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Original Article

Associations between Anisometropia and Depth of Amblyopia in Benghazi, Libya

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Abstract

Background: Amblyopia is a disorder characterized by a decrease in the best-corrected visual acuity in one or both eyes with no clear structural anomalies or ocular pathology. There are three primary types of amblyopia: anisometropic, strabismic, and sensory deprivation amblyopia. Anisometropic amblyopia occurs in children having a difference in refractive error between the two eyes and occurs in the more ametropic eye. Furthermore, there is a strong association of anisometropia with strabismus. **Aim:** The study aimed to investigate the association between age, sex, laterality, and type of refractive error on the depth of anisometropic amblyopia. Settings and Design: This was a retrospective (observational) study. Data were analyzed using IBM SPSS 23.0 software. **Materials and Methods:** One hundred and nine patient's files with anisometropic amblyopia were investigated, who were followed in a pediatric eye clinic in Sohail Elatrash's eye hospital Benghazi, Libya, between January 2008 and December 2018. **Results:** There is no effect of the type of gender on the depth amblyopia with $P = 0.57$. Furthermore, there is no difference in the predominance of amblyopia between the right and left eye ($P = 0.93$). Age is correlated in a positive manner with the depth of amblyopia ($P = 0.035$). **Conclusions:** in our study, eye laterality and gender had no effect on the depth of anisometropic amblyopia. The age and the smallest amount of astigmatism difference between both eyes had a direct proportion on the depth of anisometropic amblyopia.

Keywords: Age, amblyopia, anisometropia, anisometropic amblyopia, gender

Introduction

Amblyopia is a disorder characterized by a decrease in the best-corrected visual acuity in one or both eyes with no clear structural anomalies or ocular pathology.[1]

During the sensitive period, visual development in infancy or early childhood relies on equal and good quality visual images in its anatomical and physiological maturation at both levels, retina and the primary visual cortex result in irreversible defects.[2] Amblyopia is considered the most common cause of monocular visual loss in children, contributing to over 90% of consultations of children to ophthalmologists and orthoptists.[3-5]

Amblyopia has three primary types: anisometropic, strabismic, and sensory deprivation amblyopia.

Anisometropic amblyopia, which is a common type of amblyopia, occurs in children having a difference in refractive error between the eyes and occurs in the more ametropic eye.[6-9]

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The issue of the persistence of anisometropia in early life is clearly of relevance to the association between anisometropia and amblyopia. It appears to be the only associated abnormality in around one-third of cases of human amblyopia.[10,11]

Anisometropic amblyopia seems to be discovered at a later age in contrast to other types of amblyopia because of no apparent pathology and thus becomes deeper and may become untreatable also.[3]

We investigated in our study the association between depth of anisometropic amblyopia with age, gender, laterality, type, and amount of refractive error.

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Materials and Methods

A retrospective (observational) records review was conducted on 109 subjects diagnosed with unilateral anisometropic amblyopia, who were followed at a pediatric eye clinic in Sohail Elatrash's Eye Hospital, between January 2008 and December 2018.

These patients were diagnosed and treated by a team of pediatric ophthalmologists and optometrists at the hospital.

All subjects had a comprehensive eye examination including detailed fundus examination, visual acuity test for distance by either picture Snellen chart or the illiterate Snellen chart, cycloplegic refraction, and cover tests for near and distance. Cycloplegic refraction was performed by Auto Kerato-Refractometer (Topcon®KR8000). Full refractive correction was prescribed, and visual acuities were noted at the second visit. Patients were diagnosed with amblyopia if their interocular visual acuity difference 1 and more Snellen lines. Amblyopia was classified mild, moderate, and severe according to both the refraction values and the visual acuities. All individuals had healthy ocular structures with no history of any surgery.

Anisometropia was defined as deference of 1.00 standard deviation (SD) in any meridian between both eyes.

Based on the amount of refractive error, we classified each refractive error as:

- Mild (myopia: −0.50 D to <−3 D; hyperopia: +0.50 D to <+3 D; and astigmatism: 0.50 D to < 1 D)
- Moderate (myopia: −3 D to <6 D; hyperopia: +3 D to <+ 6 D; and astigmatism: 1 D to <2 D)
- Or severe (myopia: −6 D and over; hyperopia: +6 D and over; and astigmatism: 2 D and over)[12]
- Amblyopia, in general, was defined as visual acuity of worse than 6/9 Snellen or 0.2 Log MAR in the affected eye.[13]

The severity of amblyopia is often classified according to the visual acuity in the affected eye, using visual acuity testing. "Mild" amblyopia is classified as being visual acuity of 6/9–6/12, "moderate" amblyopia as being worse than 6/12–6/36, and "severe" amblyopia as being worse than 6/36.

Associations between the depth of amblyopia and the age and/or gender of the subjects, the laterality of the amblyopic eyes, the type, and the magnitude of the refractive error of the amblyopic eyes and the magnitude of anisometropia were statistically analyzed.

We used nonparametric tests because our values were nonnormal in distribution: Pearson's Chi-square test, two-sided Spearman's correlation. P <0.05 was considered statistically significant.

The research adhered to the tenets of the Declaration of Helsinki.

Data were analyzed using IBM SPSS 23.0 (SPSS Inc., Chicago, IL, USA) software.

Results

The study included 109 patients' files with unilateral anisometropic amblyopia in the pediatric eye clinic in Sohail Elatrash's Eye Hospital, in Benghazi, Libya.

They were selected and classified according to the inclusion criteria in this study.

General analysis

There were more number of females (58 [53.2%]) than the number of males (51 [46.8%]). The minimal age was 1 year, and the maximum age was 19 years with a mean of 5.34 years and a median of 5.00 and a SD of 3.11 year.

Astigmatism was found to be the most common type of refractive error, comprising 39.4% of the amblyopic eyes, followed by hyperopia in 33.9% of eyes and myopia of 3.6%.

Mild refractive error account of 31.3%, moderate refractive error 43.8%, and severe refractive error 24.9% for all types of refractive error. The spherical equivalent ranging from - 12.50 to + 10.00 SD. Visual acuity with mean of the logarithm of the minimum angle of resolution (log MAR) of 0.5; this before achieving improvement.

Severe amblyopia was found in 15.6%, moderate amblyopia in (20.6%), and the remaining eyes with mild amblyopia.

Analysis of anisometropic amblyopia

There is a strong association with increasing age and the amplitude of amblyopia (P = 0.035) and Mann–Whitney U-test = 607.5.

No effect of type of gender on magnitude nor on the correction of amblyopia in all three types of refractive error with P = 0.57 and P = 0.021, respectively.

Table 1 shows the deferent grades of anisometropic amblyopia in between genders, which show an increase incidence of severe and moderate amblyopia in males but not with a statistically significant value (P = 0.73).

With treatment, amblyopia in males improved in 29.2% and did not improve in 70.8%, whereas in females, the improvement noted in 57.7% and did not improve in 42.3%. The probability of improvement of amblyopia in female is better than in males who were statistically significant value (P = 0.021 Pearson χ^2 = 3.3).

Table 1: Deferent type of amblyopia in between genders

Gender	Mild amblyopia	Moderate amblyopia	Severe amblyopia	Total
Male				
Count	9	19	14	42
Percentage within gender	21.4	45.2	33.3	100.0
Female				
Count	18	26	20	64
Percentage within gender	28.1	40.6	31.3	100.0
Total				
Count	27	45	34	106
Percentage within gender	25.5	42.5	32.1	100.0

There is no difference between the right and left eyes ($P = 0.93$, Mann–Whitney U-test = 1391) in the presence of amblyopia, and there is not a statistically significant difference in the depth of amblyopia on either side, as shown in Table 2.

Analysis of visual acuity correlations among amblyopic eyes in deferent refractive error

Correlations in amblyopic myopic eyes

There was a negative correlation between the magnitude of spherical error in myopic eyes and their visual acuity with $P = 0.013$; also, the depth of amblyopia increases with younger age with $P = 0.831$, and it was the worst in comparison to other refractive errors. [Table 3, and Figure 1].

Correlations in amblyopic hypermetropic eyes:

The same with hypermetropia was that the spherical error is statistically correlated with visual acuity (depth of amblyopia) with $P = 0.032$ and rho = −0.300 [Table 4], in a negative relation Figure 2.

Correlation of amblyopic eyes with astigmatism

In astigmatism, the relation of the cylindrical power difference with visual acuity was strongly significant statistically, with $P = 0.015$ and rho = −0.383 [Table 5, and figure 3].

In contrast to this, the cylindrical error difference between eyes decreases with age ($P = 0.06$ and rho = 0.714). The visual acuity, if not treated, becomes worse, as the patient's age increases $P = 0.900$ rho = 0.020.

In hypermetropia and myopia, the situation is the same regarding the spherical equivalent difference between the amblyopic and healthy eyes, as the age increases, the difference decreases ($P = 0.29$, r = 0.22 for hyperopia) and ($P = 0.57$, r = 0.235 for myopia).

In contrast with age, the spherical equivalent difference and vision had an inverse relation with each other ($P = 0.017$, r = −0.285 for hyperopia) and ($P = 0.061$, r = −0.685 for myopia).

Discussion

In our study, the number of females with anisometropic amblyopia was slightly higher, as observed in studies by Park *et al*. and Chua and Mitchell. Contrary to our findings, males were higher in other studies, such as Lee *et al*.[14-16]

Younger children with anisometropia were found to have lower prevalence and depth of amblyopia in comparison to older children with $P = 0.035$, which are the same conclusion by Donahue *et al*.[17]

There is no statistically significant difference between the right and left eye. Other studies found different side predominance, mostly on the left eye which had more amblyopia;[18,19] however, there is no good and solid evidence regarding this variation in the laterality of the amblyopia in the literature.

The most important factors in determining the depth of anisometropic amblyopia were thought to be the magnitude of anisometropia, the spherical equivalent of the refractive error of 3.5 D or more, or anisometropia of 1.0 D or more was risk factors for developing amblyopia, according to Latvala *et al*.[20]

Kutschke *et al*. found that patients with anisometropia of myopia and astigmatism and mixed astigmatism had poorer visual outcomes, which is similar to our findings.[21]

The depth of amblyopia increases with increased age observed in our study was also observed by Donahue *et al*. A trend for increasing anisometropia with age is also supported by the studies of Bourne *et al*.[22] This was also observed in our study with $P > 0.05$ rho = 0.205.

Furthermore, a meta-analysis by Weale demonstrates that the prevalence of anisometropia in patients without amblyopia increases linearly with age.[23]

Our results in hypermetropia showed that the spherical powers of the amblyopic eyes were more strongly correlated with visual acuities than the differences of the spherical powers between amblyopic and healthy eyes (rho: 0.0300;

Table 2: Percentage of deferent type of amblyopia on the right and left eyes

	Mild amblyopia	Moderate amblyopia	Severe amblyopia	Total
Right eye				
Count	11	27	15	53
Percentage within side	20.8	50.9	28.3	100.0
Left eye				
Count	16	18	19	53
Percentage within side	30.2	34.0	35.8	100.0
Total				
Count	27	45	34	106
Percentage within side	25.5	42.5	32.1	100.0

Table 3: Correlations in amblyopic myopic eyes with age and spherical error

Visual acuity before the intervention	Age	Spherical error
R	0.090	−0.817
P	0.831	0.013

Table 4: Correlations in amblyopic hyperopic eyes with age and spherical error

Visual acuity before the intervention	Age	Spherical error
r	0.016	−0.300
P	0.910	0.032

Table 5: Correlations of amblyopic eyes with astigmatism and age

Visual acuity before the intervention	Age	Spherical error	Cylindrical error
R	0.082	−0.383	0.160
P	0.601	0.015	0.283

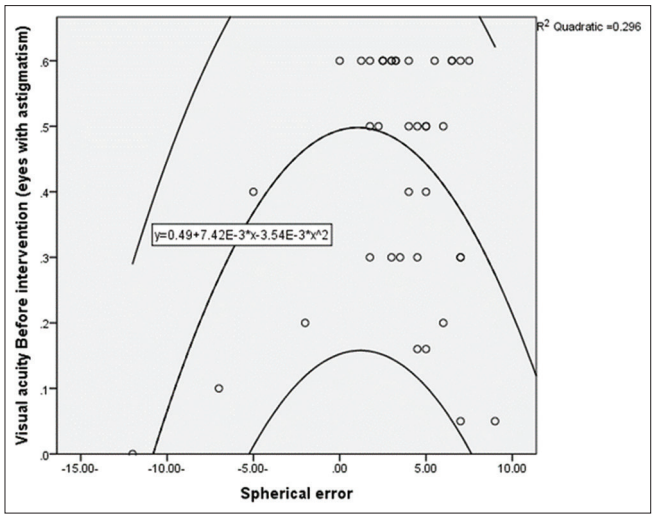

Figure 1: Correlations in amblyopic myopic eyes

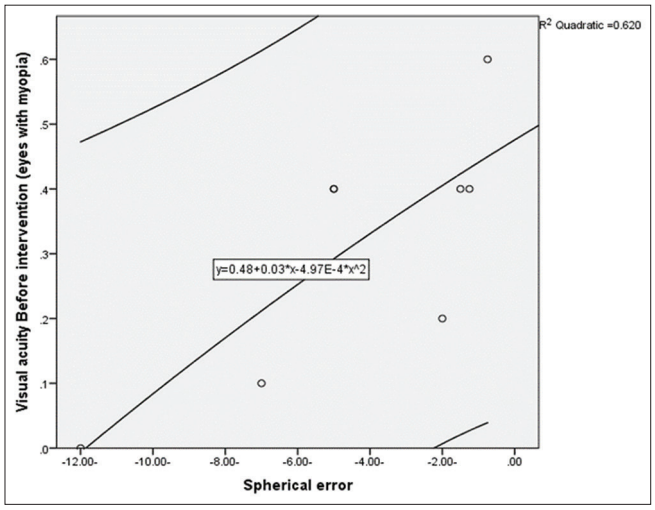

Figure 2: Correlations in amblyopic hyperopic eyes

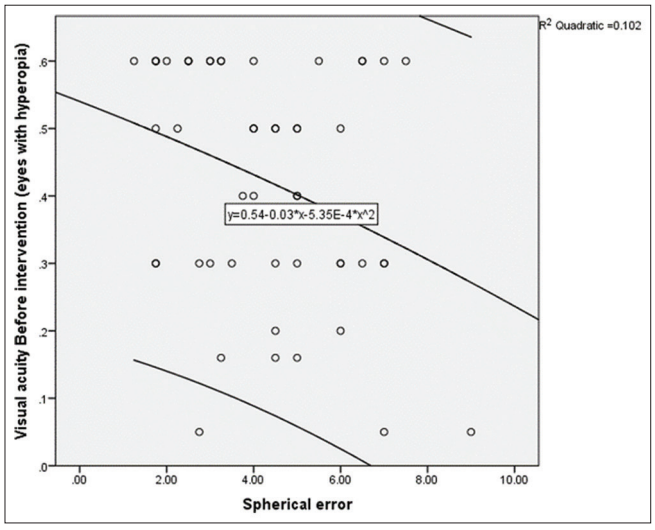

Figure 3: Correlations of amblyopic eyes with astigmatism

rho: 0.274; $P = 0.032$), whereas in myopia, the differences of spherical powers between healthy and amblyopic eyes were more strongly correlated with log MAR visual acuities of the amblyopic eyes compared to spherical powers and spherical equivalents of the amblyopic myopic eyes, respectively (rho: 0.817; rho: 0.623; $P = 0.013$). In astigmatism, cylindrical power of the amblyopic eye and the difference of cylindrical powers between eyes was more strongly correlated with log MAR visual acuities of the amblyopic eyes than the spherical equivalents and difference of spherical equivalents between eyes in astigmatic amblyopic eyes, respectively (rho: 0.383; $P = 0.015$).

Conclusions

There are no associations between eye's laterality or the gender with the depth of the anisometropic amblyopia found.

The age of the patient had a direct relation with the depth of amblyopia.

Thus, the smallest amount of anisometropia mainly astigmatism had a strong effect on the depth of amblyopia.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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ملخص المقال باللغة العربية

الارتباط بين تفاوت الانكسار وعمق الغمش في عيون الأطفال ببنغازي، ليبيا

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الخلفية: الغمش هو اضطراب يتميز بانخفاض حدة البصر مع عدم وجود شذوذ بنيوي واضح أو أمراض بصرية. هناك ثلاثة أنواع أساسية من الغمش: الغمش المتفاوت الانكسار، الغمش الحولي، وغمش الحرمان الحسي. يحدث الغمش متفاوت الانكسار عند الأطفال الذين لديهم اختلاف في الخطأ الانكساري بين العينين ويحدث في العين المتباينة الانكسار. علاوة على ذلك، هناك ارتباط قوي بين تفاوت الانكسار مع الغمش.

الأهداف: هدفت الدراسة إلى التحقق من العلاقة بين العمر والجنس والخط الجانبي ونوع الخطأ الانكساري على عمق الغمش المتفاوت الانكسار.

الإعدادات والتصميم: كانت هذه دراسة بأثر رجعي (رصدية).

المواد والأساليب: تم التحقيق في مائة وتسعة من ملفات المرضى الذين يعانون من غمش متباين الخواص، وتم متابعتهم في عيادة عيون الأطفال في مستشفى عيون سهيل الأطرش بنغازي، ليبيا، ما بين يناير 2008م وديسمبر 2018م. تم تحليل البيانات باستخدام برنامج IBM SPSS 23.0. اعتبر $P < 0.05$ ذات دلالة إحصائية.

النتائج: لا يوجد تأثير لنوع الجنس على عمق الغمش ($P=0.57$). علاوة على ذلك، لا يوجد فرق في غلبة الغمش بين العين اليمنى واليسرى ($P<0.93$). يرتبط العمر بطريقة إيجابية بعمق الغمش ($P<0.035$).

الاستنتاج: في دراستنا، لم يكن لجانب العين والجنس أي تأثير على عمق الغمش متباين الانكسار. كان للعمر وأصغر قدر من فرق الإستجماتزم بين كلتا العينين نسبة مباشرة على عمق الغمش متباين الانكسار.

الكلمات المفتاحية: العمر، الغمش، تفاوت الانكسار، الغمش متباين الانكسار، الجنس.