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EFFECT OF CAFFEINE INTAKE ON CARDIOPULMONARY EFFICIENCY TEST

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Abstract

Caffeine is known to stimulate the central nervous system and various studies have investigated the effects of caffeine on neurocognitive enhancement. Its benefits on exercise performance have not been fully elucidated by taking into consideration the various cardiovascular and respiratory parameters. The present study was done to analyse the effects of caffeine on cardiopulmonary efficiency using Harvard Step Test to calculate fatigue index, pre and post consumption of caffeine and compare the same by statistical analysis.25 healthy male and female MBBS Students whose caffeine intake is less than once in 2 weeks were selected for the study. Students who consume coffee/ any other caffeinated drink at least once a week were excluded. For finding out the cardiopulmonary efficiency of the students, Harvard step test was used and the fatigue index of each student was calculated before and after intake of 200 mg coffee. The results were compared with paired t test and p value was calculated. Majority of the students showed an increase in Fatigue Index after coffee consumption. Caffeine amplifies and promotes the sympathetic stimulation which occurs during physical exercise likely contributing to increased maintenance of performance and decreased fatigue index. So this interventional study showed that there is increased in cardiopulmonary efficiency post coffee consumption as increase in pulse post Caffeine Consumption was less as compared to pre caffeine.

Keywords: Caffeine, cardiopulmonary, Harvard step test, neurocognitive, fatigue index, exercise

1. INTRODUCTION

Caffeine is the natural content of coffee beans one of the most widely consumed natural and legal psychoactive substances in the world and is closely linked to a human's life. (1) It is known to stimulate the central nervous system and regulate the body's physiological responses in various ways.(2) (3) (4) It appears to be beneficial by reducing the visual and auditory reaction times, resulting in more clear thinking. (5)(6) It has been shown to help learning and improve memory of tasks in which information is passively presented. (7) Evidence from the research literature suggests that 150 to 250 mg (8) of ingested caffeine improves exercise performance. Caffeine may enhance performance during

endurance exercise, particularly prolonged and exhaustive exercises. There is also evidence for caffeine as an ergogenic aid for short-term, high-intensity athletic performance. [9] [10] Although various studies have investigated the effects of caffeine on neurocognitive enhancement, its benefits on exercise performance have not been fully elucidated by taking into consideration the various cardiovascular and respiratory parameters. Thus, there is a need for research for a better understanding of caffeine ingestion prior to exercise on exercise capacity and fatigue level using cardiopulmonary efficiency tests after exercising. The present study seeks to find out the effects of low doses of caffeine on the heart rate of non caffeine consumers. MBBS students were included in this study as they are mostly likely to develop regular caffeine intake in future. Hence it is important to know all the ways in which caffeine affects the human body.

Aim and Objective

To analyse the effects of caffeine on cardiopulmonary efficiency using Harvard Step Test to calculate fatigue index pre and post consumption of caffeine and compare the same by statistical analysis.

2. METHODOLOGY

This is an interventional study.

The study was done in Department of Physiology, BJGMC, Pune. The study subjects were 25 students, age and BMI matched, male and female of first year M.B.B.S. from BJGMC, Pune.

Inclusion criteria:

- Both male and female students of first year M.B.B.S.
- Students whose caffeine intake is less than once in 2 weeks.

Exclusion criteria:

- Students who consume coffee/ any other caffeinated drink at least once a week
- Students who exercise on a regular basis, athletes and sportsmen

Prior starting, the procedure was explained to the students and their consent for the study was taken. Harward's fatigue index was used as a parameter for cardiopulmonary efficiency. The pre caffeine fatigue index was calculated by using Harvard's step test. For male subjects 20 inch high bench and for females 18 inch high bench was used and the subjects were asked to step up and down on it at the rate of 30/min for 5 mins. At the end of the test pulse rate was counted for 1-$1_{1/2}$ min, 2-$2_{1/2}$ min and 3-$3_{1/2}$ min. [11] [12] Fatigue index was calculated by the formula

$$\text{Fatigue index} = \frac{\text{Duration of exercise in secs}}{2 \times (\text{sum of pulse during recovery})} \times 100$$

Following is the grading of fitness according to this test [11] [12]

Excellent - >90

Above Average - 80-90

Average - 65-79

Below Average - 55-64 and

Poor- <55

Then the students were given coffee (coffee sachet containing 200mg of caffeine was used to prepare coffee) as a source of caffeine. After administering coffee, post caffeine fatigue index was calculated by using same test.

The results were entered in excel sheet. The pre and post caffeine values were compared with paired t test and p value was calculated.

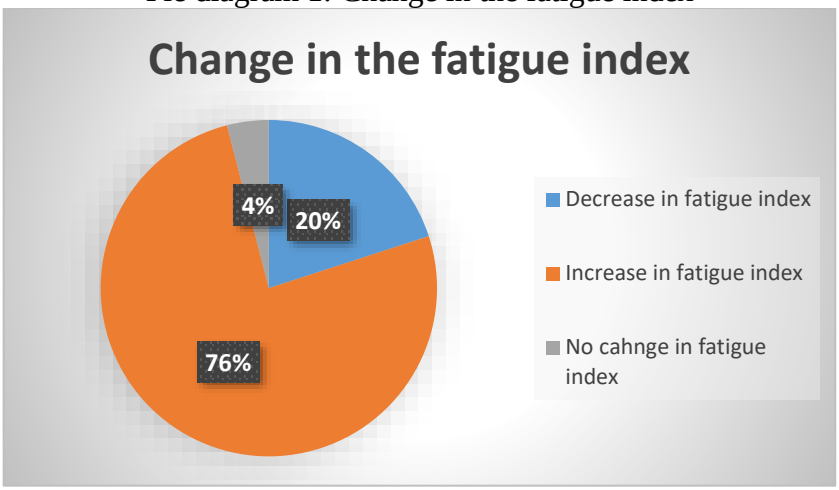
3. RESULTS

As per the calculations and statistics, out of the 25 students in the survey, 19 students showed a increase in Fatigue Index, 5 students showed an decrease in Fatigue Index, and 1 student showed no change in Fatigue Index after coffee consumption.
Paired t test was applied to pre and post values and p value calculated. It was found to be < 0.005 which is highly significant. That means fatigue index has significantly increased after coffee consumption.

Table no 1: Pre and Post caffeine fatigue index of the subjects

Pre caffeine fatigue index	Post caffeine fatigue index
44.64	48
55.55	51
55.76	51.5
52.44	57
46.29	53.76
42.01	47.62
46.73	56.4
52.45	55.76
46.73	45.73
42.61	56.17
44.91	58.14
48.7	55.97
52.1	57.69
40.87	50.36
47.77	53.38
44.38	53
47.77	55.97
48.7	51.9
42.14	46.88
47.17	57
48.39	44.37
42.86	41.44
47.62	48.38
47.32	49.66
58.27	58.14

Pie diagram 1: Change in the fatigue index



Graph 1: Pre and Post caffeine fatigue index of the subjects

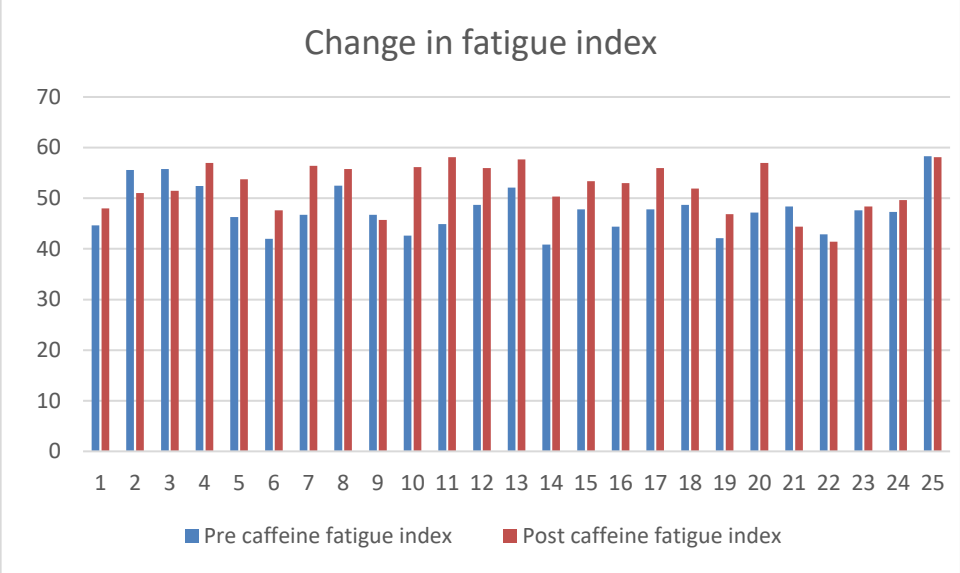


Table no. 2: Statistical Analysis

t-Test: Paired Two Sample for Means		
	44.64	*48*
Mean	47.8975	52.38416667
Variance	21.15788043	22.59197319
Observations	24	24
Pearson Correlation	0.375180959	
Hypothesized Mean Difference	0	
df	23	
t Stat	-4.203334359	
P(T<=t) one-tail	0.000169602	
t Critical one-tail	1.713871528	
P(T<=t) two-tail	0.000339205	
t Critical two-tail	2.06865761	

4. DISCUSSION

Caffeine is the natural content of the fruit, leaves and beans of coffee, cacao, and guarana plants. It is present in beverages like coffee, tea, soda and energy drinks and supplements. [1]
Many studies have proved that caffeine is a central nervous system stimulant and decreases sleep. It enhances various aspects of mental or cognitive functions and decreases reaction time. Caffeine also improves attention span and vigilance. [2] [3] [4] [5] [6] It is also habit forming.[13] There are also studies stating the ergogenic effect of caffeine on improving exercise performance.[9] [10] 200 mg of caffeine or less is the safe level for healthy people without comorbidities and pharmacokinetic disturbances and is usually not associated with toxic effects.[8]
But the effects of caffeine on cardiopulmonary fitness has not been widely studied. Cardiopulmonary fitness is an important marker of physical and mental health. Cardiopulmonary fitness refers to the capacity of the circulatory and respiratory systems to supply oxygen to skeletal muscle mitochondria for energy production needed during physical activity. [14] [15]
Hence the present study was undertaken with a view to evaluate the effect of caffeine intake on cardiopulmonary efficiency tests. The Harvard step test was used to calculate fatigue index as a parameter to assess the cardiopulmonary efficiency. The present study was an interventional study. Study subjects were 25 students of 1st MBBS, both male and female. The pre caffeine consumption (in the form of coffee) fatigue index was calculated for all the subjects by Harvard step test. After that they were given a cup of coffee and post caffeine fatigue index was again calculated. The two values of fatigue index of each subject were entered in excel sheet. Paired t test was applied and p value calculated. The p value was found to be <0.005 which is highly significant and it proves that there is significant difference between pre caffeine and post caffeine fatigue index.
Maximum number of subjects i.e. 19 (76%) showed increase in fatigue index,5 subjects (20%) showed a decrease and 1 subject (4%) showed no change in the fatigue index. Significant increase in the fatigue index shows a positive co relation between coffee consumption (within safe limits) and cardiorespiratory fitness.
There are many theories explaining caffeine-mediated improved muscle performance .One is increased Ca++ release from the sarcoplasmic reticulum which enhances muscle contraction.[16] Caffeine blocks the fatiguing effect of Adenosine on CNS is also one of the proposed theory.[17] Another reason is preservation of muscle glycogen through the inhibition of phosphodiesterase .[18] [19] [20] Enhanced fat oxidation and oxygen saturation are some other causes.[21] [22] Hence, multiple factors may be responsible for the increase in exercise performance after caffeine intake.

5. CONCLUSION

Caffeine which is commonly consumed as coffee on a large scale has its effects only on our central nervous system as a stimulant but also affects our cardiovascular efficiency and physical fitness in a positive way (when taken in safe dose).As proved by the present study it has beneficial effect on muscle performance. There is further scope for research in this topic on a large scale and with greater sample size.

Conflict of interest
None of the authors had any conflict of interest in the study.

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