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Impact on intraocular pressure before, during and after fish yoga pose

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ABSTRACT

Purpose: To evaluate the effects of head-down position on intraocular pressure (IOP) during yoga pose in ageing subjects.

Methods: This was a prospective, observational study which included 44 participants, total - 88 eyes. Subjects were divided into two groups of 22 subjects based on age. The IOP was measured of both eyes of the subjects in 4 different positions.

Results: There were significant difference in IOP baseline between two positions in both groups (p=0,000) and between age of the participants (p=0,000). During the yoga pose, the IOP was significantly higher than top value of the normal range of IOP (>21 mmHg) after 1 minute of exercise. In both groups (younger (Y) and older (O)) the IOP changes:

1. Seated position before yoga pose – IOP(Y)=16 mmHg; IOP(O)=15,3 mmHg
2. Yoga pose – IOP(Y)=24,6 mmHg; IOP(O)=22.4 mmHg
3. Immediately after yoga pose entered in sitting position - IOP(Y)=19 mmHg; IOP(O)=16,6 mmHg
4. After 5 min in sitting position - IOP(Y)=15,5 mmHg; IOP(O)=15 mmHg

Conclusions: In both groups the highest IOP was found during the head down yoga pose. However, the IOP significantly returns to the initial value as it was before the yoga pose in both groups.

***Keywords**:* intraocular pressure, yoga pose, IOP, head position, glaucoma, young, older.

Introduction

Yoga is an ancient heritage, which gained popularity in western world in 19th century [1, 2, 3, 4, 5, 6]. Hatha is one of the most common practiced type of yoga, which includes physical postures (Asanas), the mind (Meditation) and the breath control (Pranayama) [7, 8]. Yoga is becoming more and more popular in the whole world. Based on USA Yoga federation findings, there are around 300 million people practicing yoga in the United States. For 2 years period, the number of people practicing yoga has increased by 16 million. Among them, 14 million are elder people. In Germany, 15.7 million people are currently practicing Yoga [9]. Nowadays yoga is used as an alternative therapy in many chronic diseases. According to literature review by Raub, J. A. et al, many studies revealed that yoga/breathing techniques show improvement in lung function for asthma and chronic bronchitis patients [7]. Beneficial effects of yoga also were found in depression, migraine, asthma, allergies and especially cardiovascular diseases [8, 10]. However, there are numerous studies describing negative effect of yoga headstand posture on increasing the intraocular pressure [11]. IOP starts to move upwards immediately after assuming a head down position in body vertical position [12]. Increasing age and elevated intraocular pressure are one of the main risk factors of glaucomatous optic nerve damage and severe vision loss. Clinical study have showed that increased intraocular pressure could provoke progression of open-angle glaucoma (OAG) [13]. IOP variability during different head positions and the growth of yoga popularity among different age groups are the key factors to outline this topic. This study was designed to evaluate the effects of head position down on IOP during yoga pose in ageing subjects.

Materials and methods

This was a prospective observational study followed the principles of the Declaration of Helsinki.

44 Caucasian (Europid) subjects, in total – 88 eyes were included in this study. Participants were subdivided into two groups based on age: 1) younger than 30 and 2) older than 60 years old. All 44 subjects who volunteered were yoga beginners.

Subjects were excluded from the study if they met one of the following criteria:

(1) age between 30-60 years old, (2) subjects, who could not perform specific yoga pose, (3) recently treated severe eye disease or performed any ocular operations, (4) diagnosed with glaucoma or optic nerve damages, (5) elevated IOP more than 21 mmHg.

Inclusion criteria were as follows: (1) all volunteered participants contain in age range younger than 30 or older than 60, (2) subjects, who could maintain in yoga position for at least 1 minute (Table 1). All of 44 participants were included in the study.

Young group	**Older group**
< 30	> 60
Able to maintain in yoga pose	
IOP < 21 mmHg	
No diagnosed with glaucoma	
Never diagnosed with disease of cornea	
No previous ocular operations	
No optic disc changes	

Table 1 Participants inclusion criteria.

Before the study all the details were explained to the subjects and the written consent was obtained. The demographics and other details about subjects were documented. The risk factors for glaucoma, ocular hypertension or other previous eye diseases, operations, smoking and family history of glaucoma were inquired. Details related to physical activities as type, duration of exercise, performed yoga poses, and history of systemic illnesses and prescribed medicine were collected.

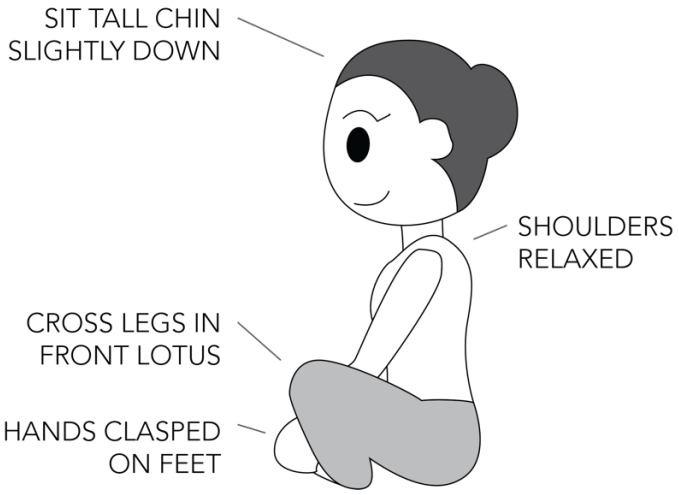

Figure 1 Sitting position (Lotus pose)

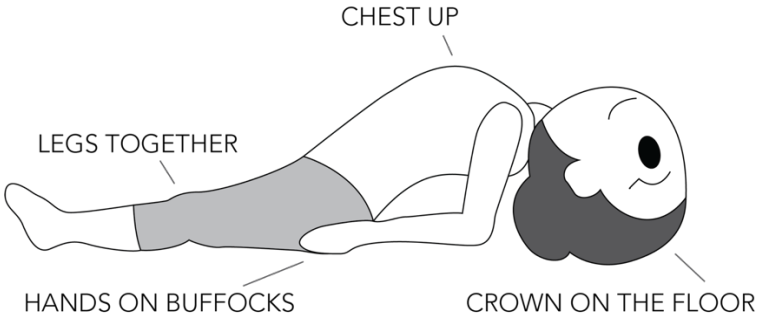

Figure 2 Yoga position (Fish pose)

Each participant was required to stay certain time in 2 different poses. In this study Lotus pose is called sitting position and head-down Fish posture – yoga pose. First one is Sitting Cross-Legged position (known as Lotus pose) (Fig 1). This pose helps to connect the mind, body and spirit in neutral position, which is a goal of yoga. After 5 minutes of siting in Lotus position, participants moved to 90 degrees head-down pose, where body was in horizontal position with chest up. This posture is called Fish or Matsyasana position in yoga (Fig 2). This pose is easy to perform, therefore, it is suggested for beginners. In Fish position subjects remained for 1 min and then moved back to seated pose.

The 4 intraocular pressure measurements were taken. (Fig 3) The IOP was measured for all subjects between 12 p.m. and 2 p.m.

The Icare Tonometer was used to measure intraocular pressure changes after each pose. First of all, participants were required to spend 5 minutes in seated position, then 1 minute in Fish position and return to seated position for 5 minutes. The IOP was measured of both eyes of the subjects after 5 minutes in a seated position, 1 minute into the yoga pose, immediately after entering sitting position and 5 minutes later in the seated position (Fig 3).

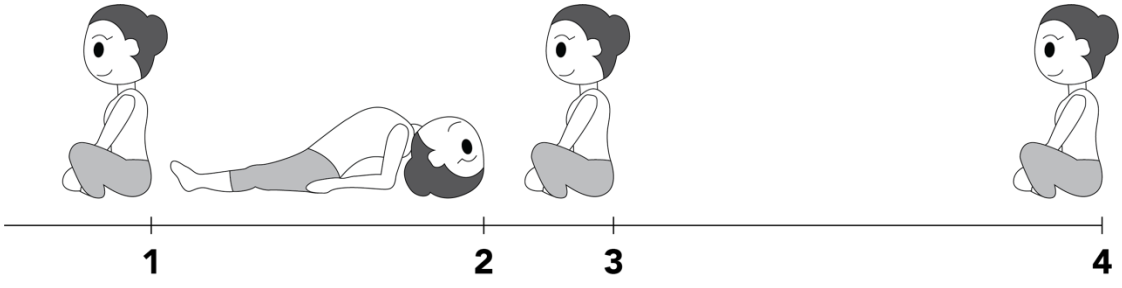

Figure 3 IOP Measurements

The Icare tonometer automatically takes 6 IOP measurements and calculates the average reading. The highest and the lowest IOP measurements must be removed from the average amount by tonometer itself. Before measurement the probe must be inserted, and the support subject's forehead must be done in order to obtain an accurate measurement. The tonometer's central groove must be in horizontal position. Subjects were asked to relax and look straight ahead, when IOP measurements were made directly to the center of the cornea. The distance between tip of the probe and cornea should be 4-8 mm. In all position the right eye was measured first. In yoga (Fish) pose the subjects' head must be 90 degrees down to the floor, therefore we used Icare tonometer, keeping tonometer's groove in horizontal position as it is recommended, but the support was on the cheek bone instead of the forehead. Even though we were able to make measurements directly to the cornea with suitable distance.

Statistical Analysis

Data were analyzed using paired two-sample Student's t-test. The correlation between IOP and the age of the participants were observed. We performed an analysis with baseline IOP values for each pose (seated and Fish pose). The same type of statistical analysis was used involving comparisons among gender, diagnostic groups and poses. Statistical significance was declared $p < 0,05$ for correlations.

Results

All the 44 participants completed the study. There were 8 men and 36 women. The subjects were divided into two groups based on age: younger than 30 years old and older than 60. Younger group consisted of 22 participants (2 men, 20 women) with a mean age of 23,45 and older group was formed of 22 subjects (6 men, 16 women) with a mean age of 69,82. The mean BMI of younger group – 21,89 kg/m^2, older group – 28,13 kg/m^2. For all participants the arterial pressure was measured, the mean blood pressure of 119,55/80 in younger group and of 129,55/83,64 in older group (Table 2).

	Younger group 22 Subjects	Older group 22 Subjects	Total 44 Subjects
Mean of age (yrs.)			
	23,45	69,82	46,64
Sex (n)			
Men	2	6	8
Women	20	16	36
Mean of BMI (kg/m^2)			
	21,89	28,13	25,01
Mean of BP (mmHg)			
Systolic	116,55	129,55	124,55
Diastolic	80	83,64	81,82

Table 2 Participant Demographics

None of the subjects in both groups have ever diagnosed with glaucoma, however 8 participants had a positive family history of glaucoma. 14 participants from older group had hypertensive heart disease and used antihypertensive medications. 45,5% of participants smoke and 27,2% participates in sports at least twice a week (Table 3).

Parameters	Number (%)
Family history of glaucoma (n)	8 (9,1%)
Hypertension (n)	14 (31,8%)
Diabetes (n)	0
Smoking (n)	20 (45,5%)
Myopia (n)	14 (31,8%)
Hyperopia (n)	16 (36,4%)
Astigmatism (n)	2 (4,55%)
The nature of work (n) Sedentary Active	 24 (54,5%) 8 (18,2%)
Participation in sports (n)	12 (27,2%)

Table 3 Participants History

No statistical significant differences were found between postural IOP changes and hypertensive heart disease, smoking, positive family history of glaucoma and regular sports activities in subjects.

In total, 352 measurements of the IOP were performed among two groups. Figure 4 shows, how IOP changes during study. In yoga (Fish) pose, the IOP was significantly higher (average IOP 23,48 mmHg) than the normal range of IOP (10-21 mmHg) after 1 minute of exercise. However immediately after fish

pose with the average of 17,8 mmHg IOP returns to normal range IOP and after 5 minutes in seated position completely decreased to the original value (mean IOP 15,5 mmHg) as it was before performing yoga posture (avg. IOP 15,6 mmHg) (Figure 4). The statistically significant correlation was found in IOP baseline between two positions (seated and yoga pose) in both aging groups ($p<0.000$).

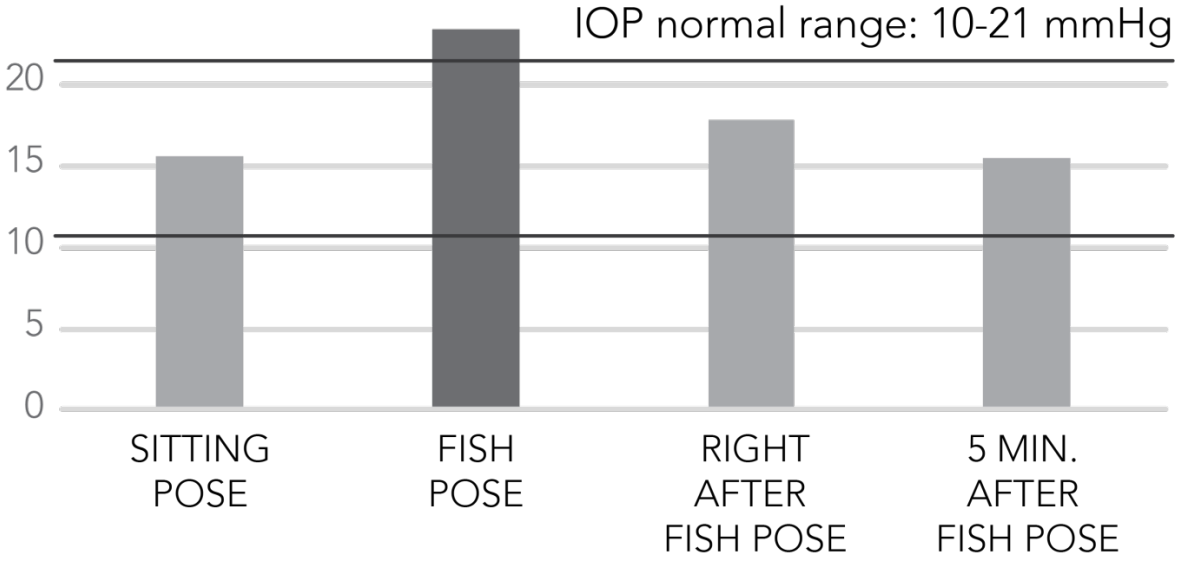

Figure 4 Average IOP & Pose

There was also significant difference between age of the participants and mean IOP ($p<0,000$). In both groups (younger (Y) and older (O)) the mean IOP changes (Figure 5): in seated position before yoga pose – IOP(Y)=16 mmHg; IOP(O)=15,3 mmHg. In Yoga pose – IOP(Y)=24,6 mmHg; IOP(O)=22.4 mmHg. Immediately after yoga pose entered in sitting position - IOP(Y)=19 mmHg; IOP(O)=16,6 mmHg and after 5 min in sitting position - IOP(Y)=15,5 mmHg; IOP(O)=15 mmHg.

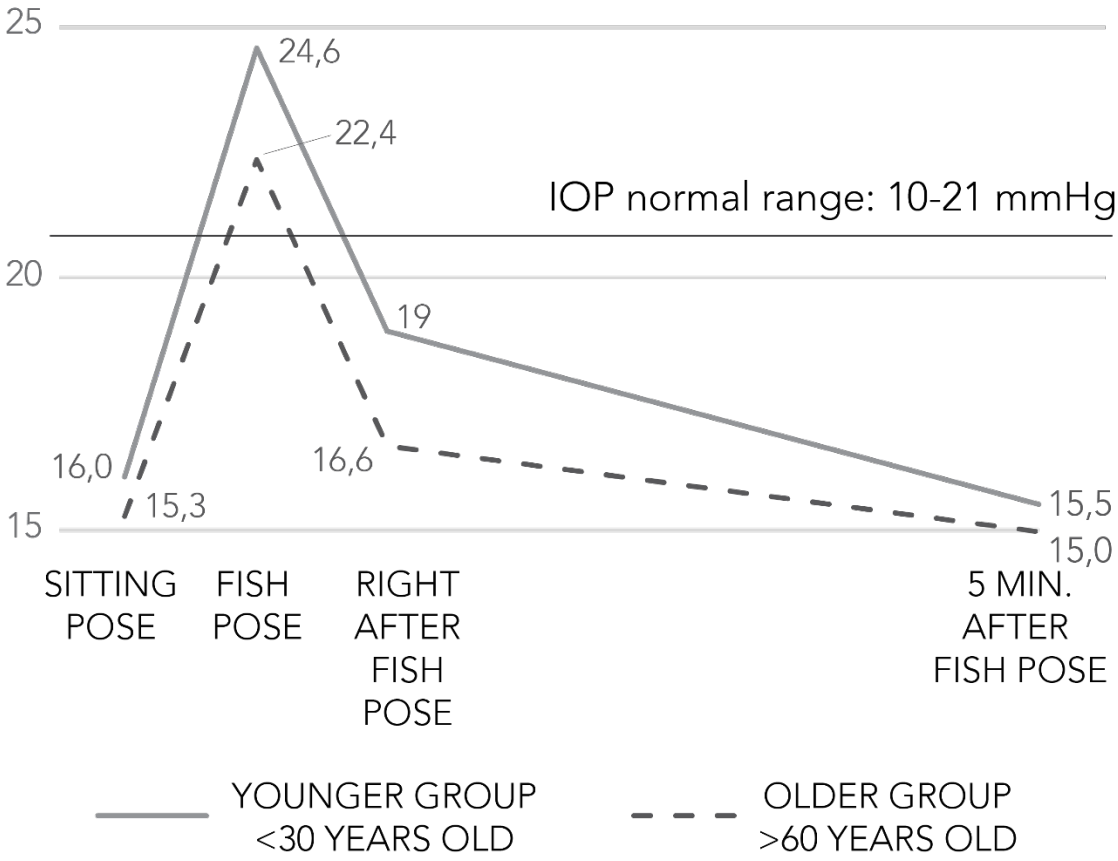

Figure 5 IOP changes before, during and after Yoga Pose

In both groups there were no significant differences found between left and right eyes during study. The IOP of both eyes fluctuates almost the same by changing positions. In younger group during yoga pose the mean IOP grew faster and reach the peak with the mean IOP of 24,8 (mmHg) right eye and 24,4 (mmHg) left eye comparing to older group with the average IOP of 22,5 (mmHg) right eye and 22,3 (mmHg) left eye (Figure 6 & 7).

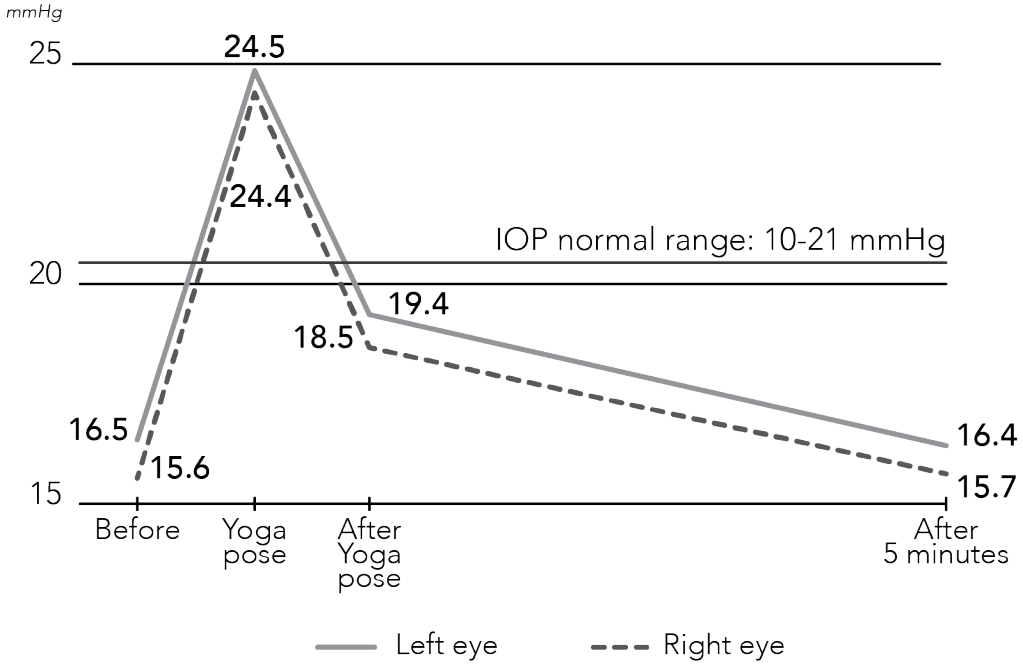

Figure 6 IOP change between right and left eyes (younger group)

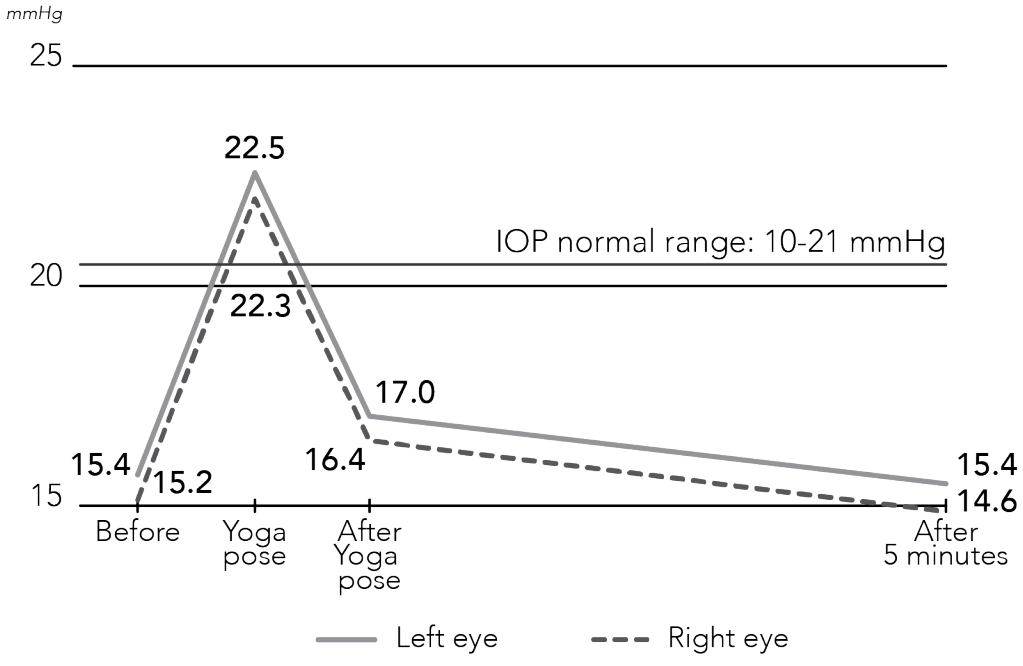

Figure 7 IOP change between right and left eyes (older group)

Discussion

Yoga is used as a therapy, which may help to recover after disease, injury, it promotes positive hemostatic response in cellular reaction and reduces the internal stress [14]. The headstand posture (known as Sirsasana) (Figure 8) is one of the main poses among yoga participants. According to the participants, they do not feel IOP increasement or do not complain of ocular side effects, while performing headstand posture [15]. Several studies have described the effects of headstand pose on increasing IOP [15, 16, 17, 18]. The studies with Sirsasana pose, which is a headstand posture in body vertical position, showed 2-fold growth [15, 17, 19].

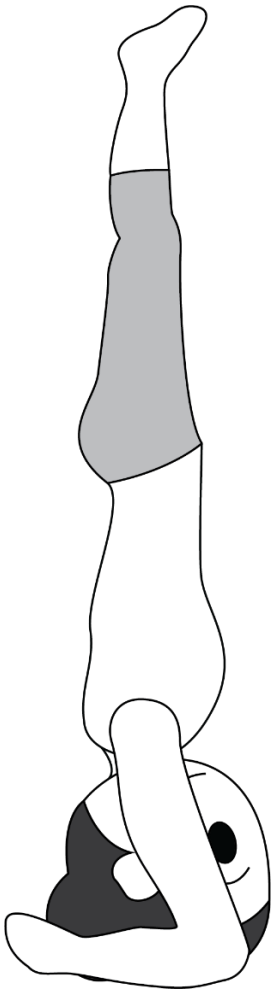

Figure 8 Sirsasana, headstand posture

To our knowledge this is a first research, performed with head-down position in horizontal body posture to study the variation of IOP. We compared the mean IOP changes before, during and after yoga pose between young and older groups. Results showed, the higher growth of IOP in younger group during yoga pose comparing to older group. It could be related to better adaptation of blood flow in younger age. In addition, during headstand

position, the blood flow to the retinal veins comes slower [20]. Elevated IOP particularly is a major risk for glaucoma patients. Even though for older people the growth of intraocular pressure during yoga is lower than younger, it is recommended for elder participants exercise due to other factors. As longer the yoga participants perform head-down posture, the longer duration of increased IOP [17]. According to other articles, during head-stand posture the IOP increase may be explained with raised episcleral venous pressure [21, 22]. Different head position may compress the neck vessels, which provoke elevation of episcleral venous pressure [23]. Additionaly, other studies assumed that the IOP may go up due to increasement of ocular blood volume [24]. In literature there are few case reports with negative effect of headstand posture on sight or functional retinal changes. Based on the article-case report by Gallardo et al [17], individual with 10 years yoga experience and performance of Sirasana yoga posture for 30 minutes, may have prolonged elevated intraocular pressure. This clinical case showed, that increased IOP remains the same highly during the whole yoga posture performance and could provoke retinal changes. It suggests exercising headstand posture caution with shorter duration of time or avoid it. As well another case report found branch retinal vein occlusion after performing constantly headstand posture. Recently, the case report by S.Y.Chong et al [25], showed the cause of head-down position to acute posterior vitreous detachment. Therefore, it should be documented about yoga in advance and complete ophthalmologic examination should be done for every yoga practitioners. Previous study [16] showed that in the standing head down position (Figure 9), the IOP as well significantly increases beyond the normal range for healthy and people with open angle glaucomam (OAG). Glaucoma disease in the study did not demonstrate important effect on IOP increase [16].

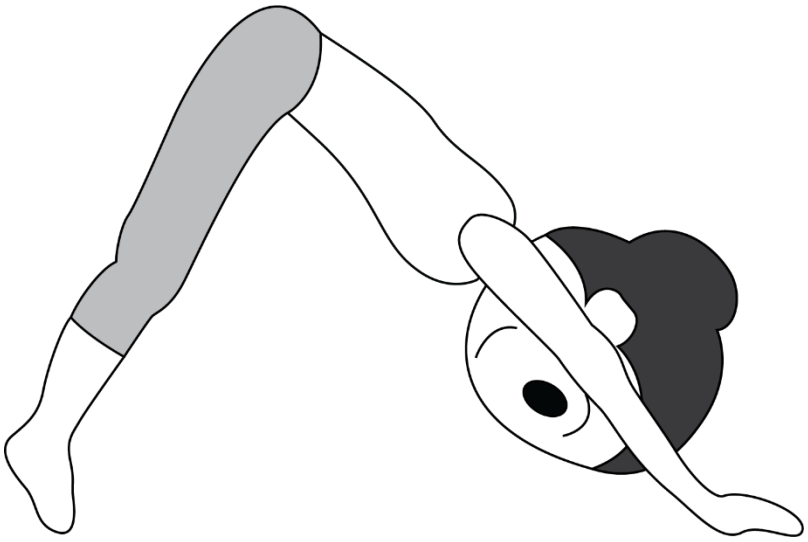

Figure 9 Standing head down position

Limitations

The study includes only 44 participants, in total 88 eyes, only younger than 30 and older than 60 years old subjects. 31-59 years old people were not included into this study, so we may need to improve our study to explore IOP changes in middle age people. In both groups all the subjects were only Caucasians. Based on study by Mani Baskaram et al [15], Caucasians had lower IOP growth after headstand yoga pose compare to Asians Indians. The number of participants was low, even though we found significant associations between IOP changes and yoga position. Our study focuses on IOP data, participants' history of smoking, hypertensive heart disease, near, long sightedness and other, however no correlation was found between IOP changes and these factors.

No ocular examination was performed for participants prior to the study. We did not check ocular perfusion, cerebrospinal fluid pressure, perimetry or optic nerve examination, which may potentially contribute to positional changes in IOP.

Blood pressure was measured; however, the blood pressure was in normal range in both groups. Even though some of older group's participants had arterial hypertension, the disease for all participants was controlled by used antihypertensive medicine. Therefore, we could not associate blood pressure changes with variation of cerebrospinal fluid pressure during yoga posture. The steeper head-down position determines increasement of cerebrospinal fluid pressure and IOP, which is a risk for glaucomatous optic nerve [26].

Icare tonometer was used to measure intraocular pressure. According to the Icare tonometer's recommendations, the support to subject's forehead must be done to obtain suitable measurement. However, in order to measure IOP in head down position and keeping tonometer's groove in horizontal position (as it is recommended), our support area was modified to the cheek bone. We believe, there is no difference in anatomical distances between the center of cornea and the forehead or the cheekbone.

Another limitation was the short duration of maintaining in each position. Potentially, the IOP would increase higher, if participants stayed in yoga position longer. However, we still determine the IOP above the normal range during head-down posture.

Furthermore, the lack of yoga experience and short duration of time in specific position may have influenced IOP changes during study. Based on the case report [17], the participants with long headstand history have higher IOP, while performing yoga pose. Potentially, the IOP changes depend on speed of body change, duration in a specific pose, blood pressure changes and episcleral venous pressure.

In conclusion, we found significant correlation between IOP changes and age of the participants. There was meaningful difference between IOP changes and two positions (yoga posture and sitting pose). In both groups the highest IOP was found during the head down yoga pose. However, the IOP returns to the initial value as it was before the yoga pose in both groups. It is possible that headstand yoga posture may not be beneficial to all yoga members. Therefore, these findings suggest exercising headstand posture caution especially for older subjects and complete ocular examination must be fulfilled for all yoga participants.

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