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CAFFEINE'S COLLEGE SURGE: INVESTIGATING ITS ROLE IN COPING STRATEGIES AMONG UNDERGRADUATES DURING THE COVID-19 ERA

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Abstract: Caffeinated beverages have long been a staple for college students, raising concerns about caffeine overuse. A recent survey conducted across five U.S. universities revealed a staggering 92% of students reporting caffeine consumption in the past year. This trend is on the rise, largely attributed to a lack of education regarding overconsumption. Notably, the primary source of caffeine among college students, regardless of gender, was found to be coffee. The study, "Intake of caffeine from all sources and reasons for use by college students," conducted by Mahoney and colleagues, not only identified coffee as the preferred choice but also provided insights into demographic factors influencing caffeine consumption. Age, gender, family income, and ethnicity were considered to assess how caffeine consumption varies among different student groups.

While the Food and Drug Administration (FDA) recognizes caffeine as a potential component of a healthy diet, caution is warranted. Excessive caffeine intake can pose health risks, particularly contingent on factors such as body weight, medication use, and elevated stress levels. This abstract sheds light on the prevalence of caffeine consumption among college students, its growing trend, and the importance of informed caffeine use, considering individual health circumstances.

Keywords: Caffeine Consumption, College Students, Caffeine Overuse, Health Risks, Demographic Factors

1. Introduction

For many years, caffeinated beverages have been consumed by college students for various reasons and caffeine overuse is one of the main concerns (Driver et al., 2020). A recent survey done at five geographically dispersed United States universities found out that about 92% of the surveyed students reported consuming caffeine within the past year and that these numbers continue to increase due to lack of education pertaining to the overuse of the beverages (Mahoney et al., 2019). Specifically, their study concluded that coffee was the main caffeinated beverage consumed by many college students of both genders (Mahoney et al., 2019). Furthermore, in their study titled “Intake of caffeine from all sources and reasons for use by college students”, Mahoney and others presented demographic characteristics of study participants based on their age, gender, family income, and ethnicity to compare how caffeine is consumed among different groups of college students (Mahoney et al., 2019). According to the Food and Drug Administration (FDA), caffeine can be a part of a healthy diet for most people, however too much caffeine consumption may pose health danger to one’s body depending on their health status, for example body weight, medication use, and increased stress levels to name a few (FDA, 2018).

1.1 Background

Historically, caffeine is considered to be the most utilized psychoactive drug in the world (Ferre, 2013). It has a psychostimulant effect as it shares the pharmacological properties of classical psychostimulants

such as cocaine and amphetamine. Those properties include arousal, motor activation, and reinforcing effects (Ferre, 2013). Studies show that caffeine helps raise alertness and improves short-term memory. Hence, many college students try to have some caffeinated beverages like coffee and energy drinks, during their study sessions as many believe that it helps them retain more information over a short period of time, promotes better understanding, enhances their moods, and enables them to process information faster (Francies, 2017; Beek et al., 2019).

Despite the perceived benefits of caffeinated drinks by many college students, there are negative side effects resulting from too much consumption of the product, such as dehydration, stomach aches, and nervousness (Radhakrishnan, 2018). Also, research shows that caffeine consumption could lead to poor dietary choices, cardiovascular diseases, behavior changes (i.e., stress and anxiety, sleep disorder), interference with food absorption, bone, and dental problems to name a few (Beek et al., 2019). Moreover, literature suggests that there have been deaths in youths linked to caffeine overdose when one consumes over 80 cups of coffee in a short period of time (Radhakrishnan, 2018). For example, according to Radhakrishnan and the Central Ohio's Original NPR Station, in 2014, Logan Stiner, an eighteen-year-old male student from Ohio and former athlete was found dead with a caffeine blood concentration level of 70 microgram/ml after consuming caffeine powder because he wanted to have more energy to successfully perform in his physical activities. Further, a report from his mother states that the deceased used a special substance as a "pre-workout" regimen on a daily basis to prepare for his sports performance (Radhakrishnan, 2018; SUPCO To Hear Lawsuit, 2020).
According to the Substance Abuse and Mental Health Service Administration (SAMHSA), between 20052011 people who overused caffeinated beverages were admitted to the emergency room department about 14 times more frequently than in previous years. Furthermore, the visits to the emergency room department that were related to consuming energy drinks doubled from 2007 (10,000 admissions) in comparison to 2011 (20,000 admissions), and these increasing trends in E.R. admissions cannot be ignored by public health research (SAMHSA, 2013). Research warns that, for many individuals trying to quit caffeinated beverages abruptly can experience potential negative health complications such as headaches, fatigue, irritability, nervousness, or dysphoria (CDC, 2020). Hence to avoid all the unpleasantness that one may experience when trying to withdraw from caffeine dependence, a slow gradual decrease monitored by a healthcare providers' advice is highly recommended in order to reduce negative side effects that can be unpleasant to a human body (FDA, 2018).

1.2 Purpose of study

This study examined college students' caffeine intake habits and their perceptions during COVID-19 pandemic time. Currently there is a knowledge gap in the perception towards caffeine consumption among college students and how it may impact their overall health, in addition to the stress associated with the pandemic. Demographic characteristics of study participants will be examined based on their age, gender, race/ethnicity, and academic status. Upon data collection, evidence-based intervention strategies will be provided with the goal of increasing awareness that may discourage excessive caffeine consumption among college students.

1.3 Research Questions

This study aims to answer the following two research questions:
R.Q.1: Is there a difference between one's academic standing level and their excessive caffeine consumption?

R.Q.2: Is there an increase in caffeine consumption among college students during a pandemic?

1.4 Theoretical Foundation

This research project examined caffeine consumption habits among undergraduate college students from a predominantly first-generation minority serving institution. In this study, an integrative framework often used to assess an individual's readiness to change and progress to adopting a positive behavioral modification known as the Transtheoretical Model (TTM, also known as the Stages of Change Model) was used. This model posits that as individuals attempt to change a behavior, they will move through five stages: precontemplation, contemplation, preparation, action, and maintenance (Glanz & Rimer, 2005). Further, TTM provides a structure for the conceptualization and the measurement of the change of behavior by identifying the strategies that can be followed in making desired change easy. By incorporating this model, we provide evidence-based intervention strategies for college students with the efforts to educate and ultimately reduce their excessive daily caffeine consumption (Nigg, et, al., 2011).

2. Literature Review

2.1 Energy Drinks and Caffeinated Cocktails Consumption Consequences among College Students.

In their study, Obrien et al. (2008) discussed how energy drinks have been of common use among college students. In 2006 Americans spent 3.2 billion dollars on energy drinks because beverage companies focused more on energy drinks specifically among youth and women (Obrien et al., 2008). Also, 34% of adults aged 18-24 drink energy drinks regularly and hence their study examined the relationship between high alcohol use, energy drinks, and college student behaviors. They interviewed a total of 4,237 students who answered questions about their consumption of Alcohol mixed with Energy Drinks (AmED) and found that 87% of them, ages 18 – 22 reported being drunk and 23% of them reported consuming AmED at least once in a month.

The consumption of AmED is prevalent among college students in the United States and this has significant risk factors for injury in college students because it increases the consumption of alcohol (Obrien et al., 2008). Further, their study also showed that students who were younger, male, White, intramural athletes, and sorority members were consuming AmED at a higher rate. In their analysis, they found that AmED was highly associated with binge drinking (6.4 days vs. 3.4 days on average; $p < 0.001$), and they consumed alcohol twice as many episodes of weekly drunkenness (1.4 days/week vs. 0.73 days/week; $p < 0.001$). The students who drank more caffeinated cocktails ($p < 0.05$) reported engaging in negative health behaviors such as non-consensual sexual activities, riding with a drunk driver, or getting injured as a result of accidents, which ended up requiring medical attention.

2.2 Caffeine Consumption Patterns and Beliefs of College Students

In another study, McIlvain et al. (2011) examined the reasons why college students consume caffeinated beverages and came up with three emergent themes: a). trying to stay alert in order to increase their school concentration levels, b). trying to stay awake longer, and c). trying to wake up after a long or late night. The consumption of energy drinks such as Red Bull, Monster, Spike Shooter, and Coffee has increased dramatically among young college students (McIlvain et al., 2011). For example, research shows that retail sales of $1.2 billion energy drinks increased to $9 billion in 2011 from $6.6 billion in 2007 (McIlvain et al., 2011). Further, the study findings suggest that 31% of U.S. teenagers were energy drinking consumers with a mixture of caffeine. For example, Spike Shooter contains 428 milligrams of caffeine, while 12-ounce Coca-Cola has 34 milligrams of caffeine and this piece of literature also found that more than 23% of the participants ages 6-19 reported overdosing on caffeinated beverages at some point in their lives. Moreover, evidence from the study showed that overdosing on caffeine had adverse

physical effects on one's health (i.e., increased blood pressure, body temperature, heart rate, sleep deprivation, central nervous system disorder, seizures, vasodilation, trembling, severe allergy reaction, and headache to name a few (McIlvain et al., 2011). In the end, McIlvain et al reported that 83% of the students who participated in their study had at least one sign/symptom of caffeine intoxication, 51% had one sign/symptom of caffeine withdrawal, and their levels of consumption was 3 – 5 more than the recommended amount (2011).

2.3 Daytime Sleepiness, Circadian Preference, Caffeine Consumption, and Use of Other Stimulants among Thai College Students.

Tran et al. (2014) examined the association between consumption of caffeinated stimulants and daytime sleepiness and evening chronotype among 3,000 Thai college students. A self-administered questionnaire was used to measure the demographic characteristics of the participants. The results of their study showed that among participants, the daytime sleepiness prevalence was 27.9 % (95% CI: 26.2–29.5%), while the evening chronotype prevalence was 13% (95% CI: 11.8–14.2%). After adjusting for age, sex, smoking, BMI, and physical activity, Tran et al. (2014) found that users of any stimulant beverage had 2.68-fold higher odds of being evening chronotypes than non-users. Furthermore, stimulant beverage consumers had 22% higher odds of undergoing daytime sleepiness than non-consumers. This study revealed a strong association between consuming any stimulant beverage with evening chronotype and daytime sleepiness (Tran et al., 2014).

The results also noted that evening chronotypes are affected by the number of stimulant beverages used per week. For instance, students who consumed two stimulant beverages per week had 2.65-fold higher odds of being evening chronotypes (OR 2.65; 95% CI 1.81–3.90) than those who consumed less than one stimulant beverage per week. On the other hand, those who were consuming three or more stimulant beverages per week had 3.65-fold higher odds of being evening chronotypes (OR 3.65; 95% CI 2.58–5.16) than those who consumed less than one stimulant beverages per week (Tran et al., 2014). By the end of the study, Tran et al., recommended the provision of effective education and prevention programs to improve sleep hygiene and reduce energy drink consumption among college students (2014).

2.4 Caffeine Intake Habits and the Perception of Its Effects on Health Among College Students

Bucher et al. (2019) studied caffeine intake habits and the perception of its effects on health among college students by using a quantitative, cross-sectional approach. They examined descriptive characteristics of students in Northern Indiana by collecting data on a Likert-type scale. This study showed that, on a daily basis, 75% of the participating students consumed one or more caffeinated beverages for taste or during periods of stress, in social settings, or when they needed to drive for long distances.

Bucher et al. also found out that college students were aware of caffeine's short- and long-term health effects, whereby many of them admitted that caffeine had negatively affected their sleep, fluctuated one's mood, or to their belief that caffeine improves the ability to concentrate for longer duration.

The study also reported how college students consumed caffeine to help them increase their productivity where most of them believed that it contributed to boosting their alertness, sustained productivity, acted as a source of energy, vigilance, increased mood for a short time, and helped one get a better grade. In conclusion, Bucher et al. recommended that more research that will examine the rationale behind caffeine consumption among college students is needed in order to increase their understanding of caffeine's side effects (2019). In addition, their study called for more education

regarding alternatives to increased caffeine intake (i.e., education on stress management techniques, sleep-promoting habits, moderation in caffeine intake, and time management) (Bucher et al., 2019).

3. Methods

3.1 Methods and Design

This study utilized quantitative research methods with a special emphasis on descriptive analysis. This approach was the best choice for the study participants due to the nature of the delivery of online education as a result of COVID-19 pandemic in 2020 - 2021. Further, this approach allowed for a diverse pool of participants to be collected electronically from a group of undergraduate college students enrolled in a general education health science course that is a required class for all students enrolled at the university. Prior to data collection, the researchers of this study completed the Collaborative Institute Training Initiative (CITI Program) Human Subject Web-based Training on how to protect research participants. The study received an Institutional Review Board (IRB) approval from the designated institution prior to data collection.

3.2 Study Sampling

The survey was voluntarily collected from one selected college required course that had two sections in the Spring 2021. This is a course for all university entering majors, dominated by freshman students. A total sample of 350 college students were reached for both male and female, ages 18 and older. No identifying information such as students' names was inquired. Further, the survey was administered to all participants in the same environment, in an online setting following instructions that were approved by the university IRB board. There were no incomplete surveys as we added a feature that did not allow participants to skip a question; however, an option to completely discontinue with the survey was provided on the informed consent at the beginning of the questionnaire to provide freedom to those who may wish to withdraw their participation completely.

3.3 Survey Instrument, Reliability, and Validity

The survey was constructed after a thorough literature review and input gathered from the research team after examining emergent themes from other studies. The first sets of questions were demographic in nature whereby we asked participants to share their academic standing level, their age range, race/ethnicity, and gender, with the goal of providing evidence-based recommendations that will meet the needs of each specific population.

Further, we asked a set of 10 Likert-scale questions about participants' consumption of caffeine beverages. The response options were as follows: (4) Strongly Agree, (3) Agree, (2) Strongly Disagree, and (1) Disagree. The simplicity of our survey design allowed for an easy comparison of the data, and ultimately data analysis. The instrument went through a rigorous review from the IRB board, academic peers, and professors' feedback in order to establish face-validity.

3.4 Informed Consent

A well-structured informed consent was administered following IRB review and approval. Participants were informed that their contribution to this study was completely voluntary and that it would not affect their current grade in the course. No student was coerced to participate in the study. Also, students were informed that their participation was completely voluntary and that it will not affect their current grade in the course. Further, participants were informed that there were no right or wrong answers, and they were free to discontinue their participation at any time if they felt uncomfortable to continue with the survey.

3.5 Statistical Analyses

We first conducted descriptive statistics to examine the frequency distribution of our sample in order to understand the socio-demographic background of the study participants. We summarized this data using means and standard deviations for continuous variables and counts. Percentages were also calculated for categorical variables.

Pearson Chi-square analysis was conducted in order to examine the nature of the relationship between variables with the goal of teasing out which groups actually differed from each other. All analyses were performed using SPSS Statistical Software for Windows (IBM SPSS< version 27, Chicago, IL, USA). All reported p-values are two-sided and deemed statistically significant at a 0.05 level.

4. Results

4.1 Table 1. Demographic characteristics of the Students

Variable	**Overall (N= 176)**	
	N	**%**
Gender		
Female	135	76.7
Male	41	23.3
Age		
18-21	109	61.9
22-25	45	25.6
26-29	9	5.1
30+	13	7.4
Race		
Asian or Pacific Islander	11	6.3
Black or African American	10	5.7
Hispanic or Latino	123	69.9
Native American	1	0.6
White or European American	24	13.6
Other	7	4
Academic standing		
First Year	42	23.9
Second Year	42	23.9
Third Year	43	24.4
Fourth Year	26	14.8
Fifth Year or more	23	13.1
Number of Caffeinated		

Drinks		
5-6	56	31.8
3-4	110	62.5
1-2	9	5.1
0 (None)	1	0.6

A total of 176 undergraduate students responded to the survey, yielding a 50% response rate from the participant pool. There were 76.7% females and 23.3% males who participated in this study. In terms of age distribution, the majority of the participants were 18-21 years old (61.9%), followed by the 22-25 age group (25.6%), and the lowest percentage of the participants were between ages 26-29 (5.1%).
In terms of race distribution, participating students were from different racial backgrounds with the Hispanic or Latino forming the highest percentage (69.9%) among all the other races. There were 13.6% of Whites/European Americans, 6.3% Asian or Pacific Islanders, followed by 5.7% Black or African American, and the rest of the participants were from other different races as presented on table (1). We asked participants to share their academic standing level with the goal of providing evidence-based strategies that may be implemented in different tiers. Nearly half of the participants were either in their first year (23.9%) or second year (23.9%) students. The rest were third year (24.4%), fourth year (14.8%), and the remaining were fifth year or more (13.1%) in terms of their academic standing level. Furthermore, students were asked about the number of caffeinated beverages consumed on a daily basis, and 62.5% of them shared that they normally have 3-4 cups a day, and 31.8% of them consume anywhere between 5-6 cups a day. Additionally, 5.1% of the students were consuming 12 cups a day, and only 0.6 % of students did not drink any caffeinated beverages.

Research Question 1

R.Q. 1: Is there a difference between one's academic standing level and their excessive caffeine consumption?

A Chi Square test was conducted to find if there is a difference in one's academic standing level and their caffeine consumption and results are presented below.

Null Hypothesis (H0)

There is no difference between one's academic standing level and their caffeine consumption.

Alternate Hypothesis (H1)

There is a difference between one's academic standing level and their caffeine consumption. Findings:

Pearson Chi-square test is 33.820 with a P value of 0.001 and hence the null hypothesis is rejected meaning that there is a difference between one's academic standing level and their caffeine consumption as many 2nd, 3rd, 4th, and 5th year students had more consumption patterns but there were no differences for 1st year students.

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)

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Pearson Chi-Square	33.820[a]	12	.001
Likelihood Ratio	35.320	12	.000
Linear-by-Linear Association	10.541	1	.001
N of Valid Cases	176		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.23.			

Research Question 2
R.Q. 2: Is there an increase in caffeine consumption among college students during a pandemic?
A descriptive analysis was conducted to find if there is an increase in one's caffeine consumption during COVID-19 pandemic time and the results are presented below.

Figure 1. Number of Caffeine Consumption during the Pandemic

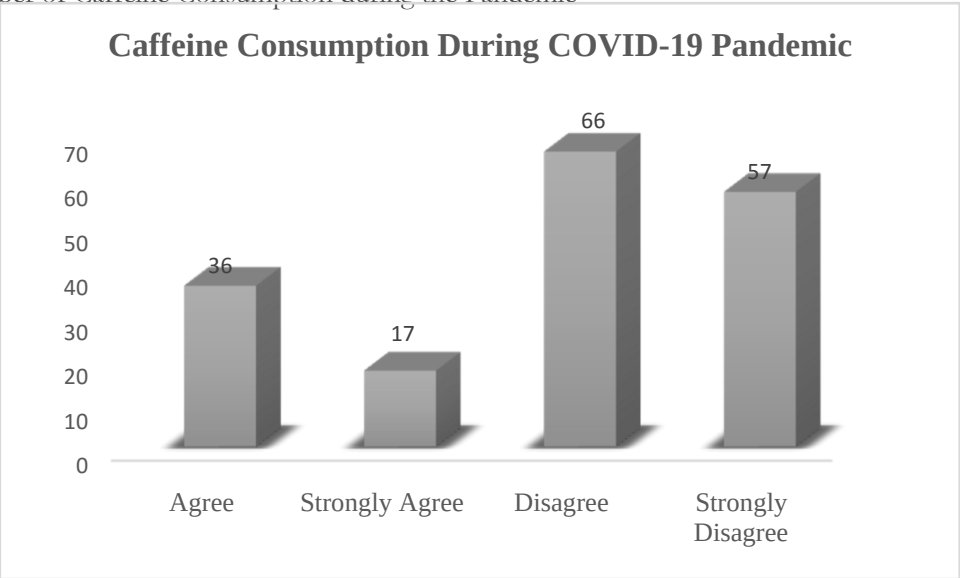

Figure 1 above presents 123 (70%) students who strongly disagreed and disagreed that there was an increase in their caffeine consumption during the pandemic. On the other hand, 53 (30%) studentsstrongly agreed and agreed that there was an increase in their caffeine consumption during the pandemic.
Table 4 below presents an analysis of 176 students whereby 141 (80%) reported having the ability to go for 24-72 hours without caffeine, while 35 (20%) could not abstain from caffeine for that length of time. Further, at least 126 (72%) of the students reported drinking caffeinated beverages for the taste, and the remaining 50 (28%) of the students shared that taste does not affect their decision to consume caffeinated beverages. At least 120 (68%) of the students stated that that they don't take caffeinated beverages before going to class or taking a test, and only 56 (32%) of the students do that.

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When the students were asked if they found themselves craving caffeinated drinks regularly, most of them (85%) answered no. Furthermore, most of the participating students (83%) said that they don't binge drink caffeinated drinks when they feel stressed.

Table 4: General Findings

Please choose 1 of the following responses: (4) = Strongly Agree (SA); (3) = Agree(A); (2) = Disagree(D); (1) = Strongly Disagree (SD)	SA 4	A 3	D 2	SD 1
I could go 24-72 hours without caffeine	109	32	19	16
I drink caffeinated beverages for the taste	32	94	29	21
I drink caffeinated beverages for the effects	25	61	49	41
I usually drink caffeine before class or taking a test	16	40	63	57
I find myself craving caffeine, if I don't have it, I will get a headache	11	15	50	100
I binge drink caffeinated drinks when I am stressed	11	19	54	92
I have tried to quit consuming caffeine but was unsuccessful	4	14	67	91
I have tried to quit consuming caffeine and was successful	31	53	50	42

5. Discussion

5.1 Theoretical Approach

Creating evidence-based intervention strategies are an integral part of public health work in behavioral modification. This study recommends the utilization of the Trans Theoretical Mode (also known as TTM) where in all stages different change processes are applied until study participants are able to achieve a quit status. When students are first introduced to the idea that caffeinated beverages may not be good for their health, many of them may not be interested (precontemplation stage) to take any action. However, with the use of simple descriptive data provided by the FDA and other testimonies from those who have lost loved ones as a result of caffeine overdose, participants may move to stage two (contemplation) and begin the thinking process that could last up to six months (Edberg, 2015).During the third stage (preparation), college students should be encouraged to make the necessary behavioral change within a month after receiving health information that will help them move on to the fourth stage (action) to reduce or abstain from caffeine overuse as part of their daily regimen. If provided with proper tools on how to cope with the withdrawal symptoms, participants can resume the fifth stage (maintenance)and try to maintain the new behavior for over a period of six months (Edberg, 2015). Finally, when participants have achieved a successful behavioral change and show no signs of potential relapse, they can be celebrated for their hard work and get discharged (termination) from the intervention program and this usually happens at least 12 months from the start of the process.

5.2 Recommendations

The researchers of this study have some recommendations for individuals who may be regular users of caffeinated beverages. The first recommendation is to limit their consumption of caffeine to the recommended daily amount of no more than 400 milligrams, an amount that is equal to four cups of coffee, ten cans of cola, or two energy drink shots (Mayo Clinic, 2020).

The second recommendation is to stop drinking caffeinated beverages gradually, as most people continue to drink caffeinated beverages to avoid withdrawal symptoms. Reducing caffeine consumption over two or three weeks helps the body make new changes without causing withdrawal symptoms (Cleveland Clinic, 2020).

The third recommendation is to start drinking decaf coffee and substitute caffeinated beverages with water or vitamin water as an option. One study showed that water consumption is healthy for our bodies, flushing caffeine from the system, and keeping one hydrated (Cleveland Clinic, 2020).

5.3 Study Limitation

One of the potential limitations of this study is its small sample size of 176 participants, however it was impressive to get a 50% response rate given the nature of online survey participation during COVID-19 pandemic time. Future studies that will assess students' caffeine consumption during pandemics or stressful times are highly encouraged. Second, the sample of the surveyed students is derived from one academic institution, hence limiting the diversity of the answers, and therefore the results may not be generalized to students at other universities. Third, the demographic profile of the sample reflects that 135 (76.9%) of the participants were females, and 123
(69.9%) of the sample identified themselves as Hispanic or Latino; this further limits the generalizability of our results. Fourth, data was collected in an online modality because of COVID-19 pandemic circumstances, and this is a challenge for efficient data collection as online survey participation without any extra credit points may be less motivating to students. Future studies that will collect data in an in-person classroom environment are highly recommended. Lastly, this study used cross-sectional data, limiting our ability to assess causal relationships between increased caffeine consumption and COVID-19 pandemic. Also, because of the online survey methodology, participants were not screened for use of any caffeinated beverages, and they may have provided inaccurate information, either because they may forget or not pay attention to what they consume during the day.

6. Conclusion

This study examined college students' caffeine intake habits and their perceptions during COVID-19 pandemic time with the goal of providing evidence-based recommendations that will help reduce their daily intake. One-third of college students reported drinking caffeinated beverages on a regular basis. These students are at increased risk for dehydration, stomach aches, nervousness, poor dietary choices, poor behavior changes (i.e., stress, anxiety, and sleep disorder), that may interfere with their food absorption. Hence the incorporation of well-studied health theories such as TTM may be a useful strategy in addressing behavioral health modification among groups of people. Future research that will be conducted in a longer time frame with a larger sample size of college students is needed to further examine the association between caffeine usage during stressful pandemic times.

7. Disclosure Statement

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