HIGH SCHOOL EDITION
Journal of Student Research
Volume 11 Issue 3 (2022)

Analysis of Anxiety and Depression in the Context of Commercially-Available Energy Beverage Consumption

Nathan Ming[1] and Chloe Cavanaugh[#]

[1]Los Gatos High School, Los Gatos, CA, USA
[#]Advisor

ABSTRACT

Introduction

Energy drinks are common in the diets of teenagers. Despite the increase in consumption in American teenagers, little has been done to study its effects on the anxiety and depressive behaviors of teenagers.

Methods

25 participants were selected including a majority of Asians and Caucasians between the ages of 12 to 22. The participants filled out a survey that recorded a baseline for a week, and then drank increasing dosages of energy drinks the following week while continuing to fill out a survey. They filled out a survey that was designed with SIG E CAPS indicators on each day, and the results were compared using a student's t-test.

Results

The results were not statistically significant, but this supports that the caffeine limit set by the Food and Drug Administration does indeed prevent negative effects of caffeine on adolescents. One participant, with a pre-existing psychiatric condition, withdrew from the study after his markers of anxiety were significantly higher in the week that he took the energy drinks.

Discussion

While the study was limited in both scale and dosage, it did fall in alignment with the body of literature that preceded it. To formulate a statistically significant study with results that have a higher confidence level, the dosage of caffeine and the number of participants who consume it would need to be increased.

Conclusion

The study, while not being statistically significant, reinforced the pediatric limit of caffeine and opened the door to further studies that involve a higher dosage or more participants.

Introduction

Adolescents and adults around the world consume energy drinks to sustain themselves over periods of great stress or increased workload. Commonly, these drinks are carbonated beverages that contain sweeteners, flavorings, and caffeine in order to boost an individual's alertness and delay the urge to fall asleep. Energy drink consumption and regulation for adolescents remains controversial. In certain countries, such as the UK, energy drinks are considered controlled substances and require age-specific identification to purchase.[1] However, in the United States there are no age-specific regulations or limitations on energy drink purchases by adolescents. Given this lack of limitations, the Food and Drug Administration has suggested a maximum dosage of 400 milligrams of caffeine per day for adults (defined as those above the age of 18), but the dosage recommendation is adjusted to 100 milligrams of caffeine daily for adolescents.[2]

Multiple studies have found mood changes as a result of energy drink consumption.[1,3,5] One study observed that tension and anxiety scores increased significantly relative to placebo at 1h post consumption in Austrian adolescents.[3] A study conducted on South Korean students' energy drink intake indicated energy drink intake was significantly associated with sleep dissatisfaction.[4] The authors concluded that energy drinks led to detrimental effects related to stress, sleep, and overall mood. Additional research conducted in North America supports higher cases of insomnia, abdominal pain, and irritability.[19] In a study conducted in 2017, healthy 18-year olds were subjected to 946 mL of caffeine and 15 participants exhibited negative effects during the energy drink arm and 13 participants exhibited the same negative effects during the caffeine control arm.[5] Adverse effects named by the study included anxiety, insomnia, dizziness, nausea, and shortness of breath.

Similarly, the American teenage demographic consume large amounts of energy drinks.[6, 7] However, scientific study has been sparse in documenting the effect of energy drinks on the adolescent mind in America. Through literary research, there was a significant lack of research done in the United States on the effects of these drinks on teenagers (those under 18), and specifically that done with low doses. The purpose of this study is to investigate the effect of energy drink consumption on adolescent mood. It was hypothesized that energy drink consumption would increase markers of anxiety and depression in the individuals undergoing the testing, due in part to the caffeine but also due to the added sugars.[2, 3, 5, 8] Learning about the effects of energy drinks on adolescents is important due to the implications it could have on the developing mind and body during the critical developmental period of adolescence. As many students consume these drinks, and often in large quantities, better understanding of the effects of these substances is needed.

Methods

Study Recruitment

25 individuals were recruited to participate in this study. They were recruited via a variety of methods: through school sponsored postings and advertisements, personal contact, social media, as well as word of mouth communication. The participants included 11 identifying as female and 14 identifying as male. The eldest was 22 and the youngest was 12. All identified in the target demographic of students (either in middle school, high school, or college who were enrolled in full time education). The average age (of those who completed the study) was 16.04 years old. Five participants withdrew from the study pre-maturely for a variety of reasons including (but not limited to): health-related, parental concern, and lack of time. Certain individuals chose to withdraw from the study, and one was kind enough to share information about his ADHD that prompted his withdrawal. This individual, male, aged 14, was advised to stop after the energy drink consumption led to a spike in his anxiety levels (as reported in his survey in the second week of the trial).

Study Design

The energy drink chosen for this study was Red Bull, in its original flavor. Participants were de-identified in order to blind the researcher. The independent variable measured was the amount of energy drink consumed per day, starting with 20mL (of a 248mL can). Starting with 20mL, it increased by 20mL each day, for one week. Before the study (two weeks prior), participants were asked to not drink any caffeine in order to clear their systems for the study. No data was formally collected of the participants' caffeine habits prior to the study. In the week prior, participants were asked to drink a matched, increasing volume of water per day (as Red Bull in the following week) in order to create a baseline using a placebo. Each participant served as their own control for the statistical analyses that followed. Participants were asked to drink the water or Red Bull at approximately 3:00 PM in the afternoon. They were then asked to complete a survey at approximately 8:00 PM at night. The survey investigated markers of anxiety and depression using SIG E CAPS (Sleep, Interest, Guilt, Energy, Concentration, and Appetite, Psychomotor, and Suicidal ideation). Data collected was subsequently analyzed. In total, each participant filled out the survey 7 times for a baseline and 7 times while drinking the Red Bull. For participant's safety, all were allowed to opt out at any time without negative consequence. In addition, no participant was ever requested to drink over the pediatric recommended limit of 100 mg (roughly one can or 248 ml of Red Bull). A link to the survey can be found here.[22]

Statistical Analyses

Data was collected and analyzed through the use of Microsoft Excel. Data was run using a two-tailed paired student's t-test with a confidence level of 95% and a p-value of 0.05. The collection period was a 14 day period that involved comparisons across days in a week, therefore degrees of freedom was 6. Participants' number scores for each question were taken (7 each week, 14 total) and evaluated using the following formula of the student's t test.

Results

Demographics

Out of a total of 25 participants who participated in the survey, the majority identified as either Asian (36%) or Caucasian (40%). There were 10 Asian participants and 9 Caucasian participants. Out of the remaining racial categories, there was a small representation of 4 African American participants, and one of each Native American and Pacific Islander identification. It is important to stress that the onboarding survey asked for the participant's primary racial identity (i.e. what race made up the majority of his or her genetic composition) and secondary racial identities were not tracked further.

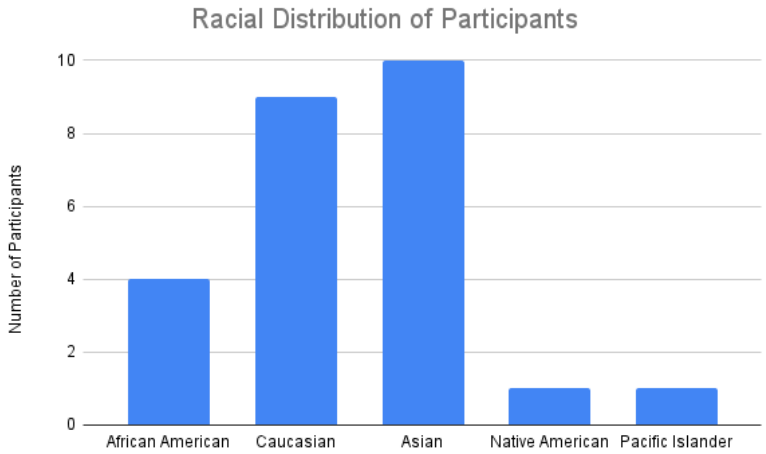

Figure 1. Chart of racial distribution of participants. Participants were surveyed based on their primary racial identity (highest percentage of their genetic composition) only.

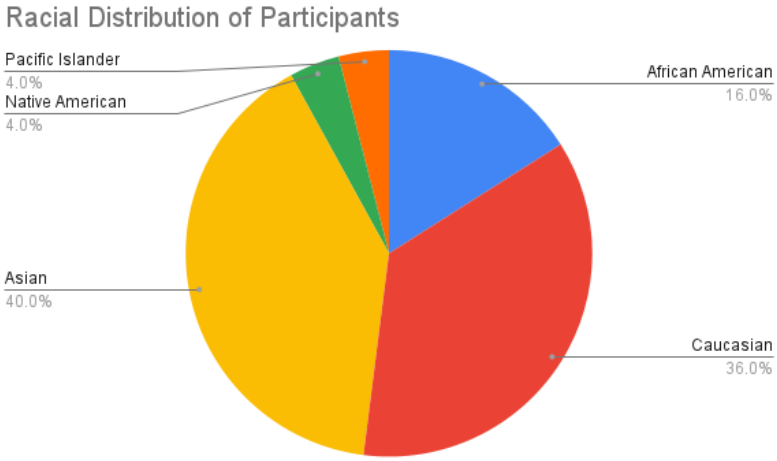

Figure 2. Pie chart of racial distribution of participants.

Age

Participants fell under the age range of 12 to 22. The majority of participants were aged between 14 and 18, comprising a total of 19 participants making up a total of 76% of all participants. Outliers included a single 12 year old and two 22 year olds. There were no participants aged 20 or 21 years old. Outliers made up a total of 12% of the participants.

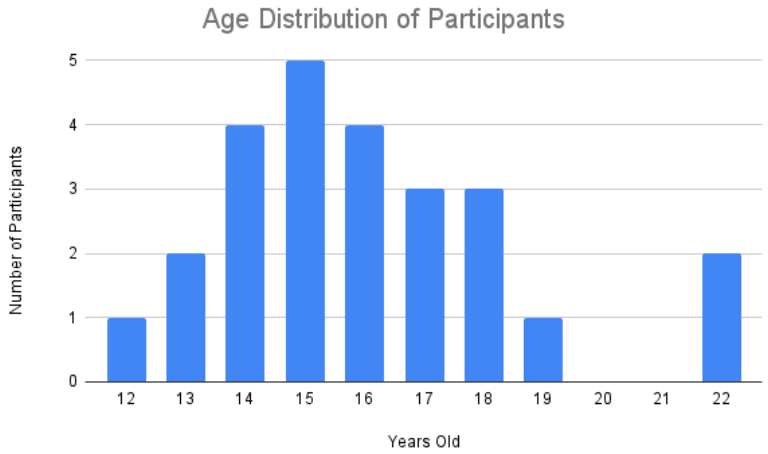

Figure 3. Chart of age distribution of participants. Participants were asked to provide their age at the time of this study.

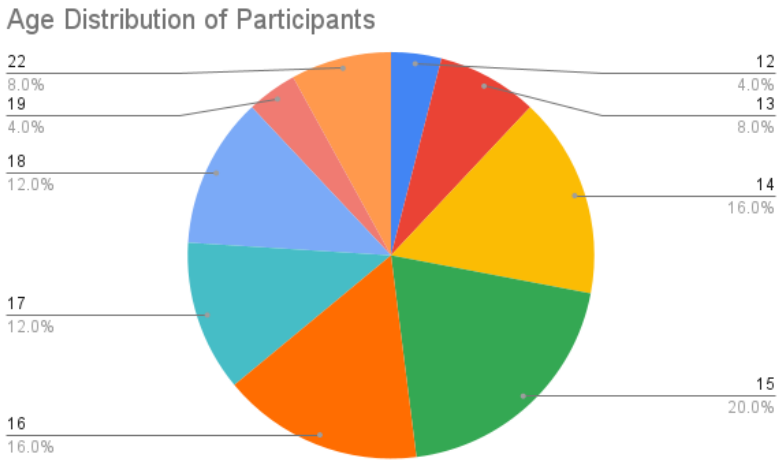

Figure 4. Pie chart of age distribution of participants.

Sex

15 of the participants identified as male, representing 60% of the total sample size. The other 10 participants identified as female, representing 40% of the total sample size.

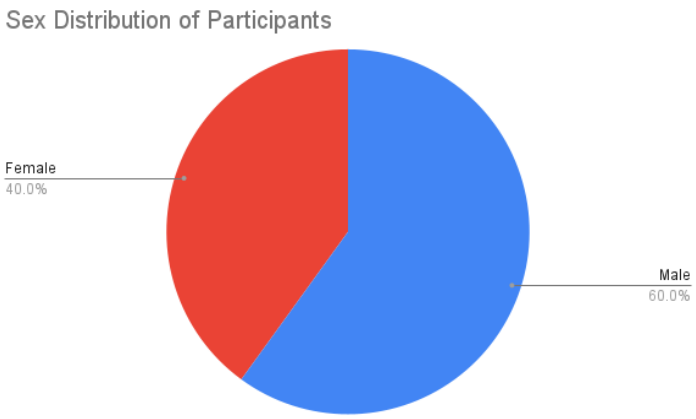

Figure 5. Pie chart of sex distribution of participants.

Statistical Analysis

Overall, the t-tests revealed that there was little significance (defined as **≥ 95% confidence level)** of the results. However, certain individual data points were determined to be relatively significant as a result of the t-test if it yielded ≥ 50% confidence level within the limited context of this study. There were a total of 51 somewhat significant (confidence level of ≥ 50%) outcomes of the t-test, out of a total 275 t-tests that were performed on the data (due to 11 questions on each survey filled out by 25 participants). As a result, 19% of the data yielded a relatively significant result with a confidence level of ≥ 50%. It is also key to note that a total of 31 surveys (of a total collection of 350 surveys, 14 surveys each for 25 participants) were submitted after the collection period (later than 8 pm of the day they intended to represent). The average number of missed submissions was 1.24 survey submissions per person. Unfortunately, all but two participants had at least one missed survey submission.

Birthday of Participant	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11
2-Jan	1	0.51612072	0.2746451	0.68905223	0.3450324	1	0.37620553	0.70300823	0.19962167	0.72260374	0.68905223
8-Feb	0.35591768	0.35591768	1	0.09413277	1	0.1723083	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
17-Mar	0.68905223	0.60364506	0.35591768	0.35591768	1	0.1723083	1	0.73576486	0.60364506	0.23080941	0.1403463
28-Mar	0.35591768	0.56857126	0.28940322	#DIV/0!	1	0.30995874	0.09413277	#DIV/0!	0.18239226	0.1723083	1
5-Apr	0.04525627	1	0.10304617	0.68905223	0.1723083	0.08214815	0.01574141	0.11121512	#DIV/0!	0.23080941	#DIV/0!
7-May	0.09413277	0.1723083	0.35591768	0.09413277	0.35591768	0.07814075	#DIV/0!	0.23405744	#DIV/0!	0.19962167	0.10304617
2-Jun	0.78816672	0.10304617	0.76626007	0.1723083	0.53380768	0.28940322	0.23080941	0.60364506	0.04724633	0.2665697	0.38625533
18-Sep	0.52649996	0.48161781	1	0.68905223	0.76626007	0.75071378	0.8805362	0.1723083	0.35591768	0.3208081	0.60364506
23-Nov	0.82907952	1	0.22212157	0.23405744	1	0.48588324	0.39994216	0.60364506	0.35591768	1	0.38625533
2-May	0.28622241	0.30783608	0.12128702	0.85880235	0.39994216	0.22859673	0.65400462	0.7927449	0.23080941	0.89895612	0.70300823
2-Sep	0.52649996	0.25631546	1	0.63137426	0.90094963	0.75071378	0.76626007	0.1723083	0.35591768	0.3208081	0.19747303
3-Aug	0.52649996	1	0.73576486	0.76626007	0.7927449	0.67292651	0.3208081	0.55464642	1	0.8805362	0.23080941
13-Jan	0.42622965	0.74356538	0.31656096	0.38625533	0.18793957	0.90940396	0.3208081	0.53380768	0.19962167	0.61826089	0.39547943
4-Dec	0.38625533	0.90282963	0.83823	0.67484291	0.23405744	0.4891023	0.17545109	1	0.35591768	0.32158006	0.62207265
9-May	0.52649996	0.48161781	1	0.48161781	0.76626007	0.75071378	0.8805362	0.68905223	0.70300823	0.10121156	0.1723083
15-May	0.39403074	0.08631487	0.35591768	0.38625533	0.90094963	0.3450324	0.88679665	0.68905223	0.35591768	0.11055174	0.21994382
18-Dec	0.48161781	0.1723083	0.35591768	0.16193823	0.11094656	0.58914367	0.10304617	0.85284005	0.54716161	0.4662874	0.75071378
19-Jan	0.52649996	0.1723083	0.65400462	0.27965829	0.36321747	0.68905223	0.42622965	0.17934131	0.85880235	0.85880235	0.86883234
23-Mar	0.48161781	0.15631962	0.04724633	0.03001975	0.67719175	0.18793957	0.78816672	0.14832754	0.40342606	0.12195242	0.48880905
18-Jun	0.62498899	0.1339746	0.82907952	0.07814075	0.74356538	0.90460649	0.8805362	0.19962167	0.35591768	0.1403463	0.63940274
24-Feb	0.09413277	0.07814075	0.45705165	0.82907952	0.19962167	1	0.08440082	0.1723083	0.28320903	0.60364506	0.3208081
29-Jan	0.38625533	0.51612072	0.47973477	0.68905223	0.49677072	1	0.37620553	0.70300823	0.19962167	0.72260374	0.68905223
27-May	0.09413277	0.09413277	0.07814075	0.00823735	0.04525627	0.1403463	#DIV/0!	0.07814075	0.08631487	0.19962167	0.10304617
22-Apr	0.06183473	0.28940322	0.14280044	1	0.56857126	0.10599733	0.00370682	0.00678479	0.00096454	0.0053196	0.0104958
18-Jul	0.06333554	0.67292651	0.07814075	1	0.40717051	0.22482182	0.00653002	0.1403463	0.44806493	0.32498107	0.76626007

Figure 6. Participants' birthday (for de-identification) and relative t -test value for each of the questions over a 14-day period. Yellow values denote a statistical confidence level of p = .5 or 50% confidence. Blue values denote a divide by zero error in the t-test equation. Orange values denote data that fell under the statistical confidence level of p = .5 or less than 50% confidence.

Question Number	Full Question (as how it appears on the survey)
Question 1	On a scale of 0 to 10, how much did your sleep improve or worsen? (5 being no change).
Question 2	On a scale of 0 to 10, how much motivation did you feel in completing your home-work? (5 being no change).
Question 3	On a scale of 0 to 10, how much more or less interested were you to complete extra-curricular/hobbies/activities (anything you do outside of school) in the afternoon? (5 being no change).
Question 4	On a scale of 0 to 10, how guilty do you feel? (5 being no change).
Question 5	On a scale of 0 to 10, how fulfilled do you feel? (5 being no change).
Question 6	On a scale of 0 to 10, how was your energy level compared to your normal? (5 being no change).
Question 7	On a scale of 0 to 10, how was your concentration compared to your normal? (5 being no change).
Question 8	On a scale of 0 to 10, how was your appetite compared to your normal? (5 being no change).
Question 9	On a scale of 0 to 10, how anxious do you feel compared to normal? (5 being no change).
Question 10	On a scale of 0 to 10, how much non-intentional movement did you have today compared to normal? (i.e. foot tapping, nervous ticks, fidgeting, etc.) (5 being no change).
Question 11	On a scale of 0 to 10, how much aggression did you feel towards yourself and/or others compared to normal? (5 being no change).

Figure 7. A list of the corresponding questions as they appeared on the survey.

Any t-test result highlighted in yellow demonstrates a statistical confidence level of $p \geq .5$ or 50% confidence. While none of the data is technically "significant", relative to other data points it is significant in this smaller scale research. In response to question 5 regarding fulfillment, 9 individuals reported relatively (in the context of this study) significant levels of greater or worse fulfillment on a daily basis. In response to question 6 regarding energy level, 6 individuals reported significantly greater or worse energy levels. Question 11 regarding aggression also yielded 6 individuals reporting significantly greater or less aggression. 6 individuals also reported statistically significant results regarding non-intentional movement (showcased in Question 10). It is important to note that the data skewed mostly toward a negative result. When going back to review individual responses, the data skewed towards individuals reporting negative effects of energy drink consumption. For example, eight of the nine participants who reported relatively statistically significant results for fulfillment

mentioned that their fulfillment was less than normal. Similarly, energy levels were reported as lower than normal by all six of the individuals whose data was relatively significant. Five of the six individuals who reported non-intentional movement data that was relatively significant reported that they experienced an increase in non-intentional movement compared to normal. While the overall results of the study are anything but conclusive, there are certain data points that do suggest a possibility of negative effects that energy drinks cause upon the user. Statistical results between the individual who chose to withdraw and the other participants showed a significant increase for the individual who had pre-diagnosed ADHD. He withdrew after day 3 of the second week (where he drank the energy drink dosage assigned to him). Running the statistical t-test on his incomplete results, provided the trends in his responses would have continued, there would be a result that ≥ 90% confidence level that energy drinks negatively impacted his markers of anxiety and depression using the SIG E CAPS survey developed for this study.

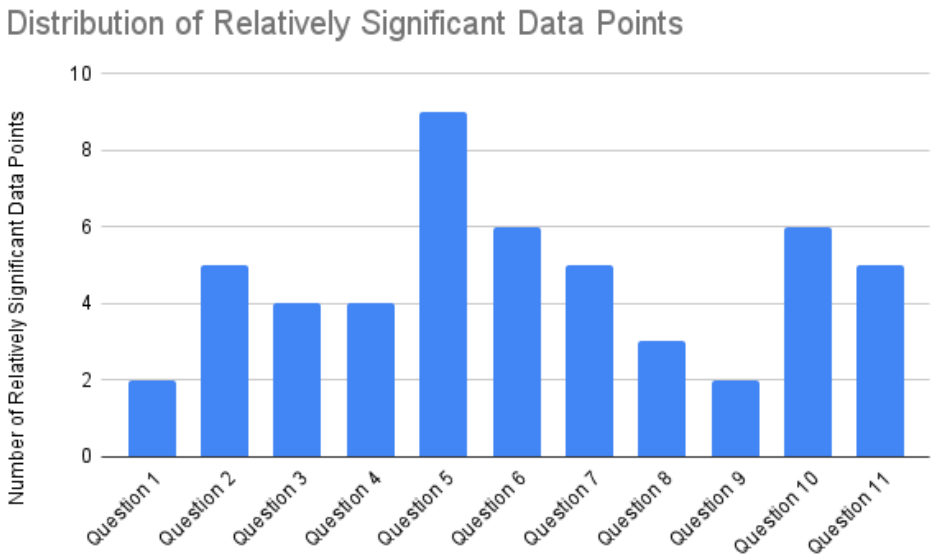

Figure 8. Distribution of Relatively Significant Data Points. Larger bars indicate more data points that were determined to be statistically significant relative to the study as a whole. Relatively statistically significant results are defined (in this study) as having a confidence level of 50% or higher, or a p value of p ≥ .5.

Data points that showed increased include questions 5, 6, and 10. These are questions asking about fulfillment, energy level, and non-intentional movement, respectively. As a result of the increased number of data points (each showing an individual's difference between the placebo and energy drink), the increase in significant data points over the rest of the data demonstrates that energy drinks significantly impacted the data that participants reported. Out of 25 participants, 9 of them had significantly more or less fulfillment. Referring to the individual responses, the majority reported less fulfillment than they normally felt. 6 of the 25 participants reported significantly more or less energy during the day, as well as more or less non-intentional movement. Looking at responses specifically, this data also skews towards individuals having more energy and unintentional movement. However, all questions did yield at least two individuals with relatively statistically significant results.

Discussion

The lack of significance (≥ 95% confidence level) indicates that the pediatric limits on energy drinks and caffeine do not significantly affect an adolescent's mood. This study demonstrated that the pediatric dose does not

influence changes in anxiety and depressive indicators.[2] Certain values (illustrated in yellow) were considered sub-significant relative to the other results of this study. However, the majority of participants were unaffected by the dosage of energy drinks given and their results were statistically insignificant. This points to the pediatric dose being correct in negating harmful effects of caffeine intake.

This study was conducted with a limited budget and limited participants. Several aspects should be considered for further investigation of this relationship. As many adolescents consume energy drinks far in excess of the recommended pediatric dose, a higher dose of energy drink consumed by participants would be more representative of the real amount of energy drinks consumed by teenagers.[20] Given the small sample size of participants in this study, further research with a greater number of participants would also be more representative and provide more conclusive results. Sleep, surprisingly, noted very little significance in results, with only two individuals reporting relatively statistically significant results. This contrasts with previous literature in which decline in quality of sleep was an observed result of energy drink consumption.[12-14] While fulfillment, nervous ticks, and aggression all resulted in the greatest number of significant data points (pointing to the energy drinks having the greatest effect), this falls in line with previous literature demonstrating increases in anxious behavior.[15] Further testing would also require a larger sample size to yield more statistically significant results.

The amount of energy drink consumed is simply not representative of the real world. On average, adolescents were found to consume 244 mg of caffeine on average per day[10]. In addition, energy drinks are available in over 140 countries (including the United States) and are the fastest growing US beverage market. Sales were expected to top $9 billion in 2011, with half of the energy drink market consisting of those between the ages of 12 and 25.[9, 11] This study's results show an alignment with the previous bodies of literature that the pediatric-suggested limit of caffeine does not impact individuals in any noticeable amount. To conclusively answer this question, this study would need to be modified to include a much larger sample size (to increase statistical significance and confidence level) as well as investigate with higher doses of energy drinks. Due to the average adolescent consuming 244 mg of caffeine per day, participants of this new study would need to consume in excess of two cans per day to more accurately represent conditions students are accustomed to, in addition to exceeding the recommended pediatric dosage to investigate the culminating side effects (should they exist).[7, 9] Only by increasing both dosage and sample size would a definitive answer to the effects of energy drinks on the adolescent mind be reached.

A method of garnering demonstrated support (such as financial incentive) should be used in order to ensure the timely deliverance of data.[16] While this study was limited in its budget, a financial motivator (gift card, cash, prize) could help ensure that surveys are filled out promptly and without delay. During this study, the participants averaged 1.24 missed submissions. As a result, the information conveyed in these surveys could have been skewed by the later date, as participants would have had to recall their feelings from the day prior. In addition, not all data was collected in a timely manner, as a few outlier submissions took upwards of 3 days to be received. This begs the question as to how does a study effectively manage participant's submissions without delay, and if the results would have been different had the participants submitted all surveys exactly on time.

In addition, while participants were asked to clear their systems of caffeine two weeks prior to this study, there was no way of determining whether or not participants actually did so. A study with greater financial backing and access to more resources could, in theory, utilize blood plasma to measure the caffeine intake in the blood prior and during the study.[17] As a result, data generated could be a reflection of withdrawal syndrome from not receiving the same amount of caffeine as before. Previous literature also cited that energy drinks were commonly consumed as part of social gatherings. This study did not measure or request information in regards to the habits that these energy drinks were consumed, raising the question of whether intentional peer pressure to drink these drinks could lead to different results.[18] The study was additionally limited as no data was formally collected on prior energy drink consumption of participants. Further studies would benefit from ana-

lyzing a participant's previously recorded intake of caffeine and the effects in both placebo trials and experimental trials. Finally, as exhibited by the individual who withdrew before the study concluded, more research that could possibly isolate groups of individuals who have pre-existing mental health conditions and those who do not would help to draw conclusions based on how it affects individuals with different underlying conditions.

Conclusions

Overall, this dose of energy drink does not seem to be significant, supporting the pediatric dosage limit of caffeine as being correct and effective in not instigating side effects of energy drink consumption. However, as evidenced by the participant who struggles with ADHD and had to withdraw after consultation with his physician, those who have a pre-diagnosed condition may be at a higher risk for exhibiting negative effects from energy drinks. While this study was conducted with a limited budget and limited participants, the study was able to suggest that pre-diagnosed conditions are susceptible to increased energy drink consumption while the pediatric safe dosage is safe for those without a pre-diagnosed condition. Statistical results between the individual who chose to withdraw and the other participants showed a significant increase for the individual who had pre-diagnosed ADHD. Running the statistical t-test on his incomplete results, there would be a ≥ 90% confidence level that energy drinks negatively impacted all of his markers of anxiety and depression using the SIG E CAPS survey developed for this study. More testing would need to be conducted in order to further subdivide individuals diagnosed and undiagnosed with pre-existing mental health conditions. To further elucidate the effects of caffeine on adolescents and their behavior, utilizing a greater number of participants and a higher dosage may elucidate significant trends of energy drink effects on adolescent mood, as well as provide more statistically significant results and findings.

Acknowledgments

I would like to formally thank the participants. Without their cooperation and participation, this entire endeavor would not have been possible. I would also like to thank my parents for supplying me with the financial backing and for assistance in logistical coordination. Finally, the largest acknowledgement that I would like to give is to Ms. Chloe Cavanaugh (current MD/PhD candidate at Princeton University) for her mentorship and guidance. Words cannot describe how thankful I am to be under your guidance.

References

1. Visram, S., Cheetham, M., Riby, D., Crossley, S. and Lake, A., 2016. Consumption of energy drinks by children and young people: a rapid review examining evidence of physical effects and consumer attitudes. *BMJ Open*, [online] 6(10), p.e010380. Available at: <http://doi:10.1136/bmjopen-2015-010380>
2. Anon. 2021. Highly Concentrated Caffeine in Dietary Supplements: Guidance for Industry *FDA.gov*
3. Walther, J., Aldrian, U., Stüger, H., Kiefer, I. and Ekmekcioglu, C., 2014. Nutrition, lifestyle factors, and mental health in adolescents and young adults living in Austria. *International Journal of Adolescent Medicine and Health*, [online] 26(3), pp.377-386. Available at: <https://doi.org/10.1515/ijamh-2013-0310>
4. Park, S., Lee, Y. and Lee, J., 2016. Association between energy drink intake, sleep, stress, and suicidality in Korean adolescents: energy drink use in isolation or in combination with junk food consumption. *Nutrition Journal*, [online] 15(1). Available at: <http://doi:10.1186/s12937-016-0204-7>

5. Fletcher, E., Lacey, C., Aaron, M., Kolasa, M., Occiano, A. and Shah, S., 2017. Randomized Controlled Trial of High-Volume Energy Drink Versus Caffeine Consumption on ECG and Hemodynamic Parameters. *Journal of the American Heart Association*, [online] 6(5). Available at: <http://doi:10.1161/JAHA.116.004448>
6. Alsunni, A., 2021. Energy Drink Consumption: Beneficial and Adverse Health Effects. *International Journal of Health Sciences*.
7. Miller, K., Dermen, K. and Lucke, J., 2018. Caffeinated energy drink use by U.S. adolescents aged 13–17: A national profile. *Psychology of Addictive Behaviors*, [online] 32(6), pp.647-659. Available at: <http://doi:10.1037/adb0000389>
8. Paglia, L., Friuli, S., Colombo, S. and Paglia, M., 2021. Paglia L, Friuli S, Colombo S, Paglia M. The effect of added sugars on children's health outcomes: Obesity, Obstructive Sleep Apnea Syndrome (OSAS), Attention-Deficit/Hyperactivity Disorder (ADHD) and Chronic Diseases. *European Journal of Paediatric Dentistry*, [online] Available at: <http://10.23804/ejpd.2019.20.02.09>
9. Bernstein, G., Carroll, M., Thuras, P., Cosgrove, K. and Roth, M., 2002. Caffeine dependence in teenagers. *Drug and Alcohol Dependence*, [online] 66(1), pp.1-6. Available at: <https://doi.org/10.1016/s0376-8716(01)00181-8>
10. Temple, J., 2009. Caffeine use in children: What we know, what we have left to learn, and why we should worry. *Neuroscience & Biobehavioral Reviews*, [online] 33(6), pp.793-806. Available at: <https://doi.org/10.1016/j.neubiorev.2009.01.001>
11. Seifert, S., Schaechter, J., Hershorin, E. and Lipshultz, S., 2011. Health Effects of Energy Drinks on Children, Adolescents, and Young Adults. *PEDIATRICS*, [online] 127(3), pp.511-528. Available at: <http://doi:10.1542/peds.2009-3592>
12. Malinauskas, B., Aeby, V., Overton, R., Carpenter-Aeby, T. and Barber-Heidal, K., 2007. A survey of energy drink consumption patterns among college students. *Nutrition Journal*, [online] 6(1). Available at: <https://doi.org/10.1186/1475-2891-6-35>
13. Bonnet, M., Balkin, T., Dinges, D., Roehrs, T., Rogers, N. and Wesensten, N., 2005. The Use of Stimulants to Modify Performance During Sleep Loss: A Review by the Sleep Deprivation and Stimulant Task Force of the American Academy of Sleep Medicine. *Sleep*, [online] 28(9), pp.1163-1187. Available at: <https://doi.org/10.1093/sleep/28.9.1163>
14. BERNSTEIN, G., CARROLL, M., DEAN, N., CROSBY, R., PERWIEN, A. and BENOWITZ, N., 1998. Caffeine Withdrawal in Normal School-Age Children. *Journal of the American Academy of Child & Adolescent Psychiatry*, [online] 37(8), pp.858-865. Available at: <https://doi.org/10.1097/00004583-199808000-00016>
15. Richards, G. and Smith, A., 2015. Caffeine consumption and self-assessed stress, anxiety, and depression in secondary school children. *Journal of Psychopharmacology*, [online] 29(12), pp.1236-1247. Available at: <http://doi:10.1177/0269881115612404> [Accessed 29 November 2021].
16. Yu, S., Alper, H., Nguyen, A., Brackbill, R., Turner, L., Walker, D., Maslow, C. and Zweig, K., 2017. The effectiveness of a monetary incentive offer on survey response rates and response completeness in a longitudinal study. *BMC Medical Research Methodology*, [online] 17(1). Available at: <https://doi.org/10.1186/s12874-017-0353-1>
17. Carey, R. and DePalma, G., 1994. A simplified method for the measurement of caffeine in plasma and brain: evidence for a cortical-subcortical caffeine concentration differential in brain. *Journal of Neuroscience Methods*, [online] 53(1), pp.19-22. Available at: <http://10.1016/0165-0270(94)90139-2>

18. Nassaif, M., Alobed, G., Alaam, N., Alderrazi, A., Awdhalla, M. and Vaithinathan, A., 2016. Energy Drink Consumption Practices of Young People in Bahrain. *Central Asian Journal of Global Health*, [online] 4(2). Available at: <http://doi:10.5195/cajgh.2015.216>
19. Visram, S., Cheetham, M., Riby, D., Crossley, S. and Lake, A., 2016. Consumption of energy drinks by children and young people: a rapid review examining evidence of physical effects and consumer attitudes. *BMJ Open*, [online] 6(10), p.e010380. Available at: <http://10.1136/bmjopen-2015-010380>
20. Vercammen, K., Koma, J. and Bleich, S., 2019. Trends in Energy Drink Consumption Among U.S. Adolescents and Adults, 2003–2016. *American Journal of Preventive Medicine*, [online] 56(6), pp.827-833. Available at: <https://doi.org/10.1016/j.amepre.2018.12.007>
21. Form available at https://forms.gle/dpcNvuika3f2sehu5