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# Perceived effect of caffeine-containing products consumption on nocturnal sleep and daytime functioning among students of a private tertiary institution in southern Nigeria

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**Abstract**

**Context:** University students who deprive themselves of enough nocturnal sleep due to academic activities are at risk of the deleterious effects of sleep deprivation that usually follow. To reverse these effects, they tend to consume substances such as caffeine to counteract fatigue and possibly give them the feeling of alertness they need to perform their daily activities given that there is a popular concern that the academic demands of University training can cause significant stress and the need to gain insight into the effects of caffeine on students.
**Objective:** This study set out to assess the self-reported effects of the consumption of caffeine-containing products on nocturnal sleep and daytime functioning among students of Novena University, Ogume Delta State, Nigeria.
**Materials and Methods:** The study adopted a descriptive cross-sectional design conducted among 400 students comprising 217 males and 183 females selected through random sampling. Data were collected using a 27-item questionnaire containing four sections; socio-demographic characteristics, caffeine consumption pattern, sleeping habits, and daytime functioning. The data was analysed using SPSS version 23 and presented in descriptive and inferential statistics at $P < 0.05$ level of significance.
**Results:** More than one-third of the respondents (68.50%) affirmed consuming caffeine-containing products such as caffeinated drinks and beverages. Only 21.50% affirmed practicing sleep deprivation and 40.10% agreed that their consumption of caffeine-containing products increases during times of academic stress. There was a significant relationship between the hours of sleep of the respondents and their consumption of caffeine. More than half of the respondents (71.90%) affirmed experiencing daytime sleepiness while about 40% affirmed experiencing caffeine-induced daytime dysfunction.
**Conclusion:** There was a significant relationship between the level of caffeine consumption and students' sleep quality. Caffeine-induced sleep deprivation and caffeine-induced daytime dysfunction are widespread among undergraduate students in the study population.

Keywords: Consumption of caffeine, Daytime functioning, Students, Sleep.

## Introduction

Sleep is a physiological and psychological state essential for the proper well-being of an individual. It is part of what is considered the sleep-wake cycle which has been shown to exhibit robust circadian rhythmicity. The suprachiasmatic nucleus (SCN) which is located in the anterior hypothalamus is home to the master circadian clock that regulates this internal circadian process.[1] For college students and even adults on a larger scale, 7-9 hours of nocturnal sleep is recommended.[2] Inadequate sleep,

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usually less than six hours per night, which is popular among nightshift workers, University students, and even aircrew can lead to acute or chronic sleep deprivation. Insufficient sleep and varying sleep schedules can affect various body processes ranging from the consolidation of memory, alertness and mood, cardiovascular system, immune system, hormone, temperature, and glucose regulation.[3-6] Generally, existing literature has shown that sleep deprivation is harmful to the health and general well-being of an individual.[7]

In line with the rising need to develop means of coping with the effects of sleep deprivation (such as daytime sleepiness), the college-aged population tends to consume more caffeine as presented in different products such as caffeinated drinks (e.g. Coca-Cola, soda) and caffeinated beverages (e.g. tea, coffee) due to the established appeal of caffeine's perceived ability to improve performance, counteract fatigue, and elevate mood.[8-11] On the other hand, it is known that students also consume caffeine-containing products to induce sleeplessness — also known as sleep deprivation. In man, sleep seems to be the function most sensitive to the effects of caffeine.[12] If caffeine consumption is not wisely regulated during the first daytime, sleep deprivation will result, and performance deficits will be experienced during the subsequent daytime. Caffeine consumed during the day possesses the ability to disrupt the ensuing nocturnal sleep via the reduction in 6-sulfatoxymelatonin (the main metabolite of melatonin).[13] Also, a deficit in nocturnal sleep of as little as 90 mins for just one night can lead to a reduction of daytime objective alertness by one-third.[14]

Insufficient sleep and varying sleep schedules have been widely reported in the college population, with 28% of students reporting daytime sleepiness[15] and 25% of students reporting less than six and a half hours per night.[5,16] Academic and emotional stress, tension, and worry are the most common reasons for decreased duration and quality of sleep in students in tertiary institutions.[5,6,17,18] To help cope with this sleep deficit and be able to fulfil academic duties, students often rely on substances that can keep them awake and alert. One among such substances is caffeine.

Caffeine is one of the oldest central nervous system (CNS) stimulants that have maintained its pharmacological and economic relevance for decades. It is considered an adenosine antagonist which works through the competitive binding and subsequent blockade of adenosine receptors (majorly $A_1$ and $A_2$), thereby causing the secretions of various neurotransmitters such as dopamine, serotonin, and norepinephrine.[8,19,20] Although caffeine can be found naturally or artificially in several products, the most common include coffee, tea, soda, and chocolate.[21,22] Low to moderate caffeine consumption, is perceived to have some benefits, which may include, improved cognitive and behavioural effects, enhanced mood, and potentially increased neuroprotection against certain disease.[23,24]

Caffeine also affects both stages of sleep: rapid eye movement (REM) and non-rapid eye movement (NREM), resulting in decreased sleep quality and/or increased sleep latency.[25] To make up for this sleep deficit, individuals may rely on caffeine the next day to counteract daytime sleepiness, leading to a cycle of caffeine use and sleep deprivation.[11,24,26] This is common in University students, with previous studies showing over 48% of this population experience short sleep time and 28% reported daytime fatigue.[27,28] This could disrupt the efficient mental and physical health required for maximum academic performance.

Caffeine mainly disrupts sleep via the inhibition of adenosine receptors ($A_1$ and $A_2$). This receptor antagonism of caffeine alters the biological circadian rhythm and delays nocturnal sleep, thereby creating a state of sleep debt characterized by cycles of insufficient sleep and daytime sleepiness. Due to caffeine's ability to counteract sleepiness or lethargy and promote wakefulness or alertness; a consumer can easily develop caffeine dependence, and this could translate into caffeine abuse. Caffeine can cause sleep disturbances as well within the sleep-wake cycle. If caffeine is consumed into mid-afternoon, it continues to act as an anti-fatigue agent as well as a diuretic throughout the late evening.[29] It can affect anywhere from 1-3 hrs consumed before bedtime to up to 12 hrs earlier, depending on the individual. In those individuals vulnerable to stress, disturbed sleep is even more probable.[29,30]

Some studies have also reported that students with low overall sleep quality tend to have lower Cumulative Grade Point Averages (CGPAs) compared to those who reported adequate sleep quality.[31,32,33] Although caffeine may be used to keep a student energized to perform academic duties, its use affects the sleep cycle, causing a decrease in sleep quality which may lead to poorer performance and reduced CGPAs.[34,35] Although studies have shown an effect of caffeine on sleep and the importance of sleep on academic performance, there is a paucity of information evaluating the basis for the relationship between caffeine consumption, sleep, and daytime functioning among students in private tertiary institutions in Southern Nigeria.

## Methods

**Study Design:** The study was a cross-sectional design that determined the perceived effects of the consumption of caffeine-containing products on nocturnal sleep and daytime functioning among students of Novena University, Ogume Delta State, Nigeria.

**Study Area:** The study was conducted in Novena University the first private-owned University in Delta State. The University was founded in 2006 and operates three colleges which include the College of Health Sciences, College of Natural and Applied Sciences, and College of Management and Social Sciences.

**Study Population:** The study population comprised students of Novena University Ogume, Delta State.

**Inclusion Criteria:** Inclusion criteria for respondents were undergraduates at Novena University, non-caffeine-naïve, and gave informed consent to participate in the study.

**Exclusion Criteria:** Students who are not undergraduates at Novena University, those not available during the data collection, and students who refused to give consent to participate in the study.

**Sample Size Determination:** The formula for sample size calculation for single proportion was used for the study.[36]

$$no = \frac{Z^2pq}{d^2}$$

no = the minimum sample size, z = 1.96 at 95% confidence interval obtained from statistical table of normal distribution, P = 27.0% or 0.27, i.e., Proportion of caffeine consumption to work on school project among college students,[37] q =1.0-p=1- 0.27=0.73, d = degree of accuracy desired (0.05)

$$no = \frac{1.96^2 x0.27x0.73}{0.05^2} = 303$$

**Using the formula for Finite Population Correction for Proportions**

$$n = \frac{no}{1+\frac{(no-1)}{N}}$$

Where n= Calculated Sample Size
N= Estimated population size of students in Novena University which is 2500.[38]

$$n = \frac{303}{1+\frac{(303-1)}{2500}}$$

n = 270
Therefore, the minimum sample size for the study would be 270 students.

**Sampling Technique:** A two-stage sampling technique was used to collect the data. The University was clustered into three colleges of Health Sciences, Natural and Applied Sciences, and Management and Social Sciences. The colleges were then stratified into departments and a simple random sampling technique was used for the selection of the students across the departments.

**Instrument for Data Collection:** The main research instrument used in the present research was a structured questionnaire developed after a critical examination of the objectives of the study. The research instrument was a 27-item questionnaire that had four (4) parts numbered 1, 2, 3, and 4. Part 1 was designed to gather personal (demographic) information of the respondents while parts 2, 3, and 4 were designed to elicit information concerning the respondent's sleep habits, level of caffeine consumption, and its perceived effects on their daytime function respectively.

The questionnaire was developed following consultation with established sleep questionnaires such as the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS). The article on the development of a questionnaire to assess sleep-related practices, beliefs, and attitudes was also consulted.[39]

**Method of Data Collection:** A questionnaire was self-administered to each participant during their class sections. The cover letter informed them of the nature and purpose of the research and assured them of the confidentiality of their response. A total of 400 questionnaires were distributed and used for analysis.

The questionnaire was used to gather data on the effects of caffeine consumption in various forms on nocturnal sleep and daytime functioning among students.

**Statistical Analysis:** The data gathered were analysed using Statistical Packages for Social Sciences (SPSS) version 23.0. The results were presented in frequencies, percentages, charts, and tables. General descriptive statistics and chi-square tests were also run. The statistical significance was set at $P < 0.05$.

## Results

### Demographic Characteristics

According to Table 1, more than half of the respondents 217(54.30%) were males, 262(65.50%) were between ages 15-24 years with a mean age of 23.38±5.21 years and majority 334(83.50%) were single. Also, a greater part of the respondents 382(95.50%) were Christians, 136(34.0%) was in the Department of Public and Community Health and a few 48(12.0%) affirmed to take prescription medication for a sleep disorder such as insomnia or narcolepsy.

### Reasons for Consuming Caffeine

Figure 2 shows that 52.90% of the respondents concurred to consuming caffeine because they need more energy, 17.50% said when studying for an examination, and 10.60% for pleasure and enjoyment.

### Sleep Habits

According to Table 3, 112(28.0%) of respondents affirmed to going to bed by 11-12am, 81(20.30%) 10-11pm and 64(16.0%) affirmed to 9-10pm. Furthermore, 182(45.50%) concurred to fall asleep <30minafter they have laid down; almost one third 130(32.50%) affirmed to waking up and begin daily activities around 5-6 am and 124(31.0%) affirmed to getting 5-6 hours of sleep at night. Besides, 172(43.0%) would rate their sleep to be fairly good while 231(57.80%) affirmed to occasionally go to bed later than usual during examination periods.

### Experience of Daytime Dysfunction due to Caffeine-Induced Sleep Loss

According to Figure 3, 59.50% of respondents have never experienced daytime dysfunction due to caffeine-induced sleep loss, 24.10% affirmed to experiencing daytime dysfunction due to caffeine-induced sleep loss less than once per week, and few 8.80% affirmed to experiencing daytime dysfunction due to caffeine-induced sleep loss 1-2 times per week.

### Daytime Functioning when Feeling Sleepy

More than one-third of the respondents 98(35.80%) agreed they would sleep more or better if they feel sleepy during the day, 133(48.50%) agreed they would take a nap and 78(28.50%) disagreed that they would increase caffeine intake (Table 5).

### Gender and Caffeine Consumption

Table 6 shows that males 160(40.0%) consume caffeine more than females 114(28.50%). The association between gender and caffeine consumption was also significant at $P<0.05$. Thus the null hypothesis which states that there is no significant association between gender of the respondents and caffeine consumption was rejected.

### Age and Caffeine Consumption

As shown in Table 7, there was no significant association between the ages of the respondents and their consumption of caffeine at $P>0.05$. Since the

**Table 1: Demographic Characteristics of the respondents**

| Variable | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 217 | 54.30 |
| Female | 183 | 45.80 |
| **Age (Years)** | | |
| 15-24 | 262 | 65.50 |
| 25-34 | 129 | 32.30 |
| 35-44 | 6 | 1.50 |
| 45-54 | 3 | 0.80 |
| **Department** | | |
| Public and Community Health | 136 | 34.0 |
| Intelligence & Security Studies | 78 | 13.5 |
| Computer Science | 16 | 4.0 |
| Economics | 9 | 2.3 |
| Mass Communication | 20 | 5.0 |
| Accounting | 21 | 5.3 |
| Political Science | 49 | 12.3 |
| Business Administration | 15 | 3.8 |
| Biochemistry | 6 | 1.5 |
| Energy & Petroleum Studies | 21 | 5.3 |
| Microbiology | 12 | 3.0 |
| Chemical Sciences | 8 | 2.0 |
| Public Administration | 9 | 2.3 |
| **Taking prescription medication for a sleep disorder such as insomnia & narcolepsy** | | |
| Yes | 48 | 12.0 |
| No | 352 | 88.0 |

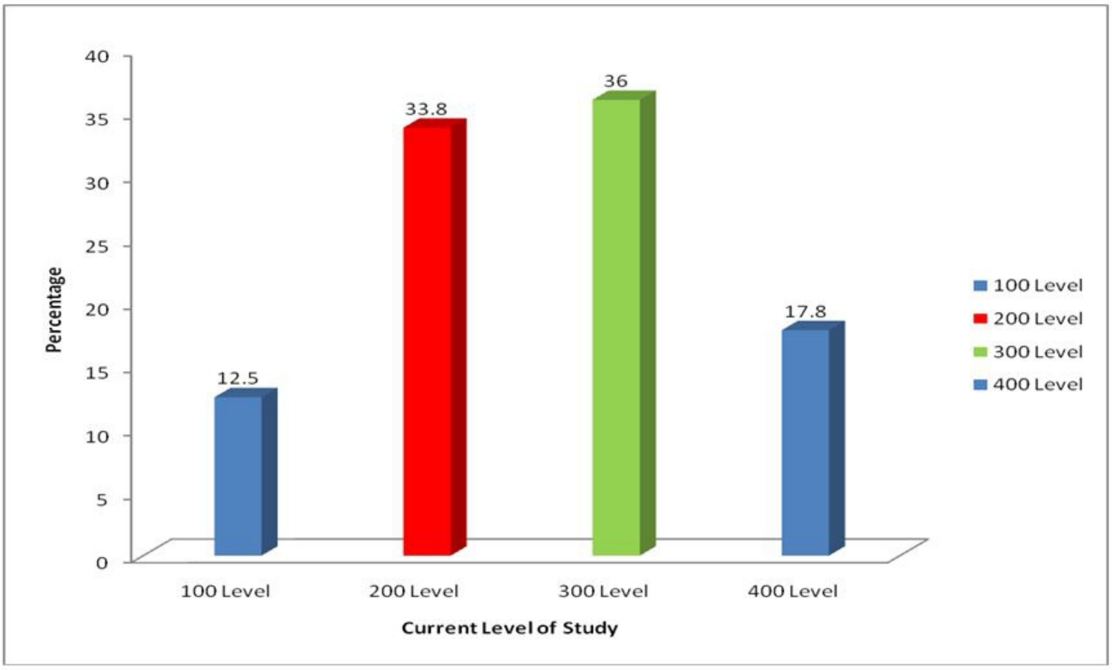


**Figure 1: Current level of study of the respondents**

**Table 2: Pattern of Caffeine Consumption of the Respondents**

| Variable | Frequency | Percentage |
|---|---|---|
| **Do you consume caffeine** | | |
| Yes | 274 | 68.50 |
| No | 126 | 31.50 |
| **In what form do you consume caffeine** | | |
| Caffeinated Drinks/Colas | 194 | 43.50 |
| Caffeinated Beverages | 113 | 25.30 |
| Energy Drinks or Shooters | 57 | 12.30 |
| Cocoa or Chocolate products | 70 | 15.70 |
| Over counter drugs | 12 | 2.70 |
| **Frequency of consumption of caffeine among the respondents** | | |
| Never/almost never | 75 | 27.40 |
| Once/twice a week | 114 | 41.60 |
| 3-5 days a week | 44 | 16.10 |
| Almost every day | 41 | 15.0 |
| **Describe your caffeine consumption** | | |
| Non-Caffeine consumer (<5mg per day) | 58 | 21.20 |
| Low Caffeine consumer (5-200mg per day) | 153 | 55.80 |
| Moderate caffeine consumer (201-500mg per day) | 54 | 19.70 |
| High caffeine consumer (501-750mg) | 9 | 3.30 |
| **Do you practice sleep deprivation** | | |
| Yes | 59 | 21.50 |
| No | 215 | 78.50 |
| **Do you feel your caffeine intake increases during times of academic stress** | | |
| Yes | 110 | 40.10 |
| No | 164 | 59.90 |

P-value is higher than 0.05, we would conclude there is no significant association between the age of the respondents and their consumption of caffeine.

**Total Sleep Time and Caffeine Consumption**
According to Table 8, there was a significant difference between the hours of sleep of the respondents and their consumption of caffeine at $P<0.05$. Since the P-value is lower than 0.05, we would conclude there is a significant difference between the hours the respondent spends sleeping and their consumption of caffeine.

**Predictors of Caffeine Consumption**
According to Table 9, the significant predictors of caffeine consumption include the level of study (OR=7.873, 95% CI=3.621-17.117), gender (OR=1.589, 95% CI=1.032-1.119), and hours of sleep at night (OR=1.018, 95% CI=0.824-1.257).

**Daytime Functioning**
As shown in Table 4, more than one-third of the respondents 107(39.10%) affirmed feeling daytime sleepiness once/twice a week, 134(48.90%) concurred to feeling excessive sleepiness during

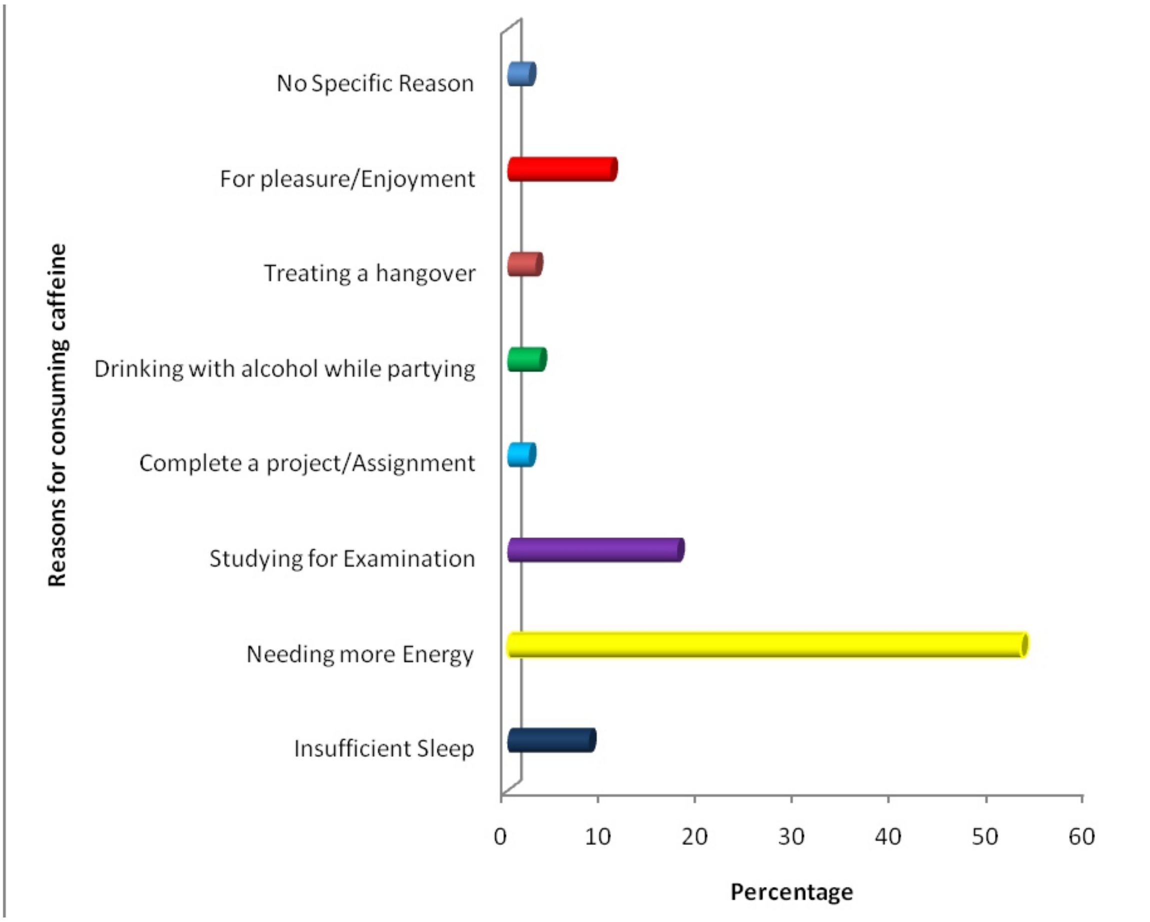


**Figure 2: Reasons for consuming caffeine**

independent study time once/twice a week and 131(47.805) affirmed to never/almost never feeling excessive sleepiness during class study time. In addition, a little more than half of the respondents 140(51.10%) concurred to experiencing improved performance in academics almost every day.

**Level of Study of the Respondents**

About 36.0% of the respondents were in 300 level of study, 33.80% were in 200 level and 17.8% were in 400 level of study as shown in Figure 1.

**Caffeine Consumption**

According to Table 2, more than two-thirds of the respondents affirmed consuming caffeine, of which 194(43.50%) affirmed consuming Caffeinated Drinks/Colas, 113(25.30%) Caffeinated Beverages, and 57(12.30%) Energy Drinks or Shooters. The frequency of consumption of caffeine also shows that 114(41.60%) affirmed to consuming caffeine once/twice a week, 44(16.10%) affirmed to consuming caffeine 3-5 days a week and 41(15.0%) affirmed to consuming caffeine almost every day. Furthermore, more than half 153(55.80%) of the respondents would describe themselves as low caffeine consumers (5-200mg per day); only 59(21.50%) affirmed practicing sleep deprivation and 110(40.10%) concurred that their caffeine intake increases during times of academic stress.

**Table 3: Sleep Habits of the Respondents**

| Variable | Frequency | Percentage |
|---|---|---|
| **When do you go to bed** | | |
| Before 8 pm | 24 | 6.0 |
| 8-9 pm | 30 | 7.50 |
| 9-10 pm | 64 | 16.0 |
| 10-11 pm | 81 | 20.30 |
| 11-12 am | 112 | 28.0 |
| 12-1 am | 38 | 9.50 |
| 1-2 am | 30 | 7.50 |
| After 2 am | 21 | 5.30 |
| **How long does it take you to fall asleep** | | |
| <30 Minutes | 182 | 45.50 |
| 30-1 Hour | 129 | 32.30 |
| >1 Hour | 89 | 22.30 |
| **Time to wake up and begin daily activities** | | |
| Before 3 am | 6 | 1.50 |
| 3-4 am | 24 | 6.0 |
| 4-5 am | 80 | 20.0 |
| 5-6 am | 130 | 32.50 |
| 6-7 am | 87 | 21.80 |
| 7-8 am | 47 | 11.80 |
| 8-9 am | 17 | 4.30 |
| 9-10 am | 6 | 1.50 |
| 10-11 am | 3 | 0.80 |
| **How many hours of sleep do you typically obtain at night** | | |
| <5 Hours | 105 | 26.30 |
| 5-6 Hours | 124 | 31.0 |
| 6-7 Hours | 118 | 29.50 |
| >7 Hours | 53 | 13.30 |
| **Rate your sleep quality** | | |
| Very Good | 207 | 51.80 |
| Fairly Good | 172 | 43.0 |
| Fairly Bad | 9 | 2.30 |
| Very Bad | 12 | 3.0 |
| **Do you go to bed later than usual during examination periods** | | |
| Never or almost never | 58 | 14.50 |
| Occasionally | 231 | 57.80 |
| Every time | 111 | 27.80 |

**Table 4: Daytime Functioning in Relation to Caffeine Intake**

| Variable | Frequency | Percentage |
|---|---|---|
| **How often during the school week do you feel daytime sleepiness?** | | |
| Never/almost never | 77 | 28.10 |
| Once/twice a week | 107 | 39.10 |
| 3-5 days a week | 30 | 10.90 |
| Almost every day | 60 | 21.90 |
| **How often during the school week do you feel excessive sleepiness during independent study time?** | | |
| Never/almost never | 76 | 27.70 |
| Once/twice a week | 134 | 48.90 |
| 3-5 days a week | 25 | 9.10 |
| Almost every day | 39 | 14.20 |
| **How often during the school week do you feel excessive sleepiness during class study time?** | | |
| Never/almost never | 131 | 47.80 |
| Once/twice a week | 113 | 41.20 |
| 3-5 days a week | 15 | 4.50 |
| Almost every day | 15 | 5.50 |
| **How often during the school week do you experience improved performance in academics?** | | |
| Never/almost never | 29 | 10.60 |
| Once/twice a week | 53 | 19.30 |
| 3-5 days a week | 52 | 19.0 |
| Almost every day | 140 | 51.10 |

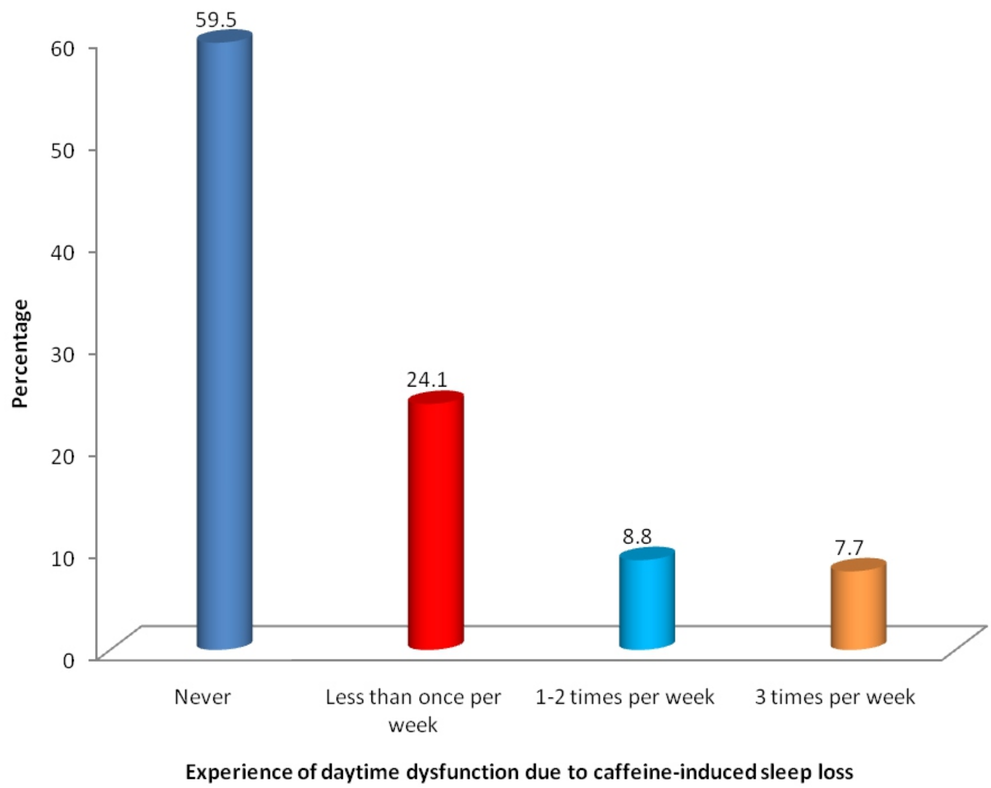


**Figure 3: Experience of daytime dysfunction due to caffeine-induced sleep loss**

**Table 5: Daytime functioning when feeling sleepy**

| | Strongly Disagree | | Disagree | | Unsure | | Agree | | Strongly Agree | |
|---|---|---|---|---|---|---|---|---|---|---|
| **If you feel sleepy during the day, which of the following do you do** | F | % | F | % | F | % | F | % | F | % |
| **Sleep more or better** | 47 | 17.2 | 37 | 13.5 | 69 | 25.2 | 98 | 35.8 | 23 | 8.4 |
| **Take a nap** | 12 | 4.4 | 43 | 15.7 | 60 | 21.9 | 133 | 48.5 | 26 | 9.5 |
| **Increase caffeine** | 71 | 25.9 | 78 | 28.5 | 63 | 23.0 | 50 | 18.2 | 12 | 4.4 |
| **Increase Exercise** | 42 | 15.3 | 59 | 21.5 | 51 | 18.6 | 80 | 29.2 | 42 | 15.3 |
| **I never feel sleepy** | 86 | 31.4 | 104 | 38.0 | 33 | 12.0 | 36 | 13.1 | 15 | 5.5 |

**Table 6: Association between Gender and Consumption of Caffeine**

| **Gender** | **Consumption of Caffeine** | | **$X^2$** | **Df** | **P-Value** |
|---|---|---|---|---|---|
| | **Yes** | **No** | | | |
| **Male** | 160(40.0%) | 57(14.30%) | 6.019 | 1 | 0.014 |
| **Female** | 114(28.50%) | 69(17.30%) | | | |

**Table 7: Association between Age and Consumption of Caffeine**

| | **Sum of Squares** | **Df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|
| Between Groups | 1.026 | 3 | 0.342 | 1.587 | 0.192 |
| Within Groups | 85.284 | 396 | | | |
| Total | 86.310 | 399 | | | |

**Table 8: Association between Hours of Sleep and Consumption of Caffeine**

| | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 3.478 | 1 | 3.478 | 16.710 | 0.000 |
| Within Groups | 82.832 | 398 | 0.208 | | |
| Total | 86.310 | 399 | | | |

**Table 9: Predictors of Caffeine Consumption among Respondents**

| Variables | Wald | df | Sig. | Odds Ratio | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| **Gender** | 5.970 | 1 | 0.015 | 1.589 | 1.032 | 1.119 |
| **Age** | 12.060 | 1 | 0.001 | 0.750 | 1.115 | 1.242 |
| **Level of Study** | 27.119 | 1 | 0.000 | 7.873 | 3.621 | 17.117 |
| **Taking prescription medication** | 11.829 | 1 | 0.001 | 0.124 | 0.038 | 0.408 |
| **Hours of sleep at Night** | 9.138 | 1 | 0.003 | 1.018 | 0.824 | 1.257 |
| **When you go to bed** | 11.475 | 1 | 0.001 | 0.802 | 0.707 | 0.911 |
| **Quality of sleep** | 3.043 | 1 | 0.081 | 0.746 | 0.536 | 1.037 |

## Discussion

This study evaluated the self-reported effect of caffeine consumption and its consequence on nocturnal sleep and daytime functioning among students of Novena University, Ogume, Delta State. Few relationships were present between caffeine consumption and selected variables.

Existing literature suggests that an increase in age may lead to an increase in caffeine consumption. In support, a study by Mahoney et al.[40] found out that older students consumed more caffeine-containing products such as coffee, tea, and energy drinks when compared to younger age groups. This means older students may be consuming more caffeine as classes become more complex or if there is an increased need for focus and attention as their academic career progresses; nevertheless, the results from this study fail to support this hypothesis. This could probably be attributed to the unrestricted availability of caffeine-containing products to all and sundry.

Another significant relationship found in this study was between the hours the respondents spend sleeping and their consumption of caffeine. The results from this study showed that students who consumed different types of caffeinated beverages including popular energy drinks had higher likelihoods of poor sleep quality compared with those who abstained from such. These findings are largely consistent with the study by Drake et al.[41] which examined the effect of 400mg of caffeine administered at three different times before the participants' usual bedtime, and found that doses even 6 hours before bedtime significantly disturbed sleep compared to placebos. Most studies have examined caffeine administration during the daytime with large latencies between ingestion and sleep onset, which of course allows interactions with other potential sleep interference vectors such as dietary intake. Despite this reduction at sleep onset, both sleep efficiency and total sleep time (TST) were significantly reduced in experimental conditions, relative to placebo.

The association between gender and caffeine consumption was significant in this study with the results showing males 160(40.0%) consuming more caffeine than females 114(28.50%). This hypothesis is supported by a study conducted by Mahoney et al.[40] which showed that mean caffeine intake was 120mg/d (in males) and 111mg/d (in females) for coffee; 61mg/d (in males) and 50 mg/d (in females) for tea; 38 mg/d (in males) and 36 mg/d (in females) for colas; 53mg/d (in males) and 30mg/d (in females) for energy drinks.

The findings also show that the level of study, gender, and TST which is the total hours of sleep at night were the significant predictors of caffeine consumption. The results show that 52.90% affirmed that they consume caffeine because they need more energy, 17.50% said when studying for an examination, 10% said when experiencing insufficient sleep and 10.60% said for pleasure and enjoyment. This result is supported by several literatures which have shown that University students increase caffeine consumption under adverse circumstances such as increased sense of stress, insufficient sleep, and while studying for exams.[1,41,42]

Insufficient sleep and irregular sleep-wake patterns (which are usually results of altered circadian rhythms) have been observed at high rates in campuses and sleep problems have been reported to be associated with lower academic performance, impaired social relationships, more risk-taking behaviour, and poorer overall health status.[5,35] Students rate such sleep problems second only to stress in relation to the negative impact on academic performance. Poor sleep quality among students usually results in sleep deprivation which manifests as excessive daytime sleepiness.[43] This study further evaluated the possibility of daytime function impairment in caffeine-consuming University students. It was observed that more than 50% of the respondents reported excessive daytime sleepiness as a consequence of caffeine consumption, and about 41.60% reported daytime dysfunction due to caffeine-induced sleep deprivation.

Caffeine, one of the most commonly consumed stimulants, has been shown to have both positive and negative behavioural, cognitive, and health effects depending on the amount consumed. As reported in a study by Nehlig and Boyet,[44] caffeine is a methylxanthine and adenosine receptor antagonist that has proven to possess potent psychoactive properties. Since adenosine is a physiologic sleep enhancer,[45] as well as an essential component of homeostatic sleep regulation,[46] the brain concentration of adenosine determines the depth and duration of sleep.[44] Existing literature supports that caffeine consumption significantly reduces sleep time, lengthens the perceived onset of sleep, and disturbs sleep quality[47] as observed in the present study with a significant number of respondents reporting disturbed sleep quality following a daytime of caffeine consumption.

Daytime sleepiness resulting in discontinuous sleep is a significant problem among University students today.[48] Poor sleep quality is associated with high failure rates and poor academic performance.[27,49] A study conducted by Lawson et al in 2019, among medical students in Ghana, reported that increased frequency of fatigue and sleepiness during daytime lectures was a result of poor nocturnal sleep quality.[50] According to the authors, the observation was found to affect the required optimum concentration and alertness during lecture times, thus contributing to poor academic performance.[50] Students with poor academic performance tend to spend more hours at night reading and often deprive themselves of sleep in a bid to improve their grades. This creates a vicious cycle that is associated with an adverse effect on sleep quality and mental health. Taken together, results from this research reinforce evidence linking sleep disturbances and poor sleep quality with higher frequencies and doses of caffeine consumption. In summary, the need to overcome psychological stress, heavy academic workload, and increase concentration during classes, could be some of the reasons for the prevalence of caffeine consumption among students in the University.

**Conclusion**

This study shows the existence of a significant relationship between the consumption of caffeine-containing products and sleep quality, total sleep time, and the subsequent daytime dysfunction. Due to the widespread effects of caffeine on body neurochemicals and its ability to enter almost all body systems, students and high caffeine consumers are advised to reduce its intake.

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Conflict of interest

The authors declare that there are no conflicts of interest regarding this publication.

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