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Change in refractive status and pupil size during different yoga posture among healthy subjects

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The purpose of this study was to find out the effect of different yoga postures on the refractive status and pupil size among healthy individuals. The cross-sectional study involved 27 healthy individuals with a mean age of 19.9±1.69 years. The procedure was explained to the subjects and written informed consent obtained. Structured yoga training was given for all participants to get them to perform five yoga postures. On completion of training, refractive error and pupil size were measured for each subject using photo refractometer at rest and while performing yoga. Comparing refractive error measurements with all the yoga postures no statistical significant difference observed, but when the mean value of pupil size baseline reading compared with each yoga postures, we found a significant change in pupil size during the asana ($p<0.001$). The study shows a significant increase in pupil size across yoga postures as compared to prone position. There was no change in the refractive status across all yoga postures.

Keywords: Accommodation, Photo refractometer, Pupil size, Yoga posture

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Yoga is an ancient Indian science which includes the practice of specific postures that leads to mind, body and spirit integration. These facts of life combined, enhance not only well-being but also improves physical health. A combination of yoga practices reduces the symptom of visual strain in person with progressive myopia[1].

The physiological benefits are to yoga practice have been well understood and are gaining more interest among the healthy individuals. Recent studies showed that various asanas create physiological and psychological change which helps to improve the quality of life and better health[2].

Human lens has the natural ability (Accommodation) to adjust shape and curvature to maintain good focus in vision at all distances. This involuntary activity by ciliary body is controlled by the autonomic nervous system response. The ciliary muscle adjusts radial tension on the natural lens and changes the lens curvature, which adjusts the focal distance of the eye in order that one may focus on a given object[3].

The pupil, an aperture located in the center of the iris regulates the entry of light into the retina by the action of two antagonistic muscles in the iris i.e., the sphincter and dilator. Activation of the sphincter, under parasympathetic control, constricts the pupil (miosis), whereas activation of the dilator, under sympathetic control dilates the pupil (mydriasis). The parasympathetic and sympathetic pathways under the influence of complex neuroanatomical pathways control the pupillary size and the pupil size is known to also vary under conditions of background illumination, accommodation, and vergence[4].

Refractive errors account for half the cases of avoidable vision impairment globally. Yoga posture could influence the refractive status, accommodative status and pupil size. Studies so far reported that Intra ocular pressure will vary in supine or head down position but the change in pupil size and refractive changes with yoga postures are not known[5,6,7]. The purpose of this study was to find out the effect of different yoga postures on the accommodative/refractive status and pupil size among healthy individuals.

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Methodology

A cross-sectional study was conducted on 27 subjects aged between (18 to 25 years), including both genders and they were selected from students of Manipal Academy of Higher Education. The current study enrolled participants through a convenient sampling strategy over the study period. Eligible volunteer participants were asymptomatic, non – contact lens users, those who can maintain the yoga posture (after getting trained from division of yoga). The study excluded subjects with refractive error (≥±3.00D), dilated pupils, regular yoga practitioners, any ocular injuries/surgeries, any systemic diseases/injuries. Subjects who could not perform the five yoga postures after the training session were also excluded from the study.

The study protocol was approved by the institutional review board of Manipal Academy of Higher Education and the study followed the tenets of the Declaration of Helsinki. The procedure was explained to the subjects and written informed consent obtained. Physical examination was done for all participants to know their general health. A brief ocular and detail systemic history was taken followed by the vision assessment for distance and near. The slit lamp examination was done to rule out subjects with any ocular conditions. The demographic (self-reported name, date of birth, sex) and baseline measurement was taken before yoga training. The change in refractive status and pupil size were measured using a photo refractometer (Plusoptix A09) during 5 different yoga postures in darkroom illumination.

Five days of professional yoga training was given for all participants in five predetermined postures Fig. 1 (Ustrasana, Padangusthasana, Sarvangasana, Uttanpadasana and Dhanurasana) at division of Yoga. Training was given every day for about 30 min in the yoga division. It was instructed to subjects not to eat for 3 h or not to drink water for 1 min before the yoga practice. We have included only those participants who can maintain that posture for 30 s to 1 min (until the measurements were taken).

Refractive status and pupil size measurement were obtained for each yoga postures immediately as they assume respective yoga positions. Baseline measurements were taken ina prone position (Fig. 2) using Plusoptix A09. The experimental data were obtained after the five days of yoga practice. The second measurement was taken after they reached the perfect yoga posture. During these two (baseline & yoga) experimental session three continuous measurements were taken and the average value of refractive status and pupil size was considered for analysis.

Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) version 16 - IBM 2009. Paired t-test was used to analyze the data and p-value <0.05 were considered statistically significant. To analyze the data refractive status (sphere, cylinder, spherical equivalent [sphere +1/2 cylinder]) and pupil size was compared with the

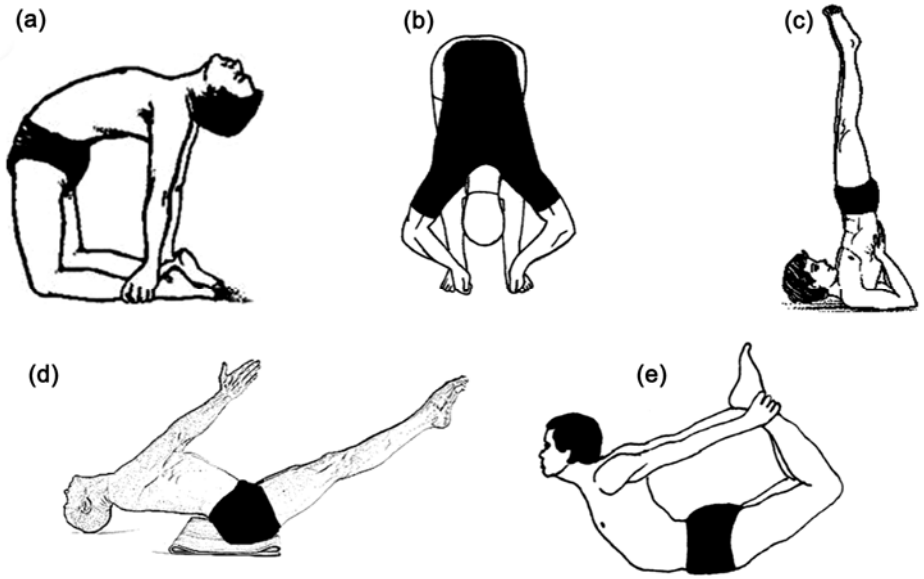

Fig. 1 — Different yoga postures (A) Ustrasana, (B) Pandagusthasana, (C) Sarvangasana, (D) Uttanpadasana, (E) Dhanurasana

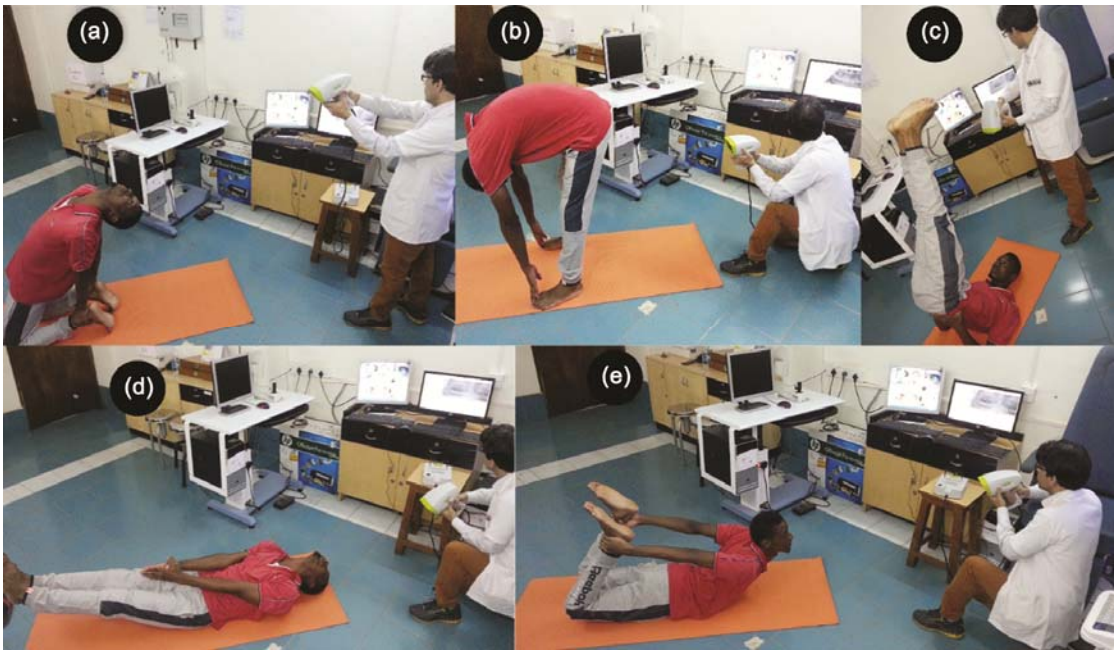

Fig. 2 — Measurements were taken in these yoga postures: (A) Ustrasana, (B) Pandagusthasana, (C) Sarvangasana, (D) Uttanpadasana, (E) Dhanurasana

baseline reading and each of the 5 different postures. Since each yoga posture had different outcomes and even though the same subjects performed these postures, repeated measure ANOVA was not considered for analysis.

Results

Twenty-seven subjects participated in this study within the age range of 18-25 years, with the mean age of (19.9±1.69) years. There were 21 females (78%) and 6 males (22%) among the 27 participated in this study.

Kolmogorov- Smirnov test was used to evaluate the normality of the data distribution since data was normally distributed parametric test (i.e., Paired t-test) was used to compare the mean values of different yoga postures with baseline values.

Refractive error was measured for 27 eyes (mean± SD) in Diopters. The values before yoga training were, sphere (0.48± 1.04) and cylinder (-0.44±0.22) and after 5days of yoga, training measurement was taken in each postures (Table 1). Data analysis revealed there were no statistically significant difference in baseline value and different yoga postures (Table 1). There is no change in refractive status during these postures (Fig. 3). Pupil size was also measured in different yoga postures. When we compared with the baseline reading with each yoga posture it showed significant change (Fig. 4).

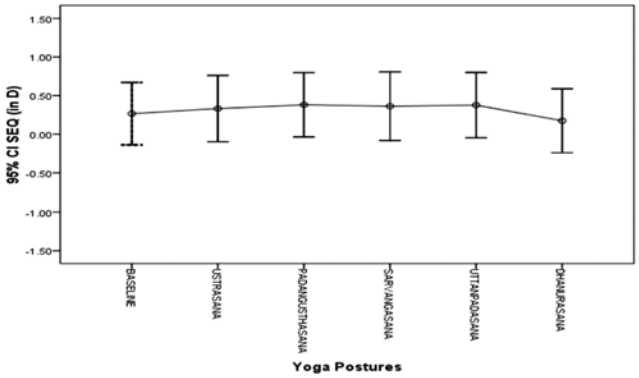

Fig. 3 — Change in mean values of (spherical equivalent refraction) baseline and 5 different yoga postures

Table 1 — Mean ±SD for baseline and all the five yoga postures

Postures	Sphere	Cylinder
Baseline	0.48±1.04	-0.44±0.22
Ustrasana	0.52±1.08 (0.565, -0.181 to 0.101)	-0.39±0.22 (0.134, -0.119 to 0.016)
Padangusthasana	0.58±1.05 (0.204, -0.262 to 0.058)	-0.41±0.20 (0.503, -0.106 to 0.053)
Sarvangasana	0.57±1.10 (0.267, -0.234 to 0.067)	-0.41±0.20 (0.416, -0.092 to 0.039)
Uttanpadasana	0.58±1.06 (0.192, -0.234 to 0.049)	-0.40±0.21 (0.290, -0.103 to 0.032)
Dhanurasana	0.37±1.07 (0.145, -0.039 to 0.255)	-0.41±0.222 (0.365, -0.104 to 0.039)

n=27, Mean±SD (*p value*, 95% CI of difference in mean value)

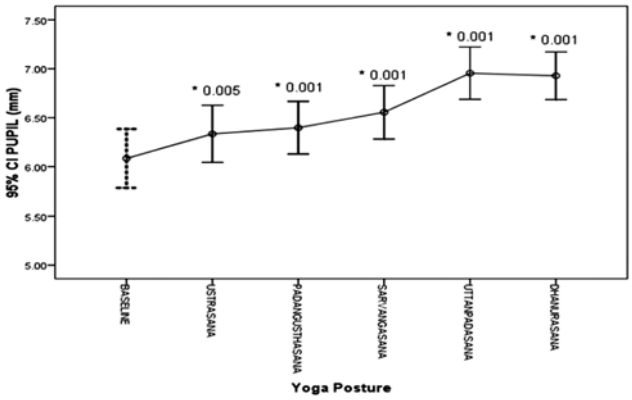

Fig. 4 — Change in mean values of (pupil size) baseline and 5 different yoga postures (**p*-value)

Discussion

The present study reported the effect of different yoga posture on the refractive status and pupil size. The different postural position of yoga, such as Ustrasana, Padangusthasana, Sarvangasana, Uttanpadasana and Dhanurasana, were practiced for a duration of 5 days. Refractive status and pupil size measured by using Plusoptix A09 at baseline and at five different yoga postures. Variability in refractive status is an indirect method to study the accommodation changes using power refractor[8]. The current study shows no significant change in refractive status across 5 different yoga postures as compared to baseline. Though there are limited studies reporting similar ocular effects with yoga, studies show that there change in lens shape and position during prone and supine position[6].

Compared to baseline yoga positions there was statistically significant effect on pupil size, as it dilated with all 5 yoga postures. Increase in pupillary size was more evident with Uttanpadasana and Dhanurasana. Yoga practice has been reported to have a positive effect on general physiology and well-being; our study results show the change in pupillary size which probably intimate the effect of yoga on sympathetic or parasympathetic pathways. Another probable factor that influences pupil size variation in room illumination, though the current study adopted uniform protocol to take Plusoptix measurements in dark room we did not measure the exact illumination of the room. In future studies, this variability in illumination shall be controlled by monitoring standard illumination at all yoga positions and evaluates the change in pupil size using Plusoptix.

Previous studies have only tested the headstand position; commonly practiced yoga positions also increase intraocular pressure (IOP). All four positions (i.e., Adho Mukha Svanasana, Uttanasana, Halasana and Viparita Karani) showed a significant increase in IOP in all subjects. In glaucoma patients, the severity of their disease was in association with their increase in IOP during all four positions. The study has been conducted to rule out the impact of sirsasana yoga on intraocular pressure; they report a 2-fold increase in IOP[7]. IOP is also known to increase as pupillary diameter increases, patient with shallow anterior chamber and those with angle closure glaucoma are more affected by dilation of the pupil. Dilated pupils lead to blocking of anterior drainage angle and leads to a rise in IOP and pupil block is also a risk factor for angle closure glaucoma[9,10]. The increase in IOP in previous studies could also be due to the dilation of the pupil as shown in this study. The increase in pupil size could probably be one of the factors that leads to raise in IOP across head down postures of yoga. Patients with suspected angle-closure glaucoma should probably avoid yoga postures which lead to an increase IOP[6,7]. Yoga practitioners should be aware of the significant increase in IOP during these common positions, specifically glaucoma patients with severe disease[6]. Given the fact that clear evidence exists regarding the efficacy of both exercise and yoga interventions in alleviating symptoms and improving outcomes of patients with various eye diseases needs to be further studied.

This study excluded patients on ocular medications which could have influenced the physiology of pupil and eye. Yoga and its effect on the eye is an emerging area of research interest but as per previous literature search, the effect of yoga on ocular parameters related studies have not conducted to improve the eye conditions such as accommodation and physiological changes in various population

Limitations of the study include relative effects of these different types of yoga on the pupil size (sympathetic or parasympathetic pathways) and refractive status has not been adequately examined. Yoga postures may stimulate sympathetic activity further studies can be done to see the neurological changes during different postures. The current study included young participants and five yoga postures, further studies with larger and age-stratified sample size will help us to understand clearly the role of yoga on ocular and visual parameters. Yoga is additive to care, but an effective, feasible, and alternative in

improving health. Extensive research is needed to examine the efficacy and acceptability of yoga interventions for the pupil size in different populations especially in geriatric and glaucoma patients.,

Conclusion

The study shows a significant increase in pupil size between yoga postures (Ustrasana, Padangusthasana, Sarvangasana, Uttanpadasana and Dhanurasana) as compared to baseline/prone position. There was no change in the refractive status of the across yoga postures.

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