



## Original Artical

# The Association of Intelligence Quotient and Astigmatism

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**Objective:** To find association between intelligence of individuals and their astigmatism by calculating their Intelligence Quotient and correlating it with degree and type of astigmatism

**Materials & Methods:** Structured WAIS (Wechsler Adult Intelligence Scale) IQ test Performa was used to assess IQ level of subjects by non-verbal questions. The IQ scoring of patient was done automatically by online process. A sample size of total 159 astigmatic patients, were asked to fill the Performa containing questions. Individuals involved in study were between 18-35 years of age having astigmatism up to 6.00 DC and experiencing no other ocular pathology.

**Results:** Out of 49 individuals of right eye having against the rule (ATR) astigmatism, more individuals had above average and Gifted IQ status. Out of 76 individuals of right eye having with the rule (WTR) astigmatism more individuals had average IQ. Out of 19 individuals of right eye having Oblique astigmatism more individuals had average IQ status.

Out of 135 individuals of right eye with low astigmatism more individuals had average IQ status. Out of 22 individuals with moderate astigmatism more individuals had below average IQ status. Two out of 2 individuals with high astigmatism were having challenged IQ status.

Out of 53 individuals of left eye against the rule (ATR) astigmatism more individuals had above average and gifted IQ Status. Out of 76 individuals with left eye with the rule (WTR) astigmatism more individuals had average IQ. Out of 19 individuals with Oblique astigmatism more number of individuals had average IQ status.

With 0.00 to 1.50 DC of left eye, greater numbers of individuals i.e., 51 were with average IQ status. With 1.50 to 3.00 DC, greater numbers of individuals i.e., 9 were with below average IQ status.

**Key Words:** Astigmatism, With the rule, against the rule, Intelligence quotient.



## Introduction:

Refractive error is most common reason of visual impairment and leads to recreational, academic and financial deficits to a healthy person. Astigmatism is a type of refractive error in which unequal radius of curvature of optical surfaces leads to blur image. It diminishes the visual acuity by lowering the radius of curvature and focusing power of cornea in one meridian than its perpendicular meridian. Two elements of astigmatism are known and measured that is refractive and corneal astigmatism.

Uncorrected astigmatism in young children during sensitive period when visual system is developing; produces amblyopia. Studies have revealed that if there is hindrance in visual incentive in specific angles during most sensitive period of visual development, called critical period then even if particular interposition is taken, reduced response to visual incentive in specific angles is seen. Thus, if deprivation of visual incentive occurred in specific period of individual that is critical period then there is an impediment in development of binocularity

Few environmental circumstances play an important role as a risk in astigmatism. For example playing a video game for hours was interlinked with more extreme astigmatism. Risk of developing astigmatism is twice in relatives of individuals of astigmatic patient who share 50% of these genes like parents, siblings and offspring. Thus there is an evidence of remarkable genetic participation to astigmatism.

Both types of resolution acuities that is distance and near are decreased by increasing uncorrected cylindrical power. There is comparatively better distant and near visual acuities with against-the rule astigmatism as compared to with-the rule and oblique astigmatism. As the uncorrected cylindrical power increases beyond -3.00DC, reading fluency is decreased. Uncorrected WTR astigmatism also causes very poor reading fluency. It was also found that optical blur induced by astigmatism that is not corrected; activates the development of myopia. Stereo-acuity i.e., depth discrimination is also affected by astigmatism. Uncorrected astigmatism also negatively affects the Detection acuity, grating acuity, hyper-acuity and contrast sensitivity.

Astigmatism is influenced by age, gender, genetic, racial and environmental factors. Astigmatism varies with age. Newborn babies have ATR astigmatism immediately after birth and varied from ATR to WTR up to the age of approximately 20years. From 20-40 years it remains unchanged and after that it moves again towards ATR astigmatism. High lid tightness in teens causes WTR astigmatism. A reduction in lid tension in aged people causes ATR astigmatism.

Astigmatism is most common refractive error in many countries like Indonesia where it accounts for about

30% while approximately half of people in certain areas like Japan and Taiwan are affected by astigmatism. Studies conducted on people of Japan, South India, Myanmar, and Singapore did not show any difference in prevalence of astigmatism in males and females. Studies performed on people of Beijing have, however, shown that prevalence of astigmatism was higher among females when compared to males. On the other hand, a similar study performed on people of Central India revealed that prevalence of astigmatism was higher in males than in females.

Children with developmental disability have a higher incidence of Refractive errors. Developmentally retarded children have higher incidence of hypermetropia and astigmatism. The prevalence of astigmatism is approximately 30% and depends on age and on races which are scrutinized. The usual refractive error that reports for approximately 13% of the errors of refraction of a person's eye is astigmatism. As age of population increases, the size of prevalence increases. The reason is that with increasing age, astigmatism shifts towards ATR astigmatism. The catalogued value of astigmatism is near about 10 percent in grown up individuals.

Human intelligence is a sum of mental processes such as pondering, recalling, reading, learning, problem solving and using language. Basic and extremely complicated behavioral stock can be learned in the whole life of a person. There are huge dissimilarities between individual's judgment, penetrating the problem and learning, which leads to differences in individual's ability to manage the daring cases. These differences are relatively resolved by hereditary components.

Each individual differ from the other in his ability to interpret complex ideas and learn from his own experience. Intelligence quotient (IQ) is the cognizant mental ability, or that it is the ability of a person that allows you to think, comprehend and resolve the analytical and hypothetical problems. Several types of intelligence are fluid, crystallize, general, analytical and practical intelligence. Another type of intelligence is emotional intelligence that allows a person to become acquainted with his or her sentiments and handle these feelings according to type of circumstance.

There is a strong alliance between higher prevalence of myopia and higher education level. A link is also present between severity of education and eye growth. Rate of progression of myopia is also variable during an academic year. Rate is higher during time duration of intense level of studies and is less during vacations especially in summer breaks

Men have bigger dimension of brain as compared to women. But women's brain has finer links between two cerebral hemispheres through corpus callosum. So it is not understandable that either men or women would get benefit

cerebral hemispheres through corpus callosum. So it is not understandable that either men or women would get benefit from this<sup>20</sup>.

The factors that are responsible for IQ of a child are hereditary factors of a child, parental intelligence and their educational status and social environment in which a child is oriented. The area of the brain that is responsible for intelligence and short term memory is Frontoparietal. There is a typical hereditary factor behind IQ score of different individuals. Enigmatic genetic association between multiple genes is responsible for variable IQ score<sup>15</sup>.

Improvement in intelligence is noticed by good nutrition, good schools, and full attendance in educational institutes. Others factors that are also responsible for improvement in intelligence of a child are involvement of parents in child's education, a good facility of books and internet, many other sources to gain information and knowledge, enhancing experience, supporting social environment<sup>21</sup>. The continuous long term anxiety is damaging to certain areas of brain specific for attention and memory i.e., (short term and long term)<sup>17</sup>.

No evidence was found that there is a gender difference that effect on general intelligence. On average men shine well on some factors while women on others. Some tests showed no gender difference while, some tests showed a variance of 0.5 SD or more. These variances were due to the fact that females have good verbal abilities such as eloquence and recalling. Males have good visuospatial intelligence and perform well on such type of tests.

On intelligence, a conventional evaluation was done in France in 20<sup>th</sup> century to identify children who need additional pedagogic training. Until now Intelligence testing is used for much the same intention to identify children who are mentally handicapped or with difficulty in learning, understanding, and using spoken and written language. Most of the scientific investigations related to Psychometric tests of intelligence was carried out in Australia, America and sixth largest continent; Europe<sup>23</sup>.

The Intelligence Quotient scale is a relative scale and constructed using interval scales and values are compared to persons of similar gender and age. When we are estimating a certain quantity then there is a fallacy in measurement. All IQ test scores have a certain amount of fallacy. When we know this fallacy then a true value of IQ score can be measured and accuracy increases. Studies show that those IQ tests which are a combination of a series of tests show a lesser error of measurement. While those IQ tests which consist of a single test show a greater amount of zero error<sup>23</sup>.

SAT scores were used to measure intelligence quotient. Numerous educational institutes take this test and

study has disclosed that when students are sick then performance on this test decreases but when they are well then performance on this same test increases and student gets higher score. In the same way multiple preparatory classes for this SAT test increases the test score<sup>23</sup>. Researches continue and measurement of intelligence modifies from psychometric measurement of intelligence to Mental Chronometrics. Chronometrics is measurement of mental processing speed by the use of reaction time in one thousandth of a second. Thus the definition of intelligence becomes modified and more advanced by the work of Jensen on Mental Chronometry<sup>23</sup>.

### Study Designs, Materials and Methods:

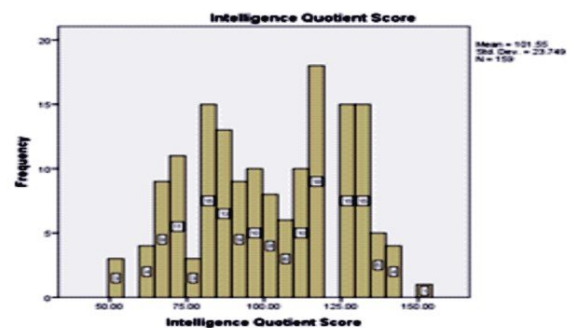
**Study design:** descriptive/ cross sectional

**Population & Sampling method/ sample size:** 159 Young adults both males and females of 18 to 35 years of age, having astigmatism above  $\pm 0.5$ DC were selected. Study was conducted in the months of September, October and November 2014. Mentally Retarded persons, Persons not willing to perform on IQ test, Persons with any other ocular pathology and Persons with irregular astigmatism were excluded.

**Data Collection Procedure:** Informed consent was obtained from each participant, describing the details of study and implications thereof. A detailed socio-demographic picture of the subject was obtained. Astigmatism of patient was evaluated by non-cycloplegic refraction and by Jackson Cross Cylinder (JCC) technique. IQ level of patient was assessed by non-verbal questions as mentioned in WAIS (Wechsler Adult Intelligence Scale) IQ test.. The IQ scoring of patient was done automatically by online process.

### Results:

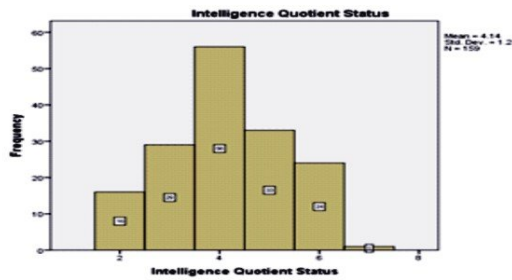
**Fig.1: Intelligence Quotient Score:**



Out of 159 individuals involved in study, 120 IQ Score attained by greater number of individuals that is 18. IQ score

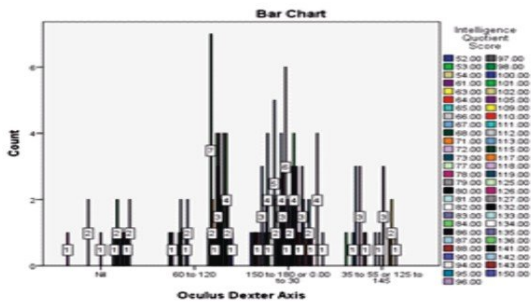
125,130 and 80 was attained by 15 individuals each. IQ Score 150 was attained by only 1 individual.

**Fig.2: Intelligence Quotient Status:**



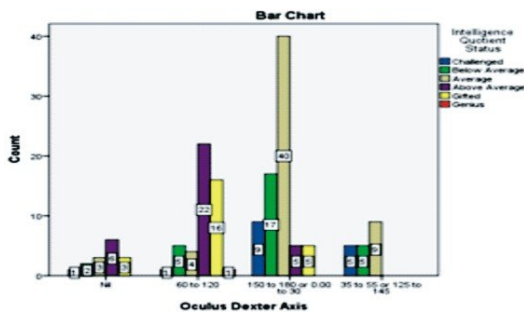
Frequency of challenged individuals is 16; below average is 29; Average is 56; above average is 33; Gifted 24; and Genius is 1.

**Fig. 3: Right Eye Axis versus Intelligence Quotient Score**



Most of the patients of ATR astigmatism axis are with 115 IQ score. Most of the patients with WTR astigmatism axis are with 94 IQ score. P value is less than 0.05. This shows that there is strong association between axis of right eye and IQ of subjects

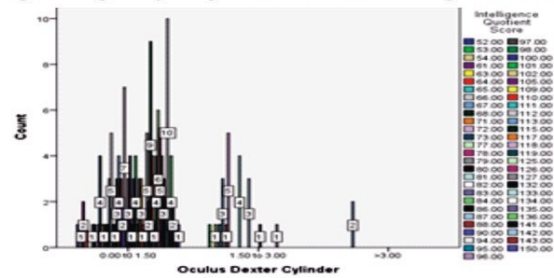
**Fig. 4: Right Eye Axis versus Intelligence Quotient Status:**



Most of the patients with Nil axis are above average IQ status; with ATR astigmatism axis, most of the individuals are with above average IQ status; with WTR and with Oblique

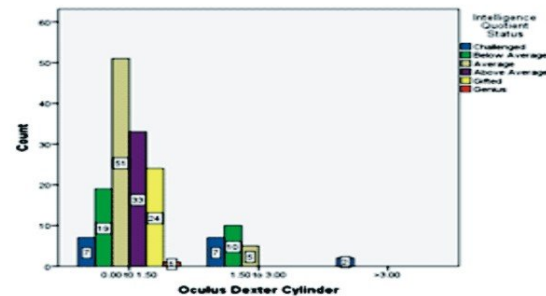
astigmatism axis, most of the individuals are with average IQ status. P value is less than 0.05; this shows that association of right eye axis with IQ Status is significant

**Fig 5: Right eye Cylinder versus Intelligence Quotient**

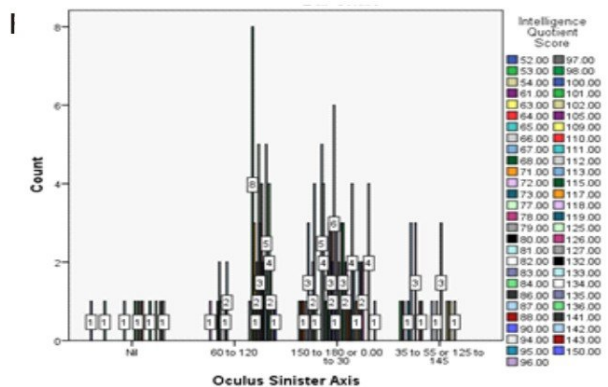


Most of the patients with low astigmatism are with IQ score 134. Most of the patients with moderate astigmatism are with IQ score 72 and with high astigmatism, most of the patients are with IQ score 67. P value is less than 0.05; this shows association of OD cylinder with IQ score

**Fig. 6: Right eye Cylinder versus Intelligence Quotient Status:**

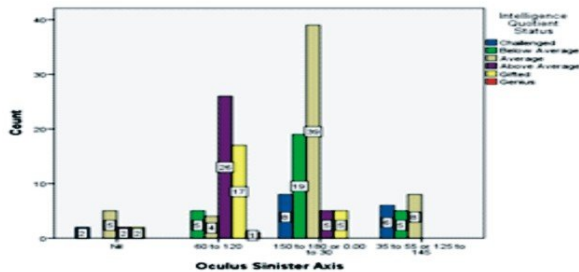


Most of the patients with low astigmatism are with average IQ status. Most of the patients with moderate astigmatism and high astigmatism are with below average IQ status. P value is less than 0.05; this shows that association of OD cylinder with IQ status is significant.



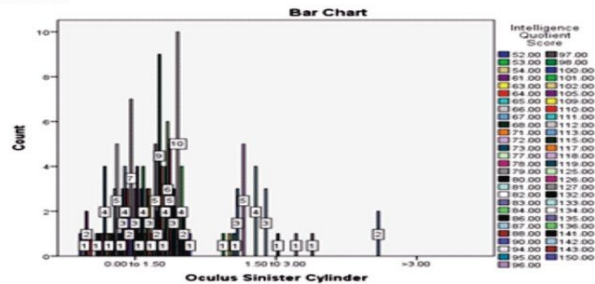
Most of the patients with ATR astigmatism axis are with 115 IQ score. Most of the patients with WTR astigmatism axis are with 94 IQ score. P value is less than 0.05; this shows there is strong association of left axis with IQ score.

**Fig. 8: left eye Axis versus Intelligence Quotient Status:**



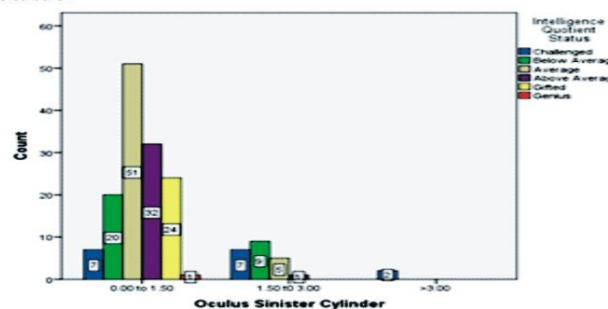
Most of the patients with nil axis are with average IQ status. With ATR astigmatism axis, most of the patients are with above average IQ status. With WTR and Oblique astigmatism axis, most of the patients are with average IQ status. P value is less than 0.005; this shows that association of OS axis with IQ status is strongly significant.

**Fig. 9: Left eye Cylinder versus Intelligence Quotient Score:**



Most of the patients with low astigmatism are with 134 IQ score. Most of the patients with moderate astigmatism are with 72 IQ score and with high astigmatism; most of the patients are with 67 IQ score. P value is less than 0.05; this shows the association of OS cylinder with IQ score is significant.

**Fig. 10: Left eye Cylinder versus Intelligence Quotient Status:**



Most of the patients with low astigmatism have average IQ status. Most of the patients with moderate astigmatism have below average IQ status and most of the patients with high astigmatism; have challenged IQ status. P value is less than 0.05; this shows the association of OS cylinder with IQ status.

**Discussion:**

Astigmatism is a type of error of refraction where there is a difference in curvature and focusing power of cornea in different meridians of cornea, which results in reduction of vision and if not corrected for longer time most commonly associated with Lazy eye<sup>2</sup>.

Various studies reveal an association between Intelligence Quotient and Astigmatism, as there is a relation between axis orientation and intelligence Quotient. ATR Astigmatic Patients show greater prevalence towards above average IQ status. WTR Astigmatic individuals show a greater prevalence towards average IQ status. Individuals also show a greater prevalence towards a high IQ status when the astigmatism is less than 1.00 DC<sup>12</sup>.

This study reveals that P value is less than 0.05; this shows that association of astigmatism axis with IQ Status is significant. Most of the patients with ATR astigmatism axis are with above average IQ status; with WTR and with Oblique astigmatism axis, most of the individuals are with average IQ status. P value is less than 0.05; this shows the association of astigmatic amount with IQ status. Most of the patients with low astigmatism are with average IQ status. With moderate astigmatism, most of the patients are with below average IQ status and with high astigmatism, most of the patients are with challenged IQ status

WTR astigmatic patients showed a lower IQ level as compared to ATR astigmatic patients. The reason behind greater IQ level of ATR astigmatic patients is that ATR astigmatic patients show a better near vision as compared to WTR astigmatism. Patients with high astigmatism more than 3.00 DC showed lower IQ status. The reason behind this is that with increasing uncorrected cylindrical amount, near vision of patient is reduced. Thus the astigmatism that is not corrected causes a burden on vision of patient<sup>4</sup>.

Individuals who performed the WAIS IQ test at morning timing when their mind were fresh showed a good performance on IQ test and took a much less time to perform it. While individuals who performed the WAIS test at afternoon showed an average performance. Same time disturbing environment also interfere with the performance on IQ test.

All IQ tests show a certain amount of imperfection or error called "Zero Error", this error increases when using a single IQ test. While IQ tests which consist of a series of tests, this error reduces<sup>23</sup>.



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