other illicit drugs.[33] Furthermore, findings using a large sample of US adolescents reported that obese girls, but not boys, were more likely to use alcohol and smoke cigarettes, but not marijuana.[34]

Findings from longitudinal studies examining adolescent weight status and substance use are more inconclusive and have mainly focused on tobacco use. A study of early adolescents in the US indicated that obese girls were less likely to initiate tobacco use 2 years later compared to non-obese girls.[35] On the other hand, another US study and a Swedish study found that smoking initiation was more likely among obese girls compared to nonobese girls.[36,37] No significant relationships were found among boys. A recent study using 2 samples of US adolescents indicated that BMI did not predict alcohol or other substance use 2 years later.[38] Similarly, an epidemiological study of rural US adolescents did not find a significant association between obesity trajectory and substance use.[39] The inconsistent results from these longitudinal studies call attention to the need for additional prospective and more comprehensive research.

The current study sought to clarify past findings on adolescent weight status and risk of problematic substance use by utilizing a large sample of US adolescents to identify whether overweight or obesity status in adolescence is a predictor of unique patterns of problematic substance use in young adulthood. To achieve this end, a person-centered approach, latent class analysis (LCA), was utilized to identify unique patterns of problematic substance use by considering responses to multiple items on cigarette smoking, alcohol use, and marijuana use simultaneously. Prediction of adolescent weight status to problematic substance use patterns was then assessed.

METHODS

Participants

The current study used data from The National Longitudinal Study of Adolescent Health (Add Health), consisting of a nationally representative sample of adolescents in grades 7-12 in the US during the 1994-95 school year. Participants were enrolled in 80 high schools and 52 middle schools. During the initial wave of the study, 20,745 adolescents in grades 7-12 (11-19 years of age) participated in both a school survey and in-home interview between April and December 1995. Written informed consent was obtained from both parent and

adolescent. Participants were eligible to participate in the second wave of data collection about one year later (April-August 1996). A third wave of in-home interviews occurred from July 2001 to April 2002, which included 15,197 young adults aged 18-26 years. Information was collected on mental and physical health, health-risk behaviors, and contextual factors related to family, peer, school, and neighborhood.

The analytic sample for the current study included 15,119 of the 15,197 participants interviewed at Wave 3 (young adulthood) during 2001-02; we excluded 78 persons for whom no substance use data were available. Of these 15,119 young adults, 53% were women; 54% White, 21% Black, 15% Latino; 7% Asian; 3% other. The average age of participants at Wave 1 was 16.10 years ± 1.72 and at Wave 3 was 22.47 years ± 1.76. Wave 1 (adolescent) BMI% was available for 97% of the analytic sample, with 25% meeting overweight (14%) or obesity (11%) status. In terms of socio-economic variables, 93% of partic-ipants in the sample reported mother education at Wave 1. Of available data, 20% of mothers received less than a high school education; 34% were high school graduates; 19% completed some college; and 28% completed college or beyond. Also, 75% of parents of participants in the analytic sample completed an in-home interview at Wave 1, including annual household income. Of available data, 29% reported less than $25,000, 33% between $25,000 and $49,999; 23% between $50,000 and $74,999; and 8% between $75,000 and $99,999.

Measures

Individual characteristics—Adolescents were asked to report their sex (1 = female, 0 = male) and race/ethnicity at Wave 1. Ethnicity variables for African-American, Asian, Latino, and white were dummy coded (eg, 1 = African-American, 0 = non-African-American). Adolescents also reported on residential mother's education status at Wave 1 (1 = less than a high school education; 2 = high school grad; 3 = completed some college; 4 = completed college or beyond), which was used as a proxy for SES, given that household income was only available for 75% of participants who had completed parent interviews at Wave 1.

Weight status—At Wave 1 (11-19 years old), adolescents self-reported their height and weight. Self-reported height and weight data have been found to be reliable for 96% of adolescents in the Add Health sample.[40] Height and weight were used to calculate age- and sex-specific BMI [weight(lbs)/[height(in)^2] × 703] percentiles using the Centers for Disease Prevention (CDC) 2000 growth charts.[41] Obesity was defined as having a BMI percentile at or above the 95th percentile, and overweight defined as having a BMI percentile at or above the 85th percentile and below the 95th percentile. Adolescents either meeting overweight or obesity status were combined to create an overweight/obesity indicator (1 = overweight or obese, 0 = non-overweight or obese).

Substance use—At Wave 3 (18-26 years), young adults responses to multiple questions on cigarette smoking, alcohol use, and marijuana use were included in analyses. Five items related to cigarette smoking were selected, which included whether participants had ever: (1) tried cigarette smoking, even just 1 or 2 puffs (0 = no, 1 = yes); (2) smoked an entire cigarette (0 = no, 1 = yes); (3) smoked cigarettes regularly, that is, at least 1 cigarette every

day for 30 days (0 = no, 1 = yes); and (4) smoked at all in the past 30 days (0 = no, 1 = yes). They were also asked (5) how many cigarettes smoked per day in past 30 days, which was recoded into a categorical item (0 = none, 1 = 1, 2 = 2-9, 3 = 10-20, 4 = 20+ cigarettes).

Six items on alcohol use were included in analyses. Participants were asked: (1) whether they had drank more than 2 or 3 times since June 1995 (Wave 1) (0 = no, 1 = yes); (2) days consumed alcohol in the past year (0 = none, 1 = couple times a year, 2 = couple times a month, 3 = 1-2 times a week, 4 = 3-7 times a week); (3) days consumed 5 or more drinks in past 12 months (0 = none, 1 = couple times a year, 2 = once a month or less, 3 = couple times a month/week, 4 = 3-7 times a week); (4) days consumed 5 or more drinks in the last 2 weeks (0 = none, 1 = once, 2 = 2-9, 3 = 10+ times); (5) whether they had been drunk in the past year (0 = none, 1 = couple times a year, 2 = once a month or less, 3 = couple times a month/week, 4 = 3-7 times a week); and (6) whether they had driven while drinking since June 1995 (Wave 1) (0 = no, 1 = yes).

Three items related to marijuana use were also selected for analyses. Participants were asked: (1) whether they had used marijuana since June 1995 (Wave 1) (0 = no, 1 = yes); (2) whether they had used marijuana in the past year (0 = no, 1 = yes); and (3) number of times marijuana consumed in the past 30 days, which was recoded into a categorical item (0 = none, 1 = once, 2 = 2-9, 3 = 10+ times).

Planned Analyses

Latent class analysis (LCA) is used to identify underlying patterns among observed categorical indicators (eg, substance use behaviors) and classify individuals who respond similarly into latent classes.[42-44] LCA is an iterative process using full information maximum likelihood estimation. Using Mplus version 7,[45] model-building steps were taken to select the best-fitting class model of substance use in young adulthood and then ascertain whether adolescent weight status and other individual characteristics predicted membership in particular substance use classes.

Statistical indices, parameter estimates, and practical implications are used to determine the best-fitting model.[43,44,46] The unconditional model is first specified (ie, 1-class model), which is then used as a comparison for an increasing number of classes until the models specified no longer converge or have useful application. Statistical indices, like the Bayesian Information Criterion (BIC)[47] and the LoMendell-Rubin likelihood ratio test (LMR LRT),[48] as well as interpretability of classes are key in determining model selection. Item-response probabilities refer to the likelihood that an individual in a given latent class will endorse a particular item response. They are used to confirm that individuals in each latent class have similar response patterns to the observed indicators and that class response patterns are distinct from each other. After selecting the best-fitting model, covariates are added to the model. Logistic regression coefficients are estimated by setting the beta parameter to 0 for the reference class; thus, providing an estimation of log-odds that indicate an endorsement of a covariate for a certain class relative to the reference class.

Ethnicity, sex, and a proxy for socioeconomic status (maternal education) were included in the covariates analysis in addition to weight status, as each is strongly tied to disparities in

obesity prevalence and substance use risk. Among adolescents, African Americans and Latinos have higher overweight and obesity prevalence than Whites, and boys are more likely to be overweight or obese compared to girls.[4] In young adulthood, men are more likely to use marijuana, cigarette smoking is more prevalent among Whites than African Americans, and Whites and Latinos report more binge drinking than African Americans.[5] Generally, SES indicators like parental education and household income have shown that lower SES is associated with higher weight status,[49] although associations with substance use are mixed.[5]

RESULTS

Descriptive Data

Table 1 compares the average rate of overweight/obese adolescents' substance use in young adulthood to non-overweight/obese adolescents. Across all cigarette smoking indicators, overweight/obese adolescents had higher rates compared to nonoverweight/obese adolescents. In contrast, overweight/obese adolescents had lower rates of highrisk alcohol use compared to non-overweight/obese adolescence. No significant differences were found between groups for marijuana use.

Latent Class Analysis

Model selection—LCA was conducted to identify latent classes of cigarette smoking, alcohol use, and marijuana use in young adulthood. Table 2 presents the statistical fit indices for 5 classes (the 6-class model did not converge). Model selection is generally based on a scree-like test, in which better fitting models are represented where the indices begin to level off.[50] Although the 5-class model had the lowest values in fit criteria, indices began to level off significantly after the 3-class model; consequently, the 3-, 4-, and 5-class models were further explored before selecting a best-fitting model. Examination of parameter estimates identified the 4-class model as best-fitting the data in terms of classifying the underlying heterogeneity of cigarette, alcohol, and marijuana use in the sample. Class probabilities, homogeneity of item-response within classes, and distinct item-response patterns across classes were assessed to determine which model was most interpretable.[43,46] The 3-class model was able to identify a low and a high substance use class, but the third class lacked homogeneity. Two classes in the 5-class model lacked homogeneity and there was a lack of distinctiveness between 2 classes. Figure 1 illustrates the item-response probabilities of each class of the 4-class model. Classes appear homogenous and distinct, and class sizes were found to be substantial as well.

Identified classes—Considering item-response probabilities for each class (Figure 1), classes were identified based on endorsement of substance use behaviors. A little over one-third of the participants (34.7%) reported very low substance use behavior (Class 1; Low Substance Use). Of these, close to 80% stated that they had never smoked an entire cigarette, over 95% stated they had not been drunk or binged on alcohol, and almost 90% had never tried marijuana.

Participants in the Regular Smokers class (Class 2; 12.4%) showed high endorsement of cigarette use, with 96% reporting having been a regular smoker at some point (at least 1 cigarette a day for past 30 days) and all reporting smoking in the past 30 days. Over one-third (38%) smoked 2-9 cigarettes and just over half (52%) smoked 10 or more cigarettes on days smoked in the past 30 days. Similar to the Low Substance Use class, problematic alcohol use was very low. Also, although 40% had tried marijuana since the start of the study, only one-fourth had used marijuana in the past year.

The High-risk Alcohol Use class (Class 3; 32.6%) was characterized by problematic alcohol use but less risky cigarette and marijuana use. Approximately 70% stated they had used alcohol multiple times a month or week in the past year, about 80% indicated they had engaged in binge drinking or been drunk in the past year, and 50% stated they have binged in the last 2 weeks. Also, 35% reported drunk driving. In regards to cigarette and marijuana use, few had ever been regular smokers (16%), and almost none had smoked in the past 30 days. Although 39% reported using marijuana in the past year, less than one-fourth reported using more than once in the last year.

Last, the High Substance Use class (Class 4; 20.2%) represents participants with the highest levels of problematic substance use. Almost all (99%) reported to be regular smokers who smoked in the last 30 days, with over half smoking 10+ cigarettes on days smoked. Over 85% reported drinking multiple times per month or week in the past year, and the majority reported binge drinking and being drunk in the past year (93%) and binge drinking in the past 2 weeks (74%). Over half (55%) stated they had driven drunk. Two-thirds (69%) reported marijuana use in the last year, with 45% using more than once in that period.

Predictors of class membership—Covariates were added to the LCA model to determine whether adolescent weight status predicted particular substance use classes. A covariate model including weight status (overweight or obese), sex, race/ethnicity (African American, Asian, Latino, White), and maternal education was estimated simultaneously using latent multinomial logistic regression (Table 3). Using the Low Substance Use class as a reference class, adolescents meeting overweight or obesity status had a greater likelihood of being classified into the Regular Smokers class ($\beta = .37$, OR = 1.45, $p < .001$) than the Low Substance Use class. Similarly, overweight or obese adolescents were more likely to belong to the Regular Smokers class than the High Substance Use ($\beta = .35$, OR = 1.42, $p < .001$) and the High-risk Alcohol Use ($\beta = .43$, OR = 1.54, $p < .001$) classes.

As for other individual characteristics (see Table 3 for statistical values), women were less likely to be classified into any problematic substance use class compared to the Low Substance Use class. African Americans, Asians, and Latinos were less likely to be classified into the High Substance Use or Regular Smokers classes than the Low Substance Use class, and African Americans and Asians also were less likely to belong to the High-risk Alcohol Use class compared to the Low Substance Use class. On the other hand, Whites were more likely to belong to the High-risk Alcohol Use class compared to the Low Substance Use class. Adolescents residing with mothers with higher education status were more likely to be classified into the High Substance Use and High-risk Alcohol Use classes than the Low Substance Use Class, but were less likely to belong to the Regular Smokers

class than the Low Substance Use class. The covariate analysis also was conducted with annual household income, with results unchanged. Annual household income was not included in the final model because a significant proportion of the sample (25%) did not have household income information, as this information was collected with parent-report at Wave 1.

DISCUSSION

Sole consideration of average group differences of substance use rates give an incomplete picture of the potential risks overweight or obese adolescents face in young adulthood. The average group differences shown in Table 1 suggest that cigarette smoking and alcohol use rates only vary slightly between overweight/obese and non-overweight/obese groups. Statistical, but not clinically meaningful differences, may contribute to a false assumption that weight status is not an important predictor of substance use. However, with the utilization of a person-centered approach, not only were unique patterns of substance use behavior in young adulthood identified, but a more comprehensive assessment of adolescent weight status as a risk factor for problematic substance use was achieved.

Ultimately, the key relationship between higher weight status and problematic substance use points to regular cigarette smoking. Overweight or obese adolescents had a greater likelihood of belonging to the Regular Smokers class in young adulthood than any other class. On the other hand, overweight or obesity status in adolescence did not predict greater likelihood of belonging to the High-risk Alcohol Use of High Substance Use classes; consequently, higher weight status does not appear to be a risk factor for problematic alcohol or marijuana use. Also, given that overweight or obese adolescents did not have a lower likelihood of belonging to the Low Substance Use class vs problematic substance use classes, higher weight status does not appear to lower the likelihood of problematic substance use behavior.

Although the current study clearly indicates that overweight or obese adolescents have a greater likelihood of being a regular smoker in the absence of problematic alcohol or marijuana use compared to non-overweight/obese adolescents, past longitudinal studies have reported mixed findings regarding the role of higher weight status on cigarette smoking.[35-38] Consideration of alcohol use and marijuana use alongside cigarette smoking, and assessment of cigarette smoking behaviors other than smoking initiation, which was a focus of previous studies, increases understanding of the relationship between weight status and cigarette smoking. One of the main questions arising from the current findings pertains to why higher weight status is related specifically to regular cigarette smoking but not other forms of problematic substance use. Although there are many hypotheses linking higher weight status to cigarette smoking, to date, only a handful of studies present evidence on the potential pathways by which higher weight status in adolescence is linked to cigarette smoking. For instance, overweight and obese individuals may initiate cigarette smoking because they perceive it as an effective weight loss strategy.[51,52] Also, perception of being overweight or obese and focus on body size are related to smoking initiation, particularly among adolescent girls.[37,53] In addition to social factors, biological ones also may inform the relationship between higher weight status and regular cigarette smoking. Food and drugs are

known to activate the same neurological pathways containing dopaminergic receptors linked to reward sites in the brain[54,55] that may explain their co-occurrence. For instance, recent studies examining the pathway from cigarette smoking to obesity from adolescence to young adulthood suggest that decreased cigarette smoking is associated with increased weight status.[56,57] The negative relationship between decreased smoking and increased weight status suggest smoking and eating have similar neurophysiological response systems, as noted by other studies.[58,59] For this reason, bidirectional relationships between weight status and cigarette smoking during the transition from adolescent to young adulthood should be explored more fully in future studies.

Other findings from the current study revealed that ethnic and sex differences in substance use membership were generally in line with previous findings. Similar to prevalence rates reported in the National Survey on Drug Use and Health,[5] results showed that African-Americans, Asians, and Latinos were at lower risk of problematic cigarette, alcohol, and marijuana use, and males were at higher risk of belonging to problematic substance use classes. Future research should seek to assess whether ethnicity and/or sex moderates the relationship between higher weight status and substance use, as this is yet unclear. Given that ethnic and sex disparities exist among substance use, as well as obesity status,[4] these differences may influence the degree to which risk behaviors are engaged in by overweight or obese adolescents from specific ethnic and/or sex groups. For instance, if the objective to engage in regular cigarette smoking for overweight or obese adolescents is to lose weight, this relationship may be stronger among white females than other groups, as they are most often subjected to social stigma and other negative social consequences resulting from higher weight status.[60]

Of course, several limitations need to be considered. First, the current study relied on self-reported height and weight to measure BMI% for adolescents. Although measured BMI data is favored over self-report, relatively minor differences in reliability between self-reported and measured BMI data have been reported in adolescence[40,61] and numerous studies have successfully used ADD Health self-reported BMI data.[62-64] Second, it is important to note that weight status was only accounted for at one point in time during adolescence. It is unknown whether adolescents meeting overweight or obesity status at Wave 1 met overweight or obesity status across most or all years of adolescence. Similarly, we expect that some adolescents meeting overweight or obese status at different points in time during adolescence were not accounted for in the analyses. BMI data are available one year after Wave 1 (Wave 2) and 60% of participants meeting overweight or obesity status in Wave 1 also met overweight or obesity status in Wave 2. Third, the study was unable to examine socio-contextual and neighborhood variables that may inform how higher weight status contributes to cigarette smoking risk, such as low peer status or limited neighborhood resources for maintaining healthy weight. Fourth, the variation of age in the sample at each assessment point (eg, 18-26 years at Wave 3 increases the difficulty in interpreting findings as a result of developmental milestones, such as transition to college when high-risk alco-hol use increases substantially.

Acknowledging these limitations, the current study still has important implications for public health efforts aimed to mitigate health-risk behaviors among young adults.

Specifically, emphasis should be placed on decreasing the risk of cigarette smoking in overweight or obese adolescents. Although more research is needed to identify the processes by which adolescent weight status influences cigarette smoking risk, physicians and other health professionals should address smoking risk with overweight or obese adolescents and probe for psychosocial or physiological stressors that may initiate high-risk smoking activity. Adolescents are exposed to many psychosocial stressors as they transition into young adulthood (eg, college, employment, leaving home). Taking on the responsibilities of their own health behaviors may be too difficult for some adolescents already negotiating with significant developmental changes. Overweight and obese adolescents may find themselves dealing with these types of stressors; on top of this they likely may be experiencing social exclusion and victimization. The culmination of risks may contribute to an overweight/obese adolescent's decision to engage in regular smoking behavior as a weight management strategy and/or to decrease anxiety. They may be especially willing to engage in regular cigarette smoking if they believe smoking has similar effects on their physiological state as eating does (eg, feeling calm, pleasure). However, without knowing the health service needs of overweight and obese adolescents, as well as other socio-contextual factors that largely influence obesity risk (physical activity resources, access to and knowledge of healthy nutrition), intervention efforts targeting smoking among overweight or obese youth will not be as effective. Empirical studies that can integrate multiple lines of research on obesity and substance use risk are warranted to answer questions about preventing and treating health risks in this unique population.

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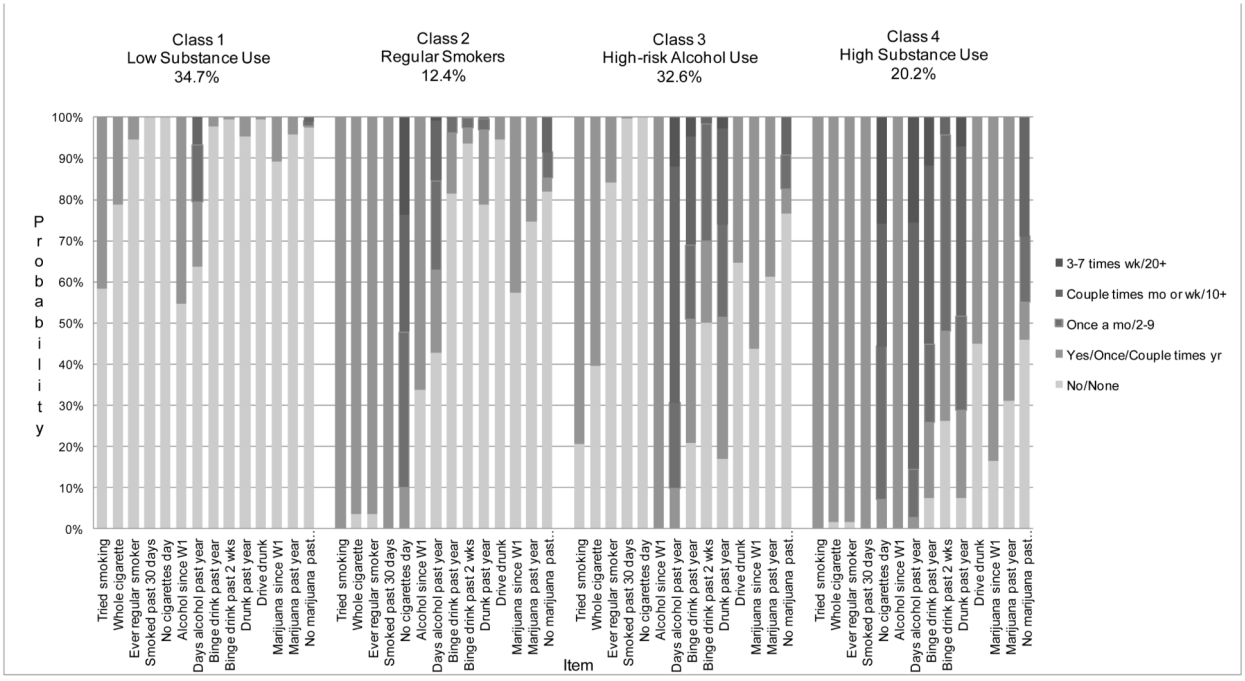

Figure 1. Substance Use Classes in Young Adulthood: Item-response Probabilities

Table 1

Cigarette, Alcohol, and Marijuana Use in Young Adulthood: Overweight/Obese vs. Non-overweight/Obese Adolescents

	Overweight/Obese	Non-overweight/Obese
Cigarette	**%**	
Tried cigarette	74	73
Smoked entire cigarette***	61	59
Smoked regularly***	41	38
Smoked past 30 days***	35	32
No. cigarettes per day (more than 1)***	32	29
Alcohol	**%**	
Drank since W1**	76	78
Alcohol in past year (multiple times per month or week)***	40	46
Binge drink in past year (multiple times per month or week) *	20	22
Binge drink in past 2 weeks*	31	33
Drunk past year (multiple times per month or week***	16	19
Drunk driving***	21	24
Marijuana	**%**	
Marijuana since W1	44	45
Marijuana past year	31	32
No. of times used marijuana in past year(more than once)	18	17

*** **p < .001**

** **p < .01**

* **p < .05**

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Table 2

Latent Class Model Fit Indices (N = 15,119)

Classes	Log Likelihood	Free Parameters	BIC	Adjusted BIC	AIC	LMR LRT p-value for k-1
1	−174995.39	30	350279.49	350184.15	350050.78	N/A
2	−146775.79	61	294138.63	293944.78	293673.58	.000
3	−134435.31	92	269756.00	269463.63	269054.62	.000
4	−128469.95	123	258123.61	257732.72	257185.89	.000
5	−123837.44	154	249156.94	248667.54	247982.89	.000

Note.AIC = Akaike information criterion; BIC = Bayesian information criterion; LMR LRT = Lo-Mendell-Rubin likelihood ratio test.

Table 3

Estimated Odds Ratios (OR) of Class Membership in Relation to Obesity, Sex, Race/ Ethnicity, and Education Indices ased on a Multinomial Latent Class Regression Model

	Reference class: Low Substance Use (Class 1)					
	vs Regular Smokers (Class 2)		vs High-risk Alcohol Use (Class 3)		vs High Substance Use (Class 4)	
	β(SE)	OR(95%CI)	β(SE)	OR(95%CI)	β(SE)	OR(95%CI)
Overweight/ obese vs non-overweight/obese	.37(07)***	1.45(1.26-1.66)	−.06(.05)	.95(.85-1.04)	.02(.06)	1.02(.91-1.15)
Female vs Male	−.20(.06)**	.82(.73-.92)	−.67(.05)***	.51(.46-.56)	−.95 (.06)***	.39(.34-.44)
African American vs. non-AA	−1.23(.18)***	.29(.21-.42)	−1.03(.15)***	.36(.27-.48)	−1.75 (.17)***	.17(.12-.24)
Asian/Pacific Islander vs non-API	−.96(.20)**	.38(.26-.57)	−.58(.16)***	.56(.41-.77)	-.97(.18)***	.38(.27-.54)
Latino vs non-Latino	−1.19(.18)***	.31(.21-.43)	−11(16)	.90(.65-1.23)	−1.08 (.17)***	.34(.24-.47)
White vs non-White	−16(.17)	.86(.61-1.19)	.29(.15)*	1.34(1.003-1.79)	.24(.16)	1.27(.93-1.74)
Higher vs lower mother education	.−.16(.03)***	.85(.80-.90)	.20(.02)***	1.22(1.17-1.27)	.09(.02)***	1.10(1.05-1.14)

*** **p < .001**

** **p < .01**

* **p < .05**