

## Prevalence of Primary Open Angle Glaucoma in Obstructive Sleep Apnea Syndrome

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Article information	Abstract
<p>Article history: Received: 24 Jan 2013 Accepted: 28 Feb 2013 Available online: 15 Apr 2013 ZJRMS 2014; 16(1): 44-47</p> <p>Keywords: Obstructive sleep apnea syndrome Hypopnea Open Angle Glaucoma</p> <p>*Corresponding author at: Department of Ophthalmology, Geriatric Ophthalmology Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran. E-mail: besharaty@gmail.com</p>	<p><b>Background:</b> Obstructive sleep apnea (OSA) is partial or complete recurrent upper airway obstructions during sleep. Reduction in blood flow of the optic nerve head is an important causative factor in glaucoma. The objective of this study is to determine the prevalence of primary open angle glaucoma (POAG) in OSA patients.</p> <p><b>Materials and Methods:</b> From September 2009 to January 2010 in this descriptive-analytic cross sectional study, 90 cases of patients with OSA referred to Yazd Shahid Sadoughi hospital were collected and studied by polysomnography, blood gas analysis and ocular examination including measurement of intra ocular pressure, gonioscopy, funduscopy and automated perimetry. Statistical analysis was performed by SPSS software.</p> <p><b>Results:</b> Thirty-one patients had mild OSA, 30 patients had moderate OSA and 29 patients had severe OSA. The prevalence of POAG in this group of patients was 10% (95% CI: 4-16). It is higher than the general population in the same age group (<math>p=0.017</math>). There was no significant correlation between the presence of glaucoma and apnea hypopnea index (AHI), mean saturation arterial O<sub>2</sub> (MSaO<sub>2</sub>), body mass index (BMI), sex and age. A significant correlation between AHI with IOP and cup/disc ratio was not documented.</p> <p><b>Conclusion:</b> According to our founding, the prevalence of POAG in OSA patients was higher than the general population in the same age group. Thus we recommend screening of glaucoma in OSA patients. This Study suggests that AHI, MSaO<sub>2</sub>, BMI, sex or age are not important risk factors for glaucoma in OSA patients.</p>

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### Introduction

Primary open-angle glaucoma (POAG) is a chronic and progressive multifactorial optic neuropathy that is with a characteristic acquired loss of optic nerve fibers. This is the most common form of glaucoma [1, 2] and one of the major causes of irreversible adult blindness throughout the world [3]. Approximately 1-2% of the population over 40 years old and 10% of people aged over 70 are affected, but about half of them are unaware of this [4, 5]. There are typical optic nerve changes on ophthalmic examination and it is associated with specific visual field defects over time. Many various factors including blood pressure, IOP (intraocular pressure), vascular resistance and auto regulatory mechanisms involved in this pathophysiology [6, 7].

Factors such as elevated IOP and systemic hemodynamic changes have the most contribution to POAG [4]. The focus on IOP with regards to glaucoma relates to the fact that, to date, it is the only known risk factor that can be clinically manipulated [8]. Early detection and treatment of these risk factors cannot be prevented POAG as such but its progression can be delayed. The patient will not notice symptoms relating to POAG until the visual field changes are very advanced.

For this reason, screening remains the only tool for detection of glaucoma [9]. It should involve tonometry (measuring the IOP), visual fields and an examination of the optic disc.

OSA (Obstructive Sleep Apnea) is the most common form of sleep apnea and defines by partial or complete recurrent upper airway obstructions during sleep [10, 11]. The prevalence of sleep-disordered breathing is approximately 2% in women and 4% in men between 30 and 60 years old [12]. Several previous reports mention the significant relationship between sleep apnea and some eye disorders such as Floppy eyelid syndrome [13, 14], eyelid hyperlaxity [15], papilledema [16], non-arteritic anterior ischemic optic neuropathy [17, 18], retinal vein occlusion [19], although the pathophysiology of this relationship is unclear [2]. Walsh and Montplaisir were the first people that reported the relationship between sleep apnea and POAG [20]. Mojon et al. reported that from 69 OSA patients only 7.2% were diagnosed with glaucoma. They found the significant relationship between AHI (apnea/hypopnea index), IOP, visual field defect and optic disc changes [21]. Three studies by Geyer et al. [22] and Girkin et al. [23] and Kadyan et al.

[24] reported that there was no association between glaucoma and OSA. Therefore, it is unclear whether glaucoma is associated with OSA or not. In patients with OSA, hypoxia, hypercapnia, and increase ventilatory effort during repetitive periods of apnea during sleep may cause systemic hypertension, cardiac arrhythmias, cerebrovascular accidents, and polycythemia [25]. Thus, the purpose of this study was to explore the prevalence of primary open angle glaucoma in obstructive sleep apnea patients.

## Materials and Methods

A total of 90 patients with OSA that referred to Shahid Sadoughi hospital from September 2009 to January 2010, were selected for this descriptive-analytic cross sectional study. The protocol and informed consent were approved by the Ethics Committee of the Shahid Sadoughi University of Medical Sciences, Yazd, Iran and before the sampling; we took a written consent from all patients. For all participants, polysomnography was performed in two centers related to our university. OSA was diagnosed as an AHI (apnea/hypopnea index) more than 5 (after polysomnography). AHI was classified to determine the severity of OSA: mild (AHI, 5-15), moderate (AHI, 15-30), and severe (AHI >30). Accordingly, 31 patients were classified in mild group, 30 in moderate group and 29 in severe group. The patients with severe cataract or history of ophthalmic surgery were excluded from this study.

Simultaneous measurement of BMI (body mass index), blood gas and a complete ophthalmologic examination including Goldman tonometry, gonioscopy and funduscopy were performed for each subject. The subjects' BMI was calculated as measured weight divided by the square of measured height ( $\text{kg/m}^2$ ).

For patients with a suspected optic nerve cup or glaucoma, visual field was measured by Humphrey visual field analyzer. Eye examinations in all patients were done by one ophthalmologist and all data were registered in patients' questionnaire.

For examination of optic disc morphology, Stereoscopic slit-lamp biomicroscopy with a 90D lens was used. Primary open-angle glaucoma was diagnosed with typical glaucomatous optic neuropathy, glaucomatous visual field defects, open angle untreated IOP above 21 mmHg.

AHI, IOP, glaucomatous optic disc changes, and diagnosis of glaucoma were measured as main outcome measures in this study.

Values are presented as mean values standard deviations (mean $\pm$ SD) and percentages. Statistical significance was set at  $p < 0.05$ . Data were analysis with independent samples *t*-test, one way ANOVA, Fisher's exact and  $\chi^2$  tests. Analysis was carried out by using SPSS-15 statistical software.

## Results

Ninety-three patients were examined from September 2009 to January 2010. One patient with severe cataract

and 2 cases with a history of ophthalmic surgery were excluded from this study. Of the 90 participants, 63 patients (70%) were men and 27 (30%) were women with mean age  $51.77 \pm 14.1$  (24-75 years). Fifty two of them (57.8%) had BMI >30, 38 (42.2%) had  $25 < \text{BMI} < 30$ , and 4 patients had BMI <25. Thirty one patients had mild OSA, 30 patients had moderate OSA and 29 patients had severe OSA. General characteristics and grading OSA are shown in table 1 and 2.

The prevalence of POAG in this group of patients with OSA was 10% (95% CI: 4-16). Although it was higher in women, but no statistical significance was discovered between men and women group. It is higher than the general population in the same age ( $p = 0.017$ ). One of the cases with glaucoma had the floppy eyelid syndrome.

There was no significant correlation between the presence of glaucoma and age, sex, apnea hypopnea index (AHI), mean saturation arterial  $\text{O}_2$  (MSaO<sub>2</sub>) and body mass index (BMI) (Table 3). Meanwhile a significant correlation with AHI wasn't documented for IOP and cup/disc ratio.

Also increasing of OSA grading did not effect on IOP and the mean IOP was similar between the three groups of OSA patients (mild, moderate and severe) (Table 4).

Based on our results, there is no correlation coefficient between MSaO<sub>2</sub>, C/D and IOP of both eyes but statistical significance was discovered for MSaO<sub>2</sub> and AHI ( $p = 0.006$ ,  $r = 0.286$ ).

**Table 1.** Patients' clinical characteristics, polysomniography parameters and ocular examination

Characteristics	Mean $\pm$ SD (range)
Age (years)	51.77 $\pm$ 14.1 (24-75)
BMI ( $\text{kg/m}^2$ )	32.27 $\pm$ 5.92 (21-50)
AHI	27.72 $\pm$ 21.23 (5-105)
MSaO <sub>2</sub>	82.24 $\pm$ 6.8 (53-95)
IOP*	
OD	15.23 $\pm$ 2.91 (10-26)
OS	15.45 $\pm$ 3.59 (10-32)
C/D*	
OD	0.22 $\pm$ 0.11
OS	0.23 $\pm$ 0.14

BMI:body mass index; AHI= apnea/hypopnea index; MSaO<sub>2</sub>= Mean Saturation arterial O<sub>2</sub>; IOP= intraocular pressure; OD= right eye; OS=left eye

\* Pearson's  $p < 0.001$

**Table 2.** OSA grading in two groups, with or without glaucoma

OSA Grading	Patients with glaucoma (group I) [N (%)]	Patients without glaucoma (group II) [N (%)]	Total [N (%)]
Mild ( $5 < \text{AHI} < 15$ )	3 (9.7)	28 (90.3)	31 (100)
Moderate ( $15 < \text{AHI} < 30$ )	3 (10)	27 (90)	30 (100)
Severe ( $30 < \text{AHI}$ )	3 (10.3)	26 (89.7)	29 (100)

**Table 3.** Association between parameters and glaucoma

	With glaucoma (Mean $\pm$ SD)	Without glaucoma (Mean $\pm$ SD)	<i>p</i> -Value
Age (years)	55.11 $\pm$ 10.84	51.4 $\pm$ 14.43	0.458
AHI	24 $\pm$ 17.41	28 $\pm$ 21.66	0.582
MSaO <sub>2</sub>	78.77 $\pm$ 10.48	82.62 $\pm$ 33.6	0.111

**Table 4.** Mean studied parameters according to OSA groups

		Mild OSA Mean±SD	Moderate OSA	Severe OSA	p- Value
IOP*	OD	15.22±3.02	15.20±3.37	15.28±2.29	0.505
	OS	15.12±3.14	15.16±3.16	16.1±4.41	
C/D*	OD	0.2±0.11	0.21±0.1	0.23±0.11	0.662
	OS	0.2±0.11	0.23±0.11	0.27±0.18	
BMI (%)	<30	18 (34.6)	12 (23.1)	22 (42.3)	0.1
	>30	13 (34.2)	18 (47.4)	7 (18.4)	
MSaO <sub>2</sub> *		85±3.45	81.33±7.04	82.24±6.87	0.017

\* Mean±SD, ANOVA test

## Discussion

In this study, the prevalence of glaucoma in people with sleep apnea was 10%. Obstructive sleep apnea is a sleep disorder characterized by abnormal repetitive episodes of upper airway occlusion or instances of abnormally low breathing, during sleep. Apnea can last from 10 seconds to 2 minutes, and may occur 5 to 30 times or more an hour. So far it has been proven that the repetitive night asphyxia and arousal from sleep may cause spikes in blood pressure and other several physiological changes such as systemic hypertension, left ventricular dysfunction, pulmonary hypertension and myocardial infarction [26-30] but few studies have examined the effects of sleep apnea on physiological functions of the eyes [31].

The vascular changes may damage the optic nerve head perfusion and may cause glaucomatous optic neuropathy [10]. Several proposed pathophysiologic mechanisms may associate between OSA and glaucoma, although these hypotheses have not been established yet. These mechanisms include:

- Direct hypoxia injury to the optic nerve and disrupted auto regulation of blood flow from periods of hypotension during apneas [31-33].
- Increase the platelet aggregation in patients with sleep apnea [34]
- Increase IOP during sleep [35]
- Perfusion defects in optic nerve caused by nocturnal hypotension due to apnea [32]
- Low diastolic pressure and systemic hypertension in patients with sleep apnea [16]
- Impaired blood supply of the optic nerve, increased vascular resistance and visual field defects as a result of apnea [36]

Studies estimated that the prevalence of POAG among patients with OSA was from 2 to 27% compares to 2% in

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the general population [37-40]. In 1982, Walsh and Montplaisir spoke about the relationship between sleep apnea and glaucoma for the first time [20] and since then several studies had been conducted on the relationship between these two diseases. Mojon et al. [37] reported that the prevalence of glaucoma in 69 patients with OSA was 7.2%. Karakucuk et al., Sergi and one study in Thailand reported an increase prevalence of glaucoma (12.9%, 5.9% and 13.6%; respectively) in patients diagnosed OSA [36, 40, 41]. The highest prevalence of glaucoma (27%) in these patients reported by Bendel et al. among 100 patients [39].

In our study, the prevalence of glaucoma in people with sleep apnea was 10%. This indicates the high prevalence of glaucoma in these patients compared to the general population (2%) similar to previous studies and suggests a high correlation between glaucoma and sleep apnea. It can be a newly recognized risk factor in the incidence of glaucoma [42-44].

The results of this research were different from some previous studies. The first study was published by Geyer et al. and suggested a prevalence of glaucoma only 0.2% among 228 patients with glaucoma that these were not significantly different from that of the general Caucasian population [38].

According to these findings, the prevalence of POAG in OSA patients was higher than the general population in the same age group. Thus early screening and treatment of glaucoma in OSA patients is important to delay glaucoma progression. This study suggests that AHI, MSaO<sub>2</sub>, BMI, sex or age are not important risk factors for glaucoma in OSA patients.

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## Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

## Conflict of Interest

The authors declare no conflict of interest.

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