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**ORIGINAL ARTICLE**

# Effects of Caffeine on Mood, Memory and Attention

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## ABSTRACT

**Aim:** The Experimental study was carried out to investigate the effects of caffeine and caffeine withdrawal on mood, memory and mindful attention awareness of the students of Government College University, Lahore.

**Methodology:** A total number of 24 participants aged between 18-26 years were recruited for the study from government college university among which there were 12 participants in the experimental and 12 participants in the control group. Furthermore, pretest and posttest equivalent group design was applied. Firstly, the standard progressive matrices (SPM) was used as a screening tool and then, to measure the effects of caffeine on attention awareness, memory and mood, the mindful attention awareness scale (MAAS), Wechsler memory scale (WMS) and brief mood introspection scale (BMIS) were applied.

**Results:** The within group analysis was carried out by applying Friedman test which yielded the effects of caffeine and caffeine withdrawal on all the variables of the study. The lowest score of experimental group participants in posttest1 on these subscales indicates the impact of caffeine withdrawal while the score of participants on some subscales of these tests was not affected due to it.

**Conclusion:** The findings of the experimental study helped to investigate the effects on caffeine and caffeine withdrawal on mood, memory and mindful attention awareness of university students. Most of the results of the present study were according to the results of researches that were conducted previously on caffeine but a few differed as well. The experimental study has implications for students, our society in general, researchers as well as for the parents of students.

**Keywords:** Caffeine, withdrawal, effects, mood, memory and mindful attention awareness

## INTRODUCTION

Caffeine is a naturally occurring substance that is present in approximately more than 60 species of plants which includes coffee beans, tea leaves, cocoa seeds and guarana. Caffeine is not just produced naturally but it can also be produced synthetically which can be added to different types of foods, soft drinks and medicines for instance, synthetically produced caffeine is most commonly added in pain relieving, pain suppressing and cold and flu medicines (Heckman, 2010). The caffeine has a property of stimulating the brain by giving the effect of alertness and minimizing the effects of sleepiness. It is also one of the highest consumed drug in the world and in most parts of the world caffeine is not supervised or controlled (Nehlig, 1992) The quantity of caffeine that is safe for consumption varies between places and their cultures as in Australia the authorities related to health recommends people to consume caffeine less than 600mg per day (Harland, 2000).

Caffeine is a drug that stimulates the central nervous system (CNS) and it belongs to methyl xanthine class and it's course of action in the brain is not different than cocaine and substituted amphetamines as it blocks adenosine receptors that are A and A2A. ( Fisone, 2004). The adenosine receptors causes feelings of sleepiness and tiredness, the caffeine blocks these receptors so a person does not feel tired as well as it enables dopamine and norepinephrine to function more effectively (Addicott, 2014).

There are both physical and psychological effects of caffeine that are experienced by people who consume caffeine in a greater amount (Daniels, 1998). Caffeine can cause high blood pressure and the blood vessels can also get constricted (Daniels, 1998). The "gastrointestinal motility" and "gastric acid" secretion can get affected by caffeine consumption (Bokema, 1999). The consumption of caffeine in large quantities can accelerate bone loss in postmenopausal women ("Caffeine in the diet", 2013). The people who consume caffeine in a normal amount do not experience any type of problems but those who consume caffeine excessively experience the problems of excessive urination causing either water excretion or salt excretion ( Maughan, 2003). The excessive use of caffeine can also cause dehydration in the body. The psychological issues that can occur due to excessive consumption are anxiety disorders, jitteriness, insomnia and increased sleep latency (Ker, 2010). Caffeine has been known to worsen the symptoms of anxiety disorders when taken in amounts of more than 300g per day (Smith, 2002).

According to the 5th edition of diagnostic and statistical manual of mental disorders caffeine comes under the class of substance dependence disorders. or more symptoms among twelve symptoms should be present in order meet the criteria of the disorder. These include restlessness, nervousness, excitement, insomnia, flushed face, Diurses, gastrointestinal disturbance, muscle twitching, rambling flow of thoughts and speech, tachycardia or cardiac arrhythmia, periods of inexhaustibility, and psychomotor agitation. (American psychiatric association, 2013). The withdrawal symptoms of caffeine occur when a person stops consuming the minimum amount of 100 grams of caffeine per day (Malenka, 2009). To diagnose the caffeine withdrawal disorder there should be an abrupt cessation or reduction of caffeine use, followed within 24 hours by three or more from the five symptoms. Those symptoms are headache, marked fatigue or drowsiness, dysphoric mood, depressed mood or irratibility, difficulty concentrating, flu-like symptoms (nausea, vomiting, or muscle pain/stiffness) ( American psychiatric association, 2013).

Another research was conducted to see the "effects of caffeine on the working memory on load related brain activation middle aged men" (klaassen, etal., 2013). . The result of the experiment showed that as compared to the placebo there was an effect of caffeine on the working memory of the participants and it was concluded that those participants who took caffeine had performance accuracy. There has not been a notable difference found in the visual control of task of participants in caffeine or placebo conditions.

**Purpose of the Study:** The studies have been conducted in other cultures to check the effects of caffeine and caffeine withdrawal on different variables but no such study have been conducted in Pakistani culture. So the rationale of the present study is to investigate the effects of caffeine and caffeine withdrawal on mood, memory and mindful attention awareness among the university population of Pakistan. Furthermore, this study shall also reveal the risk factors that may accompany caffeine dependence. Students often develop a tolerance to caffeine and start to consume in larger amount to get the same effects and if caffeine is not available, then, they can start to show caffeine withdrawal symptoms that may also include cognitive deficits which can lead

to deterioration in academic achievement of the students. Thus, it is the aim of this research to exactly find out how influential caffeine and caffeine withdrawal can be so as to form appropriate management and counseling plans for underachievers in future along with developing awareness of caffeine dependence.

**Hypotheses:**

- There will be a significant positive effect of caffeine on the mood, memory and mindful attention awareness of university students.
- There will be a significant difference in mood, memory and mindful attention awareness of experimental group and control group.
- The caffeine withdrawal will have a negative effect on the mood, memory and mindful attention awareness of the participants of experimental group.
- The participants without having caffeine withdrawal will tend to score higher on the scales of mood, memory and mindful attention awareness as compared to those participants who are having caffeine withdrawal.
- The participants experiencing caffeine withdrawal will tend to score lower on the scales of memory, mood and mindful attention awareness.

## METHOD

**Design:** A total number of 24 male/female participants were recruited among which there were 12 participants in the experimental group and 12 participants in the control group. All the participants were from GC university who were enrolled in either MS or MPhil programs and the age range of participants were between 18-26 years. Only those participants were recruited for the experiment who consumed minimum 100mg caffeine per day and used tea bags. Pretest and posttest equivalent group design was used in the present study in order to see the effects of caffeine and caffeine withdrawal between experimental and control group.

**Measures:** Ravens progressive matrices (Raven, 1938) was applied on the participants to measure their intelligence level before assigning them to experimental or control group. The age range of the test is between 5 years to elderly people which generally indicates the intelligence level of people. The test has 12 subscales that are A, B, C, D, E and the difficulty level in each set gradually increases as the questions progresses and all the diagrams in the question are made up in black color on white background (Domino & Marla, 2006). The mindful attention awareness has been used to measure attention awareness of the participants of the current experimental study. The scale developed by the authors Brown & Ryan in 2003 is a 15 items scale which normally assess the mindfulness of the participants and the questions that are in the measure assess the level of attention of participants and the awareness for instance the knowledge of what is currently happening around a person. (Brown & Ryan, 2003). Wechsler memory scale was applied to measure the effects of caffeine on memory. It was developed by David Wechsler for the age range of 16 to 89 years is a neuropsychological test for measuring different types of memory. It has different versions and the version that is used to measure memory in the present study is WMS-3 which has eleven subsets that are auditory immediate, visual immediate, immediate memory, auditory delayed, auditory delayed, visual delayed, audio recognition delayed, general memory and working memory. The time that is required to complete the administration of the test is around 40 to 50 minutes (Hall & Frith,2010). The second test which has been used for the purpose of assessing the effect of caffeine on mood is brief mood introspection scale which was developed by Mayer & Gaschke in the year 1998.

**Procedure:** The experiment was divided into four phases, in the first phase 32 people were interviewed and a sample of 24 participants who were willing to take part in the study as well as were fulfilling the necessary criteria's was recruited from the Masters level students of Government College University Lahore. The age range of participants was between 18 to 26 years and no one from either group left the study. The students who consume 100mg or more caffeine per day were recruited for the study. The sample was selected through in depth interview mainly from the area of cafeteria. They were told about the current experiment in detail, those who fulfilled the inclusion criteria were requested to take part in the experiment, informed consent was given to them and they were allowed to leave the experiment at any time if they wanted to..

In second phase of the experiment the pretest 1 which consisted of Wechsler memory scale, brief mood introspection scale and mindful attention was administered on the participants of experimental group as well as on the control group. After that the participants of experimental group were instructed to maintain a 6 days record diary of caffeine intake. They were provided with a caffeine record diary, 36 disposable cups (200ml) to each participant, Lipton yellow label teabags and they were instructed to consume tea in the provided cups and to use tea bags for the purpose of getting accurate results from the experiment. In that diary the participants were asked to record the time and quantity of caffeine consumption for each day. On the 7$^{th}$ day the record diaries were assessed for distributing the students in control or experimental group.

The permission for using the scales in the experiment was taken from the authors. The confidentiality regarding demographical form as well as their participation was ensured to the participants. All the participants were informed in detail about the purpose as well as about all the steps of the experiment. It was made clear to the participants that their participation is voluntary as well as they were given a choice to leave the experiment at any point whenever they want to. The results of the experiment were told to all the participants who took part in the study as well as the results were also emailed to the authors of the scales.

## RESULTS

For the purpose of analyzing the effects of caffeine on mood, memory and mindful attention awareness the non-parametric tests were applied that is Friedman test was applied for within group analysis and Mann-Whitney test for between group analysis.

Table 1: Within Group Analysis Friedman test to see the differences in repeated measures for mindful attention awareness scale (MAAS) in experimental group (N=12) and control group (N=12).

| Variables | Experimental Group | Control Group |
|---|---|---|
| | Mean Rank .P | Mean Rank .P |
| Pretest 1 MAAS | 2.54 .001 | 1.92.54 |
| Pretest 2 MAAS | 2.71 | 2.25 |
| Posttest 1 MAAS | 1.38 | 1.83 |
| Posttest 2 MAAS | 3.38 | _ |
| $X^2$(df) | 16.162(3) | 1.217(2) |

Note: MAAS= mindful attention awareness scale

The results of the test indicates that there was a significant difference in the repeated measures for mindful attention awareness in the experimental group, $x^2$ (3, N=12) = 16.16, P=.001. The test results also indicates that there was an non-significant difference in the repeated measures for mindful attention awareness in the control group, $x^2$ (2, N=12)=1.21, P=.54.

The result of the Friedman test indicated that there was a significant difference in the repeated measures for pleasant unpleasant mood in experimental group, $x^2$ (3, N=12) = 19.46, P=.00.

It further showed that there was a significant difference in the repeated measures for positive tired mood in experimental group, $x^2$ (3, N=12) = 20.25, P=.00.

Finally, it also indicated that there was a significant difference in the repeated measures for negative relaxed mood in experimental group, $x^2$ (3, N=12) = 20.06, P=.00.

No significant differences were reported for the repeated measures for arousal calm mood in experimental group and no significant differences were reported for the repeated measures for

the arousal calm mood, pleasant unpleasant mood, positive tired mood and negative relaxed mood in control group.

Table 2: Friedman test to see the differences in repeated measures for brief mood introspection scale (BMIS) of experimental group (N=12) and control group (N=12).

| Variables | Experimental Group | | Control Group | |
|---|---|---|---|---|
| | Mean Rank | P | Mean Rank | P |
| Arousal Calm | | | | |
| Pretest 1 AC | 2.63 | .78 | 2.13 | .82 |
| Pretest 2 AC | 2.71 | | 1.88 | |
| Posttest 1 AC | 2.42 | | 2 | |
| Posttest 2 AC | 2.25 | | - | |
| $X^2$ (df) | 1.05(3) | | .38(2) | |
| Pleasant Unpleasant | | | | |
| Pretest 1 PU | 2.08 | .00 | 1.58 | .20 |
| Pretest 2 PU | 2.83 | | 2.21 | |
| Posttest 1 PU | 1.46 | | 2.21 | |
| Posttest 2 PU | 3.63 | | - | |
| $X^2$ (df) | 19.46(3) | | 3.191(2) | |
| Positive Tired | | | | |
| Pretest 1 PT | 2 | .00 | 1.67 | .33 |
| Pretest 2 PT | 2.96 | | 2.13 | |
| Posttest 1 PT | 1.46 | | 2.21 | |
| Posttest 2 PT<br>$X^2$ (df) | 3.58<br>20.25(3) | | -<br>2.17(2) | |
| Negative Relaxed | | | | |
| Pretest 1 NR | 3.04 | .00 | 2.29 | .42 |
| Pretest2 NR | 2.29 | | 1.79 | |
| Posttest 1 NR | 3.33 | | 1.92 | |
| Posttest 2 NR | 1.33 | | _ | |
| $X^2$(df)- | 20.06(3) | | 1.73(2) | |

Note: AC= Arousal calm, PU= pleasant unpleasant, PT= positive tired, NR= negative relaxed

Table 3: Friedman test to see the differences in repeated measures for wechsler memory scale (WMS) in experimental group (N=12) and control group (N=12).

| Variables | Experimental Group | | Control Group | |
|---|---|---|---|---|
| | Mean Rank | P | Mean Rank | P |
| Auditory Immediate | | | | |
| Pretest 1 (WMS) IAI | 1.50 | .00 | 1.23 | .00 |
| Pretest 2 (WMS) IAI | 2.46 | | 2.00 | |
| Posttest 1 (WMS) IAI | 2.63 | | 2.75 | |
| Posttest 2 (WMS) IAI<br>$X^2$ (df) | 3.42<br>14.07(3) | | -<br>15.80(2) | |
| Visual Immediate | | | | |
| Pretest 1 (WMS) IVI | 2.38 | .01 | 2.04 | .10 |
| Pretest 2 (WMS) IVI | 2.21 | | 1.58 | |
| Posttest 1 (WMS) IVI | 1.96 | | 2.38 | |
| Posttest 2 (WMS) IVI<br>$X^2$ (df) | 3.46<br>9.94(3) | | -<br>4.55(2) | |
| Immediate Memory | | | | |
| Pretest1(WMS) IIM | 2.08 | .00 | 1.54 | .00 |
| Pretest2(WMS) IIM | 2.42 | | 2.75 | |
| Posttest1(WMS) IIM | 1.92 | | 1.71 | |
| Posttest2(WMS) IIM<br>$X^2$ (df) | 3.58<br>12.84(3) | | -<br>10.73(2) | |
| Auditory Delayed | | | | |
| Pretest 1(WMS) IAD | 1.92 | .01 | 1.63 | .10 |
| Pretest 2 (WMS) IAD | 2.25 | | 1.92 | |
| Posttest 1 (WMS) IAD | 2.33 | | 2.46 | |
| Posttest 2 (WMS) IAD<br>$X^2$ (df) | 3.50<br>10.93(3) | | -<br>4.57(2) | |
| Visual Delayed | | | | |
| Pretest1(WMS) IVD | 2.33 | .03 | 1.25 | .00 |
| Pretest 2 (WMS) IVD | 2.63 | | 2.54 | |
| Posttest1 (WMS) IVD | 1.79 | | 2.21 | |
| Posttest 2 (WMS) IVD<br>$X^2$ (df) | 3.25<br>8.46(3) | | -<br>11.51(2) | |
| Auditory Recognition Delayed | | | | |
| Pretest1 (WMS) ARD | 2.71 | .12 | 1.58 | .17 |
| Pretest 2 (WMS) ARD | 2.08 | | 2.17 | |
| Posttest 1 (WMS) ARD | 2.13 | | 2.25 | |
| Posttest 2 (WMS) ARD<br>$X^2$ (df) | 3.08<br>5.74(3) | | -<br>3.45(2) | |
| General Memory | | | | |
| Pretest1 (WMS) IGM | 2.31 | .00 | 1.33 | .00 |
| Pretest 2 (WMS) IGM | 2.56 | | 2.29 | |
| Posttest 1 (WMS) IGM | 1.58 | | 2.38 | |
| Posttest 2 (WMS) IGM<br>$X^2$ (df) | 3.50<br>13.72(3) | | -<br>9.41(2) | |
| Working Memory | | | | |
| Pretest1(WMS) IWM | 2.38 | .00 | 1.25 | .00 |
| Pretest2(WMS) IWM | 3.25 | | 2.38 | |
| Posttest1(WMS) WIWM | 1.38 | | 2.38 | |
| Posttest 2 (WMS) IWM | 3 | | - | |
| $X^2$(df) | 15.33(3) | | 11.57(2) | |

Note: IAI= index score of auditory immediate, IVI= index score of visual immediate, IIM= index score of immediate memory, IAD= index score of auditory delayed, IVD= index score of visual delayed, ARD= auditory recognition delayed, IGM= index score for general memory and IWM= index score of working memory.

The result of the Friedman test indicated that there was a significant difference in the repeated measures for auditory immediate in experimental group, $x^2$ (3, N=12) = 14.07, P=.00 as well as in control group, $x^2$ (2, N=12) = 15.802, P=.00.

It also showed that there was a significant difference in the repeated measures for visual immediate in experimental group, $x^2$ (3, N=12) = 9.94, P=.01.

There was also a significant difference in the repeated measures for immediate memory in experimental group, $x^2$ (3, N=12) = 12.84, P=.00 as well as in control group, $x^2$ (2, N=12) = 10.73, P=.00.

Furthermore, there was also a significant difference in the repeated measures for auditory delayed in experimental group, $x^2$ (3, N=12) = 10.93, P=.001.

There was also a significant difference in the repeated measures for visual delayed in experimental group, $x^2$ (3, N=12) = 8.46, P=.03 as well as in control group, $x^2$ (2, N=12) = 11.51, P=.00.

There was also a significant difference in the repeated measures for general memory in experimental group, $x^2$ (3, N=12) = 13.72, P=.00 as well as in control group, $x^2$ (2, N=12) = 9.41, P=.00.

Lastly There was also a significant difference in the repeated measures for working memory in experimental group, $x^2$ (3, N=12) = 15.33, P=.00 as well as in control group, $x^2$ (2, N=12) = 11.57, P=.00.

No significant differences were reported for the repeated measures for visual immediate and auditory delayed in control group and no significant differences were reported for the repeated measures for the auditory recognition delayed in both experimental and control group.

Table 4: Between Group Analysis Mann-Whitney U Test for mindful attention awareness scale

| Test | Mean Rank | | Mann-Whitney U | Z | P | R |
|---|---|---|---|---|---|---|
| | Experimental Group | Control Group | | | | |
| MAAS posttest 1 | 8.67 | 16.33 | 84.50 | -2.66 | .00 | -.54 |

Note: Mindful attention awareness scale

Mindful attention awareness scale of caffeine users Mean rank = 8.67 (experimental group) differed significantly from (control group) Mean rank = 16.33 two days after the caffeine was not consumed, u= 84.50, z= -2.66, p=.00 and r= -.54.

Table 5: Mann-Whitney U Test for brief mood introspection scale

| Test | Mean Rank | | Mann-Whitney U | Z | P | R |
|---|---|---|---|---|---|---|
| | Experimental Group | Control Group | | | | |
| BMIS subscale (pleasant unpleasant) Posttest 1 | 8.62 | 16.38 | 118.50 | -2.68 | .00 | 0.54 |
| BMIS subscale (Tired Positive) Posttest 1 | 8.46 | 16.54 | 23.50 | -2.81 | .00 | 0.11 |
| BMIS (Negative Relaxed) Posttest 1 | 15.83 | 9.17 | 32.00 | -2.32 | .02 | 0.09 |

Note: brief mood introspection scale

The scores on subscale Pleasant Unpleasant of brief mood introspection scale (experimental group) Mean rank=8.62 differed

significantly from (control group) Mean rank= 16.38 two days after caffeine was not consumed, u= 118.50, z= -2.68, p=.00 , r= 0.54. The scores on scale Tired Positive of brief mood introspection scale (experimental group) Mean rank= 8.46 differed significantly from (control group) Mean rank= 16.54 two days after caffeine was consumed u= 23.50, z= 2.81, p=.00 and r=0.11. The scores on subscale Negative Relaxed of brief mood introspection scale (experimental group) Mean rank= 15.83 differed significantly from the (control group) Mean rank= 9.17 two days after caffeine was consumed u=32.00, z= -2.32, p= .02 and r= 0.09

Table 6: Mann-Whitney U Test for Wechsler Memory Scale

| Test | Mean Rank | | Mann-Whitney U | Z | P | R |
|---|---|---|---|---|---|---|
| | Experimental Group | Control Group | | | | |
| WMS subscale (Working Memory) Posttest 1 | 7.21 | 17.79 | 8.50 | -3.67 | .00 | 0.15 |

Note:WMS= Weschelor memory scale

The scores on subscale working memory of Weschelor memory scale (experimental group) Mean rank= 7.21 differed significantly from (control group) Mean rank= 17.79 two days after caffeine was consumed u=8.50, z=-3.67, p=.00 and r= 0.15

## DISCUSSION

The present experimental research was conducted to assess the effects of caffeine and caffeine withdrawal on mood, memory and mindful attention awareness of the students of Government college university Lahore. The results of the experiment were calculated by applying the non-parametric tests, so the link of the current study with different studies which has already been conducted previously shall be analyzed and discussed in detail in the following paragraphs.

The results of mindful attention awareness for within group analysis was conducted by applying Friedman test that shows the difference of means in all the phases of both experimental and control group of the experiment. The highest score of experimental group participants in terms of mean rank is of pretest 2 and the lowest score is of posttest 1which most likely indicates the impact that caffeine withdrawal has on attention awareness. Furthermore, highest score of control group participants in terms of mean rank is of pretest 2 and there is minimal difference in the scores for pretest 1 and posttest. There is also a significant difference in the scores of mindful attention among the different phases of the experiment in the experimental group which is evident in the value of chi-square. While there was no significant difference reported in mindful attention scores among the control group. This result is in accordance with the expected outcome as the mindful attention of the participants of the experimental group was the one hypothesized to go through change due to caffeine withdrawal. A study was conducted by (Dixit 2012) to investigate the "effects of caffeine on attention and information processing: evidence from stroop task" which was conducted on the sample of 30 participants.

For between group analyses Mann-Whitney u test was applied which showed the difference in the posttest 1 of the experiment. The posttest 1 was applied on the participants after the two days of caffeine withdrawal on the participants of experimental group. The results showed that participants of experimental group had lower mean rank scores on mindful attention awareness as compared to the mean rank of control group participants. The participants of control group who were not experiencing caffeine withdrawal felt more attentive and aware as compared to the participants of experimental group who were tested after caffeine abstinence for two days. So it indicates that caffeine has an effect on the mindful attention awareness of students because the control group performed better so the caffeine withdrawal led to low attention awareness which resulted in poor performance of the participants. A research was conducted to check whether there is an effect of habitual caffeine consumption on the attention and memory of the participants or not by (Hameleers, et.al, 2000).

The highest score of experimental group participants in terms of mean rank for the subscale visual delayed is of posttest 2 and the lowest score is of posttest 1. Furthermore, highest score of control group participants in terms of mean rank is of posttest and the lowest score is of pretesttest1. This result is in accordance with the expected outcome as the performance of the participants of the experimental group was hypothesized to go through change due to caffeine withdrawal. An experimental study was conducted by (Yassa, 2014) to see the effect of caffeine on long term memory.

The results of memory (WMS) for within group analysis conducted by applying Friedman test shows the difference of means in all the phases of both experimental and control group of the experiment. The highest score of experimental group participants in terms of mean rank for the subscale Auditory immediate is of posttest 2 and the lowest score is of pretest1. Furthermore, highest score of control group participants in terms of mean rank for Auditory immediate is of posttest and the lowest score is of pretesttest1. The results of subscale Auditory immediate shows that it was not much affected due to caffeine withdrawal in terms of the result of posttest1 which was taken after the caffeine withdrawal of 48 hours.

For between group analyses Mann-Whitney u test was applied which showed the difference in the posttest 1 of the experiment. The posttest 1 was applied on the participants after the two days of caffeine withdrawal of the participants of experimental group. The results showed that participants of experimental group had lower mean rank scores on working memory scale as compared to the mean rank of control group participants. The participants of control group who were not experiencing caffeine withdrawal were much better on working memory subscale as compared to the participants of experimental group who were tested after caffeine abstinence for two days. So it indicates that caffeine has an effect on the working memory of students because the control group performed better so the caffeine withdrawal led to low working memory performance which resulted in poor performance of the participants. A study was conducted by (Valzelli, Baiguerra, & Giraud, 1986) for the purpose of examining the effect of caffeine on memory recall. This experiment was known as the "shutter box avoidence task" and the results of the experiment showed that the recall of the rats got improved because of caffeine due to which the experimenters concluded that the caffeine improves the recall. In the current study the results of the experiment also showed that in posttest1 which was performed after 48 hours of caffeine withdrawal showed that the participants of control group who were not on caffeine withdrawal performed better as compared to the participants of the experimental group who experienced caffeine withdrawal so it means that caffeine do enhance some domains of working memory.

**Implications of the Experimental study:** The study will educate the parents about the importance of keeping a check and balance on the caffeine intake of their children as evident by the findings that how a sudden cessation of caffeine results in worse psychological and physical effects in the form of caffeine withdrawal. The study will also enable the researchers to investigate the effects of caffeine and caffeine withdrawal on other similar areas that have not been investigated yet in our culture.

**Limitations:** The sample of the study could have been large and students other than MS or MPhil could have been recruited for the experimental study but due to limited time it could not have been possible. In future, further researches related to caffeine can be conducted for investigating the effects of caffeine on a large population.

## CONCLUSION

The findings of the experimental study have effectively established the effects of caffeine on mood, memory and mindful attention and

awareness. The results of within group analysis indicated the difference in the mean ranks of all phases of experimental and control group. The lowest score of experimental group participants was on posttest1 which was in accordance with the expected outcome as the performance of the participants of the experimental group was hypothesized to go through change due to caffeine withdrawal. For the between group analysis Mann-Whitney u test was applied which showed the difference in the posttest 1 which was applied after two days of caffeine withdrawal. The mean ranks of experimental group participants on mindful attention awareness, subscales of BMIS that are subscale pleasant unpleasant, positive tired and negative relaxed and the subscale of Wechsler memory scale that is working memory was lower on posttest 1 as compared to the participants of control group which indicates the effect of caffeine withdrawal as it led to poor performances.

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