



## Original Article

# Association of Season of Birth and Refractive Errors

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**Objective:** To date, many studies have been done to prove any association between refractive errors, season of birth and photoperiod in different regions. This study aims to find any association between these factors in Pakistani Population.

**Methods:** Demographic data i.e. age, gender, educational level of all subjects was asked. After taking informed consent all patients were subjected to same preliminary tests i.e. visual acuity, family ocular history, pinhole, ophthalmoscopy, refraction by retinoscopy, Keratometry and axial length measurement using A-Scan.

**Results:** Out of 318 subjects most were females (73.58%) and in range 21-25 years. BCVA of all subjects was 6/6 both for right and left eyes. Most of the subjects were born in summer and had myopic refraction (92.58%) while few were hypermetropic (7.55%) and most subjects have low refractive errors (0.75-2.99D). We found strong association between season of birth and refractive error (p-value:0.000) as well as K-readings and axial lengths as subjects born in summer were more myopic, had greater corneal curvatures and increased axial lengths than those born in other seasons. However we did not find any association between hypermetropia (including ocular parameters associated with it) and season of birth.

**Conclusion:** After adjusting for all other factors, people born in summer are more myopic with strong variation in axial length and corneal curvature. However hypermetropia does not show any significant difference.

**Key words:** Season of Birth, Refractive Errors.



## Introduction:

Refractive error is an error in focusing of light on the retina. Parallel rays of light from a distant object are brought into focus precisely on the retina in emmetropic eye, and a clear image is perceived. Majority of individuals have some degree of refractive error, although often do not require correction. Refractive errors may be present from an early age and may persist throughout life. Genetic and environmental factors influence in producing refractive error.<sup>1</sup> It is classified into Myopia, Hyperopia and Astigmatism.

Myopia (nearsightedness) occurs when the rays of light coming from infinity are focused in front of light sensitive layer retina. Increased dioptric power of the cornea, relatively high axial length, and high refractive index of lens contributes in inducing the myopia in patient.

It is now strongly accepted that genes play an important role to cause myopia. When researches was done in younger population in United Kingdom and in Denmark, to find the etiology of myopia it was observed that myopia is mostly caused by genetic factors to be transferred from parents, while the environmental factors play a little role.

Hyperopia (farsightedness) occurs when the rays of light coming from infinity are focused behind light sensitive layer retina. Relatively short axial length, and low refractive index lens may affects hyperopia in individuals.

The dominant factor for the development of hyperopia is also genetic, likewise myopia. Some studies have been completed in this regard which shows the results of hyperopia similar to myopia. For example Hammond et al have shown the results of hyperopia to be transferred though genes.

Astigmatism Refractive power of the cornea is different in different meridians, and the light rays cannot be brought to a single point on the retina. It may occur with myopia or hyperopia.

Genetic factors also play an important role to develop the astigmatism as there are some studies which indicate the inheritance of astigmatism but its percentage is very less as compared to other refractive error including myopia and hyperopia in which genes play an important role.<sup>2</sup>

The worldwide amount of refractive error is not known exactly, because different countries group them according to different criteria, including age, definitions of blindness, and examination methods.<sup>3</sup>

It is reported that above 5 years of age 153 million people have impairment of vision due to uncorrected refractive errors and worldwide approximately 8 million are blind. Approximately 12.8 million children in the age group 5-15 years are low vision patients from uncorrected or inadequately corrected refractive errors.<sup>4</sup>

The most common type of refractive error in the

world is myopia, the amount of people affected from this is thought to be estimated about 1.44 billion, which is equal to the 22.6% of world's total population. During the 20th century the occurrence of myopia has increased in the world, and now it is thought that it will affect at the epidemic level, especially in East Asia where it affect more than 80% of the population.<sup>5</sup>

The type of pathological hyperopia is less common than physiological hyperopia. The most common cause of hyperopia is the shortening in the axial length of eyeball. In the United States its occurrence is about 14 million which is about 10% of the total population. At the time of birth children are hyperopic in nature in a small amount, which then become emmetropic though the process of emmetropization.<sup>6</sup>

Performance of children in classroom and their learning abilities like inability to read material on white board and their poor vision all are due to uncorrected refractive errors.<sup>7</sup>

Season of birth reflects other population-wide changes in environmental variables including temperature, humidity, diet, sleeping time and so on were studied. This study addressed that these environmental variables were risk factor for refractive error. The relationship between season of birth and refractive error may provide further insights into how light levels could affect refractive status in early life.

The previous study reported that the high myopia is significantly associated to season of birth. High myopia was more prevalent in people born in summer or autumn as compared with those born in winter. Regular seasons are summer, winter, spring and autumn.<sup>1</sup>

Refractive errors are primary ocular disorder in 1.3% population as described in survey of Nepal.<sup>8</sup>

In Nepal and China studies showed that, the main reason of impaired visual acuity of 0.5(20/40) or less was uncorrected refractive errors. They further reported that Myopia is a major cause of decrease vision in school going children. Prescription of glasses can benefit a large number of children.<sup>9,10</sup>

Researchers studied data from the different age of persons. The purpose of these studies was to find out the association of birth with refractive error. Their results showed that myopia was slightly more common in subjects born in summer season.<sup>11,12</sup>

The possible roles of perinatal duration of photoperiod (day light hours) and season of birth in the development of myopia were studied in Israel. Their result showed that the myopia was more common in population born in summer months.<sup>8</sup>

Children born in winter season have more tendency towards Myopia as discussed in a study conducted in China.<sup>7</sup> Hyperopia and Myopia was analyzed by season of birth in a study". Individuals of both gender and of different age groups



study". Individuals of both gender and of different age groups were selected. The refraction was determined by retinoscopy. The study concluded that although there was high myopia present in the population but that was not associated to any season of birth.<sup>13</sup>

A study for association between birth month/ photoperiod and refraction in infancy was carried out which showed higher percentage of refractive error was present in infants who were born in summer season as compared to winter season.<sup>12</sup>

High myopia was significantly associated with the season of birth and the subject born in summer and autumn were highly myopic than subject born in winter in a study carried out in UK on individuals of different age group.<sup>14</sup>

Association between the birth season and refraction in three years old children showed that children born in autumn season were mostly hyperopic.<sup>15</sup>

#### Objectives:

1. To find any association between season of birth and refractive errors.
2. To find any correlation between season of birth and parameters of eyeball.

#### Results:

**Table No.1: Distribution of births according to seasons**

	Frequency	Percent
<b>Spring</b>	72	22.6
<b>Summer</b>	130	40.9
<b>Autumn</b>	30	9.4
<b>Winter</b>	84	26.4
<b>Not known</b>	2	0.6
<b>Total</b>	318	100.0

Season of birth was determined by asking subjects their date of births. Most of the subjects know their date of births according to which they fall in summer season.

**Table No.2: Refractive Error Right Eye**

	Frequency	Percent
<b>0.75 - 2.99</b>	261	82.1
<b>3.00 - 5.99</b>	48	15.1
<b>&gt; 6.00</b>	9	2.8
<b>Total</b>	<b>318</b>	<b>100.0</b>

We did not find most cases of high refractive errors. Most of the patients were with low refractive errors.

**Table No.3: Refractive Error Left Eye**

	Frequency	Percent
<b>0.75 - 2.99</b>	258	81.1
<b>3.00 - 5.99</b>	51	16.0
<b>3.00</b>	9	2.8
<b>Total</b>	<b>318</b>	<b>100.0</b>

Similarly in left eye most of the patients have low refractive errors.

**Table No.4 Type of Refractive Error**

	Frequency	Percent
<b>Myopia</b>	294	92.5
<b>Hyopia</b>	24	7.5
<b>Total</b>	<b>318</b>	<b>100.0</b>

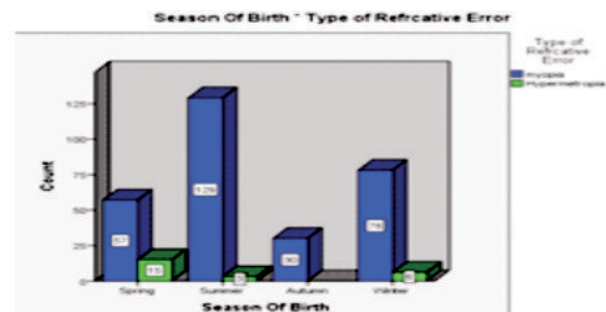
Myopia was the most common refractive error being 92.45%.

**Table No.5: Severity of refractive error**

	Frequency	Percent
<b>Low</b>	228	71.7
<b>Moderate</b>	81	25.5
<b>High</b>	9	2.8
<b>Total</b>	<b>318</b>	<b>100.0</b>

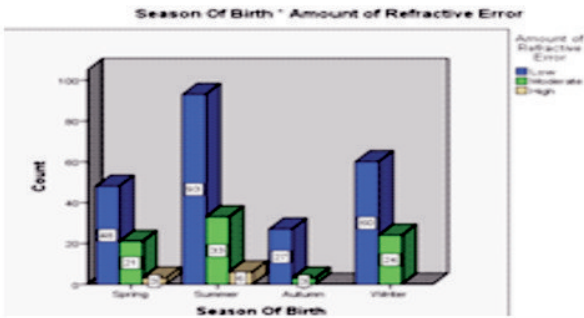
We did not find the same amount of refractive error. Our subjects were mostly with low refractive errors.

**Fig.1: Season of Birth versus Refractive Errors**



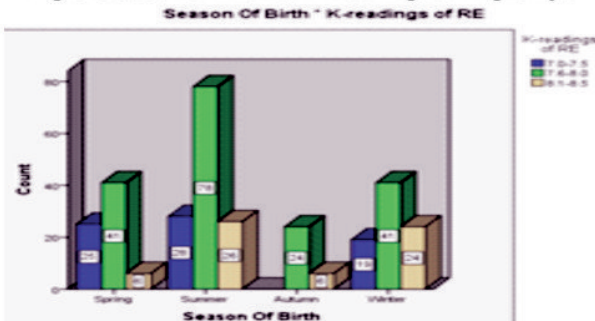
This chart shows a strong association between season of birth and refractive errors. Subjects born in summer have predominantly myopic eyes ( $p < 0.005$ )

**Fig.2: Season of Birth & Amount of Refractive Errors**



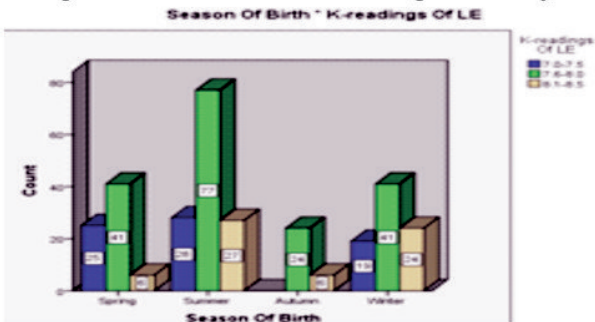
Our study was unable to show any association between amounts of refractive error and season of birth. This might be due to small sample size.

**Fig.3: Season of Birth & K-Readings of Right Eye**



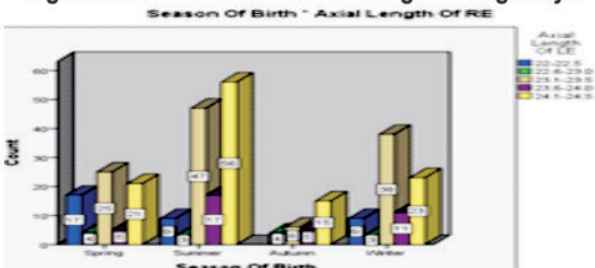
We found a strong relation between corneal curvature and season of birth. Our subjects mostly have 7.6-8.0mm k-readings who were born in summer (p=0.001)

**Fig.4: Season of Birth & K-Readings of Left Eye**



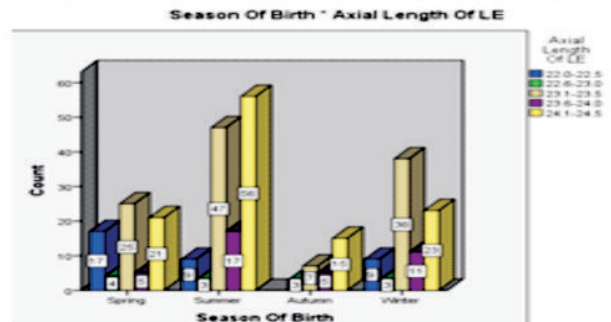
Similarly we have significant association between corneal curvature of left eye and season of birth (Fig.4) as p-value=0.000.

**Fig.5: Season of Birth & Axial Length of Right Eye**



Our study shows a strong association between summer season and axial length. p=0.002

**Fig.6: Season of Birth & Axial Length of Left Eye**



Axial length of left eye also follows the same pattern as subjects born in summer have larger axial lengths which result in their myopic refraction.

**Discussion:**

Presently myopia is increasing day by day, and economically it is becoming a burden, because many other eye diseases such as retinal detachment and choroidal neovascularization are caused by high myopia. It is becoming a major health problem, so necessary measurements should be taken to control high myopia.

The possible roles of perinatal duration of photoperiod (day light hours) and season of birth in the development of myopia were studied in Israel. Their result showed that the myopia was more common in population born in summer months.<sup>8</sup>

This study show the similarity with our study, as the day light hours are increased in early period of life in infants, these infants show myopia in later life. In summer season as the day period is enhanced, so the light entering in the eye also increases for a longer period, so the children born in summer season are myopic.

Another study show that high myopia was significantly associated with the season of birth and the subject born in summer and autumn were highly myopic than subject born in winter in a study carried out in UK on individuals of different age group.<sup>16</sup>

This study is also in the favour of our study, as showing the close relation of children born in summer season with myopia.

A study for association between birth month/ photoperiod and refraction in infancy was carried out which showed higher percentage of refractive error was present in infants who were born in summer season as compared to winter season.<sup>17</sup>

This study shows an association with our study showing that myopia is associated with summer season. Most



to 25 years. Myopia is the most common in the individuals born in summer season, and it mostly individuals have moderate to high degree of myopia.<sup>18</sup>

### Conclusion:

In Pakistan we have long summer (6 months almost) and small duration of winter (3 months). So here people have more exposure to daylight as days are long in summer. This strong exposure to light affected their ocular parameters i.e. axial length and keratometry. This results in more myopic refraction in people born in summer than in other three seasons. We found more myopic prescriptions shortly before and after summer which means that those patients also have some effect of light exposure. However other factors are also found to affect amount of refractive errors like near work, hobbies, family ocular history. But effect on corneal curvature and axial length is purely due to strong light exposure however it needs to be further evaluated.

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