Changes in Adolescent Binge Drinking between 2007 to 2017: A Youth Risk Behavior Survey (YRBS) study

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Abstract

Background: Youth binge drinking is a major issue within the United States with consequences including drinking and driving, risky sexual behavior, victimization defined as being physically or verbally victimized at school or home and adverse hormonal function. The objective of this study was to assess the change in adolescent binge drinking between 2007 and 2017.

Methods: The Youth Risk Behavior Survey **(**YRBS) is a cross-sectional questionnaire conducted annually to examine self-reported youth risk behaviors. The current study focuses on risk factors for binge drinking as well as change in youth binge drinking between the 2007 and 2017 YRBS surveys. The YRBS is administered to all students within YRBS preselected districts and to standardize variation in Race and Ethnicity, gender, and grade between the 62 high school districts. The primary research outcome was binge drinking classified as a respondent who answered yes to "Have you had more than 5 drinks during one drinking session in the past 30 days". The 10 year difference in frequency of demographic and risk behavior questions including alcohol consumption, physical activity, <5 hours sleep, trying cigarettes, trying various drugs and feeling sad or hopeless were calculated for total survey respondents and respondents who self-classified as binge drinkers in each year. A chi-squared analysis was used to assess the probability of association between binge drinking and demographic groups or survey questions within a the YRBS sampled population. Finally, an adjusted logistic regression was used to model whether binge drinking was statistically associated with year surveyed.

Results: The difference in frequency of binge drinking within the past 30 days was 26% in 2007 versus 13.5% among 2017 survey respondents, which represents a >48% decrease between samples. The survey results showed a 33% reduction in students who reported trying alcohol and a 20% reduction in trying alcohol before age 13. A univariate analysis of other risk behavior questions with a statistically significant change over 10 years included a decrease in the use of cigarettes, cocaine, heroin, and other drugs surveyed. There has also been a 33% increase in feelings of sadness or hopelessness between the surveyed populations.

Discussion: The current study supports research demonstrating a reduction in binge drinking among U.S. youth. Overall, high school students reported to be engaging less in drug and alcohol-related risk factors. The hypothesized reasons for this reduction include better legal enforcement of vendors and venues, rise of new technology of the internet and social media that provide alternative sources of entertainment, a decreased glamorization of alcohol consumption and the development of other ways to spent time [14].

Introduction

Risk-taking is the largest contributor to adolescent morbidity and mortality within the United States. Approximately ten thousand 15 to 19-year old's die annually from preventable causes related to risk behaviors [1]. One such risk behavior is youth binge drinking which can include drinking and driving, risky sexual behavior, victimization and adverse hormonal function [2].The Youth Risk Behavior Surveys (YRBS) examines adolescent risk-taking behaviors including health behaviors (physical activity and sleep), use of illicit drugs, and use of alcohol. The objective of this study was to examine changes in high school student binge drinking and related behavioral risk and health status indicators between 2007 and 2017.

Evidence about Teen Alcohol Use

The prevalence of current alcohol use decreased by 50.8% in a study examining the prevalence of alcohol use between 1991 and 2015 using YRBS data for a high school population [4]. The National Institute of Health (NIH) National Institute on Alcohol Abuse and Alcoholism estimates that by 15 years of age, approximately 29.8% of teens have had at least one drink and by age 18 about 58.0% of teens have had a drink. However, teen binge drinking, defined as more than five drinks per session, is still a major concern. The NIH estimates that teens consume more than 90% of their alcohol through binge drinking, which may put that at increased odds for other health outcomes [2]. For example, studies show evidence of an unequal burden of alcohol consumption across grade with older students drinking at higher prevalence rates, across sex with males drinking at a higher prevalence rate compared to females and across racial-ethnic groups

with white high school students drinking at higher rates compared to their black and Hispanic peers [5].

Physical Activity

It is estimated that no more than half of U.S. high school students meet the recommended 60 minutes of vigorous or moderate-intensity physical activity daily. During the past 30-40 years the volume and intensity of daily exercise among young people has been gradually declining [5]. There is also a documented link between physical activity and alcohol consumption. Several population-based studies have shown a positive association between physical activity and alcohol intake. A standing theory for reported increased alcohol consumption rates within student athletes makes the claim that sports teams frequently celebrate together. This association is not seen across all sports and competitions [6].

Sleep

Insufficient sleep is a risk factor for substance use in adolescence. A large study population from 2009 Fairfax County Virginia showed high school students reported an average 6.5 h of sleep per school night, with 20% obtaining ≤5 h, and only 3% reporting the recommended 9 h/night. The study indicated that just 1 h less of weekday sleep was associated with significantly greater odds of substance use [7].

Other Drug Use

Similarly, there is an association between binge drinking in adolescence and other drug use disorder in young adults [8]. Marijuana is consistently the third most reported substance of use after Alcohol and Tobacco. Marijuana and other drug use have been positively associated with alcohol consumption through binge drinking episodes [9].

Mental Health: Feeling Sad or Hopeless

According to the National Institute of Mental Health, depression in middle and high schools is increasing. In 2016, it was estimated that 12.8 percent of adolescents aged 12-17 in the United States had at least one major depressive episode in 2016. Depression in adolescents is a major risk factor for serious social and educational impairments and an increased rate of smoking, substance misuse, and obesity [10].This study population was larger but overlapping the same age groups as the YRBS but the effects of depression in a younger population may not align exactly with the YRBS surveyed cohort. Overall, it is vital to recognize and treat this disorder.

Study Objective

It is important to examine the relationship between nonmodifiable risk or mitigating factors for binge drinking. Changes in Youth Binge Drinking between 2007 and 2017 including calculating the difference between 2007 and 2017 in overall adolescent alcohol consumption rates and adolescent binge consumption rates, while also examining change in potentially related responses for other drug use, physical activity and sports participation, mental health and sleep quality.

Methods

Data Source

The YRBS is an annual survey by the Centers for Disease Control (CDC) that monitors six categories of health-related behaviors that contribute to the leading causes of death and disability among youth and adults. YRBS data is collected through a national school-based survey by the CDC along with state, territorial, and local education and health agencies and tribal governments [11]. Students were surveyed once during respective survey years and were selected due to their school's affiliation as a CDC survey site. In the current study, the 2007 and 2017 YRBS surveys were used to examine the change in youth binge drinking rates over the last decade.

A diverse community of high school students was sampled in 2007 (N = 14,041) and 2017 (N = 14,765) for a total sample (N = 28,806) of male and female high school students and young adults from the United States area were surveyed. Based on survey data, in 2007 the survey subjects were 29% Freshman, 26% Sophmore 23% Junior and 21% Senior. They were 65% Non-Hispanic White, 16% Non-Hispanic Black, 9% Hispanic and 8% Other/Unknown. Fourty-nine percent self-identified as Female. In 2007 the survey subjects were 27% Freshman, 25% Sophmore 23% Junior and 23% Senior. They were 58% Non-Hispanic White, 14% Non-Hispanic Black 14% Hispanic and 8% Other/Unknown. Fourty-six percent self-identified as Female. Table 1 provides descriptive statistics for respondents (N = 28,806).

Alcohol

The primary research outcome was binge drinking classified as a respondent who answered yes to five or more drinks in the past 30 days during one drinking session in the past 30 days. The 10-year difference in demographic and risk behavior questions was calculated for total survey respondents and respondents who self-classified as binge drinkers in each year.

Physical Activity

A dichotomized response for physical activity was created for students who participated in more than 60 minutes of physical activity on 5 or more of the past 7 days. This cutoff was chosen based on exercise recommendations by the CDC for physical activity [13].

Sleep

Survey question with multiple risk categories such as the minimum hours of sleep on school night was changed to < 5 Hours of sleep on school night to create a dichotomized response.

Various Drugs

All drugs including tobacco, marijuana, cocaine, inhalants, heroin, methamphetamine, ecstasy, steroids, and injected drugs were dichotomized.

Mental Health: Feeling Sad or Hopeless

Feeling Sad or Hopeless within the last 12 months was left as a dichotomized question.

Statistical Analysis

We used chi square tests to determine the significance of associations of binge drinking with descriptive statistics and risk behaviors including grade, Race and Ethnicity, gender, having ever tried drugs included in survey questionnaire, physical activity, sleep and feeling sad or hopeless. Likert scaler risk items were dichotomized to reflect presence or absence of risk.

Logistic regression modelling was utilized to find the odds of self-reported binge drinking in the 2017 YRBS compared to the 2007 survey populations adjusting for gender, grade, Race and Ethnicity and year surveyed given surveyed risk behaviors.

The variables Race and Ethnicity were restructured so if respondents answered yes to "Are you Hispanic or Latino?" and identified as neither Non-Hispanic White nor Non-Hispanic Black they were placed into the Hispanic Race and Ethnicity category. All remaining survey respondents were placed into Non-Hispanic White, Non-Hispanic Black, and Other/Unknown categories.

The study uses deidentified publicly available data that is IRB exempt. All data were analyzed using SAS 9.4.

Results

Our final analyses included 28,806 high school student respondents corresponding to a total study population across two survey waves. Included in this are the populations of all YRBS survey respondents in 2007 (14,041) and 2017 (14,765). The characteristics of the survey cohort in 2007 and 2017 are shown in table 1 (N = 28,806).

The difference in frequency in characteristics between the 2007 and 2017 survey cohorts of the YRBS are shown in Table 1. There were negligible changes in the difference in frequency of characteristics (gender, grade and Race and Ethnicity) of the 2017 survey respondents compared to the 2007 survey cohort. A large sample size may contribute to statistical significance even with small changes in frequency. A greater difference was observed in the difference in frequency of characteristics for the individuals defined as participating in binge drinking behavior with a 15% increase in difference in frequency of binge drinking respondents self-reporting as female. In the 2017 survey cohort there was a 21% lower difference in frequency of binge drinkers being freshmen and 18% increase in binge drinkers being seniors compared to the 2007 survey cohort. Furthermore, the difference in frequency in Race and Ethnicity between the 2007 and 2017 survey respondents showed a 59% increase in the Hispanic student population as well as a 43% increase in students who self-identified outside of Non-Hispanic White, Non-Hispanic Black and Hispanic racial categories.

Alcohol

Using the binge drinking definition of five or more drinks in the past 30 days showed that 26% of all 2007 survey respondents and 13.5% of all 2017 survey respondents participated in binge drinking behavior, or more than a 50% reduction. Similarly, a 19% reduction in the number of high school students surveyed who had tried alcohol, a 20% reduction of difference in frequency in high school students who had tried alcohol before age 13. As expected, there was little or no demonstrated change within the binge drinking sub populations. There was a slight shift of binge drinking from younger to older high school students with a 6% decrease, 2% decrease, 2% increase and 8% increase in binge drinking within Freshman, Sophomore, Junior and Senior grades likely reflecting dropout rates. Female high school students have seen an increase in difference in frequency by 15% and male high school students have seen a reduction by 13%.

Physical Activity

An examination of sports team participation in the 2007 and 2017 survey cohorts shows a 12% decrease in the number of high school students who met the recommended physical activity guidelines over the 10-year span. Within the binge drinking sub cohorts, there was similar trend yet smaller 7% decrease in meeting physical activity guidelines. There has been no change in the difference in frequency of students participating in sports teams.

Sleep

The difference in frequency in respondents who received less tan 5 hours of sleep per night shows a 33% increase in difference in frequency of students receiving inadequate sleeping hours. This number rose from 16% in 2007 to 21% in 2017. The same effect can be seen in the survey sub cohort who self-identified as engaging in binge drinking behavior.

Other Substance Use

The difference in frequency of ever trying cigarettes has decreased by 59% over the 10 years. The survey results show an even more significant 63% decrease in ever trying smoking among the binge drinking cohort. Marijuana usage remained at a similar difference in frequency in 2017 compared to 2007 with a much smaller 7% decrease. Overall, we can see the difference in frequency of each drug use has decreased over the 10-year period.

Mental Health: Feeling Sad or Hopeless

Finally, there has been a 33% increase in difference in frequency of feeling sad or hopeless in high school students. This increase has been very similar in the group who self-identify as binge drinkers.

Chi square tests determined all demographic and risk behavior questions within the YRBS sampled populations are related to self-reporting binge drinking behavior as can be seen through Chi-Square value probabilities all statistically significant in table 2.

Logistic regression modeling in table 3 showed survey respondents in 2017 were 0.91 (confidence interval 0.90-0.91) times as likely as 2007 respondents to self-report binge drinking behavior. Survey participants in 2017 were at a decreased odds of being a binge drinker after adjusting for grade, gender, and sex. The Odds Ratio between grade and being a binge drinker either survey year increased with 11^{th} OR=1.966 (1.78, 2.15) and 12^{th} grades compared to freshman. The odds for male sex compared to female were OR= 1.06 (1.005, 1.138). Finally, compared to Non-Hispanic White respondents, Non-Hispanic Black respondents were at a decreased odds OR=0.31 (0.28, 0.35) of being a binge drinker, as were Hispanic students OR= 0.65 (0.56, 0.76) and Other/Unknown OR= 0.71 (0.66, 0.77).

Discussion

Alcohol

An examination of the Changes in Youth Binge Drinking between 2007 and 2017 using the Youth Risk Behavior Survey showed a 12.5% decrease in binge drinking, or more than a 50% reduction. Overall, high school students surveyed showed to be engaging in a lesser frequency of drug and alcohol related risk factors. The differences in the two populations show a decrease in odds and an even larger decrease in odds within the populations who participated in binge drinking behavior. Overall, we can see the frequency of each drug use has decreased over the 10-year period likely reflecting the impact of school-based prevention programs.

This study further confirms adolescent binge drinking has decreased. Studies conducted by the European School Survey Project on Alcohol and Other Drugs and the Australian School Students Alcohol and Drug surveys showed the average prevalence of consuming 5 or more drinks on at least 1 occasion in the past 30 days was 39% across countries [7]. Binge drinking is

decreasing overall but teens reporting feeling sad or hopeless is on the rise. Next steps include exploring reasons why teens are drinking less.

In addition to the YBRS, two other national surveys, The National Survey on Drug Use and Health, Monitoring the Future, collect annual data on adolescent drinking patterns in the United States. These surveys have also shown a similar trend in youth binge drinking. A meta-analysis published by the Center for Behavioral Health Statistics and Quality showed a peak in the prevalence of youth binge drinking in the late 1970s to early 1980s, followed by a decrease from 41% prevalence in 1983 to 10.9% in 2015 [5].

This study confirms a significant decline in the prevalence of underage drinking in recent years. Theories to explain the decline include better legal enforcement of vendors and venues, rise of new technology of the internet and social media that provide alternative sources of entertainment, a decreased glamorization of alcohol consumption and the development of other ways to spent time. All these associations are correlations and most disappear when controlling for confounding factors [15].

The adjusted Odds Ratio for being a binge drinker in 2017 compared to 2017 was 0.91. Because the unadjusted Odds Ratio for binge drinking was 0.91 (0.90-0.92) this study provides strong evidence against confounding by grade, gender, or Race and Ethnicity. These factors are more likely independently associated with binge drinking. This study also highlights the importance of exploring other factors possibly associated with binge drinking touched upon in this study such as inadequate sleep or feelings of sadness or hopelessness.

Limitations

A key limitation of the YRBS is it is all self-reported data. The possibility and extent of underreporting and overreporting of behaviors cannot be and has not been determined by previous studies. The results of this study should not be generalized outside of the population of the United States and is likely more applicable to urban settings students as majority of YRBS respondents were of an urban background. Another limitation is that these findings are based on

only 2 time points, and it is not clear if these trends have continued or how these data which are now three years old may apply to adolescents in 2020.

Furthermore, a 1992 study conducted by the NHIS and Youth Risk Behavior Supplement demonstrated that out-of-school high school students are more likely than youths attending school to engage in most health-risk behaviors [16]. These study findings should be applied with caution to out-of-school high school students.

Implications

The implications of this study allow for further evidence to what is known, high school students are drinking and binge drinking at lower rates than a decade previously. This is important because we know of the high school students who consume alcohol, majority are binge drinkers which is linked with multiple acute health issues.

Future directions could include an exploration of the possible extent of underreporting and overreporting of health behaviors by high school students. This study utilized YRBS data which allowed for access to a wide range of adolescent experiences to be surveyed by design. The data source is both a key strength and limitation because the vast survey has not been validated for effectiveness in capturing lived experience. Surveys are notorious for underreporting stigmatized behaviors and should be interpreted with caution.

Conclusion

Finally, both high school drinking and binge drinking have gone down significantly. This decline has been documented and no one theory explains the decline although many theories credit social changes, a better legal enforcement of vendors and venues, rise of new technology of the internet and social media that provide alternative sources of entertainment and a decreased glamorization of alcohol consumption and the development of other ways to spent time.

Table 1: A summary of descriptive statistics for respondents to the 2007 and 2017 using YRBS surveys								
	2007 Sample n (%)	2007 Binge Drinkers n (%)	2017 Sample n (%)	2017 Binge Drinkers n (%)	Δ 10 Years All	Δ 10 Years Binge	P-value Δ All	P-value Δ Binge
	N=14041	N=3,976	N=14765	N=1772				
Had 1 drink on 1+ days in life	10531 (75)	3976 (100)	8918 (60.4)	1772 (100)	-0.19	0.00	<.0001	<.0001
Had first drink before 13	9913 (70.6)	3977 (100)	8342 (56.5)	1582 (89.3)	-0.20	-0.11	<.0001	<.0001
Had 1+ drinks past 30 days	6276 (44.7)	3978 (100)	4400 (29.8)	1772 (100)	-0.33	0.00	<.0001	<.0001
Five+ drinks 1+ past 30 days	3651 (26)	3979 (100)	1993 (13.5)	1772 (100)	-0.48	0.00	<.0001	<.0001
Gender							0.0333	<.0001
Female	6950 (49.5)	1840 (46.3)	7485 (50.7)	946 (53.4)	0.02	0.15		
Male	7091 (50.5)	2135 (53.7)	7279 (49.3)	828 (46.7)	-0.02	-0.13		
Grade							<.0001	0.5561
Freshman	4071 (29)	747 (18.8)	4030 (27.3)	262 (14.8)	-0.06	-0.21		
Sophmore	3678 (26.2)	950 (23.9)	3794 (25.7)	386 (21.8)	-0.02	-0.09		
Junior	3285 (23.4)	1073 (27)	3528 (23.9)	484 (27.3)	0.02	0.01		
Senior	2991 (21.3)	1200 (30.2)	2295 (23)	632 (35.7)	0.08	0.18		
Race and Ethnicity							<.0001	<.0001
Non-Hispanic White	9238 (65.8)	3005 (75.6)	8046 (58.5)	1235 (69.7)	-0.11	-0.08		
Non-Hispanic Black	2288 (16.3)	306 (7.7)	2126 (14.4)	103 (5.8)	-0.12	-0.25		
Hispanic	1277 (9.1)	377 (9.5)	2140 (14.5)	264 (14.9)	0.59	0.57		
Other/Unknown	1236 (8.8)	286 (7.2)	1860 (12.6)	170 (9.6)	0.43	0.33		

Active 60 min on 5+ past 7 days	12805 (91.2)	3272 (82.3)	11871 (80.4)	1350 (76.2)	-0.12	-0.07	<.0001	<.0001
On sports team 12 mos	7525 (53.6)	2027 (51)	8017 (54.3)	998 (56.3)	0.01	0.10	<.0001	<.0001
< 5 Hours of sleep on school night	2246 (16)	842 (21.2)	3144 (21.3)	501 (28.3)	0.33	0.33	<.0001	<.0001
Ever tried cigarettes	9856 (70.2)	3212 (80.8)	4267 (28.9)	533 (30.1)	-0.59	-0.63	<.0001	<.0001
Tried marijuana 1+ times in life	5349 (38.1)	2970 (74.7)	5256 (35.6)	1394 (78.7)	-0.07	0.05	<.0001	<.0001
Used cocaine 1+ times in life	1010 (7.2)	763 (19.2)	708 (4.8)	350 (19.8)	-0.33	0.03	<.0001	<.0001
Sniffed glue 1+ times in life	1867 (13.3)	950 (23.9)	915 (6.2)	229 (12.9)	-0.53	-0.46	<.0001	<.0001
Used heroin 1+ times in life	322 (2.3)	218 (5.5)	251 (1.7)	106 (6)	-0.26	0.09	0.6293	0.6896
Used meth 1+ times in life	617 (4.4)	445 (11.2)	369 (2.5)	143 (8.1)	-0.43	-0.28	0.0031	<.0001
Used ecstasy 1+ times in life	814 (5.8)	616 (15.5)	1018 (6.9)	391 (22.1)	0.19	0.43	0.0407	<.0001
Took steroids 1+ times in life	547 (3.9)	365 (9.2)	428 (2.9)	190 (10.7)	-0.26	0.16	0.0407	0.0068
Injected drugs 1+ times in life	280 (2)	182 (4.6)	221 (1.5)	25 (1.4)	-0.25	-0.70	<.0001	<.0001
Ever feel sad or hopeless 12 mos	3313 (23.6)	914 (23)	4636 (31.4)	527 (29.76)	0.33	0.29	<.0001	<.0001

Table 2: A list of descriptive statistics and survey questions with Chi Square Values and Pr>Chi	
Question	**Pr > Chisq**
Gender	0.018
Grade	<.001
Race and Ethnicity	<.001
Had 1 drink on 1+ days in life	<.001
Had first drink before 13	<.001
Had 1+ drinks past 30 days	<.001
Five+ drinks 1+ past 30 days	<.001
Active 60 min on 5+ past 7 days	<.001
On sports team 12 mos	<.001
< 5 Hours of sleep on school night	<.001
Ever tried cigarettes	<.001
Tried marijuana 1+ times in life	<.001
Used cocaine 1+ times in life	<.001
Sniffed glue 1+ times in life	<.001
Used heroin 1+ times in life	<.001
Used meth 1+ times in life	<.001
Used ecstasy 1+ times in life	<.001
Took steroids 1+ times in life	<.001
Injected drugs 1+ times in life	<.001
Ever feel sad or hopeless 12 mos	<.001

Table 3: Odds Ratio Estimates for Engaging in Self-Reported Binge Drinking Behavior in 2017 compared to 2007 Adjusted for Grade, Gender and Race and Ethnicity			
Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Unadjusted- Set	0.91	0.90	0.91
Q2 Male vs Female	1.06	1.00	1.13
Q3 10th grade vs 9th grade	1.51	1.37	1.66
Q3 11th grade vs 9th grade	1.96	1.78	2.15
Q3 12th grade vs 9th grade	2.62	2.39	2.87
Non-Hispanic Black vs Non-Hispanic White	0.31	0.28	0.34
Hispanic vs Non-Hispanic White	0.65	0.56	0.76
Other/Unknown vs Non-Hispanic White	0.71	0.66	0.77

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