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Prevalence of Refractive Error and Effect Factor of Refractive Error

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Abstract

This study aims to find out the status of refractive error and the factors affecting refractive error. Data were gathered through a survey of 1, 292 people. The study was conducted only to those who wished to participate in the study. Results showed that the refractive error was refractive error was 926 (71.7%), and the types of refractive error in subjects were 533 (57.6%) for myopia, 144 (15.6%) for hyperopia, 7 (0.8%) for astigmatism, and 242 (26.1%) for myopia astigmatism. Age ($r=0.000$, $p<0.05$) and refractive error were found to be related, and the vision status of the father ($r=0.03$, $p<0.05$) and the mother ($r=0.000$, $p<0.05$) was also found to be related to refractive error. Based on the findings, good life learning habits and proper work and rest balance are believed to reduce eye stress and relieve eye fatigue, which can later stabilize refractive errors.

Keywords: *visual acuity, refractive error, factor of refractive error, factor of life environmental.*

1. INTRODUCTION

Refractive errors are a phenomenon in which parallel light cannot be formed into a clear image on the retina through the refraction of the eye when the eye does not function accommodation, and an image is formed in front or behind the retina. There are many different causes of this refractive error, and one of these is genetics. [1] Of course, the use of eyes due to unhealthy habits also acts as a cause that cannot be ignored. Children are in a period of growth and development, but they do not pay attention to their usual poetic habits. For example, if you read a book or write, you may have poor light intensity, your book might be too close to the eye, you spend much time reading, or you read a book while walking or riding a vehicle. It is called a static refractive state when a distant parallel beam of more than 5m proceeds and is formed in the central fovea of the macula of the retina through the refraction of the eye without accommodation. [2-4]. Nowadays, electronics such as computers and mobile phones have been used by more and more people, which have been bringing convenience and ease many problems.

However, long-term use of electronics has a relatively serious impact on the human eye.[5] As the short-range workload increases like this, various refractive abnormalities are appearing. In the resting state of accommodation, the image focal point and center of retina(fovea) corresponding to the total refractive power of the eye determined by eye components such as the cornea, lens, anterior depth, and eye length is regularized regularized and is called emmetropia, but when it does not match on emmetropia and when it does not match, the degree is called 'refractive error' or 'ametropia'.[6] The degree

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of refractive error changes according to the parameter change and mutual harmony of the eye components.

The cornea plays a key role in the refractive function of the eye and has a refractive power of about +43D. The refractive power of the cornea increases with age, and the radius of curvature of the cornea decreases with age in inverse proportion to each other, and it has been reported that the change is greater in the horizontal than in the vertical line.[7] As the eye's refractive media grows after birth, they coordinate with each other in a process called orthokeratology. At 10 months of age, a newborn has an eye axis length of 16 to 18 mm, a corneal refractive power of 51 to 52 D, an anterior chamber depth of 1.5 to 2.9 mm, a lens thickness of 3.5 to 4 mm, a vitreous depth of 10 to 11 mm, and a refractive error of +0.40 to +2.60 degrees.[8] In general, the axial length of the eye grows rapidly from 2 to 3 years of age and stabilizes from 9 to 15 years of age. In contrast to changes in axial length, corneal refractive error does not change significantly from 6 months to 3 years of age, and the average change in corneal refractive error between 5 and 16 years of age is no more than 0.50D.[9]

As the refractive power of the eye changes, a person's vision progresses from hyperopia to emmetropia or myopia, and the complete growth of the eye continues until the age of 20, and the length of the eye axis reaches almost the same level as that of an adult. Normal children's vision is 0.1 at 6 months of age, 0.2 at 1 year of age, and gradually develops as the age increases, reaching normal vision at the age of 5-6, and some remain below normal vision (visual acuity).

In addition, children who have no genetic factors and have normal vision have weak myopia at the age of 8 to 14. Visual impairment of children in school age is usually caused by refractive abnormalities, of which is myopia, one of the most common causes of visual impairment in the world. In the case of nearsightedness, it is known that the rate of increase starts from the age of 7 to 8 and increases from the age of 9 to 11, and the incidence of nearsightedness is the highest around the age of 20. Our eyes change in refraction with age along with the growth of the body.[10] An eye with a far point (punctum remotum) of recognizable visual acuity is called emmetropic. An emmetropic eye is considered 'normal', assuming that its accommodation is within a reasonable range, also refractive error occurs at a far point (punctum remotum) and is called ametropic. The cause of refractive error in the eye is called axial ametropia when the eye axis is prolonged or shortened or long, and if it is caused by an increase or decrease in refractive power, it is called refractive ametropia.[11]

Refractive errors include hyperopia, myopia, and astigmatism, and visual impairments due to refractive error not only not only affect daily life, but can also cause loss of vision due to other ophthalmic complications, but also high myopia can lose vision due to other ophthalmic complications (glaucoma, cataracts, retinal detachment, macular degeneration, etc.) [12]

The onset of myopia affects the prevalence of high myopia in later adulthood. The earlier the onset of myopia, the greater the likelihood of developing high myopia in adulthood, and studies have shown that an early onset of myopia is consistently associated with high myopia in adulthood. There are several reports that the incidence of myopia is related to heredity, varies by ethnicity and region, and is strongly associated with prolonged close work [13,14].

In addition, the effects of refractive error depend on the following. The type of refractive error (myopia or hyperopia), the diopter of refractive error, factors such as work distance, age, and gender, and genetic and environmental factors. Genetically, the prevalence is such that children will develop myopia if their parents are myopic, and rapidly changing environmental factors play a large role in determining the onset and current pattern of myopia.[15] The prevalence of refractive errors has been reported in several countries.

In Singapore, the prevalence of myopia is reported to be 62%, in Guangzhou, China it is 49.7%, in the United States it is 20%, in Australia it is 11.9%, and in Nigeria it is 1.9%.[16-20] In addition, a study by Holden et al. reported that half of the world's population (49.8%) will be myopic by 2050, with approximately 9.8% of people having high myopia[21]. As such, refractive error has become a major public health concern. In many countries, studies have been conducted and reported on the prevalence of refractive errors, visual acuity status, and factors associated with refractive errors in various age groups. Therefore, this study aimed to investigate the status and factors of refractive error in Shandong Province, China.

2. SUBJECT AND METHOD

2.1 Subject

This study was conducted on subjects who understood the purpose of this study and wished to participate through the recruitment notice for the public of Chinese nationality. For participants under the age of 18, parental consent was required and only those whose parents or guardians agreed to their participation in the study were included.

2.2 Method

2.2.1 Measurement Tool

Before conducting this study, a preliminary survey was conducted on some participants, and based on this, the final questionnaire was additionally distributed. It was distributed online through a link to a certain website. It consisted of general situation questionnaire and glass usage habits. The survey was conducted by organizing items such as general situations (including age, refractive error, etc.), subject refractive errors, learning habits, and living environment. In addition, the subjects were classified into five groups: 9-17 years old, 18-26 years old, 27-35 years old, 36-44 years old, and 45-53 years old according to age. The degree of refractive error based on the spherical equivalent power (SED), SED ±-1.00D was classified as the low myopia and hyperopia, while moderate myopia and hyperopia was classified as ±1.25D-3.00D and ±3.25D-6.00D and more than ±600D was high myopia and hyperopia. Those who do not know its refractive errors was classified as unknown. In addition, the case of -0.75D was classified as astigmatism based on cylindrical power (CD), and astigmatism was classified according to the type of astigmatism.

2.2.2 Data Analysis

The data statistical analysis was performed using IBM SPSS Statistics 21.00. The program was used to analyze data statistics. Frequency analysis and descriptive statistics were conducted through basic statistical analysis, and the average comparison between the two groups was measured using independent t-test. The significance level of all data $p<0.05$.

3. RESULT

3.1 General Characteristics of Subjects

Among the subjects aged 9 to there were 53, 546 men (42.3%) and 746 women (57.7%). 1,292 people were classified into 5 groups according to their age, with 5 members (0.4%) in the 1st group (18-26) 245 people (19.0%) in the 2nd group (18-26) 379 people (29.3%) in the 3rd group (27-35) 320 people (24.8%) in the 4th group (45-53) and 343 people (26%) in the 5th group.

Table 1: General characteristics

Age	9~17	18~26	27~35	36~44	45~53	Total
Male	1	78	165	143	159	546(42.3%)
Female	4	167	214	177	184	746(57.7%)
Total	5(0.4%)	245(19.0%)	379(29.3%）	320(24.8%）	343(26.5%）	1292(100%)

3.2 Prevalence of Refractive Errors

Of the 1,292 people, emmetropia shows 271(21.0%) subjects and myopia were 533(41.3%), hyperopia144 (11.1%), astigmatism 7(0.5%), myopia astigmatism 242(18.7%), and unknown 95(7.4%). Among the prevalence of refractive error, myopia was found to be the most common. The prevalence of astigmatism was low.

Table 2: The Distribution of refractive error

SE(D)	**Emmetropia**	**Myopia**	**Hyperopia**	**Astigmatism**	**Myopia astigmatism**	**Unknown**	**Total**
Unknown	257	0	0	1	0	6	264(20.4%)
±0 ~ 1.00D	3	131	59	3	57	28	281(21.7%)
±1.25D ~ 3.00D	3	169	50	1	73	23	319(24.7%)
±3.25D ~ 6.00D	0	125	13	1	61	7	207(16.0%)
< ±600D	0	76	1	1	36	8	122(9.4%)
Unknown	8	32	21	0	15	23	99(7.7%)
Total	271(21.0%)	533(41.3%)	144(11.1%)	7(0.5%)	242(18.7%)	95(7.4%)	1292(100.0%)

3.3 Correlation between General Factors and Refractive error

For the correlation between the refractive errors and the four factors (gender, age, job, region), result showed that there was no significant correlation between refractive error and gender ($r=–0.062$, $p>0.05$), regions ($r=0.043$, $p>0.05$), and occupations ($r=–0.020$ $p>0.50$). However, there was a significant correlation between refractive error and age ($r=0.160$, $p<0.05$).

Table 3: The relationship between age, sex, region, occupations, and refractive errors

	Sex	**Age**	**Region**	**occupations**	**Refractive errors**
Sex	1				
Age	-.115**	1			
Occupations	-.064	.280**	1		
Region	-.013	.020	-.018	1	
Refractive errors	-.062	.160**	.043	-.020	1
** p<0.01					

3.4 Relationship between Genetic Factors and Refractive Error

Father vision status ($r=0.03$, $p<0.05$) and mother vision status ($r=0.000$, $p<0.05$) were found to be related to refractive error. If both the father and the mother have refractive error, the child is more likely to develop refractive error. There is no relationship between the visual acuity status ($r=0.654$, $p<0.05$) and refractive error. Genetic factors and refractive error were found to be related. The vision status showed consistency in both the siblings' vision status, indicating that there was no difference. In addition, refractive error showed a significant difference ($p<0.05$) in two factors: father's vision status and mother's vision status, which means that there is a difference between father's vision status and mother's vision status according to refractive error. There was a significant difference in the father's vision status ($p>0.05$), and a significant difference between the refractive error and the mother's refractive error ($p>0.05$) as shown in table 4.

Table 4: The relationship between ametropia and genetic factors

	Myopic astigmatism (n=242)	**Myopia (n=533)**	**Hyperopia (n=144)**	**Astigmatism (n=7)**	***F***	***p***
Father	2.44±1.26	2.27±1.26	2.69±1.34	2.71±1.89	4.653	0.003**
Mother	2.30±1.26	2.29±1.30	2.88±1.29	1.57±0.79	9.384	0.000**
Brothers and Sisters	2.53±1.35	2.52±1.27	2.67±1.31	2.57±1.40	0.541	0.654
* p<0.05 ** p<0.01						

3.5 Correlation between Genetic Factors and Refractive error

There was no correlation between refractive error and father's vision status (r=0.029, p>0.05) and siblings' vision status (r=0.03, p>0.05), and refractive error and mother's vision status were found to have a significant correlation (r=0.103, p<0.05) as shown in table 5.

Table 5: Correlation analysis of refractive error and genetic factors

	Ametropia	**Father**	**Mother**	**Brothers**
Ametropia	1			
Father	.029	1		
Mother	.103	.223	1	
Brothers	.038	.107	.042	1
** p<0.01				

3.6 Relationship between Learning Habits and Refractive Error

Table 6 shows that there was no between reading distance (r=0.848, p<0.05), one hour at home (r=0.123, p<0.05), writing posture (r=0.239, p<0.05), lying down (r=0.282, p<0.05), and the degree of stress (r=0.013, p<0.05) and refraction. The more stressful learning and work is, the greater the impact on vision. Learning and work should be reasonably arranged and properly relaxed to help the stable development of vision. There was no significance in a total of four factors, such as reading and writing posture, telecommuting time, and reading distance, as well as lying down for refractive error (p>0.05).

Table 6: Refractive error and learning habits

	Myopic astigmatism (n=242)	**Myopia (n=533)**	**Hyperopia (n=144)**	**Astigmatism (n=7)**	***F***	***p***
The degree of stress	2.05±0.71	1.90±0.75	2.06±0.79	1.57±0.79	3.632	0.013*
Reading while lying down or in a rocking car	2.37±1.04	2.39±0.98	2.21±1.02	2.43±0.79	1.275	0.282
Sitting posture	1.93±0.72	1.92±0.68	2.06±0.76	2.00±0.58	1.408	0.239
Working time at home	2.52±1.02	2.46±1.04	2.27±1.05	2.29±0.95	1.931	0.123
Reading distance	1.39±0.49	1.38±0.49	1.42±0.49	1.43±0.53	0.268	0.848
* p<0.05 ** p<0.01						

3.7 Correlation between Learning Habits and Refractive error

Refractive error and stress (r=-0.045, p>0.05), degree of lying down and reading (r=-0.026, p>0.05), posture of writing (r=0.241, p>0.05), and reading distance (r=0.009, p>0.05), has no correlation with refractive error and working time at home (p=0.05) as shown on Table 7.

Table 7: Correlation analysis of refractive error and learning habits

	Refractive errors	**The degree of pressure**	**Reading while lying down or in a rocking car**	**Sitting posture**	**Working time**	**Reading distance**
Refractive errors	1					
The degree of pressure	-.045	1				
Reading while lying down or in a rocking car	-.026	.028	1			
Sitting posture	.039	.029	-.054	1		
Working time	-.065*	-.033	-.048	-.013	1	
Reading distance	.009	.019	-.035	-.078*	-.004	1
** p<0.01						

4. DISCUSSION

The human eye grows to 25 years old, which is directly related to eye growth and vision. Lack of nutrients, one of the indirectly affecting factors, affects the cornea and lens, leading to dysregulation and runaway function. Recently, elementary school students who are unable to eat properly between busy parents due to their appearance or excessive diet eat a lot of fast food due to the influence of westernized diet, resulting in vision development because of nutritional imbalance have a great influence on. Vision management and prevention are very important in the elementary school period when growth is active in relation to age, and myopia refractive index is an important issue to consider in terms of preventing myopia that determines the health status of future people. Myopia shows a decrease in long-distance vision and makes you feel uncomfortable with the poetic life of everyday life. Also, In the rapidly changing industrialization process, the structure and form of the family have also changed, and the dissolution of the family has occurred. It also appears in various forms, including single-parent families, grandchildren families, and boys' and girls' families due to divorce and separation, and these structural problems are also known to be a factor in the increase in refractive error.

Refractive error refers to the failure of parallel light to form a clear image on the retina through the refractive action of the eye and to form an image in front or behind the retina. Refractive error includes hyperopia, myopia, and astigmatism. There are many causes of refractive error, and children are in a period of growth and development, and there are various situations to possibly develo0. For example, the posture of reading a book or writing is not accurate or the light is not good. The very close distance between eyes and books, too much time spent on reading, walking, or reading books in a car, can all lead to eye overwork, resulting in refractive denial.

Low or moderate myopia has no symptoms other than blurred objects. When working at a close distance, it is rather convenient because you do not have to adjust small targets or less. However, in high myopia, if the target distance is close and the two eyes are gathered too inward, symptoms of vision fatigue may appear due to the high use of internal rectum use of internal rectum.[20] Hyperopia is determined by the height of its raw refractive index and the strength and weakness of accommodation. Low hyperopia can be corrected with accommodation. Hyperopia is prone to vision fatigue because it is in a long-term controlled tension. People with low refractive index have no symptoms of astigmatism. Moderate or higher astigmatism may have impaired vision, can be seen with shadows on things, and always have symptoms of fatigue.[22] In this era, information is

rapidly developing, and with the development of electronic products, the rapid development of visual information that can be seen anywhere, that is, the increase in near-field visual work such as computers, televisions, and mobile phones, has a great impact on the refractive state of the eye.[23]

A survey of 1,292 people was conducted to find out the status and factors of refractive error of the subjects. Results showed that 533 (57.6%) were myopia, 144 (15.6%) were hyperopia, 7 (0.8%) were astigmatism, and 242 (26.1%) were myopia astigmatism. According to the results of the survey, the ratio of myopia (41.3%) is the highest among the distribution of vision, which shows that myopia is a major problem among refraction errors. As a result of this study, the number of people with a frequency of -1.25 to -3.00D was the highest at 319 (24.7%). In addition, the analysis of this study showed that refractive abnormalities are related to age. Myopia, astigmatism, and myopia are the most common at the age of 27-35, and most people in this age are in stable vocational development, and people in this age group have low frequency of work-busy outdoor activities, long hours of use of electronics, and high levels of stress in their work life can affect the development of refractive error.[24] Hyperopia occurs the most at the age of 45 to 53, and as age increases, the lens of the eye hardens and thickens, and the accommodative response of the eye muscles decreases, resulting in hyperopia.

Studies on refractive error and genetic factors have shown that mothers and fathers are related to refractive error, and factors that affect refractive error are related to genetic factors. [4-8]

In the case of mild myopia, heredity and environment affect the development of myopia. Adolescents with parents' myopia have a significantly higher risk of developing myopia, and there is a positive correlation with their parents' myopia. With age, the eye axis gradually lengthens, the refractive state of the eye changes from primitive to regular, and development is gradually completed by the age of 10, and subsequent vision development gradually increases due to various factors such as gender, overtime, sleep time, exercise time, and eye use habits.[23] Maintaining good life learning habits and properly adjusting work and rest during work learning will help reduce eye stress and relieve eye fatigue to reduce and stabilize refractive error. Refractive abnormalities are also known to be related to genetic factors, and this study also analyzed that they are related to parental refractive abnormalities and that factors affecting refractive abnormalities are related to genetic factors. In the case of simple low-medium nearsightedness, genes and environment are interrelated and whose parents have myopia have a significantly higher have a significantly higher risk of developing myopia, have a positive correlation with their parents' myopia, and genetic factors are more pronounced. It was also found that there was a relationship between learning habits and refractive error.

Maintaining good life learning habits, properly slowing down, and combining work and rest during task learning periods help reduce stress on the eyes and stabilize refractive abnormalities by relieving eye fatigue. Based on the results of this study, age, genetic factors, and usage habits can all affect the condition of refraction error, and it is believed that the above data will be used as analysis data for refraction error.

5. CONCLUSIONS

This study is meaningful in that it looked at the relationship between factors such as age, and refractive error. Prevention and control of refractive abnormalities improve the learning environment, reduces long-term near-field work, and prevents excessive regulation. In elementary schools in China, all students learn eye protection exercises. Eye protection e Eye protection exercises relieve eye fatigue through a massage which lessens the tension around the eyes. The prevention and control of refraction is also related to genetic factors, so people whose parents suffer from refraction should pay more

attention to maintaining eye health. There are still many factors that affect refractive error, and the conclusions made in this study are not comprehensive, and since eating habits are known to are known to affect eye health, future studies related to it should be conducted. Based on the findings of this study, it is highly recommended to find factors that affect refractive error to prevent and control refractive errors in the future.

Acknowledgements

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