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## ORIGINAL ARTICLE

# Prevalence of strabismic binocular anomalies, amblyopia and anisometropia. Rehabilitation Faculty of Shahid Beheshti Medical University

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### KEYWORDS

Anisometropia;  
Amblyopia;  
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Exotropia

### Abstract

**Purpose:** Manifest strabismus such as constant and alternative esotropia and exotropia, not only cause cosmetic problem in patients but also induce disorders such as amblyopia. These anomalies can lead to academic failure in students and reduce efficiency in other jobs. Therefore, determining the prevalence of binocular anomalies is important. The purpose of this study is to determine the prevalence of strabismic binocular anomalies, amblyopia and anisometropia in patients examined in optometry clinic of the rehabilitation faculty of Shahid Beheshti Medical University in 2008/2009.

**Methods:** In this study, files of 600 patients were evaluated. Cycloplegic refraction was performed in infants, elementary and middle school children and other patients had noncycloplegic refraction. Anisometropia was defined as a difference of 1.00D or more between two eyes. Amblyopia was diagnosed as a reduction of best corrected visual acuity (BCVA) to 20/30 or less in one eye or 2-line difference in the absence of pathological causes. Cover test was performed to investigate of strabismus.

**Results:** The prevalence of strabismic binocular anomalies, amblyopia and anisometropia were respectively: anisometropia in 64 patients (10.67%), anisometropic amblyopia in 9 patients (1.5%), anisometropic amblyopia with exotropia in 1 patient (0.17%), anisometropic amblyopia with esotropia in 1 patient (0.17%), bilateral amblyopia in 5 patients (0.83%), esotropia in 2 patients (0.33%), exotropia in 1 patients (0.17%) and convergence insufficiency in 2 patients (0.33%).

**Discussion:** The results show that the prevalence of anisometropia was higher than shown in previous studies but prevalence of convergence insufficiency, esotropia and exotropia was lower than previous studies.

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**PALABRAS CLAVE**

Anisometropía;  
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 Insuficiencia de  
 convergencia;  
 Esotropía;  
 Exotropía

**Prevalencia de anomalías binoculares estrábicas, ambliopía y anisometropía.  
 Facultad de Rehabilitación de la Universidad de Medicina Shahid Beheshti**

**Resumen**

*Objetivo:* El estrabismo manifiesto como esotropía y exotropía constante y alternante no sólo causa problemas estéticos en los pacientes, sino que también induce trastornos binoculares como ambliopía. Estas anomalías pueden dar lugar al fracaso académico en estudiantes y reducir el rendimiento en otros trabajos, por lo que determinar la prevalencia de anomalías binoculares es importante. El objetivo de este estudio fue determinar la prevalencia de anomalías binoculares estrábicas, ambliopía y anisometropía en pacientes evaluados en la clínica optométrica de la Facultad de Rehabilitación de la Universidad de Medicina Shahid Beheshti en los años 2008 y 2009.

*Métodos:* En este estudio se evaluaron 600 informes de pacientes. Se llevó a cabo refracción ciclopléjica en niños pequeños, niños de escuela primaria y secundaria y otros pacientes se sometieron a refracción no ciclopléjica. La anisometropía se definió como la diferencia de 1,00 D o más entre ambos ojos. La ambliopía se diagnosticó como una reducción de la agudeza visual mejor corregida (AVMC) de 20/30 o menos en un ojo o diferencias de 2 líneas en ausencia de causas patológicas. Se realizó una prueba de oclusión (*cover test*) para investigar el estrabismo.

*Resultados:* La prevalencia de anomalías binoculares estrábicas, ambliopía y anisometropía fueron, respectivamente: anisometropía en 64 pacientes (10,67%), ambliopía anisométrica en 9 pacientes (1,5%), ambliopía anisométrica con exotropía en 1 paciente (0,17%), ambliopía anisométrica con esotropía en 1 paciente (0,17%), ambliopía bilateral en 5 pacientes (0,83%), esotropía en 2 pacientes (0,33%), exotropía en 1 paciente (0,17%) e insuficiencia de convergencia en 2 pacientes (0,33%).

*Discusión:* Los resultados muestran que la prevalencia de anisometropía fue superior a la de estudios previos, pero la prevalencia de insuficiencia de convergencia, esotropía y exotropía fue inferior a la de estudios previos.

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**Introduction**

Manifest strabismus such as constant and alternative esotropia and exotropia, not only cause cosmetic problem<sup>1</sup> in patients but also induce binocular vision disorders such as amblyopia and other sensory and motor binocular vision disorders.<sup>2</sup> In addition, in intermittent strabismus may be induced symptoms such as eyestrain<sup>1,3</sup> and headache.<sup>2</sup> Therefore, determining the prevalence of binocular vision disorders is important. The purpose of this study was to determine the prevalence of strabismic binocular anomalies, amblyopia and anisometropia in patients that examined in March 2008 to March 2009 in optometry clinic of faculty of Shahid Beheshti Medical University.

Binocular vision system anomalies include sensory and motor disorders of the eyes. Sensory system disorders can be anisometropia, spasm of accommodation and accommodative infacility.

Motor system disorders, can be latent and manifest strabismus and vergence system disorders such as convergence insufficiency (CI).<sup>4,5</sup>

Anisometropia is an eye condition where one diopter or more difference between the amounts of refractive error of eyes is present.<sup>6</sup> Amblyopia is the condition in which reduced visual function exists despite full optical correction and in absence of observable ocular pathology. Amblyopia develops in infants and very young children.<sup>7</sup>

Some clinicians consider more than two snellen lines difference between both eyes or corrected visual acuity of 20/30 or worse for amblyopia to be diagnosed.<sup>1,2,6</sup>

Convergence insufficiency usually involves a high exophoria or intermittent exotropia during near vision in association with a relatively orthophoric condition at distance whit AC/A ratio being rather low.<sup>4-6</sup>

Strabismus was defined as any heterotropia at near, distance, or both. Exotropia is a manifest outward deviation of the visual axis of one or both eyes. Esotropia is a manifest inward deviation of the visual axis of one or both eyes.<sup>8</sup>

**Prevalence of strabismic binocular vision disorders, amblyopia and anisometropia**

In a study by Lara et al. (2002) to determine the prevalence of nonstrabismic accommodative and binocular dysfunctions in a clinical population in 265 patients with visual complaints, a prevalence of convergence insufficiency 0.8% has been reported.<sup>9</sup> In a study by Esteban et al., in 65 students without noticeable refractive error, amblyopia or strabismus and there was noticeable binocular disorder in 32.3%. There were convergence insufficiency in 7.7% and basic exophoria in 3.1%.<sup>10</sup> In study by Montes-Mico to determine the prevalence of general dysfunctions in binocular vision in a nonpresbyopic in 1679 subjects aged 18 to 38 years, the prevalence of convergence insufficiency

was 5.9%.<sup>11</sup> In study by Cacho-Martinez et al., the prevalence of CI was 2.25%-33%.<sup>12</sup>

In a study by Khataminia et al. (1998) in 20,858 children aged from 3-6 years in Ahvaz city, the prevalence of amblyopia was 1.03%.<sup>13</sup> In a study by Ostadi Moqaddam et al. (2008) in 2150 students in Mashhad, the prevalence of amblyopia was 1.9%.<sup>14</sup>

In a study by Hashemi et al. (2004) to determine the age and gender-specific prevalence of refractive errors in Tehran among a population-based study, the prevalence of anisometropia of 1 D or more was 6.1%.<sup>15</sup> In study by Donahue (1997-2003) in the United States in a screening program in a population of 119,311 people, 792 people presented anisometropia over 1D.<sup>16</sup>

In a study by Greenberg et al. (1985-1994) to describe the incidence and types of childhood esotropia in a population of 385 children, there were accommodative esotropia in 36.4%, acquired non accommodative esotropia in 16.6%, esotropia with abnormal central nervous system in 11.4%, relative esotropia in 10.1%, congenital esotropia in 8.1%, sensory esotropia in 6.5%, paralytic esotropia in 6.5% and untreated esotropia in 3.4%.<sup>17</sup>

## Material and methods

In this study all files of patients examined at optometry clinic of rehabilitation faculty of Shahid Beheshti Medical University from March 2008 to March 2009, were evaluated. The age of patients was from 1 to 88 years old. The patients were divided in nine different age groups.

In this study we used the following criteria:

1. For anisometropia, a difference of at least 1 D or more in the spherical or cylindrical refraction between both eyes was required.
2. The criteria for amblyopia was a difference of visual acuity of two lines or more between both eyes or a visual acuity of 20/30 or worse in the worse eye with the best optical correction.

In a this study, required information included: age, gender, type and amount of refractive error, visual acuity of each eye, type and amount of eye deviation and health of the anterior and posterior segment. This information was obtained from the files of patients and was recorded in the research form. In patients who had refractive error, visual acuity with best distance corrected in each eye was measured. If visual acuity in each eye was 20/20 and the patient was asymptomatic and orthophoric under cover test, the patient was considered as normal. Amblyopia was diagnosed as a reduction of best corrected visual acuity (BCVA) to 20/30 or less in one eye or 2-line differences in the absence of pathological causes. In addition in these patients direct ophthalmoscopy and biomicroscopy was performed to rule out organic amblyopia. Cycloplegic refraction was performed in infants, elementary and middle school children and other patients had non-cycloplegic refraction. Objective refraction was performed with autorefractometer. If there was one diopter or more of difference between the refractive error of both eyes, the patient was considered anisometropic. Diagnosis of anterior

and posterior segment disease was based on the eye examination that performed with Topcon biomicroscope and direct and indirect ophthalmoscopic examination. Cover test was performed at near and distance. Strabismus was defined as any heterotropia at near or distance, or both, on cover test. Statistical analysis was performed using contingency tables and Chi square test.

## Results

The mean and standard deviation age of patients, was respectively  $37.03 \pm 20.85$  in anisometropic patients,  $30.89 \pm 26.66$  in anisometropic amblyopia,  $15.8 \pm 13.39$  in bilateral amblyopia,  $6.5 \pm 7.78$  in esotropia and  $24 \pm 8.49$  in convergence insufficiency. The mean age and standard deviation of total population (600 patients) was  $34.21 \pm 21$ .

In this study, anisometropia was present in 10.67% (in 64 subjects), anisometropic amblyopia in 1.5% (in 9 subjects), bilateral amblyopia in 0.83% (in 5 subjects), anisometropic amblyopia with esotropia in 0.17% (in 1 subject), anisometropic amblyopia with exotropia in 0.17% (in 1 subject), esotropia in 0.33% (in 2 subjects), exotropia in 0.17% (in 1 subject), convergence insufficiency in 0.33% (in 2 subjects) while 515 patients (85.83%) had normal binocular vision (Table 1).

The total number of patients with amblyopia was 2.67% (16 cases of 600 patients). There were 56.25% of these cases (9 cases of 16 patients) presenting anisometropic amblyopia, 12.5% (2 cases of 16 patients) with strabismic amblyopia and 31.25% (5 cases of 16 patients) with bilateral amblyopia. In three esotropic patients, one case had congenital esotropia, one case had accommodative esotropia (with anisometropic amblyopia) and one case had non-accommodative esotropia. In two exotropic patients, one had alternative exotropia and other had anisometropic amblyopia.

The prevalence of strabismic binocular anomalies, amblyopia and anisometropia in men and women was not the same. The prevalence of anisometropia in men and women was 48.44% (31 of 64 anisometropes) and 51.56% (33 of 64 anisometropes), respectively. The prevalence of anisometropia in population of men and women were 11.8% (31 of 263 males) and 9.8% (33 of 337 females), respectively. Table 2 shows these results. Chi-square test ( $\alpha = 0.05$ ) shows

**Table 1** The frequency of strabismic binocular anomalies, amblyopia and anisometropia

Binocular vision disorder	n	%
Anisometropia	64	10.67
Anisometropic amblyopia	9	1.5
Anisometropic amblyopia with Esotropia	1	0.17
Anisometropic amblyopia with Exotropia	1	0.17
Bilateral amblyopia	5	0.83
Esotropia	2	0.33
Exotropia	1	0.17
Convergence insufficiency	2	0.33
Normal binocular vision	515	85.83
Total	600	100

**Table 2** The frequency of strabismic binocular anomalies, amblyopia and anisometropia by gender

Binocular vision disorder	Gender					
	Male		Female		Total	
	n	%	n	%	n	%
Anisometropia	31	48.44	33	51.56	64	100
Anisometropic amblyopia	7	77.78	2	22.22	9	100
Anisometropic amblyopia with Esotropia	0	0	1	100	1	100
Anisometropic amblyopia with Exotropia	1	100	0	0	1	100
Bilateral amblyopia	3	60	2	40	5	100
Esotropia	0	0	2	100	2	100
Exotropia	1	100	0	0	1	100
Convergence insufficiency	2	100	0	0	2	100
Normal binocular vision	218	42.33	297	57.67	515	100
Total	263	43.83	337	56.17	600	100

**Table 3** The frequency strabismic binocular anomalies, amblyopia and anisometropia among different age groups

Binocular vision disorder		Age group									Total
		Under 10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	Over 80	
Anisometropia	n	7	9	14	5	6	15	3	2	3	64
	%	10.94	14.06	21.88	7.81	9.38	23.44	4.69	3.13	4.69	100
Anisometropic amblyopia	n	2	2	2	0	1	0	1	1	0	9
	%	22.22	22.22	22.22	0	11.11	0	11.11	11.11	0	100
Anisometropic amblyopia with Esotropia	n	0	0	0	0	1	0	0	0	0	1
	%	0	0	0	0	100	0	0	0	0	100
Anisometropic amblyopia with Exotropia	n	0	0	0	0	0	1	0	0	0	1
	%	0	0	0	0	0	100	0	0	0	100
Bilateral amblyopia	n	3	0	1	1	0	0	0	0	0	5
	%	60	0	20	20	0	0	0	0	0	100
Esotropia	n	1	1	0	0	0	0	0	0	0	2
	%	50	50	0	0	0	0	0	0	0	100
Exotropia	n	0	1	0	0	0	0	0	0	0	1
	%	0	100	0	0	0	0	0	0	0	100
Convergence insufficiency	n	0	1	0	1	0	0	0	0	0	2
	%	0	50	0	50	0	0	0	0	0	100

that gender did not affect the prevalence of strabismic binocular anomalies, amblyopia and anisometropia.

The prevalence of strabismic binocular anomalies, amblyopia and anisometropia was different among age groups. The prevalence of anisometropia in patients younger than 40 years old was 54.7% (35 of 64 anisometropes) against 45.3% (29 of 64 anisometropes) in patients older than 40 years old. The prevalence of anisometropic amblyopia in patients younger than 40 years of age was 66.67% (6 of 9 anisometropic amblyopic patients) against 33.33% (3 of 9 anisometropic amblyopia) in the group of people older than 40 years old. Table 3 shows these results.

## Discussion

In a study by Hashmi et al (2004) in 6497 in population of Tehran, the prevalence of anisometropia of 1 D or higher

was 6.1%.<sup>15</sup> In a study by Yekta et al. (2010) to determine the prevalence of anisometropia, amblyopia and strabismus in schoolchildren of Shiraz, a prevalence on anisometropia 2.31% has been reported.<sup>18</sup> The prevalence of anisometropia in this study (10.67%) was higher than that reported in previous studies, possibly due to high referral rates of patients with anisometropia to this clinic. Prevalence of amblyopia in different populations is not identical and factors such as age of patients and criteria used to determine amblyopia in each study might justify those differences.

In a study by Khatami Nia et al. (1998) in 20,858 children from 3 to 6 years old in Ahvaz, a prevalence of amblyopia of 1.03% has been reported.<sup>13</sup> In a study by Ostaddi Mogaddam et al. (2008) in Mashhad, a prevalence of amblyopia of 1.9% has been reported.<sup>14</sup> In a study by Yekta et al. (2010), the prevalence of amblyopia in girls and boys was reported to be 2.32% and 2.26%, respectively.<sup>18</sup> The prevalence of

amblyopia in the present study (2.67%) was higher than that reported in previous studies. The cause of this difference might be related with the selectivity of recruitment in previous studies, usually evaluating a particular age group (Schoolchildren) while our study covered virtually all age groups (1 to 88 years old). In a study by Ghasemi (2000) in 510 patients examined at Bou-Ali eye clinic, the prevalence of amblyopia was 6.28%<sup>19</sup> which is higher than in this study. In this study the prevalence of anisometropic amblyopia was higher than strabismic amblyopia. This result is consistent with results of other researchers.<sup>20,21</sup>

In a study by Yekta et al. (2010), the prevalence of exotropia and esotropia was 1.30% and 0.59%, respectively.<sup>18</sup> In this study the prevalence of esotropia (0.33%) and exotropia (0.17%) were lower than previous study. Different study populations might justify this difference.

In summary, the prevalence of strabismic binocular anomalies, amblyopia and anisometropia in various studies was different. Factors such as type of study, criteria followed to define disorders or patients age might justify those differences. The results of this study show that the prevalence of anisometropia was higher than previous studies but prevalence of the esotropia and exotropia was lower than in previous studies.

## Conflicts of interests

The authors have no conflicts of interests to declare.

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