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Caffeine Intake for Division II Athletes: How Much and Why

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ABSTRACT

There were three objectives of this study. The primary objective was to determine the caffeine intake, sources, and reasons for consumption for student-athletes and non-athletes at a NCAA Division II (DII) university. Secondary objectives were to determine reasons for avoiding caffeine and changes in consumption during game days and non-game days as well as in season and off season; and to identify any differences between men and women athletes who participate in the same DII sport. Student-athletes (n=111) and non-athletes (n=33) were surveyed on their caffeine intake. We examine and discuss each of the objectives with special attention to amounts of caffeine consumption, the sources, and reasons for ingestion as well as any differences between the sexes. Throughout, we make comparisons on the current data of caffeine consumption to previous studies with similar demographics.

Keywords

Caffeine, Consumption, Student-athletes, College students, Survey.

Introduction

Caffeine, also known as 1,3,7-trimethylxanthine, is a stimulant commonly found in beverages such as coffee, tea and soft drinks, and to a lesser extent chewing gum and tablets. When ingested, it is quickly absorbed by the gastrointestinal tract into the bloodstream. The effects of caffeine on the central nervous system (CNS) produce feelings of alertness, focus, or even changes in physical activity, which are some of the reasons people choose to consume caffeine products [1].

Many Americans consume caffeine regularly. In fact, survey data from 2001-2010 from the National Health and Nutrition Examination Survey (NHANES) has shown that about 89% of adults in the U.S. regularly consume caffeine. The majority (98%) of caffeine consumption was in the form of beverages. Coffee, tea, and soft drinks were the most common sources of caffeine at 64%, 16%, and 18% respectively [2]. Statistics on college students is similar; however, there is less research involving this subgroup and caffeine intake [3,4], and minimal on college athletes [5].

Caffeine has been an area of interest in athletic performance research due to its potential ergogenic effects. The main mechanism of these effects is the stimulation of the CNS by caffeine; however, other possible mechanisms include an increase in calcium ion mobilization and sodium/potassium pump activity within the muscles, both of which may provide further ergogenic effects [1]. There is a large quantity of research on caffeine and physical performance. For example, Ranchordas et al., [6] found that caffeinated gum improved performance in the countermovement jump test and reduced fatigue index during repeated sprints for college rugby players. Another study found that caffeine gel ingestion increased acute muscle strength and power in trained young men [7]. Further, a meta-analysis assessed the effects of caffeine on muscle strength and power, and reported that there were small to medium improvements in performance for both aspects, particularly in the upper body [8]. In another meta-analysis, Shen et al., [9] found that caffeine was beneficial for endurance athletes with a linear relationship between the effectiveness of caffeine and the duration of the athletic event. The International Society of Sports Nutrition published a position stand stating that many, but not all, studies have demonstrated that caffeine can acutely enhance various aspects of performance such as muscular endurance, strength, sprinting, and jumping. The authors stated that caffeine has even greater effects for aerobic endurance exercise [1].

Research on the consumption of caffeine in college students, especially collegiate athletes, is not as common. Mahoney et al., [3] collected data on students from five different universities across the U.S. and found that 91.7% of students had consumed caffeine within the past year. One notable difference in their findings compared with the NHANES data [2] was a higher use of energy drinks (EDs) at 36.4% of students surveyed. The average amount of caffeine consumed was 159 mg/d for all students and 173 mg/d for regular users of caffeine. Reasons for use included feeling more awake, enjoying the taste, social aspects, and improving concentration. Mahoney et al., [3] also made comparison of athletes to non-athletes as well as reasons for consumption, but did not, however, address caffeine consumption in relation to the typical level of intensity in the athletes' respective sports – a variable we investigate in the present study. Another study found correlations between caffeine consumption and sources with other variables such as sex and sleep quality but, again, did not account for participation in athletics [4]. In a study involving five NCAA Division III schools in the Midwest, the authors found only 14.5% of collegiate athletes regularly consumed energy drinks [10]. Similarly, in a study involving non-athletes from a DI school and a DIII school in the Midwest, the authors found that 23.1% consumed energy drinks [11]. These numbers do, however, suggest a significantly higher amount of ED consumption compared to the general population shown in the NHANES study previously discussed (<1%) [2]. Interestingly, Sassone et al. [5] found a very low use of caffeinated supplements and pre-workout in Division I athletes at an average of about 5% combined.

Methods

Approval for the study was granted from Wingate University's Research Review Board. Coaches of each participating team were contacted for permission to survey their respective athletes, and surveys were sent out via email. Submissions were entirely voluntary and anonymous, and no incentives were offered. In some cases, additional emails were sent out to the students who did not respond to the initial invite. Data collection ran from May, 2024 to July, 2024. The data included responses from 144 students, including 111 student-athletes and 33 non-athletes all from Wingate University, a DII university in the Southeastern United States. The response rate for student-athletes was 27%, and for non-athletes was 9%. Students from 16 teams participated in the survey including: Men's Basketball (n=4); Women's Basketball (n=10); Men's Swimming (n=5); Women's Swimming (n=9); Men's Cross-Country (n=10); Women's Cross-Country (n=8); Baseball (n=8); Softball (n=9); Men's Tennis (n=3); Women's Tennis (n=4); Men's Lacrosse (n=7); Women's Lacrosse (n=10); Men's Golf (n=6); Women's Golf (n=2); Men's Soccer (n=7); Women's Soccer (n=9). Non-athletes were grouped based on class rank including Rising Sophomore (n=4); Rising Junior (n=9); Rising Senior (n=14); and Graduating/Graduated Senior (n=6).

The survey used in this study was a modified version of the instrument developed by Caldwell et al., [12] and used in a similar study from Mahoney et al., [3]. The survey was administered online and asked for some demographic information including class rank, sex, and athlete status. Three general categories were made to organize sources of caffeine consumption: soft drinks, energy drinks, and pre-workout with 12, 8, and 7 options listed respectively, as well as an "other" option available in each category. Students were asked to select an amount (8 fl oz, 12 fl oz, etc.), frequency (1x, 2x, etc.), and time (per day, week, month, or year) for each applicable source. The caffeine content of each source was based on product details from company websites as well as the USDA FoodData Central website. Coffee was assumed to be black coffee, and tea was assumed to be black tea. Average daily intake was calculated by determining an aggregate caffeine consumption for each submission and dividing it into a daily amount. Students were also asked to select from a list of 13 reasons why they consume caffeine and 12 reasons why they may avoid it with an "other" option available in both sections. Students could select multiple answers from each list. Student-athletes were asked to complete an additional section where they would select if there was "more, less, or no change" to their caffeine consumption for in season, off season, game days, and non-game days.

Data was analyzed using Microsoft® Excel® for Microsoft 365 MSO software with the Analysis ToolPak add-in. Chi-squared tests of contingency tables were used to determine statistically significant differences between groups for qualitative data collected. Single factor ANOVA models as well as two-sample t-tests were used to examine differences in caffeine intake between groups.

Results

The results showed 60% of respondents were female (n=87) and 40% were male (n=57). Students were determined to have consumed some amount of caffeine if they had responded to any portion of the survey excluding the section on reasons they may avoid caffeine. Students who were not in this group were considered to abstain from caffeine. 86% (n=124) of students reported drinking some amount of caffeine, while 14% (n=20) abstained from caffeine. Athletes were identical with proportions of 86% (n=96) and 14% (n=15) respectively, and non-athletes had rates of 85% (n=28) and 15% (n=5) respectively. 75% (n=43) of men reported drinking some amount of caffeine with 25% (n=14) abstaining, while 93% (n=81) of women reported consuming some amount of caffeine with 7% (n=6) abstaining. Male athletes and non-athletes were found to have higher abstinence rates than expected at 22% (n=11) and 43% (n=3) respectively (P=0.01). Female athletes were found to have less abstinence from caffeine than expected at only 7% (n=4).

Only surveys with properly completed source/frequency tables were used to calculate daily caffeine intake and to determine top sources of caffeine (n=60). Total caffeine intake was calculated using estimated caffeine content from each chosen source and divided into an average daily intake. Responses were also combined to determine response rates for each general source category: soft drinks (excluding Sprite and Fanta), energy drinks, and pre-workout. Top specific sources of caffeine were coffee (70%), tea (36.7%), Celsius energy drink (30%), Diet Coke (21.7%), and

Coca-Cola (20%). 63.3% of students reported drinking soft drinks, 60% reported drinking energy drinks, and 15% reported using caffeinated pre-workout supplements.

Average daily intake for students who consumed caffeine was 138.5 mg/d (n=60). Other average intakes determined were 123.4 mg/d for student-athletes (n=46), 188.2 mg/d for non-athletes (n=14), 133.4 mg/d for men (n=17), and 140.6 mg/d for women (n=43). No statistically significant variance regarding average daily intake was found between groups.

Reasons for caffeine consumption and avoidance were determined using all submitted surveys. Top reasons for consumption were to feel more awake and alert (61.8%), enjoy the taste (58.3%), increase physical energy (34.7%), to improve concentration (31.9%), and to study or complete schoolwork (29.9%). Male athletes were found to be more likely to consume caffeine for workouts, practice, and competition at response rates of 44%, 28%, and 34% respectively. Male athletes were also found to be less likely than expected to attribute caffeine consumption to taste (40%), while female athletes were more likely than expected to attribute it to taste (73.8%) ($P<0.001$). Top reasons students reported avoiding caffeine were possible upset stomach (19.4%), does not boost energy (16%), potential dehydration (14.6%), caused or intensifies anxiety (13.2%), and caused or intensifies feelings of nervousness (11.8%). Some students reported other reasons not listed on the survey such as to avoid dependence or to avoid building up a tolerance so they could use caffeine specifically for competition. No statistically significant differences were found for reasons why students avoided caffeine or for the effect of game day and season on caffeine consumption.

The data from student-athletes were also grouped into categories similar to the study from Sassone et al., [5]. Teams were classified into categories based on the primary energy system(s) used in their sport. These were the sports using the phosphocreatine (PCr) system (brief explosive bouts as in baseball, softball, and golf), the PCr and anaerobic glycolysis (AG) systems (a combination of explosive and high intensity aerobic activity as in basketball and tennis), and oxidative phosphorylation (most, if not all, aerobic activity as in cross-country, lacrosse, and soccer). Swimming was excluded from these calculations as the energy system used by different members of the team could vary greatly depending on the event. The PCr group had an average daily intake of 71.1 mg/d (n=9). The PCr/AG group had an average daily intake of 90.8 mg/d (n=6). The PCr/AG/OP group had an average daily intake of 119.7 mg/d (n=23). No significant variance was found between these groups for average daily intake or reasons for consumption.

Small sample sizes of each team disallowed an analysis of any statistical differences between sexes who participated in the same sport.

Discussion

To our knowledge, this is the first study to examine the caffeine intake, sources, reasons for consumption of DII student-athletes and non-athletes, and the differences between the sexes who played the same sport. Of the 144 student respondents, 86% reported drinking some amount of caffeine in the last year; a percent similar to previous research. The data from the NHANES showed that 81% of individuals aged 19-30 years and 89% of the general population consumed caffeine [2]. Similarly, the survey from the KWP Beverage Consumption Panel showed that 85.8% individuals aged 18-24 years and 85% of the general population consumed caffeine [13]. Interestingly, there was little difference in the prevalence of caffeine consumption between student-athletes and non-athletes, although differences were found between men and women. The estimated average daily intake for caffeine consumers was found to be 138.5 mg/d. This is lower than the average found in previous research on college students from Mahoney et al., [3] of 159 mg/d but higher than the 121 mg/d found for the 19-30 age group in the NHANES study [2]. It is also slightly higher than the average of 122.1 mg/d found by the KWP survey for people aged 18-24 [13].

Our survey found that 70% of respondents consumed coffee, 36.7% consumed tea, 63.3% consumed caffeinated soft drinks. These numbers are similar to the data from Mahoney et al., [3] which showed that 72% of respondents consumed coffee, 61.4% consumed tea, 68.8% consumed soda. Our data showed reasons for caffeine consumption we also similar to Mahoney et al., [3]; however, only 13.2% of our students reported social aspects as a reason they consumed caffeine. Caffeinated pre-workout powders were also included in our survey with 15% of students reported consuming these supplements. This number was notably higher than previous research from Sassone et al., [5] finding just 5% of collegiate athletes reporting its use.

It's important to note that one of the primary goals of this current study was to investigate the differences between the sexes in DII athletes. While we did find some noticeable differences between the sexes in the consumption amount and reasons for use, we were disappointed that the small sample sizes of each team disallowed us from determining if there was a difference in caffeine consumption between the sexes who played the same sport – which is a rare and interesting variable to study.

One area of our data worth noting was the prevalence of energy drink consumption. While estimated average daily intake was within U.S. guidelines for caffeine consumption (400 mg/d), there was a much higher rate of energy drink consumption compared to previous research [15]. Fulgoni et al. [2] reported that, while only making up <1% of caffeine consumption, energy drink popularity increased dramatically from 2001-2010. The KWP survey reported that 9.1% of individuals aged 18-24 consumed energy drinks [13]. More recent research on college students found rates ranging from 23.1% to 36.4% [3,11]. However, we found that for all who consumed some type of caffeine, 60% of them acquired it, at least in part, from energy drinks. Three individuals were found to have average daily intakes exceeding 400mg, with the highest being 947.7 mg/d. Given the high caffeine content of energy drinks, individuals may be more likely to exceed consumption guidelines if they regularly consume energy drinks. Considering

the interest in caffeine as an ergogenic aid in sport, it is important that coaches and other professionals understand the sources and prevalence of caffeine consumption in athletes. While there are documented benefits to performance from caffeine, coaches, and athletes should consider caffeine guidelines and possible risks of excessive caffeine intake.

There were several limitations to this study. Low response rates resulted in small sample sizes. This made statistically significant differences between groups difficult to determine, especially for comparing specific sports teams, one of the original objectives of this data collection. Our online survey relied on self-reporting and recall, which can be inaccurate. It was not required to complete every part of the survey, which resulted in many incomplete or incorrectly completed caffeine source/frequency tables – a typical occurrence in this type of data collection. Offering every possible caffeinated beverage as an option on the survey is not possible, and determining the caffeine content of each beverage, especially coffee and tea, is difficult due to the wide variation of caffeine content between different options, and whether the subject consumed the entire beverage they were reporting. The "other" category was not considered for determining average daily intake and aggregate soft drink consumption because there was no option given to write in the drink or supplement name. The swimming team was not included in the calculations regarding the 3 energy systems because the energy system utilized by each athlete varies greatly depending on their event.

Conclusions

The majority (86%) of students consumed caffeine with little difference in consumption rates between student-athletes and non-athletes. The most popular sources of caffeine were coffee (70%), soft drinks (63%), energy drinks (60%), and tea (36%). Unlike most previous instruments used, our survey included caffeinated pre-workout supplement powder options, and found that 15% of students reported consuming these products. Males were more likely to abstain from caffeine. Male athletes were more likely to drink caffeine for workouts, practice, and competition and less likely to attribute it to taste. Female athletes were less likely to abstain from caffeine and more likely to attribute caffeine consumption to taste. Most of our data was similar to previous research on college students, with lower estimated average daily caffeine intake yet considerably higher consumption of energy drinks. This present study may be valuable to coaches and other professionals who work with athletes to better understand what their athletes may be consuming and the purpose of the ingestion.

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