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**An analysis of risk behaviors in high school students that affect memory, concentration,
and decision making**

By

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Submitted in Partial Fulfillment
of the Requirements for
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Abstract

The youth population is a large portion of the total population in the United States, making up approximately 25% of all people. Youth, especially as they reach high school age, are prone to partaking in risk behaviors, or behaviors that put them at increased risk of morbidity and mortality. The Centers for Disease Control and Prevention (CDC) conducts a survey every other year to collect data on these risk behaviors called the National Youth Risk Behavior Survey (YRBS). For this study, data was pulled from the survey regarding tobacco use, alcohol use, marijuana use, physical activity, television watching, breakfast eating, and sleep quantity. These various behaviors have differing impacts on high school students, and a simple bivariate analysis was conducted to examine the relationship between those behaviors and those who answered the question “Because of a physical, mental, or emotional problem, do you have difficulty remembering, concentrating, or making a decision?” (CDC, 2016c). The results indicated that those who answered ‘yes’ to the question above were less likely to be drinkers, smokers, drug users, and less likely to be physically inactive than those who answered ‘no’. They were more likely to be physically active, get adequate sleep, and eat breakfast consistently. A stratified analysis was conducted by sex, and the results were very similar for both males and females surveyed. While other literature points to the opposite, we found that those who report a physical, mental, or emotional problem that is causing difficulty remembering, concentrating, or making decisions or more likely to exhibit healthier behaviors.

Introduction

The youth population, ages 0-17 in the United States accounts for approximately 23% of the total population, and the age group 18-22 accounts for another large section of the population (Forum on Child and Family Statistics, 2015). Because these age groups make up such a significant portion of the total population, the injuries and fatalities associated with the group also account for many of the total number of injuries and fatalities for the entire population. There are many behaviors that individuals practice that lead to increased morbidity and mortality, especially among youths (Kolbe, Kann, & Collins, 2015). Risk behaviors can become habitual and have a greater effect on their health the older the individuals get (Gerard & Buehler, 2004). The National Youth Risk Behavior Survey (NYRBS) is a survey conducted to identify these behaviors and determine potential causes (Kolbe et al., 2015). According to the 2015 NYRBS, high school aged students participated in risk behaviors involving tobacco use, alcohol use, marijuana use, lack of physical activity, television viewing, lack of breakfast, inadequate sleep, and impaired cognitive function because of a problem. The injuries or health problems that stem from these behaviors can linger for years, if not for the rest of the individual's lives, making it a priority to prevent these behaviors to keep youth in the United States safe and healthy (Gerard & Buehler, 2004).

Tobacco use is one of the most common risk behavior across all populations within the United States. Though many recent campaigns have stressed the adverse health effects of tobacco use, youth in the United States are still the most common users, and the most at risk for addiction and poor health outcomes (Centers for Disease Control and Prevention, 2015; U.S. Department of Health and Human Services, 2012). It has been shown that adolescent use of traditional tobacco products (cigarettes, cigars, chewing tobacco, etc.) have remained relatively

the same in recent years, but sources like electronic cigarettes, or e-cigs, is on the rise (CDC, 2015; HSS, 2012). In 2013, 22.4% of students reported some form of tobacco use (not including e-cig use) in the 30 days prior to taking the survey, and 31.4% of students reported tobacco use (including e-cig use) within 30 days prior to the survey in 2015 (CDC, 2014, 2016c). There has been evidence that demonstrates that nicotine may have beneficial effects on memory and attention, but also literature that supports smoking and decreased cognitive function, especially in youth (Chamberlain, O'dlaug, Schreiber, & Grant, 2012; Rezvani & Levin, 2001). While nicotine may be beneficial in certain circumstances, smoking in general is harmful to overall health, as well as cognitive function.

Alcohol use is common among high school students, with 63.2% reporting alcohol consumption at some point in their lifetime, and 32.8% reporting alcohol use in the 30 days prior to taking the survey (CDC, 2016c). Though an overall decrease from 66.2% of lifetime alcohol consumption and 34.9% currently using alcohol in 2013, it is still a large problem (CDC, 2014). Alcohol is known to cause cirrhosis, foster addiction, and cause brain impairment. In youth, drinking can lead to lifelong dependency, as well as a host of medical problems (Squeglia, Jacobus, & Tapert, 2014). According to various studies, alcohol has the potential to alter brain structure and function, which has the potential to alter behavior (Luciana, Collins, Muetzel, & Lim, 2013; Squeglia et al., 2014). This leads to decreased cognition, and could have lifelong impacts on how individuals who drink behave and make decisions (Luciana et al., 2013; Squeglia et al., 2014).

Marijuana use in the United States has grown in the past decade (Hasin et al., 2015, Meier et al., 2015; Volkow, Baler, Compton, & Weiss, 2014). According to the 2015 YRBS, 38.6% of students reported ever using marijuana, and 21.7% reported using marijuana within 30

days prior to the survey. There is conflict in the literature on whether marijuana use among adolescents is increasing in more recent years, however a significant portion of the population does use marijuana, with many students beginning before the age of 13 (CDC, 2016c; Meier et al., 2012; Volkow et al., 2014). Marijuana use, specifically during adolescence, has been associated with an increase in addictive behavior, an increase in other substance use, an impairment of brain function, and decreased cognition (Meier et al., 2012; Volkow et al., 2014).

Sleep is a key factor in healthy growth and development of youth (Shochat, Cohen-Zion, & Tzischinsky, 2014; Syväoja, Tammelin, Ahonen, Kankaanpää, & Kantomaa, 2014; Telzer, Fuligni, Lieberman, & Galvan, 2013). In 2013, 31.7% of students said they slept for eight hours or more on an average school night, which then dropped to 27.3% in 2015 (CDC, 2014, 2016c). Sleep has been shown to be necessary for proper development, weight control, and cognitive function (Shochat et al., 2014; Syväoja et al., 2014; Telzer et al., 2013). Not only does it encourage proper development and cognitive function, it has also been associated with risk taking behavior (Telzer et al., 2013). Youth with less sleep were more likely to partake in risk behaviors, increasing morbidity and mortality (Telzer et al., 2013).

Proper diet, particularly in the morning, is also a vital part of the growth and development of a child (Wesnes, Pincock, & Scholey, 2012). According to the 2015 NYRBS, 36.6% of students had eaten breakfast on all seven days prior to the survey, and 13.8% of students ate breakfast on all seven days prior (CDC, 2016c). Both in laboratory and real settings, eating breakfast has been shown to have a positive effect on the cognitive function of those who partake in early morning eating, and a negative impact on those who skip breakfast (Wesnes et al., 2012). A correlation between good academic performance and breakfast consumption has been shown as well (Adolphus, Lawton, & Dye, 2013).

Physical activity has recently become a large area of research, largely due to the rising rates of obesity on a global scale (Paravidino, Mediano, & Sichieri, 2017). In the 2015 NYRBS, 14.3% of students nationwide were physically inactive in the week leading up to the survey, 48.6% were active for at least one hour for five of the seven days, and 27.1% stated that they were active for at least one hour on all seven days prior (CDC, 2016c). Physical activity has been shown to be beneficial to children's attention spans and possibly overall cognitive function, boosting academic performance and promoting healthy growth (Syväoja et al., 2014). Sedentary behavior, like watching television, has been demonstrated to decrease amounts of physical activity as well as impair cognitive function and may cause learning disabilities (Syväoja et al., 2014). In the 2015 NYRBS, 24.7% of students watched TV for more than three hours a night on the average school night (CDC, 2016c).

The purpose of this study is to examine how tobacco use in all forms, alcohol use, marijuana use, physical activity, television watching, sleep, and breakfast eating are associated with any difficulty concentrating, remembering, or making decisions due to a physical, mental, or emotional problem in high school students in the United States.

Methods

This study used data from the 2015 National Youth Risk Behavior Survey. The National Youth Risk Behavior Survey (NYRBS) is a survey distributed to high schools across the United States from the Centers for Disease Control and Prevention (CDC). The NYRBS is published every year, and examines youth in grades 9th-12th in six different categories. Those six are, safety behaviors that lead to unintentional injury or fatality, tobacco use, alcohol and other substance use, sexual activity and abuse that can lead to unwanted pregnancy or sexually transmitted infections, dietary behaviors, and physical inactivity. The CDC receives these surveys from

states across the nation, and allows them to best demonstrate what issues are most prevalent in a young adult's life, and how injury and death can be prevented in the future. Several questions have been added to the 2015 survey from the previous surveys regarding suntan lotion use, academic grades, and cognition due to a complicating issue.

Analysis included risk behaviors involving tobacco use, alcohol use, marijuana use, lack of physical activity, television viewing, lack of breakfast, inadequate sleep, and impaired cognitive function because of a physical, mental, or emotional problem. Each risk behavior was crossed against difficulty concentrating, remembering, or making a decision because of a physical, mental, or emotional problem, which is the outcome variable. To concentrate the study, a stratified analysis was performed by sex. The dependent was crossed with each independent, with the sex of the surveyed taken into account.

A statistical analysis using SAS 9.4, an analysis program (SAS, 2017), was used to examine the relationship between tobacco use, alcohol use, marijuana use, lack of physical activity, television viewing, lack of breakfast, and inadequate sleep and how it may or may not impair cognitive function because of a physical, mental, or emotional problem. The following questions come directly from the 2015 National Youth Risk Behavior Survey:

- During the past 30 days, on how many days did you smoke cigarettes?
- During the past 30 days, on how many days did you use an electronic vapor product?
- During the past 30 days, on how many days did you use chewing tobacco, snuff, dip, snus, or dissolvable tobacco products, such as Redman, Levi Garrett, Beechnut, Skoal, Skoal Bandits, or Copenhagen?
- During the past 30 days, on how many days did you have at least one drink of alcohol?
- During the past 30 days, how many times did you use marijuana?
- During the past 7 days, on how many days did you eat breakfast?

- During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?
- On an average school day, how many hours do you watch TV?
- On an average school night, how many hours of sleep do you get?
- Because of a physical, mental, or emotional problem, do you have serious difficulty concentrating, remembering, or making decisions?

Each variable was organized dichotomously, consolidating the answers to ‘Yes’ and ‘No’ to each question. The data was run through using the CDC’s guidelines for SAS analysis (CDC, 2016b). The strata was set to STRATUM, the cluster was set to PSU, and the weight to WEIGHT per the guidelines from the CDC (CDC, 2016b). A total of 15561 observations were recorded for this study.

The aim of this study is to examine the relationship between tobacco use, alcohol use, marijuana use, lack of physical activity, television viewing, lack of breakfast, and inadequate sleep and how it may or may not impair cognitive function because of a physical, mental, or emotional problem. We will also explore this relationship by sex. In the National Youth Risk Behavior Survey, high school age children were assessed for substance use by asking if tobacco, alcohol, or marijuana was currently used around the time of the survey. Physical activity, sleep, television watching, and breakfast eating were assessed within the past month or on the average school day.

Results

In summary, an overall inverse relationship was discovered between tobacco use, e-cigarette use, alcohol use, marijuana use, lack of physical activity, and television watching. This means that those, of all ages, sexes, and grades, who indicated having difficulty concentrating, remembering, or making decisions because of a physical, mental, or emotional problem were less

likely to smoke, drink, or watch TV, or to be physically active, than their counterparts who answered 'no' to having difficulty concentrating, remembering, or making decisions due to a physical, mental, or emotional problem.

Physical activity for any amount of days, adequate sleep, and proper breakfast had a direct relationship with the outcome variable. Those, of all ages, sexes, and grades, who indicated having difficulty concentrating, remembering, or making decisions because of a physical, mental, or emotional problem were more likely to be physically active, get eight hours of sleep, and eat breakfast on a regular basis than their counterparts who answered 'no' to the question. The only variable that did not have any impact on general cognitive function was the use of smokeless tobacco. Those who answered 'yes' to having difficulty concentrating, remembering, or making decisions were more likely to use smokeless tobacco than their peers who answered 'no'.

When separated by sex, many of the results are similar to the overall results. Males with difficulty concentrating, remembering, or making a decision were less likely to use tobacco, smokeless tobacco, e-cigarettes, alcohol, and marijuana than those who did not indicate a problem. Those with a problem were more likely to be physically active for at least five days out of the week, get adequate sleep, and eat breakfast consistently than those without a problem. Both groups were equally likely to be physically active for at least seven days out of the week, be inactive for at least one day, and watch television.

Females with an issue concentrating, remembering, or making a decision were less likely to use tobacco, e-cigarettes, alcohol, marijuana, and be inactive for at least one day out of the week than those without a problem. They were more likely to be physically active for at least five or seven days out of the week, get adequate sleep, and eat breakfast consistently. Both

groups were equally likely to use smokeless tobacco. In summary, when analyzed by sex, the results were very similar for both males and females. Only minor differences occurred between the two, between very few variables.

Table 1. Demographics YRBS Survey 2015

<u>Age</u>				
	Weighted Frequency	Percent	95% Confidence Limits	
12 years old or younger	31.23360	0.20%	0.0911	0.3103
13 years old	9.36020	0.06%	0.0109	0.1094
14 years old	1562	10.03%	8.5456	11.5355
15 years old	4063	26.11%	24.9766	27.2431
16 years old	3904	25.08%	23.5944	26.5804
17 years old	3686	23.69%	22.5630	24.8079
18 years old or older	2306	14.82%	13.2992	16.3325
Total	15561			
<u>Sex</u>				
	Weighted Frequency	Percent	95% Confidence Limits	
Female	7551	48.53%	45.3972	51.9969
Male	7655	51.47%	48.0031	54.6028
<u>Grade</u>				
	Weighted Frequency	Percent	95% Confidence Limits	
9th Grade	4221	27.13%	25.4031	28.9940
10th Grade	3982	25.59%	23.6075	27.7045
11th Grade	3712	23.85%	22.5775	25.2591
12th Grade	3580	23.00%	22.1554	23.9799
Ungraded or other grade	24.7691	0.16%	0.0657	0.2535

Table 2. Multiple Variable and Decision Making, Concentration, and Memory. YRBS Survey 2015

	Weighted Frequency		Unweighted Frequency		Odds Ratios
	Yes	No	Yes	No	PE (95% CIs)
Current Tobacco Use	1335.62	10884.07	118	9563	0.46 (0.389-0.546)
Current Smokeless Tobacco Use	897.15	11615.99	740	10300	1.05 (0.841-1.311)
Current E-Cig Use	3027.13	9475.29	2803	8228	0.58 (0.518-0.656)
Current Alcohol Use	3860.19	7800.01	3390	6797	0.64 (0.568-0.728)
Current Marijuana Use	2700.35	9750.57	2514	8468	0.61 (0.541-0.687)
PA for 60+ minutes/5 days	6338.93	6212.61	5316	5746	1.46 (1.311-1.615)
PA for 60+ minutes/7days	3533.73	9017.80	2946	8116	1.48 (1.304-1.668)
No PA at least 1 day/week	1662.69	10888.85	1614	9448	0.76 (0.647-0.893)
TV for 3+ hours/week	3076.18	9485.82	2962	8600	0.80 (0.676-0.939)
8+ hours sleep/night	3530.57	8950.32	3973	7113	1.96 (1.391-1.820)
Breakfast all 7 days/week	4670.40	7917.25	3158	7831	1.59 (1.743-2.20)

Table 3. Associations between various risk behaviors and concentrating, remembering, and making decisions by sex. YRBS 2015

		Weighted Frequency		Unweighted Frequency		Odds Ratios
		Yes	No	Yes	No	PE (95% CIs)
Current tobacco use	Males	2119.55	3868.41	2013	3405	0.36 (0.293-0.444)
	Females	1456.55	4676.75	1321	3929	0.51 (0.395-0.659)
Current smokeless tobacco use	Males	2177.93	3900.46	2076	3450	0.47 (0.296-0.756)
	Females	1537.14	4795.32	1386	4040	0.95 (0.723-1.238)
Current e-cigarette use	Males	2178.15	3902.57	2076	3449	0.51 (0.429-0.615)
	Females	1534.08	4791.45	1382	4037	0.61 (0.514-0.727)
Current alcohol use	Males	1986.17	3687.62	1890	3234	0.58 (0.513-0.665)
	Females	1430.74	4466.63	1255	3727	0.71 (0.576-0.862)
Current marijuana use	Males	2174.18	3890.61	2071	3438	0.53 (0.451-0.630)
	Females	1515.64	4774.23	1364	4021	0.63 (0.533-0.751)
PA for 60+ minutes/5 days	Males	2174.96	3919.23	2072	3458	1.23 (1.052-1.427)
	Females	1532.40	4820.10	1385	4056	1.46 (1.234-1.718)
PA for 60+ minutes/7 days	Males	2174.96	3919.23	2072	3458	1.23 (0.980-1.550)
	Females	1532.40	4820.10	1385	4056	1.39 (1.182-1.624)
No PA for at least 1 day/week	Males	2174.96	3919.23	2072	3458	0.88 (0.707-1.104)
	Females	1532.40	4820.10	1385	4056	0.72 (0.560-0.916)
TV for 3+ hours/day	Males	2177.69	3910.93	2076	3451	0.85 (0.713-1.023)
	Females	1539.65	4829.83	1385	4060	0.71 (0.554-0.899)
8+ hours sleep/night	Males	2173.30	3904.46	2068	3436	1.46 (1.103-1.934)
	Females	1513.001	4785.64	1370	4025	1.62 (1.351-1.941)
Breakfast all 7 days	Males	2183.27	3929.93	2082	3462	2.13 (1.796-2.516)
	Females	1545.13	4821.75	1391	4057	1.63 (1.379-1.920)

Discussion

Because the results vary from risk behavior to risk behavior, a range of conclusions can be drawn. Tobacco use among those who claim an effect on cognition was lower, or less likely than those who did not, which was also true of both males and females. This contrasts with other pieces of literature that outline a heavier nicotine dependence and tobacco use among those suffering from a mental illness or physical disability (CDC, 2011; Depp et al., 2015; Hall et al., 2015). The limitation with the current literature is that it is all focused on adults, and not on children. The inverse relationship shown in this paper could be due to the lack of authority over their own lives, still living in a home with their parents or guardians.

Alcohol use is often connected or associated with tobacco use, leading to similar results in studies. Several authors have noted that alcohol use is also comorbid with many mental disorders, similar to tobacco use and other substances (Burns & Teesson, 2002; Schweisnburg et al., 2005). However, this study has demonstrated that in high school students, the effect is just the opposite. Those who have a cognitive issue due to a physical, mental, or emotional problem are less likely to be drinkers. This could be for the same reasons as tobacco use, that students who are having issues are more likely to be monitored by their parents than those who are not.

The same is also true for marijuana use. Alcohol use and other drug use have been shown to be comorbid, as individuals who drink alcohol also use other substances (Schweisnburg et al., 2005). Marijuana use is becoming more prevalent, especially as it becomes legal for medical and recreational purposes across the United States (Gilson, Chilcoat, & Stapleton, 1996; Schweisnburg et al., 2005). Though it is prevalent amongst high school students, those who had some cognitive impairment were less likely to use marijuana. Both male and female students were less inclined to use marijuana. It could be similar to the use of tobacco and alcohol, in that

their parents or guardians are much more vigilant because of their physical, mental, or emotional issue, and exercise more authority over their children's lives because of that.

Across the board, students were answered 'yes' to the question regarding were more likely to be physically active. It has been shown that physical activity is less likely to occur in adults with physical, mental, or emotional problems (CDC, 2016a; Rimmer, Wang, & Jurkowski, 2004). These students were also less likely to watch more than three hours of television a day, get less than eight hours of sleep a night, and not eat breakfast. It is interesting to note that those with physical, mental, or psychological issues tend to be less physically active, be more sedentary, have a poorer diet, as well as have poorer sleep patterns (Rimmer et al., 2004; Ptomey, Goetz, Lee, Donnelly, & Sullivan, 2013).

Overall, those who have difficulty remembering, concentrating, or making decisions due to some previous issue, appear to be healthier than their counterparts. They were less likely to drink, smoke, use drugs, watch large amounts of television, were more physically active, ate breakfast consistently, and got adequate amounts of sleep. According to much of the previous research, these students are more likely to have healthier behaviors. This contrasts with much of the research performed on adults, as well as their counterparts in this study. Much of the previous literature indicates people that suffer from physical, mental, or emotional issues are more likely to drink, smoke, be less physically active, and have poor eating and sleep habits. While this study is not conclusive, and does not account for all potential confounders, it does suggest an association between healthier behaviors and having a cognitive impairment due to a physical, mental, or emotional problem. Future research should be geared toward an age-adjusted analysis. The results were almost identical by sex, however, discovering when the shift occurs in the

literature could be crucial to understanding when to place certain interventions to promote healthy behaviors.

Strengths

There are several strengths to this study, the first being the sample size. Though approximately 15,000 observations have been recorded and used for this study, which is large enough to give accurate representation of each of the fifty states. It is also large enough so the confidence intervals are precise and accurate for all analyses. The bivariate analysis allowed for clear and concise results, given that it could only be 'yes' or 'no'. This makes the results clear and precise.

Limitations

There are some limitations to this particular study, the first being that the outcome variable in the survey poses a very broad question. It reads as follows, "Because of a physical, mental, or emotional problem, do you have serious difficulty concentrating, remembering, or making decisions?" (CDC 2015). The problem could be something as severe as a permanent disability, or it could just be something as simple as having a bad week. The lapse in concentration, the difficulty remembering, and the inability to make a decision could also be a one-time matter, or it could be lifelong. There is no temporal scale to compare the answer to. These leave the answers open to interpretation, which weakens the study, however, it opens the door to new, more specific research. Also, the study only filtered results by sex. While there was no real difference between males and females, other literature demonstrates differences in individuals by age. Finally, the bivariate analysis provides a very broad direct or indirect

relationships. Being a cross-sectional study, only associations can be drawn between the variables, and cause and effect cannot be determined.

Recommendations

Further research is needed to be geared towards high school students behaviors and how they change as they age. When does the shift from the results seen in high school aged students to the results seen in adults occur? The question given by the survey is broad, and could easily lead to some misunderstanding of what the question is looking for. If further research is going to be focused around this particular question regarding concentration, memory, and decision making, it needs to be narrowed. The question itself is too chunky, and needs to be consolidated, but also the context in which the question is asked. The temporal nature of the question needs to be clearly defined.

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