



Original article

Employment and Marijuana Use Among Washington State Adolescents Before and After Legalization of Retail Marijuana

Janessa M. Graves, Ph.D., M.P.H.^{a,*}, Jennifer M. Whitehill, Ph.D.^b, Mary E. Miller, M.N.^c, Ashley Brooks-Russell, Ph.D., M.P.H.^d, Susan M. Richardson, M.P.H.^e, and Julia A. Dilley, Ph.D., M.E.S.^e^a College of Nursing-Spokane, Washington State University, Spokane, Washington^b Department of Health Promotion and Policy, University of Massachusetts Amherst, Amherst, Massachusetts^c Nurse Consultant, Seattle, Washington^d Program for Injury Prevention, Education and Research (PIPER), Department of Community and Behavioral Health, Colorado School of Public Health, University of Colorado, Aurora, Colorado^e Program Design and Evaluation Services, Oregon Health Authority, Public Health Division and Multnomah County Health Department, Portland, Oregon

Article history: Received August 27, 2018; Accepted December 19, 2018

Keywords: Marijuana; Cannabis; Employment; Work; Adolescents; Teens

A B S T R A C T

Purpose: The purpose of the study was to describe associations between employment and marijuana use among adolescents 2 years before passage of 2012 ballot initiative and 2 years after the implementation of retail recreational marijuana sales took place in Washington.**Methods:** We used 2010 and 2016 data from Washington's statewide school-based Healthy Youth Survey, which is completed by more than 76,000 youth annually and representative of 8th, 10th, and 12th graders in public schools. We used "difference-in-differences" regression to estimate the odds of current, past 30-day marijuana use by working status and hours worked per week compared with nonworking youth.**Results:** Working adolescents in all grades had higher prevalence of recent marijuana use compared with nonworking adolescents. Youth working in formal settings, such as retail and service sectors, were more likely to use marijuana than nonworking and youth working in informal settings, such as babysitting. Between 2010 and 2016, marijuana use decreased significantly among working and nonworking 8th and 10th graders. Among working 12th graders, marijuana use increased significantly over time relative to nonworking youth (adjusted odds ratio: 1.34, 95% confidence interval: 1.22–1.48). Associations were stronger for youth who worked more hours per week.**Conclusions:** Working youth were more likely to use marijuana before and after Washington's legalization of retail marijuana. Legalization was associated with increases in marijuana use specifically among 12th-grade working youth. States legalizing marijuana may consider implementing interventions to support healthy behaviors among working youth.

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IMPLICATIONS AND
CONTRIBUTION

Legalization of retail marijuana may exacerbate the risk of marijuana use among older working youth relative to their nonworking peers. This finding suggests that further investigation is needed to inform intervention approaches that support working youth following the opening of legal, retail marijuana markets.

Conflicts of interest: The authors have no conflicts of interest to disclose.**Disclaimer:** The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

* Address correspondence to: Janessa M. Graves, Ph.D., M.P.H., College of Nursing-Spokane, Washington State University, P.O. Box 1495, Spokane, WA 99202.

E-mail address: janessa.graves@wsu.edu (J.M. Graves).

In the United States, many adolescents are employed at some point during the year, including in the summer [1]. Working during adolescence has been shown to provide benefits, such as educational or occupational attainment and life skills [2], as well as supporting the development of independence and autonomy [3]. Employment during adolescence has, however, also

been associated with risk-taking behaviors, including substance use [4,5].

There are several theoretical explanations for an association between adolescent employment and risky behaviors such as substance use. A large body of research has demonstrated the importance of social influence on adolescent substance use. This includes the modeling of substance use, such as by older coworkers for whom substance use is more normative, consistent with social learning theory [6]. In addition to physical modeling of behaviors is the potential transmission of both descriptive and injunctive norms of substance use by older coworkers [7]. Some have documented a dose–response relationship between employment and substance use by looking at total number of hours worked [8,9]. For example, there is empirical evidence for positive association between marijuana use and total hours worked among adolescents [8]. In addition to social learning theory and social norms, some suggested that greater time spent at work represents fewer opportunities for parents or other pro-social adults to influence adolescents, consistent with social control theory [10].

Adolescent marijuana use has been associated with a range of deleterious effects, including lower academic attainment [11], mental health consequences [12], and later dependence [13]. Previous studies provide evidence for a positive correlation between employment and marijuana use among adolescents [4,5,8,9,14]. Using national data from the Monitoring the Future survey, Kaestner et al. [4] identified an increased prevalence of recent marijuana use among working adolescents (17%–22%) compared with nonworking peers (14%–18%) in the period from 1997 to 2003.

Given the changing political landscape of retail marijuana legalization and use in the United States and concerns about the potential for increasing adolescent use, it is important to examine if marijuana legalization is associated with marijuana use among working adolescents [15]. In 2012, voters in Washington State passed ballot initiative 502, which legalized retail, nonmedical marijuana (hereafter called retail marijuana); sales to adults aged 21 years and older began July 2014 [16]. Both Washington and Colorado, the first two states to legalize retail marijuana, have not reported increases in youth marijuana use among the general student population in years immediately following legalization. Emerging studies have found little association between the implementation of legalized marijuana and increases in marijuana use among adolescents [17,18]. This is in contrast to adult marijuana use, which has increased following legalization [19–22].

Policy changes can have heterogeneous effects across subpopulations, and marijuana legalization may differentially impact adolescents by work status. However, to date, no study has specifically examined the association between employment and marijuana use in the context of legalized retail marijuana policies. The purpose of this study was to examine the relationship between marijuana use and employment among adolescents in Washington State before and after legalization of retail marijuana. Because working youth prematurely adopt adult behaviors compared with nonworking youth [22], it is possible that marijuana utilization among working youth (or youth with greater work intensity) may reflect increases observed in adults after utilization. We hypothesized that employed adolescents would experience a differential effect of the policy change such that employment would be associated with an increase in marijuana use after implementation of legalized retail sale of marijuana. Furthermore, we hypothesized that work intensity (hours worked) would be positively associated with increased marijuana use.

Methods

We used data from Washington State's well-established school-based Healthy Youth Survey (HYS) collected in 2010 and 2016. The HYS is a self-administered survey given to 8th-, 10th-, and 12th-grade students in fall of even-numbered years. (An abbreviated version is given to sixth-grade students but was not used for this study.) It is sponsored by multiple state agencies and has been administered regularly since 2002; methodological details have previously been reported [23,24]. A state sample of public schools is drawn, but all schools in the state can participate for free, and most do so. Each year, a bias analysis of the full dataset of all participating schools ("census data") has been conducted, and the data are consistently determined to be generalizable to the state's nonalternative public school youth [25,26]. We used this census dataset for our study. Student participation rates are a function of school and student nonparticipation [24]. In 2010, school-level participation rates were above 80% for all grades, and student-level participation rates for the census were 73% for 8th grade, 64% for 10th grade, and 54% for 12th grade (i.e., 64% of all 10th graders from nonalternative public schools in the state participated). For 2016, student-level participation rates were 83% for 8th, 69% for 10th, and 47% for 12th graders statewide. The survey provides data on adolescent demographics, health behaviors, illness and injury experiences, and sociocultural factors.

Variables

The main outcome measure, recent marijuana use, was defined as any use within the past 30 days. Employment status was assessed as working any hours per week for pay, not including chores in the home, yard work, and babysitting. Employment questions before 2010 were not comparable to questions asked in 2010 and 2016. Exact language for questions and responses for marijuana and employment variables are included in Tables 1 and 2. Responses were categorized both as binary (any work vs. no hours worked per week) and collapsed by categories as not currently working, up to 10 hours per week, and 11 or more hours per week. A question on workplace setting was asked in 2010 (not in 2016), and responses were categorized as "formal" (e.g., stores, restaurants, and healthcare) or "informal" (e.g., babysitting, yard work, and farm). Student sociodemographic variables that were included as potentially relevant to both marijuana use and work status were selected based on previously published studies [27–29] and included grade level, age, sex, race/ethnicity, typical grades, living situation, language spoken at home, and maternal education (a proxy measure for family socioeconomic status [23]).

We incorporated information about urban or rural community setting in four categories by linking at the school-level with Rural-Urban Commuting Area codes from the Washington Department of Health [30]. This study was determined as exempt from review by the Washington State Institutional Review Board.

Statistical analyses

We described the prevalence of work status and marijuana use among all youth by sociodemographic variables that were associated with both. Next, we described key variables by grade group (mean age, workplace setting, and the prevalence of marijuana use by work intensity and workplace setting). We

Table 1

Sample characteristics, work status, and recent marijuana use among youth, Washington State Healthy Youth Survey

Characteristic	2010			2016		
	N (%)	Currently working ^a % (SE)	Recent marijuana use ^b % (SE)	N (%)	Currently working ^a % (SE)	Recent marijuana use ^b % (SE)
Total	76,758 (100)	21.6 (.3)	17.4 (.3)	78,124 (100)	20.5 (.3)	14.4 (.3)
Grade						
8th	28,757 (37)	14.8 (.4)	9.1 (.3)	30,982 (40)	11.8 (.4)	6.0 (.3)
10th	26,410 (34)	17.2 (.5)	19.8 (.5)	27,692 (35)	16.0 (.5)	15.8 (.4)
12th	21,591 (28)	35.5 (.6)	25.5 (.6)	19,450 (25)	40.2 (.7)	25.7 (.6)
Sex						
Female	39,718 (52)	18.9 (.4)	15.3 (.4)	39,128 (50)	18.5 (.4)	14.7 (.4)
Male	36,885 (48)	24.5 (.5)	19.6 (.4)	38,670 (50)	22.6 (.4)	14.1 (.4)
Age (y)						
≤12	392 (1)	16.9 (3.9)	7.8 (2.7)	495 (1)	15.0 (3.3)	9.3 (2.6)
13–15	47,212 (62)	15.0 (.3)	12.7 (.3)	51,359 (66)	12.8 (.3)	9.7 (.3)
16–17	22,603 (30)	30.6 (.6)	24.3 (.6)	21,174 (27)	33.9 (.7)	22.6 (.6)
≥18	6,424 (8)	37.1 (1.2)	27.8 (1.1)	5,052 (6)	41.7 (1.4)	27.9 (1.2)
Race/ethnicity						
White NH	42,801 (56)	22.2 (.4)	17.3 (.4)	39,521 (51)	21.4 (.4)	14.4 (.4)
Black NH	3,186 (4)	23.2 (1.5)	23.4 (1.5)	3,310 (4)	22.2 (1.5)	17.0 (1.3)
Hispanic/Latino/a	12,064 (16)	22.0 (.8)	19.3 (.7)	15,100 (20)	21.7 (.7)	17.0 (.6)
Other	17,981 (24)	19.5 (.6)	15.4 (.5)	19,357 (25)	17.4 (.6)	12.0 (.5)
Maternal education						
≤12 y	23,944 (33)	23.3 (.5)	22.1 (.5)	22,518 (31)	22.6 (.5)	19.2 (.5)
>12 y	37,564 (52)	22.2 (.4)	15.6 (.4)	38,503 (53)	21.1 (.4)	12.6 (.3)
Missing data	11,273 (15)	15.9 (.7)	13.0 (.6)	11,557 (16)	14.4 (.6)	10.3 (.5)
Living situation						
Live elsewhere	6,711 (9)	49.9 (1.7)	31.5 (1.1)	10,024 (13)	37.0 (1.3)	25.2 (.9)
Parents/guardian	70,047 (91)	20.1 (.3)	16.1 (.3)	68,100 (87)	19.1 (.3)	12.9 (.3)
Typical grades						
Mostly As	28,869 (40)	18.7 (.5)	8.3 (.3)	31,381 (43)	17.6 (.4)	7.7 (.3)
Mostly Bs	24,116 (33)	23.1 (.5)	17.5 (.5)	23,739 (33)	21.4 (.5)	14.7 (.5)
Mostly Cs	13,572 (19)	23.4 (.7)	26.7 (.7)	12,395 (17)	23.8 (.8)	23.6 (.7)
Mostly Ds	3,729 (5)	25.0 (1.4)	37.1 (1.5)	3,176 (4)	25.0 (1.5)	29.2 (1.6)
Mostly Fs	2,290 (3)	25.7 (1.8)	40.7 (2.0)	1,869 (3)	28.9 (2.1)	32.9 (2.1)
Language at home						
Not English	13,176 (18)	25.5 (.8)	17.4 (.6)	15,682 (21)	23.9 (.7)	14.2 (.5)
English	59,547 (82)	20.6 (.3)	17.2 (.3)	58,222 (79)	19.6 (.3)	14.2 (.3)
Community						
Urban core	57,319 (75)	20.8 (.2)	17.5 (.3)	58,789 (75)	19.6 (.3)	14.1 (.3)
Suburban	11,062 (14)	22.7 (.4)	16.3 (.7)	10,846 (14)	23.1 (.8)	15.2 (.7)
Large rural town	4,344 (6)	25.4 (.7)	17.7 (1.1)	4,326 (6)	22.1 (1.3)	15.1 (1.1)
Small town/rural	4,033 (5)	26.0 (.7)	17.9 (1.2)	4,163 (5)	24.1 (1.3)	16.2 (1.1)
Work intensity, paid work per week						
Not working	56,286 (78)	0%	15.0% (.3)	57,177 (80)	0%	11.2% (.3)
Up to 10 h	8,960 (12)	^c	20.6% (.8)	7,860 (11)	^c	19.3% (.9)
11+ h	6,529 (9)	^c	33.5% (.6)	6,866 (10)	^c	33.9% (.6)
Any work	15,489 (22)	^c	26.0% (.4)	14,726 (21)	^c	26.1% (.4)

Percentages for total N may not round to 100 due to rounding.

SE = standard error; NH = non-Hispanic.

^a Work status was assessed based on the survey question “How many hours per week are you currently working for pay, NOT counting chores around your home, yard work, or babysitting?” Response options included the following: (a) none, not currently working; (b) ≤10 h/wk; (c) 11–20 h/wk; (d) 21–30 h/wk; (e) 31–40 h/wk; (f) >40 h/wk. Students who gave any answer except “none” were considered to be working.

^b Marijuana use was ascertained from the survey question “During the past 30 days, on how many days did you use marijuana or hashish (weed, hash, pot)?” “Recent marijuana use” is classified as use on one or more of the past 30 days.

^c By nature of the definition of “currently working,” all students in this category worked (100%).

examined associations between marijuana use and survey year and workplace setting (independently) using a chi-square test, stratified by grade. Using multivariable logistic regression with robust standard errors, we estimated the odds of marijuana use by work variables for 12th graders alone, both unadjusted and controlling for covariates. We further used regression to test for an interaction between work status and survey year (e.g., whether patterns of use changed differently over time among working vs. nonworking 12th-grade youth). For all analyses, we used Stata v.15.1 and specified school as a primary sampling unit.

Results

Data were available from 76,758 students who provided data for all relevant variables in 2010, and 78,124 students in 2016.

A similar percentage of adolescents reported being currently employed in 2010 (21.6%) and 2016 (20.5%; Table 1). Males, older youth, youth living away from a parent/guardian, and nonurban youth were more frequently employed than other youth (Table 1). The proportion of all adolescents reporting marijuana use in the last 30 days was greater in 2010 (17.4%) than in 2016

Table 2

Age, workplace setting, and recent marijuana use by work intensity and workplace setting among youth by grade, Washington State Healthy Youth Survey

Student characteristics	2010	2016	
Age	Mean (SD)	Mean (SD)	
8th grade (N = 59,739)	13.3 (.003)	13.2 (.003)	
10th grade (N = 54,102)	15.3 (.003)	15.2 (.003)	
12th grade (N = 41,041)	17.3 (.004)	17.3 (.004)	
Workplace setting ^a	Percent (SE)		
8th grade			
Not working	76.4 (.3)	—	
Formal setting	4.8 (.1)	—	
Informal setting	12.7 (.2)	—	
10th grade			
Not working	76.2 (.3)	—	
Formal setting	7.6 (.2)	—	
Informal setting	8.8 (.2)	—	
12th grade			
Not working	59.9 (.3)	—	
Formal setting	21.8 (.3)	—	
Informal setting	6.5 (.2)	—	
Recent marijuana use ^b	2010	2016	p value ^d
Weekly work intensity ^c	Percent (SE)	Percent (SE)	
8th grade			
Not working	7.5 (.2)	4.8 (.1)	<.001
Working up to 10 h	13.4 (.7)	11.3 (.6)	.02
Working 11+ h	26.3 (1.3)	20.8 (1.4)	.004
10th grade			
Not working	17.8 (.3)	13.9 (.2)	<.001
Working up to 10 h	22.5 (.8)	20.2 (.8)	.04
Working 11+ h	38.8 (1.3)	33.2 (1.2)	.002
12th grade			
Not working	23.0 (.4)	20.5 (.4)	<.001
Working up to 10 h	24.7 (.7)	25.2 (.8)	.66
Working 11+ h	33.6 (.8)	36.7 (.7)	.004
Workplace setting ^a	Percent (SE)		p value ^e
8th grade			
Not working	7.5 (.2)	—	<.001
Formal setting	24.4 (1.2)	—	
Informal setting	9.5 (.5)	—	
10th grade			
Not working	17.8 (.3)	—	<.001
Formal setting	34.8 (1.1)	—	
Informal setting	18.8 (.8)	—	
12th grade			
Not working	23.2 (.4)	—	<.001
Formal setting	32.9 (.7)	—	
Informal setting	21.3 (1.1)	—	

SD = standard deviation; SE = standard error.

^a Workplace setting was assessed by the question *How would you describe the place that you currently work? Pick your main job. Choose one answer.* Formal setting includes responses: restaurant/fast food, stores (grocery, clothing, gas station, and other retail), hospital/clinic/nursing home, construction, factory, and packing house/food processing. Informal setting includes babysitting, farm/dairy work, and yard work. Students who responded “other” workplace were set to missing—this included 6.0% of 8th, 7.5% of 10th, and 12.0% of 12th graders. This question on workplace setting was not asked in the 2016 survey.

^b Marijuana use was ascertained from the survey question “During the past 30 days, on how many days did you use marijuana or hashish (weed, hash, pot)?” “Recent marijuana use” is classified as use on one or more of the past 30 days.

^c Work status was assessed based on the survey question “How many hours per week are you currently working for pay, NOT counting chores around your home, yard work, or babysitting?” Response options included the following: (a) none, not currently working; (b) ≤10 h/wk; (c) 11–20 h/wk; (d) 21–30 h/wk; (e) 31–40 h/wk; (f) >40 h a week. Students who gave any answer except “none” were considered to be working.

^d p value represents significance associated with chi-square test for association between the proportion of youth indicating current marijuana use and year 2010 and 2016 within each grade and category of work intensity.

^e p value represents significance associated with chi-square test for association between the proportion of youth indicating current marijuana use and three workplace settings (not working, formal, or informal) in 2010 within each grade.

(14.4%). Marijuana use was higher among older youth and youth living away from a parent/guardian, as well as among working adolescents in comparison to nonworking students in both years (26.0% among working youth vs. 15.0% among nonworking youth in 2010, and 26.1% vs. 11.2% in 2016). Reported marijuana use increased with the number of hours worked per week in both years (e.g., 20.6% and 19.3% among adolescents who worked up to 10 h/wk in 2010 and 2016, respectively; 33.5% and 33.9% among youth working 11 or more hours per week in 2010 and 2016, respectively).

Table 2 presents grade-stratified descriptive summaries of several key variables. Youth were an average of 2 years of age apart for the three grade groups (13, 15, and 17 years old on average, respectively). Older youth were more likely than younger youth to be working and specifically more likely to be working in formal sectors (21.8% of 12th grade in comparison to 7.6% of 10th and 4.8% of 8th graders). Recent marijuana use decreased significantly for all working and nonworking 8th and 10th grade groups between 2010 and 2016; however, among 12th graders, marijuana use decreased significantly among nonworking youth (23.0%–20.5%), remained stable among those working up to 10 h/wk (24.7%–25.2%) and increased significantly among those working 11 or more hours per week (33.6%–36.7%; also see Figure 1). Based on data from 2010 alone, marijuana use was higher among youth working in formal settings in comparison to nonworking youth and youth working in informal settings for all grades.

Table 3 shows adjusted odds ratios (AORs) for regression models examining differences between marijuana use among 12th-grade working and nonworking youth, first by individual years, and then from a combined-year model. All AORs shown in this table were statistically significant at $p < .01$. In both 2010 and 2016 alone, relative to their nonworking peers, working adolescents exhibited greater odds of recent marijuana use, after adjusting for covariates (2010 AOR: 1.41, 95% confidence interval [CI]: 1.32–1.51) and in 2016 (AOR: 1.84, 95% CI 1.72–1.98). Odds for recent marijuana use were greater for youth who worked more hours per week: in 2010, the AORs for recent marijuana use, relative to nonworking youth, were 1.16 (95% CI 1.06–1.27) for youth working up to 10 h/wk and 1.65 (95% CI 1.52–1.79) for youth working 11 or more hours per week. In 2016, the odds increased to 1.41 (95% CI 1.27–1.56) for youth working up to 10 h/wk and 2.13 (95% CI 1.97–2.30) for youth working 11 or more hours per week.

We examined the “difference-in-differences” between working and nonworking 12th-grade youth over time using combined year models and interaction terms between time and working status. The interaction term between working status and time was significant (AOR: 1.34, 95% CI 1.22–1.48), indicating a greater difference in marijuana use between working and nonworking 12th-grade youth in 2016 relative to 2010. In the combined-year models, the adjusted odds for marijuana use among nonworking youth alone in 2016 relative to 2010 was .87 (95% CI .82–.93), reflecting the decreasing prevalence in that group over the same period.

The change in AORs for marijuana use over time relative to nonworking peers by intensity of work were suggestive of an even greater increase for 12th-grade youth who worked more, although not significantly different from one another: 1.25 (95% CI 1.09–1.43) for youth working fewer than 10 h/wk, and 1.33 (95% CI 1.19–1.50) for youth working 11 or more hours per week.

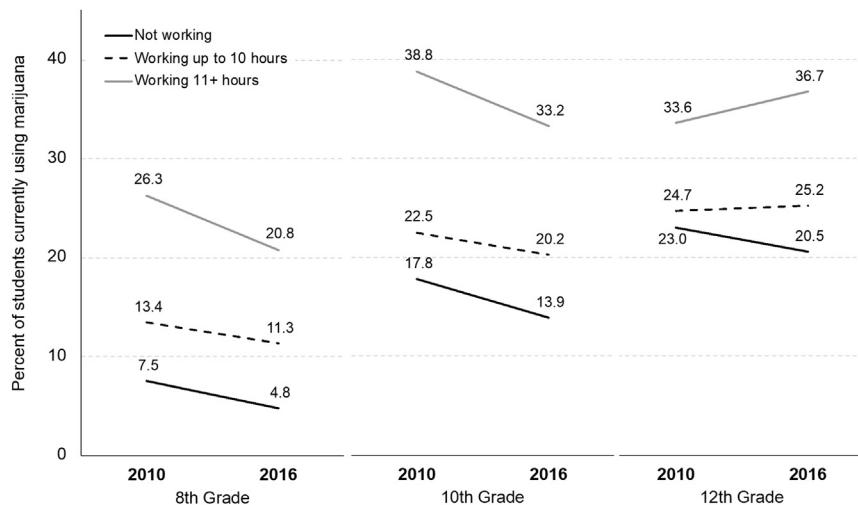


Figure 1. Prevalence of recent marijuana use among youth by grade and work intensity, Washington State Healthy Youth Survey. Note: All declines in youth marijuana use from 2010 to 2016 are statistically significant at $p < 0.05$, except 12th-grade youth working up to 10 hours per week (non-significant change) and 12th-grade youth working 11 or more hours per week, which is significantly increasing.

Discussion

This study extends previous research by providing recent evidence of the association between adolescent employment and marijuana use, including how this risk may be further increased following legalization and implementation of retail marijuana sales among older adolescents. The effect of retail marijuana

legalization was not uniform for all adolescents. Following the policy change in Washington State, marijuana use among working 12th graders remained constant or increased, in contrast to significant declines among their nonworking peers and younger youth.

Employment provides adolescents with income, as well as opportunities to develop valuable work skills [2,3]. Simultaneously, the workplace may expose adolescents to peer or adult coworkers' potentially unhealthy behaviors, including substance use [4,5]. More Washington State adults report using marijuana since legalization [22]; should changing social norms of marijuana use among adults be evident in the workplace, it is possible that working youth may be exposed to positive social norms around marijuana use. Working youth adopt mature adult-like behavior, including substance use, earlier than nonworking youth [31]. In addition to normalizing use, adult coworkers who use could potentially purchase marijuana legally and provide it to younger coworkers. Future research, including studies that are qualitative in nature, could explore the ways in which adolescents are accessing marijuana products. Such studies could clarify the mechanisms by which adolescent employment leads to greater substance use and disentangle the likely contributions of increased physical access, lessened social prohibitions for use, and roles models for use.

Raising price and restricting access to points of sale are well-described interventions that have been effective for preventing youth initiation and consumption of tobacco and alcohol [32,33]. Effectively, the opening of a retail marijuana market increased retail access, and prices have decreased since the opening of these markets [34]. Given what is known about alcohol and tobacco, these effects might be logically expected to increase youth use through increased access [15]. Working youth may have more disposable income from employment, relative to nonworking youth, and this has been proposed as a possible explanation for increased substance use among working teens [35,36]. The decreasing prices and affordability of retail marijuana may amplify this effect.

Workplace setting and employment characteristics may contribute to increased risk of youth marijuana use. In 2010,

Table 3

Associations between recent marijuana use and work status over time among 12th-grade youth, Washington State Healthy Youth Survey

	AOR ^a (95% CI)
Currently working	
Single-year models	
2010: working vs. nonworking status	1.41 (1.32–1.51)
2016: working vs. nonworking status	1.84 (1.72–1.98)
Combined year models	
Among those not currently working, 2016 vs. 2010	.87 (.82–.93)
Relative difference in change from 2016 vs. 2010 among those currently working vs. nonworking ^b	1.34 (1.22–1.48)
Work intensity	
Single-year models	
2010: working up to 10 h/wk vs. nonworking	1.16 (1.06–1.27)
2010: working 11 or more hours per week vs. nonworking	1.65 (1.52–1.79)
2016: working up to 10 h/wk vs. nonworking	1.41 (1.27–1.56)
2016: Working 11 or more hours per week vs. nonworking	2.13 (1.97–2.30)
Combined year models	
Among those not currently working, 2016 vs. 2010	.87 (.82–.93)
Relative difference in change from 2016 vs. 2010 among those working up to 10 h/wk vs. nonworking ^b	1.25 (1.09–1.43)
Relative difference in change from 2016 vs. 2010 among those working 11+ h/wk vs. nonworking ^b	1.33 (1.19–1.50)

Adjusted odds ratios (AORs) for within-group comparisons included all variables from Table 1, including covariates for age, sex, race, maternal education, living with parent, language spoken at home, grades in school, and urban–rural community type. Combined year models also include main effect terms for work status and time.

CI = confidence interval.

^a AORs are from models including all covariates shown in Table 1. All AORs in this table are significant at $p < .01$.

^b Interaction terms for work status and time.

employed youth working in a formal setting, such as in retail or service industries, were more likely to report recent marijuana use than nonworking youth and youth working in informal settings (e.g., babysitting and farm work). This may be due to youth's exposure to more adult employees in formal setting; however, additional examination is necessary. High work intensity can interfere with school, family, and age-appropriate activities among youth and therefore is often regulated.

Across all grades in this study, increased work intensity resulted in greater reporting of marijuana use; although, in younger grades, marijuana use appeared to decrease between 2010 and 2016 for working youth. The decreased marijuana use among younger working youth aligns with recently published findings of adolescent use marijuana use following implementation of legalized marijuana [17,18]. Among 12th-grade youth, the relative difference in the odds of marijuana use increased 2 years after implementation of retail sales; use increased more among youth with higher work intensity so that the odds of marijuana use among youth working 11 or more hours per week were more than double those of nonworking 12th-grade youth after marijuana legalization. Previous studies have reported increases in substance use, such as alcohol and tobacco, associated with higher work intensity among youth [36,37]; however, this is the first study to do so in the context of legal marijuana sales for both medical and recreational uses.

Supervisors and managers play an important role in workplace safety in formal settings and may have an opportunity to foster positive relationships and a safe work environment for youth [38,39]. Employers could take action by prominently expressing and enforcing zero-tolerance policies for adult employees providing substances or endorsing substance use among adolescents. Employers are unlikely to limit the work intensity of adolescent employees in the absence of public health regulations. Nationally, the Fair Labor Standards Act disallows employment among youth aged under 14 years, prohibits certain jobs for youth, and outlines specific hour standards for working youth under 16 years (e.g., allowing a maximum of 18 work hours per week during the school year and a maximum of 40 hours per week in summer [29 CFR §570.2]). State employment regulations and standards may supersede federal law if they are more protective of the minor.

Regulations can also augment the role of schools and parents and in monitoring adolescent employment. In Washington State, during the school year, working adolescents' school administration must also sign a work authorization form. Parents are critical in monitoring the safety of their children in the workplace. In Washington State, parents of minors must complete a work authorization form with the employer in order for youth to work.

Beyond such requirements, parents should discuss the advantages and disadvantages of employment with their teens. Parents may not be fully aware of the social pressures their children experience in the workplace, in addition to any potential physical hazards. Primary care physicians can support parents by screening adolescents for both work status and substance use and counseling parents on the risks of adolescent employment, particularly related to substance use. Again, policy or health promotion approaches that have been successful in prevention of harms from tobacco and alcohol use may be instructive [15]. Further research examining the impacts of such legislative changes on substance use and working youth is needed.

This study has several limitations. First, the cross-sectional nature of the data precludes us from knowing for certain that

the observed association between legalization of retail, nonmedical marijuana and marijuana use among students by work status is causal or related to some other context change (e.g., changes in youth employment laws that changed the characteristics of working youth or their experiences in the work environment); although we are not aware of any such major changes, some could have been applied locally or within specific industries or corporate entities that employ young workers. Second, self-reported marijuana use in 2016 could be greater in part due to changes in social norms and increased willingness to report use, rather than actual increases in use; however, we do not know of any reasons older working youth would be disproportionately likely to have changed with regard to self-reporting bias. Third, the response rate for 12th graders, particularly in 2016, was lower than other grades and the prior administration. The bias analysis, which considered demographic characteristics of student enrolled in public schools, did not reveal a response bias [25,26], but it is possible the respondents do not fully represent nonresponding students. If older working youth are less represented in the survey because of not remaining enrolled in school or a greater likelihood of being absent on the day of the survey, this may result in underestimates of the prevalence of marijuana use among 12th graders and potentially further underestimate changes associated with legalization. Fourth, there is some ambiguity in the question about workplace setting in comparison to the general work question so that we cannot rule out that youth who only do yard work or babysitting (i.e., not formally employed) may have indicated these were their workplace locations, rather than indicating they do not work; however, this would only have affected findings related to differences between not working and working in an informal workplace setting. Unfortunately, a question specifically differentiating between workplace settings (e.g., restaurant vs. construction) was only asked in 2010, which limits our ability to draw stronger conclusions about the changes in use after legalization being specifically associated with some workplace settings. It is possible that older youth may be employed in different work settings than younger youth, resulting in greater interaction with adults who may model substance-using behaviors or purchase marijuana for the teen following legalization; however, the current dataset does not allow such an investigation. Future data collection on this topic should include measurement of workplace exposure to marijuana-using adults and source of marijuana consumed by teens. Fifth, the associations observed in this study may be attributable to uncontrolled differences between working and nonworking youth [40]. The HYS data lack a measure of family income or socioeconomic status, and we attempted to adjust for this with a measure of maternal education (standard practice for these data); however, residual confounding may remain. Future studies should examine the relationship between employment and marijuana use across socioeconomic status differences, including household and youth employment income, in light of marijuana legalization. Also, future studies could examine more community-specific factors, such as the relationship between the density of retail marijuana outlets on youth consumption rates, as well as racial or ethnic differences [8].

This study is unique in its dual examination of youth employment and implementation of retail marijuana sales. The observed increase in marijuana use among working youth following legalization indicates that incorporating consideration of work status and work settings in prevention campaign and

intervention design may be critical. The ways in which adolescent marijuana use and the effects of marijuana legalization may be influenced by work involvement needs further investigation, particularly in light of the changing legal landscape for both medical and recreational marijuana sales in many U.S. states. Consideration by policymakers and collaborative efforts from healthcare and public health, employers, managers, supervisors, communities, schools, and parents to support healthy behaviors among young workers may be needed.

Acknowledgments

The authors would like to acknowledge Dr. Carol Runyan, whose feedback, guidance, and expertise informed the direction of this research and greatly improved the final version of this article. The authors also acknowledge Dr. Julie Maher for her statistical input and assistance.

Funding Sources

J.A.D. and S.M.R.'s contribution to this article was partially supported by the National Institute on Drug Abuse (NIDA) of the National Institutes of Health under award number 1R01DA039293.

References

- [1] Morisi TL. Teen labor force participation before and after the Great Recession and beyond. *Mon Labor Rev* 2017. U.S. Bureau of Labor Statistics. Available at: <https://doi.org/10.21916/mlr.2017.5>. Accessed February 3, 2019.
- [2] Mortimer JT. Working and growing up in America. Cambridge, MA: Harvard University Press; 2003.
- [3] Zimmer-Gembeck MJ, Collins WA. Autonomy development during adolescence. In: Adams GR, Berzonsky MD, eds. *Blackwell Handbook of Adolescence*. Malden, MA: Wiley-Blackwell; 2008.
- [4] Kaestner R, Sasso AL, Callison K, et al. Youth employment and substance use. *Soc Sci Res* 2013;42:169–85.
- [5] Wu L-T, Schlenger WE, Galvin DM. The relationship between employment and substance use among students aged 12 to 17. *J Adolesc Health* 2003; 32:5–15.
- [6] Bandura A. *Social learning theory*. New York: General Learning Press; 1977.
- [7] Rimal RN, Real K. How behaviors are influenced by perceived norms: A test of the theory of normative social behavior. *Commun Res* 2005;32:389–414.
- [8] Johnson MK. Further evidence on adolescent employment and substance use: Differences by race and ethnicity. *J Health Soc Behav* 2004;45:187–97.
- [9] Mihalic SW, Elliott D. Short- and long-term consequences of adolescent work. *Youth Soc* 1997;28:464–98.
- [10] Hirschi T. *Causes of delinquency*. New Brunswick, NJ: Transaction Publishers; 1969.
- [11] Stiby AI, Hickman M, Munafò MR, et al. Adolescent cannabis and tobacco use and educational outcomes at age 16: Birth cohort study. *Addiction* 2015;110:658–68.
- [12] Marconi A, Di Forti M, Lewis CM, et al. Meta-analysis of the association between the level of cannabis use and risk of psychosis. *Schizophr Bull* 2016;42:1262–9.
- [13] Fergusson DM, Boden JM, Horwood LJ. Cannabis use and other illicit drug use: Testing the cannabis gateway hypothesis. *Addiction* 2006;101:556–69.
- [14] Miech RA, Johnston L, O'Malley PM, et al. Trends in use of marijuana and attitudes toward marijuana among youth before and after decriminalization: The case of California 2007–2013. *Int J Drug Policy* 2015;26: 336–44.
- [15] Pacula RL, Kilmer B, Wagenaar AC, et al. Developing public health regulations for marijuana: Lessons from alcohol and tobacco. *Am J Public Health* 2014;104:1021–8.
- [16] Cambron C, Guttmanova K, Fleming CB. State and national contexts in evaluating cannabis laws: A case study of Washington state. *J Drug Issues* 2017;47:74–90.
- [17] Cerdá M, Wall M, Feng T, et al. Association of state recreational marijuana laws with adolescent marijuana use. *JAMA Pediatr* 2017;171:142–9.
- [18] Hasin DS, Wall M, Keyes KM, et al. Medical marijuana laws and adolescent marijuana use in the USA from 1991 to 2014: Results from annual, repeated cross-sectional surveys. *Lancet Psychiatry* 2015;2: 601–8.
- [19] Hasin DS, Saha TD, Kerridge BT, et al. Prevalence of marijuana use disorders in the United States between 2001–2002 and 2012–2013. *JAMA Psych* 2015;72:1235–42.
- [20] Hasin DS, Sarvet AL, Cerdá M, et al. US adult illicit cannabis use, cannabis use disorder, and medical marijuana laws: 1991–1992 to 2012–2013. *JAMA Psych* 2017;74:579–88.
- [21] Martins SS, Mauro CM, Santaella-Tenorio J, et al. State-level medical marijuana laws, marijuana use and perceived availability of marijuana among the general U.S. population. *Drug Alcohol Depend* 2016;169: 26–32.
- [22] Darnell AJ, Bitney K. I-502 evaluation and benefit-cost analysis: Second required report. Olympia, WA: Washington State Institute for Public Policy; 2017. Report No.: Document Number 17-09-3201.
- [23] Washington State Department of Health, Office of the Superintendent of Public Instruction Department of Social and Health Services Department of Commerce, Family Policy Council, et al. 2010 Healthy Youth Survey Data Analysis & Technical Assistance Manual. Tumwater, WA: Washington State Department of Health; 2013.
- [24] Washington State Department of Social and Health Services, Department of Health, Office of the Superintendent of Public Instruction, et al. Healthy Youth Survey 2016 Analytic Report. Tumwater, WA: Washington State Department of Health; 2017.
- [25] Washington State Department of Health. Healthy Youth Survey Bias Analysis 2010. DOH Pub 160-182. Tumwater, WA: Washington State Department of Health; 2010.
- [26] Washington State Department of Social and Health Services, Department of Health, Office of the Superintendent of Public Instruction, et al. Healthy Youth Survey 2016 Bias Analysis. Olympia, WA: Looking Glass Analytics, Inc.; May 2017. Available at: <https://www.askhys.net/Docs/HYS%202016%20Bias%20Analysis%205-24-18.pdf>. Accessed November 2, 2018.
- [27] Maggs JL, Staff J, Kloska DD, et al. Predicting young adult degree attainment by late adolescent marijuana use. *J Adolesc Health* 2015;57:205–11.
- [28] Shah A, Stahre M. Marijuana use among 10th grade students - Washington, 2014. *MMWR Morb Mortal Wkly Rep* 2016;65:1421–4.
- [29] Johnson RM, Fairman B, Gilreath T, et al. Past 15-year trends in adolescent marijuana use: Differences by race/ethnicity and sex. *Drug Alcohol Depend* 2015;155:8–15.
- [30] Washington State Department of Health, Office of Rural Health. Rural health data and information. Available at: <https://www.doh.wa.gov/ForPublicHealthandHealthcareProviders/RuralHealth/DataandOtherResources/RuralHealthData>. Accessed June 8, 2018.
- [31] Institute of Medicine, National Research Council. Chapter 4. Work's effects on children and adolescents. In: *Protecting Youth at Work: Health, Safety, and Development of Working Children and Adolescents in the United States*. Washington, D.C.: The National Academies Press; 1998.
- [32] U.S. Department of Health and Human Services (HHS). Preventing tobacco use among youth and young adults: A report of the Surgeon General. Atlanta, GA: HHS, Centers for Disease Control and Prevention (CDC), National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2012. Available at: <https://www.surgeongeneral.gov/library/reports/preventing-youth-tobacco-use/index.html>. Accessed October 12, 2018.
- [33] Community Preventive Services Task Force. Guide to community preventive services. What works factsheet: Preventing excessive alcohol consumption. Available at: <https://www.thecommunityguide.org/sites/default/files/assets/What-Works-Alcohol-factsheet-and-insert.pdf>. Accessed November 13, 2018.
- [34] Humphreys K. How legalization caused the price of marijuana to collapse. *Washington Post*. Available at: https://www.washingtonpost.com/news/work/wp/2017/09/05/how-legalization-caused-the-price-of-marijuana-to-collapse/?utm_term=.5bf77473a16a. Accessed September 5, 2017.
- [35] Osilla KC, Hunter SB, Ewing BA, et al. The effects of employment among adolescents at-risk for future substance use. *Addict Behav* 2013;38: 1616–9.
- [36] Paschall MJ, Flewelling RL, Russell T. Why is work intensity associated with heavy alcohol use among adolescents? *J Adolesc Health* 2004;34:79–87.
- [37] Kingston S, Rose A. Do the effects of adolescent employment differ by employment intensity and neighborhood context? *Am J Community Psychol* 2015;55:37–47.
- [38] Zierold KM. Perceptions of supervision among injured and non-injured teens working in the retail or service industry. *Workplace Health Saf* 2016;64:152–62.
- [39] Zierold KM. Youth doing dangerous tasks: Supervision matters. *Am J Ind Med* 2017;60:789–97.
- [40] Bachman JG, Staff J, O'Malley PM, et al. Adolescent work intensity, school performance, and substance use: Links vary by race/ethnicity and socioeconomic status. *Dev Psychol* 2013;49:2125–34.