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The Effect of Caffeinated Coffee on Tears Secretion among Young Adults

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ABSTRACT

Caffeine, the most often taken psychoactive stimulant, is said to have contradictory effects on tear film dynamics. **Objectives:** To determine the effect of caffeinated coffee on tears secretion. **Methods:** Quasi experimental study was conducted from January 2023 to May 2024 at Superior University Lahore including 86 subjects of ages between 18-35 years by using convenient sampling technique. After visual acuity assessment, tear secretion of participants was checked by using Schirmer test strips. Tears secretion of all the subjects was noted before and after intake of caffeinated coffee by using Schirmer test strips. Descriptive statistics and T test was used for analysis of data by using SPSS version 25.0. **Results:** Before intake of coffee, 14(16.3%) showed tear secretion in the range of 5-15 mm, 21(24.4%) were in range of 16-25mm while 51(59.3%) were in the range of 26-35mm. Tear secretions after 30 minutes of coffee intake in 23(26.7%) subjects were in the range of 5-15mm, 20(23.3%) were in the range of 16-25mm while 43(50%) were in the range of 26-35mm. Similarly tear secretions after 90 minutes of coffee intake in 35(40.7%) were in the range of 5-15mm, 32(37.2%) were in the range of 16-25mm while 19(22.1%) were in the range of 26-35mm. Tear secretions before and after intake of coffee was found to be statistically significant i.e. $p<0.05$. **Conclusion:** A decreasing trend was observed in tear secretion levels at 30 and 90 minutes following the intake of caffeinated coffee and normal prior to coffee consumption.

INTRODUCTION

Caffeine, a colourless, bitter-tasting white alkaloid, is the most widely used stimulant globally. It can be found in coffee, tea, cocoa, yerba mate, guarana, and many other food and drink items. Coffee beans are the main source of caffeine, and even decaffeinated coffee contains some residual caffeine. Caffeine influences the central anxious framework, lifting heart rate, blood weight, and readiness, whereas moreover acting as a bronchodilator and diuretic. Aside from its interaction with adenosine, caffeine has additional physiological effects due to its metabolites, leading to increased production of stomach acid, pepsin, and blood sugar, elevated fatty acid, cortisol, and adrenaline levels, and reduced calcium levels, potentially causing bone loss. Therefore, caffeine intake may exacerbate existing health conditions or contribute to certain diseases. Pregnant ladies and people with tall blood weight, cardiovascular issues, diabetes, open-angle glaucoma, or insomnia are advised to avoid coffee consumption. However, caffeine can also be utilized beneficially. It is used to treat respiratory issues in newborns and acts as an adjuvant in various medicinal compositions counting analgesics and antipyretics. In its normal shape, natural coffee might offer a few cardioprotective impacts for people without hypertension [1, 2]. Pharmacologically, caffeine acts as an antagonist to adenosine receptors, influencing multiple organ systems. Historically, it was recognized for its therapeutic potential, including treating asthma. Today, caffeine is used medically for conditions such as migraines and newborn apnea, and as an adjunct in pain management. While its effects on circulation and nerves are well-studied, its impact on ocular physiology is less understood, necessitating further research [3]. Coffee's impact on tear production and dry eye conditions remains contentious.

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Dry eyes stem from insufficient tear production or unstable tear film, potentially leading to discomfort and vision issues. Severe cases can even cause corneal ulcers and increase susceptibility to infections. Clinical assessments like the Schirmer test and tear film fluorophotometer are used but yield conflicting findings on coffee's effects. Some suggest coffee might increase tear production and protect against dry eyes, while others argue the opposite. To clarify these discrepancies, more research is needed [4]. Dry Eye Disease (DED) is a prevalent chronic condition characterized by disruptions in the tear film and ocular surface, affecting 5% to 50% of adults worldwide. [5] It significantly impairs quality of life, causing discomfort and fatigue, limiting daily activities like driving and reading, and impacting overall well-being and productivity [6]. Medical students, prone to high stress levels, often adopt habits such as increased caffeine consumption and prolonged use of digital devices for academic purposes. On average, adults in Western countries consume 200 to 300 mg of caffeine daily [7, 8]. Caffeine enhances alertness by blocking adenosine A2A receptors, reducing fatigue. Coffee is the primary source of caffeine for most adults, contributing about 80% to their daily intake. Green tea is also popular for its caffeine content, boasts additional health benefits like antioxidants and antimicrobial properties. Despite having higher caffeine levels per dried weight than coffee, green tea generally does not induce the same arousal effects [9]. Caffeine enhances alertness and reduces daytime sleepiness by blocking adenosine receptors. Research shows it improves cognitive function and attention during sleep deprivation with doses ranging from 200 to 600 mg [10]. Understanding the effects of sustained high caffeine intake on physiology, including blood pressure and decision-making, requires further study, particularly considering habitual caffeine use patterns [11]. Caffeine has been previously demonstrated to impact the eyes in numerous ways such as corneal deformities have been reported to be the result of caffeine intake [12]. Moreover, several studies suggest higher coffee intake may elevate intraocular pressure: potentially increasing glaucoma risk due to caffeine's role as an adenosine receptor antagonist [13, 14]. On the contrary, the protective roles of caffeine are also highlighted by several studies. Caffeine's impact on choroidal thickness and visual performance, including pupil size and accommodation, remains unclear and may affect reading speed and visual quality, especially in those with vision challenges [16]. Conflicting research on caffeine's effects on tear production further complicates its influence on visual performance.

Despite extensive research on caffeine's systemic and ocular effects, its specific impact on tear secretion remains inconclusive, with studies reporting both stimulatory and inhibitory effects on tear production. Additionally, limited evidence exists on the short-term temporal changes in tear secretion following standardized caffeinated coffee intake, particularly among young adults. This creates a gap in understanding whether caffeine contributes to dry eye symptoms or protective mechanisms. Therefore, the present study aimed to evaluate the short-term effect of caffeinated coffee on tear secretion using the Schirmer test and to clarify its role in altering tear film dynamics.

METHODS

A quasi-experimental study was conducted at Superior University Lahore to investigate the effect of coffee on tear secretion. The study was conducted between January 2023 to May 2023. Participants were recruited using a non-probability convenient sampling method and included 86 staff and students aged 18-35 years with normal vision (6/6 acuity). Sample size was calculated using online sample size calculation software. Smokers, alcohol consumers, elderly patients, pregnant women, and those with ocular or systemic diseases were excluded. Written and verbal consent was taken from the participants before the data collection. All the measurements regarding tear secretion measurement were made during early hours of the university timing in a controlled temperature environment. Tear secretion was assessed using Schirmer test strips to evaluate changes in tear production levels. Measurements were taken at three intervals: prior to coffee consumption, 30 minutes after intake, and 90 minutes after intake. The coffee preparation involved dissolving 4 grams of Nescafe granules in 150 ml of warm water to ensure consistency in the caffeine dose provided to all participants. All the data collected were analyzed using SPSS Version 25.0. Descriptive statistics and t-test were used to obtain results.

RESULTS

Out of total 86(100%) subjects, 72(83.7 %) were in age group of 18-25 years, 11(12.8%) subjects were in age group of 26-35 years and 3(3.5%) were in age group of 31-35 years and frequency of male was 31(36%) and for female 55(64%). Out of total 86(100%) subjects, before intake of coffee, 14(16.3%) subjects were having tear secretion in the range of 5-15mm, 21(24.4%) subjects were having tear secretion in the range of 16-25mm while 51(59.3%) were having the tear secretion in the range of 26-35mm.

Table 1: Tear Secretion before Intake of Coffee

Tear Secretion	Frequency (%)
5-15mm	14 (16.3 %)
16-25mm	21(24.4%)

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26-35mm	51(59.3%)
Total	86(100.0%)

After 30 minutes of coffee intake, out of total 86(100%) subjects, tear secretion in 23(26.7%) subjects were in the range of 5-15mm, 20(23.3%) subjects were having tear secretion in the range of 16-25mm while for 43(50%) were having the tear secretion in the range of 26-35mm.

Table 2: Tear Secretion after 30 Minutes of Intake of Coffee

Tear Secretion	Frequency (%)
5-15mm	23(26.7%)
16-25mm	20(23.3%)
26-35mm	43(50.0%)
Total	86(100.0%)

After 90 minutes of coffee intake, out of total 86(100%) subjects, tear secretion in 35(40.7%) subjects were in the range of 5-15mm, 32(37.2%) subjects were having tear secretion in the range of 16-25mm while for 19(22.1%) were having the tear secretion in the range of 26-35mm.

Table 3: Tear Secretion after 90 Minutes of Intake of Coffee

Tear Secretion	Frequency (%)
5-15mm	35(40.7%)
16-25mm	32(37.2%)
26-35mm	19(22.1%)
Total	86(100.0%)

The mean of tear secretion before intake of coffee was 2.43 ± 0.760 and after 30 minutes coffee intake mean value was 2.23mm ± 0.850. After 90 minutes of intake of coffee mean value was 1.81mm ± 0.775. The results indicate a significant decrease in tear secretion after coffee consumption. The average tear production decreased from 2.43 mm before coffee intake to 1.81 mm after 90 minutes, suggesting a consistent effect of coffee on tear reduction. The standard deviation remained relatively consistent, indicating that the effect was uniform across the study participants.

Table 4: Comparison of tear secretion before and after coffee intake among study participants

Tear Secretion	Number of Participants	Mean ± SD	p-Value
Tear Secretion Before Intake of Coffee	86	2.43 ± 0.760	p<0.05
Tear Secretion After 30 Minutes of Intake of Coffee	86	2.23 ± 0.850	p<0.05
Tear Secretion After 90 Minutes of Intake of Coffee	86	1.81 ± 0.775	p<0.05

DISCUSSION

Caffeine is a naturally occurring stimulant found in various plants, including coffee beans, tea leaves, cocoa beans, and kola nuts. The results of the present study showed that the mean tear secretion before intake of coffee was 2.43 ± 0.760 while tear secretions after 30 minutes and 90 minutes of coffee intake was 2.23 ± 0.850 and 1.81 ± 0.775 respectively. This shows reduction in tear secretion values after the consumption of caffeinated coffee. The results of this study are in accord with the study where the recorded values for tear secretions were lower after caffeine intake, implying that caffeine may limit tear secretion in certain groups of individuals [17]. However, contradictory results were reported in a study that found a significant increase in Schirmer 1 scores; therefore, caffeine stimulated tear secretion in healthy people without a dry eye [18]. The variation in outcomes may be due to differences in caffeinated products used in various studies, caffeine content in the products tested, and disparity in participants' characteristics to give credence to the extent of complexity of effects of caffeine on tear film. However, the current study specifically only investigated the short-term effects of coffee consumption, and, therefore, differences due to stress, usage of electronic devices, and metabolism differ in everybody. A systematic review of two population-based studies showed that increased caffeine consumption is very slightly linked to dry eyes [19] and that the frequency increases with caffeine consumption, especially among female [17]. The patterns of variations here noted could have been attributable to hormonal effects on tearing, although these aspects in the present research were not evaluated. Remarkably, data also showed that instances of caffeine use were again associated with healthier ocular surface and reduced tearing inflammation, thus proposing an anti-inflammatory function profile for caffeine that requires further exploration [20]. Further longitudinal research on a broad population is necessary on factors such as sleep and usage of electronics to have a better understanding of these dynamics.

This study was limited by its small sample size, single-center design, and use of non-probability convenient sampling, which may affect generalizability. Only short-term effects were assessed, and confounding factors such as screen time, hydration status, and stress were not controlled. Future studies should include larger, multi-center samples with randomized designs and evaluate long-term caffeine exposure. Incorporating objective measures like tear film stability and osmolarity would provide more comprehensive insights.

CONCLUSIONS

This study demonstrated a significant decrease in tear production after the consumption of caffeinated coffee in young adults. The findings suggest a potential link between dry eye symptoms and caffeine intake. Further longitudinal studies are recommended to investigate the underlying mechanisms and to evaluate whether individuals with dry eye symptoms might benefit from reducing caffeinated coffee intake or opting for decaffeinated alternatives.

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Authors' Contribution

Conceptualization: AB
Methodology: SS
Formal analysis: MH, I
Writing and Drafting: AS, I
Review and Editing: AS, I, MH, AB

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

The authors declare no conflict of interest.

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