Research Article

Intraocular pressure changes in different age group individuals after water ingestion

Anitha Lakshmi[1], Nagaraja Puranik[2], KF Kammar[2]

[1]Department of Physiology, Vijayanagar Institute of Medical Sciences, Bellary, Karnataka, India.
[2]Department of Physiology, Karnataka Institute of Medical Sciences, Hubli, Karnataka, India.
Correspondence to: Anitha Lakshmi, E-mail: anithalakshmi1612@gmail.com

Received March 5, 2015. Accepted July 24, 2015

Abstract

Background: The intraocular fluids exert pressure on the coats of the eyeball, which is referred to as the intraocular pressure (IOP). It varies with factors such as the time of day, heart beat rate, blood pressure level, respiration of day, heartbeat, blood pressure level, fluid intake, and respiration. Age is considered to be one among the several factors that influence IOP.

Objective: To reveal the IOP changes in each of the eyes, among the different age group individuals, immediately and at different intervals (15, 30, 45, and 60 min) after water ingestion.

Materials and Methods: Investigations were carried out in 50 young-aged, 50 middle-aged, and 50 old-aged individuals before and after water ingestion. The IOP changes in them were compared before and after water ingestion in them, and the effect was compared among the different age group individuals. Statistical analysis was done by using Student *t*-test by considering paired and unpaired *t*-test.

Result: In this study, IOP significantly increased in both the eyes, immediately after water ingestion in all the three age group individuals, when considered separately.

Conclusion: This study can be concluded with the findings that the IOPs have a propensity to increase immediately after water ingestion in different age group individuals, and this increase is more in old age individuals when compared with the young age individuals. This study may help in the prediction of ocular hypertension in relation to age, and its consequences be forecasted by using a more common parameter (i.e., IOP).

KEY WORDS: Intraocular pressure, different age groups, glaucoma, Schiotz tonometer

Introduction

Human aging indicates the progressive constriction of the homeostatic reserve of every organ system. This decline, commonly defined as "homeostenosis," is gradual, progressive, and manifests itself by 30 years of age.[1] A reduced physiologic reserve in the eye is shown by the changes in the intraocular pressure (IOP) with increasing age.

The pressure imposed by the intraocular fluids on the coats of the eyeball is defined as IOP. It is determined by the balance between the rates of aqueous secretion and aqueous outflow. Normal IOP within the general population has a range of 11–21 mm Hg. It varies with the time of day, heartbeat, blood pressure level, and respiration. Age is considered to be one among the several factors that influence IOP.[2]

On the basis of this consideration, the previous population-based studies in Caucasians have generally reported a positive relationship between the increasing IOP and age. In contrast, an inverse relationship of age and IOP has been reported in some population.[3] The definition of "normal values" primarily depends on the awareness of the distribution of IOP in relation to age. IOP is the key modifiable risk factor

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2015.05032015356	

for glaucoma.[4] Elevated IOP is one of the major risk factors for developing glaucoma or glaucomatous optic neuropathy and its progression. Glaucoma is a common ophthalmic disease in India and worldwide, and it is a significant cause of visual impairment and blindness. The economic and social statuses get reduced because of blindness, and it can lead to premature death also. The prevalence of ocular hypertension is estimated to be between 5% and 10% of the general population.

Previous studies regarding the interrelationship between water ingestion and IOP and between systemic blood pressure and IOP are available in the literature. However, no data are available, which explain the interrelationship between IOP, age, and water ingestion and correlate the changes in IOP in different age group (young, middle, and elderly) individuals after water ingestion.

In view of this point, this study was undertaken to establish the interrelationship between the IOP changes after water ingestion in apparently healthy individuals of different age groups. This study may help in the prediction of ocular hypertension in relation to age.

Materials and Methods

This study was conducted in the Department of Physiology with the assistance of Ophthalmology Department, on subjects who were first-year MBBS students who formed the young age group, and the middle- and old-aged subjects were people who visited the Ophthalmology OPD in KIMS, Hubli, Karnataka, India. The study and its conduct were cleared by the ethical committee of KIMS, Hubli.

Source of Data

The subjects of this study were the first-year MBBS/DMLT students and people who visited the OPD of Ophthalmology Department, KIMS Hospital, Hubli. Before including the subjects for the study, all the subjects were assessed clinically by a thorough history taking and a detailed clinical examination.

The past, recent, and acute illnesses of the subject were recorded for the case history. Only subjects who fulfilled the inclusion criteria were included in the study. The study was conducted between 8 a.m. and 10 a.m. in order to avoid changes owing to circadian rhythm.

The study groups consisted of 150 subjects of different age groups as follows: younger age group, i.e., 15–25 years (N = 50); middle age group, i.e., 30–40 years (N = 50); and older age group, i.e., 60–75 years (N = 50).

They were selected on the basis of the following inclusion and exclusion criteria. Trials were conducted on the same group of subjects on the same day.

Inclusion Criteria

Fifty healthy young individuals (15–25 years), 50 healthy middle-age individuals (30–40 years), 50 apparently healthy elderly individuals (60–75 years) of both the sexes were included in the study.

Exclusion Criteria

Individuals who were <15 years and >75 years; individuals who presented history of diabetes mellitus, ocular trauma, and glaucoma; and people on any type of drugs/medications, which may influence the study, were excluded from the study.

The subjects were treated with proper respect during the meetings and when the tests were being conducted on them. Doubts raised by them before, during, or after the tests were patiently addressed and ascertained that they were cleared of it.

Methods of Collection of Data

The following parameters were recorded and entered in a separate pro forma for each subject.

I. Recording of Anthropometric Parameters

1. Height (in cm) measured in the subject, standing without shoes, by standard tailor tape.
2. Weight (in kg) measured by a standard weighing machine with minimum clothing.
3. Body mass index (kg/m^2) was calculated by considering height and weight.

II. Recording of Physiological Parameters

The following parameter was recorded in lying down position.

1. IOP of both the eyes in different age group individuals was recorded by indentation method under aseptic precautions after instillation of xylocaine eye drops and using Schiotz tonometer.
2. The same procedure was repeated in these individuals at every 15 min for 1 h after water ingestion (1 L of drinking water).

Statistical Analysis

Statistical analysis was done by using the "SPSS software" under the guidance of a biostatistician of KIMS, Hubli.

All the values were presented as mean± standard deviation (SD). Comparison of the mean values of parameters between the two trials (control and study) was done by paired *t*-test.

$P \leq 0.05$ was taken as "significant" in this study.

Table 1: Anthropometric data of study subjects

Age group	Height (cm)	Weight (kg)	BMI (kg/m^2)
Young	164 ± 6.2	58 ± 7.7	21 ± 2.7
Middle	161 ± 7	57 ± 6	21 ± 2
Old	159 ± 4.5	56 ± 5.3	21 ± 1.8

Mean ± SD; $P \leq 0.05$, significant.

Table 2: IOP changes in young individuals before and after water ingestion in right and left eyes (mm Hg)

	Before water ingestion	After water ingestion				
		0 min (immediate)	15 min	30 min	45 min	60 min
Right eye	15.5 ± 1.9	19.6 ± 3.3	20.5 ± 3.3	19.7 ± 2.4	18.7 ± 2.2	18.1 ± 2.0
t		8.6	10.1	9.8	7.2	6.3
P		0.0001	0.0001	0.0001	0.0001	0.0001
Significance		≤0.05	≤0.05	≤0.05	≤0.05	≤0.05
Left eye	16.0 ± 2.1	19.8 ± 3.5	21.0 ± 3.3	19.8 ± 2.9	18.5 ± 2.2	18.2 ± 2.1
t		5.82	8.13	6.22	4.44	3.67
P		0.0001	0.0001	0.0001	0.001	0.001
Significance		≤0.05	≤0.05	≤0.05	≤0.05	≤0.05

Mean ± SD; *P* ≤0.05, significant.

Table 3: IOP changes in middle-aged individuals before and after water ingestion in right and left eyes (mm Hg)

	Before	After water ingestion				
		0 min	15 min	30 min	45min	60 min
Right eye	15.5 ± 2.0	20.9 ± 3.0	21.4 ± 2.7	19.8 ± 2.5	18 ± 1.7	17.2 ± 1.4
t		14.21	14.84	10.8	8.23	5.82
P		0.0001	0.0001	0.0001	0.0001	0.0001
Significance		≤0.05	≤0.05	≤0.05	≤0.05	≤0.05
Left eye	16.6 ± 2.5	21.0 ± 2.5	21.0 ± 2.2	19.3 ± 2.1	18 ± 1.7	17.4 ± 1.5
t		11.45	11.4	7.03	3.69	2.48
P		0.0001	0.0001	0.0001	0.001	0.05
Significance		≤0.05	≤0.05	≤0.05	≤0.05	≤0.05

Mean ± SD; *P* ≤ 0.05, significant.

Table 4: IOP changes in old age individuals before and after water ingestion in right and left eye (mm Hg)

	Before	After water ingestion				
		0 min	15 min	30 min	45 min	60 min
Right eye	16.1 ± 2.5	19.7 ± 2.9	20.6 ± 2.9	19.0 ± 2.6	17.4 ± 1.9	16.9 ± 1.6
t		14.73	14.95	8.77	6.6	5.49
P		0.0001	0.0001	0.0001	0.0001	0.0001
Significance		≤0.05	≤0.05	≤0.05	≤0.05	≤0.05
Left eye	17.3 ± 2.6	19.4 ± 2.8	19.5 ± 2.4	18.5 ± 2.2	17.3 ± 1.9	16.8 ± 1.5
t		12.3	11.99	7.98	4.16	2.9
P		0.0001	0.0001	0.0001	0.001	0.01
Significance		≤0.05	≤0.05	≤0.05	≤0.05	≤0.05

Mean ± SD; *P* ≤0.05, significant.

Result

A summary of the observations and results of this study is as follows. In this section, the results related to three groups [i.e., young age (15–25 years), middle age (30–40 years), and old age (60–75 years)] are represented as young, middle, and old age groups, respectively.

The mean ± SD of the height, weight, and BMI of young, middle, and old age groups was not significantly different in this study [Table 1].

The IOP in both the eyes of the young age individuals significantly increased immediately and at different intervals of time (15, 30, 45, and 60 min) after water ingestion, when compared with that of before water ingestion [Table 2].

The IOP in both the eyes of the middle age individuals significantly increased immediately and at different intervals of time (15, 30, 45, and 60 min) after water ingestion, when compared with that of before water ingestion [Table 3].

The IOP in both the eyes of old age group significantly increased immediately and at different intervals (15, 30, 45, and 60 min) after water ingestion, when compared with that of before water ingestion [Table 4].

Discussion

Aging is the process of becoming older or a process that is genetically determined and environmentally modulated.[4]

The body changes with aging occur in individual cell and in whole organs. These changes result in changes in the function and in appearance. As the cells age, they function less well. Eventually, old cells must die as a normal part of the body's functioning.

Most of the developed countries have accepted the chronological age of 65 years as a definition of an "elderly" or older person.[5]

Aging and IOP Changes

IOP changes with age have been studied previously. Various studies have indicated that the children have significantly lower IOP than adults. Advancing age is positively associated with the IOP, and IOP was found to increase with age in both men and women.

IOP varies with a number of other factors such as heart rate, respiration, fluid intake, systemic medication, and topical drugs. Alcohol consumption leads to a transient decrease in IOP, and caffeine may increase the IOP.[4]

In this study, an attempt was made to reveal the IOP changes in each of the eyes among the different age group individuals, immediately and at different intervals (15, 30, 45, and 60 min) after water ingestion. There was a significant increase in IOP, immediately and at different intervals (i.e., 15, 30, 45, and 60 min) after water ingestion in young, middle, and old age group individuals, when the effect was considered separately.

The study conducted by David et al.[6] supported the hypothesis that IOP is associated with age, ethnic origin, cup-to-disc ratio, refractive status, glaucoma in the family, and diabetes mellitus.

Similarly, a study conducted by Moura et al.[7] showed that IOP was similar in each eye and increased postwater ingestion, under both exercising and resting conditions. In this study, they concluded that the IOP is not affected by exercise but the water ingestion increased the IOP regardless of water temperature.

Thus, the findings of this study may indicate that the IOP changes occur in both the eyes immediately after water ingestion and after 1 h in different age group individuals. This change in IOP observed after water ingestion in all the three age group individuals indicates that, as the age increases, there may be alteration in the aqueous humour dynamics caused by aging, and there will be narrowing of the outflow tract.

Limitations

The study was not conducted in individuals aged younger than 15 years and older than 60 years. The study was conducted immediately and within 1 h after drinking water and not more than 1 h. The study was done on near normal subjects.

Conclusion

This study concludes with the following important findings, which will bear a significant importance regarding the IOP changes in relation to water ingestion in different age group individuals:

1. The IOP changes occur in both the eyes immediately after water ingestion and after 1 h in different age group individuals.
2. The IOP has a propensity to increase immediately after water ingestion in different age group individuals (i.e., young, middle, and old age group individuals).

References

1. Kasper DL, Braundwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL. *Harrison's Principles of Internal Medicine*, 16th edn, Vol. II. New York: The McGraw Hill Companies;2005. p. 44.
2. Khurana I. *Text Book of Medical Physiology*, 1st edn. India: Elseivier, 2006. p. 1183.
3. Wong TT, Wong TY, Foster PJ, Crowston JG. The relationship of intraocular pressure with age, systolic blood pressure, and central corneal thickness in an Asian population. Invest Ophthalmol Vis Sci 2009;50(9):4097–102.
4. Available at: medicine net.com.
5. World Health Organization. *Definition of an Older or Elderly Person.* Geneva: WHO, Health Statistics and Health Information Systems, 2013.

6. David R, Zangwill L, Stone D, Yassur Y. Epidemiology of intraocular pressure in a population screened for glaucoma. Br J Ophthamol 1987;71(10):766–71.
7. Moura MA, Rodrigues LO, Waisberg Y, De Almeida HG, Silami-Garcia E. Effects of submaximal exercise with water ingestion on intraocular pressure in healthy human males. Braz J Med Biol Res 2002;35(1):121–5.

How to cite this article: Lakshmi A, Puranik N, Kammar KF. Intraocular pressure changes in different age group individuals after water ingestion. Int J Med Sci Public Health 2015;4: 1726-1730

Source of Support: Nil, **Conflict of Interest:** None declared.