HHS Public Access

Author manuscript

Addict Disord Their Treat. Author manuscript; available in PMC 2019 March 01.

Published in final edited form as:

Addict Disord Their Treat. 2018 March ; 17(1): 29–39. doi:10.1097/ADT.0000000000000120.

Sex and age differences in risk factors of marijuana involvement during adolescence

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Abstract

Objectives—We aimed to examine whether there are sex and age differences in psychosocial risk factors of marijuana use during adolescence.

Methods—Data were drawn from 57,767 adolescents (8th and 10th graders) from the 2012–2013 Monitoring the Future study. We examined the association between socio-demographic and behavioral correlates with different frequencies of past-year marijuana use (non-use, occasional use: <10 time, frequent use: 10–39 times, and regular use: 40+ times). We further investigated whether these associations were similar for boys and girls of different ages.

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Contributor's statement

Dr. Chen conceptualized and designed the study, conducted the analyses, drafted the initial manuscript, and approved the final manuscript as submitted. Drs. Martins, Storr, Strain and Mojtabai interpreted the study results, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Acquisition of data: The data reported herein come from the 2012–2013 Monitoring The Future (MTF) public data files available at the Substance Abuse and Mental Health Data Archive and the Inter-university Consortium for Political and Social Research, which are sponsored by the Office of Applied Studies, Substance Abuse and Mental Health Services Administration.

Financial disclosure: Dr. Strain has received consulting fees for medical-legal cases, and from The Oak Group, Egalet Corporation, Indivior Pharmaceuticals, and Pinney Associates. Dr. Martins has received consulting fees from Purdue Pharma in 2014. All other authors declare they have no conflicts of interest.

Potential conflict of Interest Disclosures: Other authors have no conflicts of interest relevant to this article to disclose except for the above-mentioned disclosures.

Results—Overall, 20.6% of the adolescents reported past-year marijuana use: 12.1% occasional use, 4.3% frequent use, and 3.8% regular use. Girls were less likely to be frequent and regular marijuana users (frequent use: OR=0.83 [0.75, 0.93]; regular use: OR=0.41 [0.36, 0.48]) while no sex difference was noted for occasional use. Also, the odds of deviant behaviors were higher as the frequencies of marijuana use were higher. Compared to younger girls, older boys and girls had higher association between all levels of marijuana use and low self-esteem, low perceived harm, peer influence and perceived easy access. Besides, younger boys were more likely than younger girls to report an association between regular marijuana use with low self-esteem, peer influence, and perceived easy access but not with perceived low harm.

Conclusions/Importance—Findings suggest the relationship between these psychosocial correlates and frequency of marijuana involvement varies across sex and age groups. These variations ask for a nuanced approach to prevention of marijuana involvement in different groups of youth.

Keywords

marijuana use; problem behaviors; age difference; sex difference; prevention

Introduction

Marijuana is one of the most commonly abused psychoactive substances in the United States and around the world (1–4). Accumulating evidence suggests that there may be long-term effects on brain maturation during key developmental periods following heavy marijuana use in adolescence. Magnetic resonance imaging studies have found grey matter volume reduction among those who persistently use marijuana before age 17 (5). Declines of IQ scores have also been found among heavy marijuana users who started in their teens and continued into adulthood (6). In addition, some reports have suggested links between marijuana use and some mental disorders (7–11) and respiratory complications (12). In 2013, an estimated 1.7 million adolescents in the US were current marijuana users (4). Between 2008 and 2013, past-month marijuana use increased from 5.8% to 7.0% among 8th graders, from 13.8% to 18.0% among 10th graders, and from 19.4% to 22.7% among 12th graders (13). There is a need to remain vigilant and revisit risk factors and correlates of marijuana use as many countries, including the U.S., have seen changes in policies that sanction marijuana use for medical purposes and changes in social norms that support legalizing it for recreational use. Information on sex and age variations in psychosocial factors which are putative risk factors of marijuana use are important to monitor because they are instrumental for the development of targeted marijuana prevention and intervention programs.

Marijuana involvement among youth is often captured by an assay of the frequency and quantity of use. A previous study demonstrated that frequency of marijuana use is a stronger proxy than quantity of use for predicting problematic use (marijuana use disorder), and this association varied significantly by age (14). In addition, a dose-response relationship between frequency of cannabis use and psychosis liability has been proposed (15). Studies have also found that psychosocial correlates (such as decision-making) vary among individuals with different levels of marijuana use (16); so could there be sex and age

differences in the relationship between a person's socio- demographic and psychosocial characteristics and frequency of marijuana use during adolescence?

In this paper we examined the association of a number of established psychosocial and behavioral risk factors of marijuana use with frequency of marijuana use, accounting for sex and age differences in these associations. We used national samples of youth drawn from the Monitoring the Future (MTF) study (17). The risk factors examined included low self-esteem, low perceived harm, peer influence and perceived high drug availability of marijuana. These variables were selected based on past literature and behavioral models such as Problem Behavior Theory (18, 19) and the Theory of Planned Behavior (20). Both of these models find that attitudes, norms and perceived behavioral control influence behaviors. Several studies of teenage substance use behaviors have found supporting evidence for both of these theoretical models (20–23).

A number of past studies using MTF data have found strong associations between marijuana use in adolescents and self-esteem (24), perceived harm (25), peer influence (26) and perceived drug availability (27). Research also suggests that the association of these factors with marijuana use varies across sex and age groups. For instance, Cohn et. al. found differences in risk-perception across different age groups (28), and Steinberg et. al. demonstrated that adolescents of different ages held different capacities to resist peer influence (29). Also, sex was found to interact with psychosocial characteristics of marijuana use (30). Other research suggests that decision-making processes may vary among individuals with different level of marijuana use (16). Nevertheless, past research has not investigated these psychosocial factors as a function of different levels of marijuana use among boys and girls of different ages.

To address these gaps in knowledge, we analyzed data from the MTF to a) examine the socio-demographic and behavioral characteristics of adolescents in the 8^{th} and 10^{th} grades according to levels (as measured by frequency) of marijuana use, and b) assess how the relationship between psychosocial factors and levels of marijuana use differ by sex/age groups.

Methods

Study sample

Combined annual data from the MTF public use data files for the years 2012 and 2013 (N= 57,767) were analyzed. Since 1975, the MTF administers classroom surveys to a nationally representative sample of school attending American students in 8^{th} and 10^{th} graders. The survey uses a multistage, stratified sampling design with the first stage being 108 primary geographic areas and the second stage, the schools. There are four interconnected versions of the survey instrument so that a wide array of data can be collected while minimizing respondent burden. More details about MTF can be found elsewhere (3, 17). About 50–70% of originally selected schools participate in the MTF. For schools that do not participate, replacements are carefully chosen to be as similar as possible to the school being replaced. Response rates for surveys in 2012–2013 were 90–91% (8^{th} grade) and 87–88% (10^{th} grade). Half of the sampled adolescents (50.9%) were female, 53.9% were White, 10.5%

Black, 16.6% Hispanic, and 19.0% from other races and ethnicities (percentages calculated using sample weights).

Measures

Frequency of marijuana use in the past 12 months—Frequency of marijuana use was assessed by the following question: “On how many occasions (if any) have you used marijuana (weed, pot) or hashish (hash, hash oil) … during the last 12 months?” The respondents could choose from different numbers of occasions including 0, 1–2, 3–4, 6–9, 10–19, 20–39, and ≧ 40. Responses were re-categorized into the following of levels of marijuana use: no use (0 times), occasional use (1–9 times), frequent use (10–39 times), and regular use (more than 40 times).

Socio-demographic characteristics—Since the MTF does not ask about age, we used grade level as a proxy for age with 8^{th} grade (ages 13–14) categorized as the young age for this study, and 10^{th} grade (ages 15–16 years) categorized as older age. We further categorized our participants into four groups by sex and age (younger girls, younger boys, older girls, older boys). Other socio-demographic variables for the analyses included race/ethnicity (Non-Hispanic White, Black, Hispanic, Other), region (Northeast, Northcentral, West, South) and survey year.

Past-year deviant behaviors—Past-year deviant behaviors included gang fights, hurting others, stealing things, trespassing and selling drugs. Participants who reported taking part in a fight where a group of friends were against another group were categorized as having been in a gang fight. Similarly, hurting others, stealing things, trespassing and selling drugs were defined by having “hurt someone badly enough to need bandages or a doctor?”, “taken something not belonging to you worth over $50?”, “gone into some house or building when you weren’t supposed to be there?” and “sold an illegal drug?”, respectively. Those who reported yes to any one of the questions were categorized as having deviant behaviors in the past year.

Psychosocial factors: self-esteem, peer influence, perceived harm and perceived drug availability—Self-esteem was assessed by eliciting level of agreement with the statement “I feel that my life is not very useful.” Low self-esteem was operationalized by the response “agree or mostly agree” to this question. Perceived harm of marijuana was assessed by the question: “How much do you think people risk harming themselves (physically or in other ways) if they smoke marijuana regularly? (1) no risk, (2) slight risk, (3) moderate risk, (4) great risk.” Perceived low harm was operationalized by the response “no or slight risk” to this question. Peer influence was assessed by the question: “How many of your friends would you estimate … smoke marijuana or hashish? (1) none, (2) a few, (3) some, (4) most, (5) all.” High peer influence was operationalized by the response “most or all” to this question. Perceived drug availability was assessed by the question: “How difficult do you think it would be for you to get each of the following types of drugs, if you wanted some marijuana? (1) probably impossible, (2) very difficult, (3) fairly difficult, (4) fairly easy, (5) very easy.” Perceived easy access was operationalized by the response “fairly easy” or “very easy” to this question.

Statistical analyses

Analyses accounted for the complex multistage sample design, and data were weighted to adjust for differential selection probabilities using Stata 12.0 (31). We used Taylor series estimation methods to obtain proper standard error estimates for the cross-tabulations and logistic regressions. All percentages reported are weighted by study weights.

First, we created basic contingency tables and conducted multivariate logistic regression analyses to examine the association between different levels of marijuana use and socio-demographic variables, and deviant behaviors. Next the associations between different levels of marijuana use and psychosocial correlates (low self-esteem, peer influence, perceived low harm and perceived easy access) were examined. Then developmental differences (sex and age subgroups) in the association between these psychosocial factors and different levels of marijuana use were explored. This work was based on analyses of publicly available de-identified data deemed exempt from review by the Institutional Review Board.

Results

Characteristics of participants by frequency of marijuana use

The sample consisted of 57,767 adolescents. Overall, 20.6% of the adolescents had used marijuana in the past year: 12.1% (n=7,160) reported occasional marijuana use, 4.3% (n=2,524) frequent use, and 3.8% (n=2,221) regular use. We found distinct socio-demographic and behavioral profiles according to the level of past-year marijuana use. As seen in in Table 1, compared to non-marijuana users, marijuana users were generally more likely to be older (10^{th} grade). Girls were less likely than boys to use marijuana frequently or regularly while no sex difference was seen for occasional use. Participants who reported occasional use were more likely to be Black or Hispanic compared to Whites, while no racial/ethnic differences were observed among frequent or regular users.

Generally speaking, we found the odds of reporting deviant behaviors were higher as the frequencies of marijuana use were higher. For example, the odds ratio for the association of stealing and marijuana use almost doubled for each increase in level of use compared to non-use (occasional use: 3.60[3.16, 4.09], frequent use: 6.37[4.62, 8.78], regular marijuana use: 10.94[7.92, 15.11]). Similar patterns were observed for reports of gang fights, attacking others, and trespassing. Notably, the odds of selling drugs were exceptionally high among participants for all levels of marijuana use.

Sex and age differences by frequency of marijuana use

We examined levels of frequency of marijuana use based on four sex and age groups (younger girls, younger boys, older girls, and older boys), as illustrated in Figure 1. For younger girls and boys, the prevalence of occasional and frequent marijuana use was similar; in contrast, regular marijuana use was almost twice as common in younger boys as in younger girls [2.0% vs. 1.1%]. Occasional marijuana use was similarly common across the sexes and a similar pattern of higher prevalence with age was noted for both boys and girls. The prevalence of occasional use was almost two times higher in older girls (16.4%) compared with younger girls (8.3%) and in older boys (15.7%) compared to younger boys

(8.3%). Also, the prevalence of regular marijuana use was exceptionally high in older boys (8.8%), followed by older girls (3.6%), and younger boys (2.0%) and girls (2.1%).

Association of low self-esteem, peer influence, perceived low harm and perceived easy access with frequency of marijuana use

Low self-esteem, perceived low harm, peer influence and perceived easy access were significantly associated with all levels of marijuana use (Figure 2 and Appendix Table 1). In adjusted logistic regression models (Appendix Table 1), individuals with low self-esteem reported slightly increased odds of all levels of marijuana use compared to non-users. Nevertheless, in perceived low harm, the adjusted odds ratio increased across a gradient with the frequency of marijuana use. A similar pattern was observed in the measures of peer influence and perceived easy access.

Association of low self-esteem, peer influence, perceived low harm and perceived easy access with frequency of marijuana use by sex and age

We have observed a general pattern of the association between different levels of marijuana use and psychosocial correlates in adolescents of different sex and age (Table 2). Compared to younger girls, older boys and girls were more likely to report association between low self-esteem, low perceived harm, peer influence and perceived easy access with all levels of marijuana use. Younger boys were more likely than younger girls to report an association between low self-esteem, peer influence, and perceived easy access with regular marijuana use but not in perceived low harm.

Discussion

There were three main findings from this study. First, there were distinct socio-demographic and behavioral profiles of adolescents based on the frequency of past-year marijuana use. For instance, older adolescents were generally more likely than younger ones to use marijuana at all levels. Also, boys were more likely to use marijuana frequently or regularly as compared to girls while there was no gender difference observed in occasional use. Second, prevalence of perceived low harm, peer influence and perceived easy access increased as frequency of marijuana use goes up. No such gradient was found in low self-esteem. Third, older adolescents were more likely than younger girls to have association between the examined psychosocial correlates (low self-esteem, peer influence, perceived low harm, perceived easy access) and all levels of marijuana use. However, younger boys were more likely than younger girls to have association between regular marijuana use and low self-esteem, peer influence, and perceived easy access.

The finding of differences in socio-demographic profiles of adolescents who use marijuana according to levels of use offers potentially significant clinical and public health implications. A previous study indicated male-female differences in prevalence of marijuana use decreased from 1999 to 2013 (32); our study using the latest MTF data further showed that boys were more likely to engage in heavy marijuana use (frequent and regular use) than girls, while no sex difference was observed in occasional users. As animal studies showed female rats more sensitive to the rewarding effects of marijuana (33) and human studies

showed females developed marijuana use disorder more quickly than males after their marijuana initiation (34), future study to continue monitoring of occasional users of both sexes to identify the risk factors for heavier marijuana use is recommended.

Past research suggests that Black and Hispanic adolescents had surpassed Whites in reporting past-year marijuana use and marijuana use disorder (35). Our findings further suggest that minority groups were more likely to than White youth to engage in occasional use, but not in frequent and regular use. However, as previous research has found that early adolescent substance use is more strongly associated with later psychiatric disorders among Black than White adolescents (36), further study to understand the etiology of such racial differences in occasional marijuana use is crucial to prevent worse health outcomes in minority groups.

Consistent with previous studies (37), low self-esteem, perceived harm, peer influence, and perceived drug availability were all associated with marijuana use. We further found evidence suggesting that these factors played different roles in different levels of marijuana use. For instance, low self-esteem was only slightly increased in adolescents who engaged in any levels of marijuana use compared to non-users; whereas, perceived low harm, peer influence and perceived easy access had a dose-response relationship with frequency of marijuana use. Our subgroup analyses further revealed that older adolescents had higher association between low self-esteem, low perceived harm, peer influence, perceived easy access and all levels of marijuana use than young girls. In addition, younger boys were more likely than younger girls to have association between regular marijuana use with low self-esteem, peer influence, and perceived easy access but not with perceived low harm.

These findings offer potentially valuable information for the development of substance prevention or early intervention programs. Adolescents of different sex and age for whom the associations of specific psychosocial correlates with marijuana use were stronger may most benefit from interventions targeting those factors. For instance, social resistance skills programs or Life Skills Training which enhances coping abilities to peer influence (38), and normative education approaches which aims at correcting the perceived low harm and perceived easy access may be particularly helpful in reducing marijuana use among older boys and girls. In contrast, programs targeting at perceived low harm may not be as effective as strategies targeting at other psychosocial factors in preventing younger boys' regular marijuana use. Over all, our results, in resonance with previous studies, indicate the need for an age-specific or sex-specific substance prevention program (32, 35).

Consistent with the National Survey on Drug Use and Health report (4), we found marijuana users at all frequency levels were more likely to report problematic behaviors than non-users. Furthermore, a dose-response relationship between the level of marijuana use and the odds of reporting delinquency (attacking others, gang fighting, trespassing, stealing, and selling drugs) was found, with selling drugs showing the strongest association. As drug selling is found to be linked to violence (39) and even lethal violence (40), our finding suggests that violence risk should be evaluated among adolescents with heavier marijuana use.

Several limitations to this study and of the MTF data should be noted. First, due to the cross-sectional nature of the data, no causal inferences can be made. Low self-esteem may be a risk factor contributing to marijuana use but it may also be a consequence of marijuana use and its detrimental effects on academic productivity. Second, the MTF was a school-based survey; thus school dropouts, who might have more severe substance use problems or poorer social outcome, were not included. Third, the factors were assessed using single questions, which may impact the reliability of these ratings. Furthermore, self-ratings are prone to recall or social-desirability bias. Fourth, this study did not account for the influence of socio-economic status because this information was not available in the MTF. Fifth, due to the relatively low prevalence of selling drugs in non-marijuana use population, the odds ratios for the association of this behavior with different levels of marijuana use were extremely high. Finally, grade was used as a proxy for age, and it is likely that some students in each grade were older than their peers because they were held back.

Conclusion

In the context of the above limitations, this study found distinct socio-demographic and behavioral profiles for different levels of marijuana users. Furthermore, the study found sex and age subgroup variations in the relationship between marijuana involvement and psychosocial factors including self-esteem, perceived harm, peer influence, and drug availability.

Early detection and targeted interventions have been shown to positively impact adolescents' behavioral trajectory, steering them away from problem behaviors, such as drug use, and towards more positive behaviors (23, 38). Programs aimed at prevention of and early intervention for marijuana use can benefit from knowledge regarding socio-demographic differences in psychosocial correlates across levels of marijuana use in adolescents of different aged and sexes. For instance, targeting low perceived-harm may not be as effective as targeting other psychosocial correlates to curb regular marijuana use in younger boys.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding source: This study was supported by the U.S. National Institutes of Health- National Institute on Drug Abuse (NIDA) K24 DA023186 (P.I.: Dr. Strain) and R01DA037866 (P.I.: Dr. Martins) and also by the Eunice Kennedy Shriver National Institute of Child and Human Development R01HD060072 (P.I.: Dr. Martins). NIDA and NICHD have no further role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

The authors gratefully acknowledge Katherine Keyes, associate professor in Department of Epidemiology in Mailman School of Public Health, Columbia University, for her technical assistance. Dr. Keyes reported no conflict of interests.

Abbreviations

MTF	Monitoring The Future

NSDUH National Survey on Drug Use and Health

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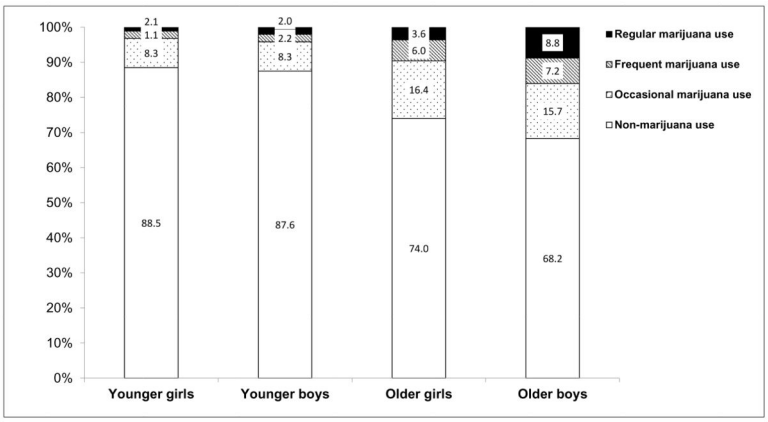

Figure 1.
Prevalence of different levels of marijuana use by four age and sex groups.

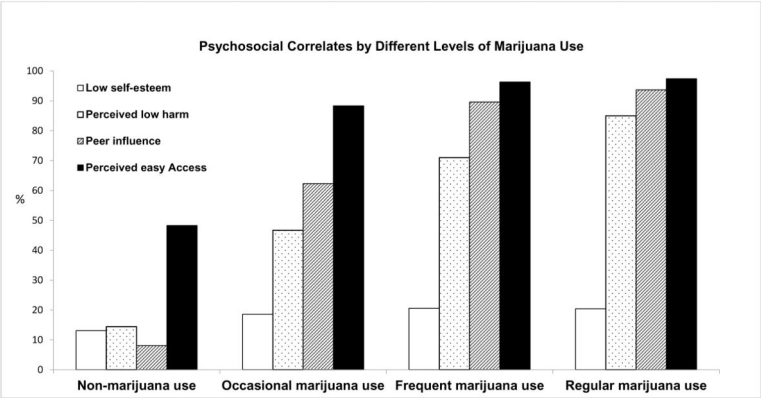

Figure 2.

Percentage of low self-esteem, perceived low harm, peer pressure, and perceived easy access in different levels of marijuana users.

Table 1

Characteristics of past-year marijuana users based on marijuana use frequency in a sample of the US school population of 8th and 10th graders (N= 57,767): data from 2012 and 2013 Monitoring The Future.

	No use (0 occasion) (N=45,862)	Occasional use (1–9 occasions) (N=7,160)		Frequent use (10–39 occasions) (N=2,524)		Regular use (≧40 occasions) (N=2,221)	
	%	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Sex							
Male	48.1	48.2	1.00	52.6	1.00	69.1	1.00
Female	51.9	51.8	0.99(0.91,1.09)	47.4	0.83(0.75,0.93)+	30.9	0.41(0.36,0.48)±
Grade level							
8th	56.8	35.7	1.00	26.0	1.00	26.0	1.00
10th	43.2	64.4	2.37(2.01,2.79)±	74.0	3.75(2.86,4.92)±	74.0	4.93(3.53,6.90)±
Race							
White	67.1	59.3	1.00	62.3	1.00	66.8	1.00
Black	13.2	15.0	1.28(1.02,1.61)*	13.4	1.10(0.79,1.53)	12.0	0.91(0.66,1.26)
Hispanic	19.8	25.7	1.47(1.14,1.91)*	24.4	1.33(0.56,1.85)	21.3	1.08(0.83,1.41)
Region							
Northeast	18.5	17.4	1.00	20.2	1.00	17.0	1.00
Northcentral	24.1	20.2	0.89(0.78,1.01)	20.0	0.76(0.67,0.86)+	22.3	1.00(0.85,1.18)
South	35.1	36.5	1.10(0.95,1.28)	34.3	0.89(0.72,1.10)	36.4	1.12(0.78,1.62)
West	22.3	25.9	1.23(1.11,1.37)+	25.4	1.04(0.89,1.22)	24.3	1.18(0.89,1.22)
Gang Fight							
No	88.4	79.0	1.00	67.4	1.00	51.5	1.00
Yes	11.6	21.0	2.73(2.41,3.09)±	32.6	3.40(2.99,3.87)±	48.5	5.06(3.69,6.93)±
Attacked Others							
No	91.0	79.7	1.00	74.7	1.00	87.8	1.00
Yes	9.0	20.3	2.56(1.96,3.47)±	25.3	3.42(2.73,4.28)±	12.2	6.30(4.28,8.25)±

	No use (0 occasion) (N=45,862)	Occasional use (1–9 occasions) (N=7,160)		Frequent use (10–39 occasions) (N=2,524)		Regular use (≧40 occasions) (N=2,221)	
	%	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Trespassed buildings							
No	84.4	63.9	1.00	55.0	1.00	52.2	1.00
Yes	15.6	36.2	3.06(2.66,3.53)$^{\pm}$	45.0	4.42(3.66,5.36)$^{\pm}$	47.8	4.96(3.98,6.17)$^{\pm}$
Stole things worth >$50							
No	96.1	87.2	1.00	79.4	1.00	69.2	1.00
Yes	3.9	12.8	3.60(3.16,4.09)$^{\pm}$	20.6	6.37(4.62,8.78)$^{\pm}$	30.8	10.94(7.92,15.11)$^{\pm}$
Sold drugs							
No	99.0	89.3	1.00	68.2	1.00	46.1	1.00
Yes	1.0	10.7	12.78(5.19,11.00)$^{\pm}$	31.8	49.82(35.89,69.16)$^{\pm}$	53.9	124.88(79.45,196.30)$^{\pm}$

*p<0.05,

$^{+}$p <0.01,

$^{\pm}$p< 0.001

Table 2

Psychosocial characteristics (self-esteem, perceived harm, peer pressure and availability) of different levels of marijuana use for youth subgroups by sex and age: Monitoring The Future, 2012–2013

	Occasional use (1–9 occasions)		Frequent use (10–39 occasions)		Regular use (≧40 occasions)	
	Wt%	aOR	Wt%	aOR	Wt%	aOR
Low self-esteem						
Younger girls	25.0	1.00	19.7	1.00	9.7	1.00
Younger boys	15.5	1.08(0.67,1.76)	9.2	0.91(0.46,1.80)	16.2	3.33(1.18,9.43) *
Older girls	36.5	2.14(1.71,2.68) ±	39.7	3.37(1.67,6.80) +	27.1	5.85(3.11,10.98) ±
Older boys	23.0	2.00(1.14,3.50) ±	31.5	3.73(2.50,5.57) ±	47.1	13.30(4.87,36.33) +
Perceived low harm						
Younger girls	16.4	1.00	12.0	1.00	7.1	1.00
Younger boys	17.7	0.98(0.78,1.23)	13.2	0.87(0.67,1.13)	12.6	1.53(0.79,2.95)
Older girls	32.2	2.43(1.85,3.20) +	33.5	3.06(1.93,4.86) +	22.5	3.65(2.58,5.17) ±
Older boys	33.1	1.89(1.39,2.58) +	41.2	2.94(2.03,4.25) ±	57.9	7.33(5.55,9.67) ±
Peer influence						
Younger girls	18.8	1.00	13.8	1.00	6.2	1.00
Younger boys	12.6	0.98(0.88,1.08)	11.7	0.96(0.64,1.43)	11.7	2.72(1.83,4.03) +
Older girls	40.7	1.41(1.30,1.53) ±	37.2	1.50(1.11,2.04) *	25.1	2.65(1.83,3.84) +
Older boys	28.0	1.12(0.88,1.44)	37.4	1.83(1.29,2.59) +	57.0	7.47(4.75,11.75) ±
Easy Access						
Younger girls	16.9	1.00	12.1	1.00	6.9	1.00
Younger boys	15.1	1.01(0.91,1.13)	11.8	0.99(0.77,1.27)	12.9	2.05(1.22,3.45) *
Older girls	36.5	1.66(1.32,2.09) +	36.1	2.20(1.73,2.79) ±	24.1	2.68(1.66,4.33) +
Older boys	31.6	1.63(1.26,2.12) +	40.1	2.86(2.18,3.74) ±	56.1	7.15(4.20,12.17) ±

Adjusted logistic regression was adjusted for race, education, region, deviant behaviors and year.

* $p<0.05$,

$^{+}$ p <0.01,

$^{\pm}$ p< 0.001