STUDY OF EFFECT OF CAFFEINE PRESENT IN COFFEE ON VISUAL AND AUDITORY REACTION TIMES ON FIRST YEAR MEDICAL STUDENTS

Authors Chandan K.dey[1] ,Rameshwar G. daokar[2]

1First author, Associate professor,Department of physiology B.J. Government Medical College,Pune

2Corresponding author, Associate professor,Department of physiology V.M. Government Medical College,Solapur

Abstract

Introduction: Caffeine present in coffee is known to be consumed by students and professionals to allay sleep and bring about concentration. Coffee being one of the mostly widely used beverages ,its effect on auditory and visual reaction time is the topic of study.

Purpose : this study is aimed at checking out if caffeine present in coffee can alter the visual and auditory reaction times in the subjects.

Materials and methods : The study was conducted on 77 medical students out of which 42 were male and 35 were female medical students. The students were not habitual coffee drinkers and were experiencing the effect of caffeine on their auditory and visual reaction times.

Results :We found that caffeine had significantly reduced the auditory and visual reaction times in both male and female medical students.

Conclusion : consumption of caffeine in the form of coffee can significantly aid students and professionals in concentration and thus reinforces the concept of usage of this beverage within limits.

Introduction

Caffeine is one of the most commonly used substance found in everyday beverages like tea and coffee.It is an alkaloid compound and is actually a bitter substance found in coffee beans, cocoa beans and many other plant products. The scientific name for caffeine is 1,3,7- trimethylxanthine(1) It is considered as one of the most commonly used psychoactive drug in the world. But used judiciously within limits it is known to have many beneficial effects.The USFDA considers moderate intake of caffeine to be 'SAFE'.

Caffeine is known to stimulate the central nervous system.Mild cortical stimulation appears to be beneficial resulting in more clear thinking and less fatigue. Caffeine in low doses is capable of causing desirable improvement of physical and cognitive functions. Safe doses of caffeine are considered to be around 300 mg/day in an adult(2,3). Beneficial doses of caffeine which increased motor and mental performances range to about 65 to 130 mg of caffeine in a single take.

But the usage of caffeine is also considered to be addictive in nature. Certain amount of psychic dependence or habituation develops from the usage of caffeine. Regular use and dependence on caffeine is known to cause cravings for this substance in the form of nervousness, headache and irritation(4). But overall the benefits of moderate caffeine usage mostly outweigh the dis-benefits.

Considering the beneficial effects of moderate caffeine usage the present study was done with a motive to find the effects of caffeine present in a standard cup of coffee on visual and auditory reaction times.

Reaction time is a simple and effective method of studying central neuronal processing and is a simple method of determining sensory-motor association, performance and cortical arousal. It is the time that elapses between a person being presented with a stimulus and the person initiating a motor response to the stimulus. Apart from the time required for sensory motor association this is the time required by the brain for perceptual decision making and motor planning (6)

Considering the effects of caffeine on improved concentration, improved attention span and other cognitive effects we decided to study the effects of caffeine on reaction time which needs good reflexes and integrated information processing in the synapses as well as in the CNS. We also had to decide on doses of caffeine so that it fell into the range where beneficial effects of caffeine would be manifested.

Materials and Methods

The study was conducted on 77 first year medical students of grant government medical college in the department of physiology when the authors were posted there. Informed consent from the subjects and Approval from the institutional ethical committee was taken to conduct the study. Entire batch of 200 students were requested to enroll for the study. But those who turned up for the study at their own will were primarily considered. Habitual coffee drinkers were excluded from the study to discard the effects of caffeine dependence.Subjects being first year medical students were mostly of the same age range. Too obese or too lean subjects were excluded from the present study.

Coffee sachets from a well-known coffee brand were taken as a source of caffeine. One coffee sachet of 1.5 gms contained 47.5 mgs of caffeine. 2 gms of coffee powder were used for making one cup of coffee which contained around 63 gms of caffeine. Considering the fact that beneficial dose of caffeine for increased mental and motor performance is taken to be around 65 to 130 mgs of caffeine our coffee dose came to near ideal doses.(7)

Subjects were tested for reaction times'before' and30 minutes'after' the intake of coffee as the effects of caffeine are known to be more pronounced within the first hour of coffee intake(8).Reaction times (RT) measurments were done in the form of auditory reaction time (ART) and visual reaction time(VRT).

Reaction time (RT) apparatus (Anandagencies ,Pune) was used for the study. It has a built-in 4 digit chronoscope and display accuracy of 1ms. Recordings were taken in the morning time.Subjects came with as usual normal breakfast. Recordings were taken 'before' and 30 minutes 'after' the intake of standard cup of coffee as mentioned before. ART was recorded for auditory beep sound stimulus and VRT for red light stimulus. The subjects were given visual and auditory stimuli from the front to avoid the effect of lateralized stimulus. They were instructed to release response key with their dominant hand as soon as they perceived the visual or auditory stimulus. Before starting with the actual test Subjects were given adequate exposure to get acquainted with the working of the apparatus.(5,9).

Statistical analysis

Statistical analysis for this study was done using Graphpad prism 5 software. Students t(paired) test was used for analyzing the results on the same set of students before and after coffee intake.Data is presented here as mean±sd. p values of less than 0.05 were accepted as indicating significant differences between pre and post coffee tests for RT.

Results

Results are summarized in tables 1 and 2.

Data wasanalyzed separately in male and female medical students. In both the genders caffeine was found to significantly decrease the reaction time. Decrease in reaction time was found in both VRT and ART.

Table 1

Effect of caffeine on 42 male medical students on their Auditory reaction time(ART) and Visual reaction time(VRT) with B showing RT before intake of caffeine and A showing RT 30 minutes after intake of caffeine.

n=42 males	B	A	p value
ART	243.5 ± 10.43	231.5 ± 12.38	< 0.05
VRT	200.2 ± 7.77	186.6 ± 12.01	< 0.05

ART and VRT values are in ms and expressed as mean ± sd

Table 1

Effect of caffeine on 35 female medical students on their Auditory reaction time (ART) and Visual reaction time(VRT) with B showing RT before intake of caffeine and A showing RT 30 minutes after intake of caffeine.

n=35 females	B	A	p value
ART	243.0 ± 10.35	228.8 ± 11.32	< 0.05
VRT	199.8 ± 10.22	183.0 ± 11.60	< 0.05

ART and VRT values are in ms and expressed as mean ± sd

Discussion

Caffeine in the form of coffee is the world's most widely used psychoactive substance. But the use of caffeine is legal and widely accepted ,unlike other psychoactive substances. Caffeine is most commonly

consumed by humans in infusions extracted from the beans of coffee plants.The USFDA lists caffeine as a “Multiple purpose generally recognized as safe food substance”.(10) Evidence for behavioural effects of caffeine is well documented in the literature.it is associated with increased subjective alertness. However there are debates on whether such changes are infact improvements or merely reversal of the negative effects of caffeine dependence(11,12). To counter these cofounded doubts we chose to administer caffeine in those subjects who were not habitual coffee drinkers.

The widespread consumption of coffee in the absence of a clear definition of physiological and behavioral spectrum of action has continued to stimulate research. Much of the research done so far has produced inconsistent results. Mental performance where speed, endurance or vigilance was required showed reported benefits from caffeine intake.(13)

Studies done on caffeine intake have shown both positive as well as negative effects on response accuracy. Possible reasons for the contradictory findings could be due to differences in dose, protocol task and subjects. The reaction time being made of sensory, decision and motor components it depends on which of these components caffeine has a major role to play.

In our study the effects of caffeine were seen to improve the reaction times in both the visual as well as the auditory scales. Studies done by Bullock and Gilliland (14) on the auditory modality have shown speeding up of the sensory component of brainstem auditory evoked potentials. This finding suggests that caffeine keeps the auditory sensory pathways alert, probably at the brainstem level.

Similarly studies done by Tharion et al (15) on both auditory and visual stimuli showed caffeine to significantly ignore distracting or irrelevant stimuli, thus helping the subjects focus more on the task, thereby giving rise to improved reaction times. Also studies done by Lorist et al (16) showed the effect of caffeine in reducing VRT by stimulating the input and output stage of information processing system.

The studydone by Lorist et al also supported the view that caffeine increases cortical arousal and perceptual sensitivity and that stimulating effect of caffeine were mainly located at input and output stages of the information processing. Caffeine did not seem to affect the central processing.

Caffeine to a certain extent also altered the energetical states of the subjects. Ingestion of caffeine within physiological limits caused the subjects to experience a decrease in fatigue, lesser drowsiness, enhanced wakefulness or increased energy. (16,17)

All these factors including improved information processing, alertness, decreased fatigue, and increased concentration could be responsible in bringing out the response obtained in our study.

Conclusion:

On the basis of our present study we could arrive at the conclusion that caffeine intake within ‘Safe’ and physiological limits could definitely help in improving the reaction times in subjects. In our study ART as well as VRT was shown to improve with supervised doses of caffeine in the form of coffee.

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