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#### Effects Of Caffeine Intake On Accommodation And Pupil Among Healthy Adults

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#### Abstract

"Effects Of Caffeine Intake On Accommodation And Pupil Among Healthy Adults" [Rajveer Singh,Mrs.Susmita Banerjee] Author information 1M.S.c Optometry Student ,Bachelor done in dr d y patil institute of optometry and visual sciencespune, Internship in narayana nethralaya-banglore. 2 Assistant Professor in dr. d y patil institute of optometry and visual sciences-pune . ABSTRACT Purpose: To assess the effects of caffeine intake on amplitude of accommodation, amplitude of accommodationan pupil size among healthy adults Methods: Two visit randomized placebo-controled cross-sectional study included 50 healthy adults aged 18-30 years who received either 200 mg of caffeine are nothing . Visual acuity, amplitude of accommodation, pupil size, accommodative facility was assess that baseline and 30 minutes. Results: Consumption of caffeine showed an increased effect on in adults. Conclusion: The study showed that the awareness of contact lens care and usage in contact Lens wearers of Bangalore is relatively high

#### **Introduction**

Caffeine (1,3,7-trimethylxanthine), the natural alkaloid is the welknown component of coffee. This psychoactive ingredient was first isolated in 1820 from coffee beans and is now used in a multitude off ood sand drinks. It is widely being consumed; the amount of consumption depends on the type of beverage sand populations . The biological source of coffee is the cofea Arabica (Family-Rubiaceae), cultivated in many countries . Excessive caffeine intake has been observed in young adults (especially students) which might result in creating adverse efects. Coincidentaly, coffee typically contains more caffeine than any other beverage, ranging from 35 mg to 175 mg of caffeine per cup . Moreover, approximately 20-30% of general population consumes more than 500-600 mg of caffeine daily.

Caffeine has its advantages as well as disadvantages . It is acentral nervous system stimulant, That promotes mental alertness and concentration, decreases insulin sensitivity and helps to

Prevent Alzheimer's and Parkinson's disease.

GSJ: Volume 9, Issue 7, July 2021 ISSN 2320-9186 Caffeine is also anadenos inereceptorantagonist; it improves motor functions, observed in

Animal models with Parkinson's disease; caffeine also enhances dopamine neuro transmission . In

addition, studies are discovering that caffeine may help with cognitive protection and be

beneficial for individuals with Alzheimer's disease, because caffeine restores brain extracellular

adenosine levels leading to an increase in cerebral blood flow.

However, excessive caffeine consumption can cause adverse effects such as increase in heart

rate, blood pressure, restlessness, nausea, and more. For a healthy adult population, the FDA

has stated that a daily caffeine intake of upto 400 mg per day (about three cups) is not

associated with any adverse effects.

**Normal sensitivity of caffeine:** most people have abnormal sensitivity to caffeine . People in this range can take in upto 400 mg of caffeine daily, without experiencing adverse effects.

**Hyposensitivity:** people in this range can have large amounts of caffeine, late in the day, and not experienceside effects, such as unwanted wake fullness.

**Hypersensitivity:** people with high tenedhy per sensitivity to caffeine can't tolerate small amounts of it without experience in generative side effects. A variety of factors causes caffeine sensitivity, such as genetics and your liver's ability to metabolize caffeine. A caffeine allergy occurs if your immune system mistakes caffeine as a harmful invader and atemptst of ightit of with antibodies.

**Caffeine And Pupil:** Because coffee is a stimulant, it triggers there lease of adrenaline which temporarily improves all the functions during the fight and flight zone. The rush of hormones can cause pupil to dilate.

Accommodation: In medicine, the ability of eye to change its focus from distant to near objects and viceversa. This process is achieved by the lens changing its www.globalscientificjournal.com

shape. Accommodation is the adjustment of the optics of the eye to keep an object in focus on the retina as its distance from the eyes varies

Mechanism Of Accommodation: According to Von Helmholtz's capsular theory the process of accommodation is achieved by a change in the shape of lens as below:

When the eye is at rest (un accommodated), the ciliary ring is large and keeps the zonules tense.

Because of zonul are tension the lens is kept compressed (flat) by the capsule.

<u>Contraction of the ciliary muscle</u> causes the ciliary ring to shorten and thus releases zonular tension on the lens capsule. This allows the elastic capsule to act unrestrained to deform the lens substance. The lens than alters its shape to become more convex or conoidal (to be more precise). The lens assumes conoidal shape due to configuration of the anterior lens capsule which is thinner at the center and thicker at the periphery.

**Far point and near point:** The nearest point at which small objects can be seen clearly is called near point or punctum proximum and the distant (farthest) point or punctum remotum.

**Range of accommodation**: The distance between the near point and the far point is called the range of accommodation.

**Amplitude of accommodation**: The difference between the dioptric power needed to focus at near point(P) and farpoint(R) is called amplitude of accommodatin

## **REVIEW OF LITERATURE**

As the part of our study we have collected a lot of information regarding our topic and from the information, we came to know that a very few comparative studies were conducted in our topic regarding effect of caffeine.So we have to assess to decide the status of effect of caffeine and its effect on physiology of eye.

## 1.<u>Caffeine In Take Is Associated With Pupil Dilation And Enhanced</u> <u>Accommodation</u>

It is purpoted that caffeine, anautonomic stimulant, affects visual performance. This study sought to assess whether caffeine intake was associated with changes in pupil size and / or amplitude of accommodation.

A double-masked cross over study was conducted in 50 healthy subjects of range 19 to25 years. Subjects were randomized to treatment such that subjects consumed either 250 mg cafeine drink orvehicle on separate days. Amplitude of accommodation was measured by the push-up technique, and pupil size using millimeter ruler fixed to a slitlamp biomicroscope in dimilumination (5lux). Amplitude of accommodation and pupil size were taken at baseline, and at 30, 60 and 90 min time points post treatment. Repeated measures one-way ANOVA and paired-test were used in analyzing data.

Amplitue of accommodation and pupil size after caffeine intake were significantly greater than vehicle (P<0 001) a each time point. Consumption of the caffeine beverage was associated with significant increases in amplitude of accommodation and pupil size with time (P<0.001). Amplitude of accommodation rose from 12.4(+/-2.2D) at baseline to 15.8(+/-2.6) at 90 min. Similarly, pupil size increased from 3.4(+/-0.4 mm) at baseline to 4.5(+/-0.72 mm) at 90 min. Consumption of vehicle was not associated with increase in amplitude of accommodation or Pupil size with time.

pupil size and accommodation are affected after in gestion of caffeine. This study suggests caffeine may have some influence on visual function

## .2. <u>Effects Of Caffeine Intake On Visual Performance Of The Eye Among</u> <u>Normal Healthy Adults</u>

The purpose of this study is to examine the effects of caffeine on visual performance of the eye among normal healthy adults. This two-visit randomized

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placebo-controlled crossover study included 49 normal healthy adults aged 18 years and above who received either 200mg of caffeine or placebo capsules. Choroidal thickness, tear break-up time, accommodative power, pupil size and reading performance were assessed at baseline, 1 hour and 2 hours..

Consumption of caffeine showed an increased effect on reading rate (p<0.05), average span of recognition and tear break up time (p=0.05) at 1 hour. There was no significant difference seen between the caffeine and placebo group in choroidal thickness (p=0.547), pupil size (p=0.137) and accommodative power (p=0.860). All the aforementioned metrics were not significant at 2 hours. Average span of recognition has a good correlation (r=0.855, p<0.01) with reading rate that was significant at 1 hour among the caffeine group.

Caffeine consumption has some effect on visual performance of the eye by increasing reading rate and tear film quality. This transient effect peaks at the 1 hour mark and can potentially help an individual have better quality of vision to improve their visual performance for near tasks.

# 3.<u>Acute Effect Of Caffeine On Amplitude Of Accommodation And Near</u> <u>Point Of Convergence</u>

Caffeine Is Widely Consumed In Kola Nuts And In Other Products In Sub-Saharan Africa. We Examined The Acute Effect Of Caffeine On The Amplitude Of Accommodation And Near Point Of Convergence Of Healthy Nigerians. Forty Volunteers Between Ages Of 20 And 27 Years With Refractive Power $\pm$  0.50 DS Were Employed. Amplitude Of Accommodation (AMP) And Near Point Of Convergence (NPC) Were Measured At 0, 30, 60 And 90 Minutes After The Ingestion Of Coffee By Two Groups Of Participants, Namely The Experimental (Caffeinated Coffee) And Control (Decaffeinated Coffee) Groups. The Result Showed That Ingested Caffeine Increases Mean AMP By Almost 2.00D Within 30 Minutes, And The Elevation, Though Variable Across Patients Is Sustained For Several Minutes. The NPC And AMP In The Decaffeinated Coffee Was Statically Insignificant (P>0.05) Within The 0-90minutes Of Ingestion. However, There Was A Significant Increase In The AMP Of The Experimental Group (P< 0.05). The Result Suggests That Further Studies Would Be Most Desirable With The Older And Larger Population.

#### Aim

To assess the effects of caffeine intake on accommodation and pupil size among healthy adults

## **Objectives**

- To assess to decide the status of effect of caffeine on young healthy patient
- Its effect on physiology of eye.

#### Materials

Site of study: Narayana nethralaya

Study Design: cross sectional study

Study Period: sep 2019-feb 2020

Sample Size: 55

#### Inclusion Criteria: Age 18-35year Emmetropia Refractive error >+/-0.25D

#### **Exclusion Criteria:**

Any ocular diseases or abnormalities Systemic illness Refractive surgeries Binocular vision problems Smoking Pregnancy

## Methodology

A randomized cross sectional study included 55 healthy subjects in narayana nethralaya ,Bangalore, India. Subjects included under inclusion criteria were between 18 years to 35 years and all the subjects were emmetropes with visual acuity 6/6 and refractive error less than+-0.25.

Subjects with any ocular diseases or abnormalities, systemic illness, refractive surgeries, binocular vision problems, smoking and pregnancy were excluded from

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the study. Informed consent form was reviewed and taken from each subject.Initial vision screening was conducted.

The subjects were randomized into two groups: the treatment group (caffeine intake) and placebo group. The quantity of caffeine in gestion was controlled by administering discrete caffeine powder in 100 ml of water to the treatment subjects (200mg). Similarly placebo group were not given anything, potentially leading to variable results. A baseline measurements includes Near Point Of Accommodation (NPA) with RAF ruler, Accommodative Facility with Accommodative Flippers and Chart {Target for accommodative Flipper exercise (N8)} and pupil size with +10D lens and PD ruler. For the Treatment group all the measurements were repeated after 30 min of Caffeine intake. For the Placebo group also all the measurements were repeated after 30 min. The readings were compared between baseline measurements and measurements after caffeine intake.

#### **Materials Used**

## **<u>1.RAFRuler(RoyalAirForce)</u>**

RAF rule (Royal Air Force Rule) provides a binocular gauge to measure objective and subjectiveConvergence as well as accommodation. The RAF rule consists of 50 cm long cubical rule with a slider holding a rotating 4 sided cube. Each side has different target. The instrument is useful for both diagnosis and treatment. This has four sides that have different measurements or functions:

- $\Box$  One side features diopter measurement from 20-2
  - $\Box$  One side feature a ruler from 5-50 cm
  - □ One side test for convergence, normal, reduced, and defective
  - One side tests ages 8-48 Are its provided for the cheek to ensure

consistency and proper height for the patient.

An accommodative target in which vertical streak target of RAF rule was used and patient was asked to tell whenever the target was seen as double. A non-accommodative target in which light was shown from 40 cm distance and patient was asked to tell when they see two lights.

## 2. <u>Accommodative Flippers And N8 Target Chart</u>

Flippers Are The Frame Holder With Two Minus And Two Plus Lenses Of Equal Magnitude. Subjects

Focuses Through One Pair Of Lenses At An Objects At Near Distance (40cm) When Objects Is Clearly

Focused, A Flick Is Quickly Performed To The Other Lens Pair And Subject Focuses Through This Process Is Then Again Repeated.

A Chart With N8 Word Size Which Is Usually Used For Accommodative Exercise.

Accommodative Facility Was Done Using ±2.00ds Flippers At 40 Cm With N8 Target. Using This, Examiner Asked The Patient To Call Out The Word After Each Flip Of Lens. Continuing This For 1 Minute And Cycles Per Minute Was Calculated By Number Of Flips.

# 3.Pd Ruler 4.+10dlens Results

- Fifty healthy subjects between 18-30 years participated in the study. At baseline, amplitude of accommodation, pupil size and accommodative facility were12.5 (+/-3.5D), 3(+/-0.5mm) and 12 (+/-5.5cpm) respectively. Amplitude of accommodation, pupil size did not differ significantly before and after caffeine intake (P>0.05) but there was significant change in accommodative facility after caffeine intake (P<0.05).</li>
- Consumption of the caffeine by subjects resulted improvement in amplitude of accommodation and increase in pupil diameter and accommodative facility. Amplitude of accommodation improved from 12.5 (+/-3.5D) at the baseline to10 (+/-2.5D) at 30 mins. Similarly, pupil diameter increased from 3(+/-0.5mm) at baseline to 4(+/-1mm) at 30 mins. Similarly, accommodative facility increased from 12(+/-5.5cpm) at the baseline to16(+/-4.5cpm) at 30mins. Amplitude of accommodation improved in all the subjects except 3-

4 as they were habitual consumers of caffeine containing beverage. Paired ttest did not showed significant difference in amplitude of accommodation and pupil size but showed significant difference in accommodative facility .In addition, unpaired t-test showed significant difference in amplitude of accommodation and pupil size but did not showed significant difference in accommodative facility.

#### **Discussion**

Caffeine Belongs To A Class Of Weak Stimulant Scale Dxanthines. Its Supposedly Beneficial Effects Perhaps Influence Its Wide Use. We Found That Amplitude Of Accommodation And Accommodative Facility Increased And Pupil Diameter Enlarged Significantly () After The Ingestion Of Caffeine Compared With Placebo.

There Have Been Few Studies Investigating The Effectof Caffeine On Structural And Functional Changes In The Eye, But The Exact Mechanism For Such Change Is Still Unclear. In This Cross-Sectional Study, We Investigated By Observing The Effect Of Caffeine On Near Point Of Accommodation, Pupil Size And Accommodative Facility Among Healthy Adults.

The Observed Increase In Accommodation Is Postulated To Have Occurred Due To The Stimulatory Effects Of Caffeine On Parasympathetic Nerves Responsible For Ciliary Muscle Constriction Allowing The Crystalline Lens To Thicken And Hence Increase Ocular Refractive Power. This Increase Will Allow The Eye To Focus Objects Closer Than Needed Leading To An Increase In The Amplitude Of Accommodation. This Study Doesn't Investigate The Association Between An Increase In Refractive Power And Amplitude Of Accommodation. As Per For The Pupil, Increased Sympathetic Nerve Activity Results In Contraction Of The Pupil Dilator Muscle Causing Pupil Dilation. The Mechanism Behind The Parasympathetic Stimulation By Caffeine Is That It Competitively Binds To Adenosinereceptors, Resulting In Their Is Levels Of Acetylcholine That Stimulates The Muscarinic Receptors Of The Ciliary Body Leading To Its Contraction. Caffeine Also Inhibits The Actions Of Adenosine, Responsible For Modulation Of Other Neurotransmitters. Consequently, There Is Rise In The Levels Neurotransmitter Including Epinephrine And Norepinephrine, Oradrenaline, Leading To Activation Of The Sympathetic Nerve Activity. Along With The Amplitude Of Accommodation And Pupil The Accommodative Facility Also Has Increased Significantly.

According To The Out Come Of This Study, Caffeine Has Paradoxical Effects On The Intrinsic Muscles Of The Eye: Dilating Pupils And Increasing Accommodative Amplitude And Facility. This May Account For The Changes In Some Visual Functions Or Vision-Related Task Associated With Caffeine Intake.

### **Over View Of Caffeine Half-Life**

Caffeine Reaches Its Maximum Peak Plasma Concentration Between 20-120 Minutes And Its Plasma Half –Life Is Between 3-6 Hours. Therefore, Caffeine Is Eliminated From Our Bodies After 4 Hours Of Ingestion. Thus, For This Study We Focused On Seeing Caffeine Effect Only At The Peak Level Of Plasma Concentration, At 30 Minutes Mark.

## **Limitation**

A Notable Limitation Of This Study Is That It Is Not Possible To In For Whether Caffeine Intake Could Result In Improvement Or Deterioration Of Near And Distant Vision . This Is Because The Final Retinal Image Formed Doesn't Only Depend On The Interplay Between Pupil Size And Accommodative Status. Hence, We Would Suggest Further Investigation In This Area. In Addition, The Subjects Recruited Into This Study Were Healthy Into This Study Were Healthy Young Adults And Who Were Not Habitual Consumers Of Caffeine Of Any Form, And Hence The Findings Of This Research May Not Be Applicable To Older Adults Or Habitual Consumers Of Caffeine...Also, We Would Suggest That Further Studies Be Conducted To Determine The Onset, Peak, And Maximum Duration Of Caffeine On The Amplitude Of Accommodation And Pupil Size And Accommodative Facility.

#### Conclusion

Caffeine Has Effect On Accommodation And Pupil Size. There Was Improvement In Amplitude Of Accommodation After The Ingestion Of Caffeine And Also The Accommodative Facility Was Improved. Along With Accommodation There Was Distinct Increment In Pupil Diameter.

Based On This Limited Study As Well As The Current Literature, It Is Not Known That What Possible Long-Term Effects Of These Transient Changes From Caffeine Can Have On Eye. Therefore, Longitudinal Studies Observing The Effect Of Caffeine On Subjects With Refractive Error, Retinal Pathologies, Binocular Abnormalities And On Geriatric Population Might Help To Better Understand The Long Lasting Effect Of Caffeine

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