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Research Paper

Investigating the Causes of Blindness and Vision Impairment in Children Younger Than 15 Years Old

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ABSTRACT

Background and Objectives: Vision impairment has very severe effects on education. It brings serious problems in life and job opportunities. In our country, Iran, accurate statistics on children with vision impairment and blindness are unavailable.

Methods: This study examined only children up to 15 years old with vision impairment and blindness. Complete eye examinations were investigated, including vision measurement of both eyes for far and near, refraction to determine refractive errors, direct and indirect ophthalmoscopy, and checking the presence of any eye deviation. Standard LogMar charts were used. In addition, the need for visual aids was examined by a low-vision specialist.

Results: A total of 708 blind and visually impaired children (371 boys and 337 girls) were examined. The average age of the participants was 3.50±8.99. Congenital retinal diseases include 42% of the causes of blindness and vision impairment in these children. Retinitis pigmentosa 9%, Leber congenital amaurosis (LCA) 8%, albinism <1%, refractive errors 9.5%, cortical visual impairment 13.6%, cataract and glaucoma each alone 7%, corneal opacity 1.7% and non-pathogenic causes, such as trauma <1% were diagnosed. A total of 63% of these children were the result of family marriage.

Conclusion: The high percentage of family marriage among the parents of these children has also increased the probability of blindness and low vision. Many of these diseases are genetic; no specific treatment has yet been discovered. The lack of proper vision rehabilitation facilities in schools and access to vision aids make the residual vision not used in the critical age of the child. Therefore, the expansion of vision impairment rehabilitation services is a necessity.

Keywords: Children, Blind, Visually impaired

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Function & Disability Journal

What is "already known" in this topic:

There are different disease that cause vision impairment in different regions around the world.

What this article adds:

The high percentage of family marriage among the parents of these children has also increased the probability of blindness and low vision.

Introduction

One of the most prominent groups of people with disabilities is the visually impaired people [1]. Blindness and vision impairment are crucial health, economic, and social issues in developed and developing countries [2]. According to the World Health Organization (WHO), blindness and vision impairment refer to a condition in which it is not possible to increase vision with the usual visual aids, such as glasses [3, 4]. Currently, nearly 39 million people worldwide are blind, and about 246 million people in the world have severe visual impairment, and their number is increasing [5, 6]. More than 90% of all visually impaired people live in developing countries [7, 8]. In the meantime, investigating the causes of blindness and its prevalence in different societies is of particular importance.

According to the WHO, about 80% of vision defects can be treated or prevented [8, 9]. Blindness and vision impairment cause serious damage to a person's life and eventually a person becomes disabled [10-12]. Blindness and vision impairment have very severe effects on education. In the future, it will bring serious problems in life and job opportunities. Many studies have not been conducted in the field of vision impairment rehabilitation in children [5, 13]. The number of vision impairment and blind children in the world is reported to be almost three million. Three percent of the world's blind people are children. Every year, 500000 people are added to these statistics. In developing countries, 400 children out of one million people are blind and visually impaired [14]. The growth and development of the child is damaged due to vision impairment [15]. According to the latest scientific results, growth and learning during infancy and childhood are very dependent on eyes and vision Visual stimulation is very vital in the first years of life and may not be very effective later [16]. Some sources relate 70% to 80% of growth and development to vision [17]. Therefore, the proper functioning of the visual system plays a vital role in the development of babies and children [18-20]. In Iran, less accurate statistics of the causes of vision impairment among children exist [21].

Materials and Methods

This is a cross-sectional study conducted in a specific population up to 15 years old.

These children mainly studied in exceptional schools or were covered by the welfare organization. First, it was announced to the above centers that this study is being implemented and these children were requested to voluntarily participate in this survey with their parents. Then the children were referred to the declared center for eye examination. The examining team consisted of a specialized optometrist (PhD) in the field of vision impairment and two optometrists with experience in the field of blindness and low vision. A special examination form was used for this study. In this form, the complete information of the participant was recorded. Complete eye examinations, including the measurement of distance vision of both eyes using the logMar chart at a distance of 3 m and less, were recorded and then converted to the equivalent of vision at a standard distance of 6 m. For example, if a child reads a line of 0.7 at a distance of three m, his vision is registered as equivalent to one logMar. If a child could not see the largest letter on the chart at a distance of one m, a single letter E with a size of 20/400 (1.3 log) was used. Near vision was also measured with the standard logMar near vision chart. To measure vision <20/200, special charts for low vision were used.

The object recognition method was used for children under 4 years old. This basis is similar to the Miniature toy test or the Lea symbol test, innovated by Abbas Riazi. These objects selected form familiar environments

for children, such as balls, toys, tissue boxes, mugs and cell phones, for example, an object with an approximate length of 15 cm at a distance of one m is equivalent to 2 logMar and an object with dimensions of 20 cm at the same distance is equivalent to 2.3 logMar, for smaller objects, vision is recorded better. On the other hand, the above objects could be detected at further distances, for example, 1.2 and 1.4 logMar were considered, respectively. In children and infants, Teller cards were used and converted to logMar scale. It is necessary to explain that with the above method, a relative estimation of vision was obtained and it cannot be said that the vision was completely recorded. In addition, the number of children in this age range was not large. The vision without light perception is equal to 3 logMar, the vision at the limit of light perception is equal to 2.5 logMar, and the vision at the limit of detecting hand motion is considered equal to 2 logMar [22].

To determine the status of blindness and low vision, the WHO criteria were used. In this classification, the vision with the maximum optical correction is determined based on the Snellen chart so that Mild vision impairment is visual acuity worse than 20/60, vision from 20/60 to 20/160 is considered moderate vision impairment, vision of 20/160 to 20/400 is severe vision impairment, vision of 20/400 to 20/1000 is profound vision impairment and vision <20/1000 is absolute vision loss close to blindness (near-total impairment) and not understanding light is considered total blindness (total impairment). Legal blindness is when the best vision obtained in the better eye, is 20/200 or less, or when, despite the acuity attained, the field of vision is 20 degrees or less [8].

Also, an auto refractometer (Topcon) was used to determine refractive errors. In case for some reason the measurement results with the device were not possible, retinoscopy was used to determine the number of refractive errors. Then subjective refraction was performed to obtain maximum vision. In the next step, with the help of direct and indirect ophthalmoscopy (HEINE) and slit lamp (Topcon), the existing disease type was examined. All participants had medical records, and the main cause of vision loss was observed in their records by an expert ophthalmologist. In the next section, the person's current problems were examined. For example, what are the problems in carrying out daily life activities? Also, if a person was suspected of a special eye condition that needed further treatment, he was referred to the nearest ophthalmologist. In the next step, the need for visual aids was examined. If a specific device was accepted, parents were advised to prepare the desired device. All those who needed glasses were given free glasses. In collecting demographic information, the age, sex, educational status, and marital status of the parents were examined. The data analysis tool in this research was SPSS software, version 22.

Results

A total of 838 children up to 15 years of age were included in the study, of which 130 children had mental disorders or even retardation, and it was found in the examinations that they did not have vision problems, and due to non-cooperation in optometry examinations, they were recognized as low vision. These people were excluded from the study and 708 people were examined and analyzed. The mean age of the participants was 3.50±8.99 years, among which the minimum age of the participant was one year and the maximum age was 15 years. Out of all the participants, 371 were boys and 337 were girls.

Among the total participants, 314 people study in elementary school, 126 people study in first secondary school, and 76 people study in second secondary school. In addition, 192 people have not yet entered the school. The causes of blindness and vision impairment were very different among the participants, the most important of which are as follows. Among these, retinal diseases are the highest cause of blindness and low vision and the lowest observed cause of vision impairment is due to albinism and trauma. Figure 1 shows the distribution of diseases leading to blindness and low vision.

According to the standards of the WHO for vision impairment and blindness among the participants, 38 people have mild vision loss, 224 people have moderate vision loss, 153 people have severe vision loss and 293 people are blind. Out of 293 blind people, 93 people are blind and 200 people are legally blind.

The results showed that many of the parents of these children have had consanguineous marriages. Figure 2 shows this situation well because it can be seen that family marriages are significantly more than non-family marriages.

The studies conducted in the above research showed that 63% of these blind and visually impaired children have a history of their parent's family marriages. Regarding the type of marriages, the ratio of cousin-cousin marriages was 14% and the ratio of cousin-cousin marriages or vice versa was 16%. After that, cousin-son marriage was 20%, which comprised the largest percentage of family marriages, then far family marriage was

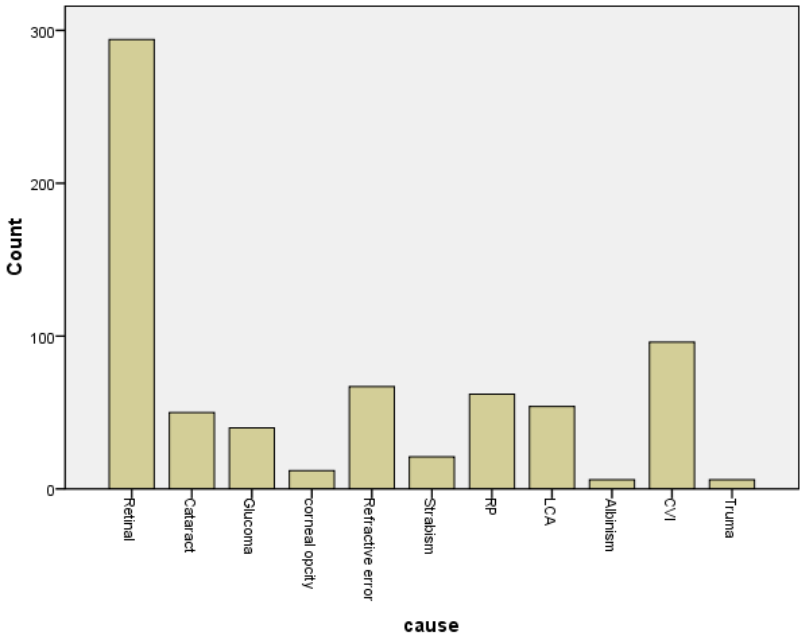

Figure 1. Frequency of diseases leading to blindness and vision impairment

11%. Regarding the type of family marriage, the results showed that maternal family marriages, i.e. cousin's son, cousin's daughter, are more than other types of marriages. The marriages of cousin's son and cousin's daughter and vice versa are also high in percent, and finally, paternal family marriages are less than the others. Another type of family marriage is the marriage of distant relatives. It has been mentioned in several sources that consanguineous marriages lead to genetic disorders, and this issue is quite obvious in the case of vision. In this study, the relationship between the type of parents' marriage and the incidence of eye disorders has been emphasized. Therefore, the results showed that out of all the participants in this project, the parents of 445 participants had a family marriage and the rest, i.e. the parents of 263 participants, did not have a family marriage. Therefore, this statistic shows a significant difference and states that the probability of family marriage leading to eye disor-

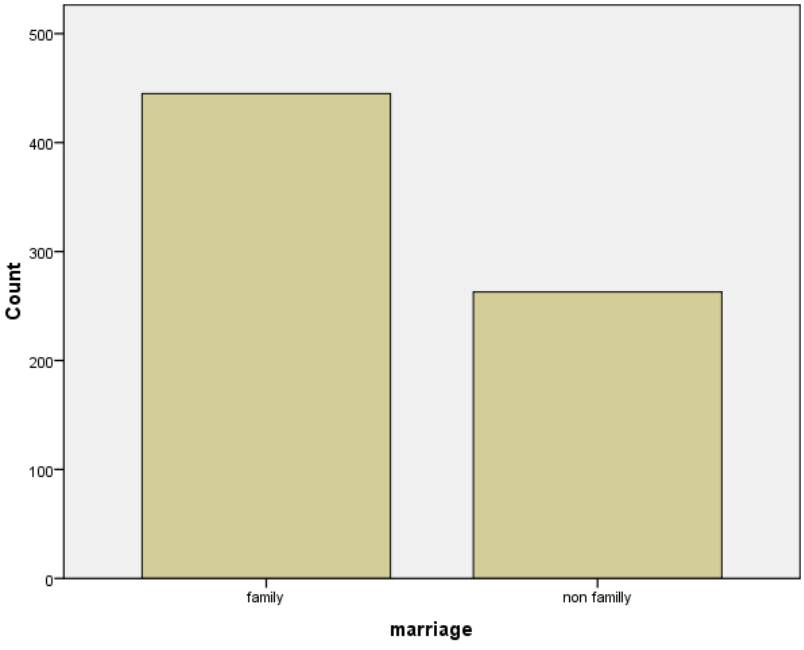

Figure 2. Marital status of parents of blind and visually impaired children in terms of family or non-family relations

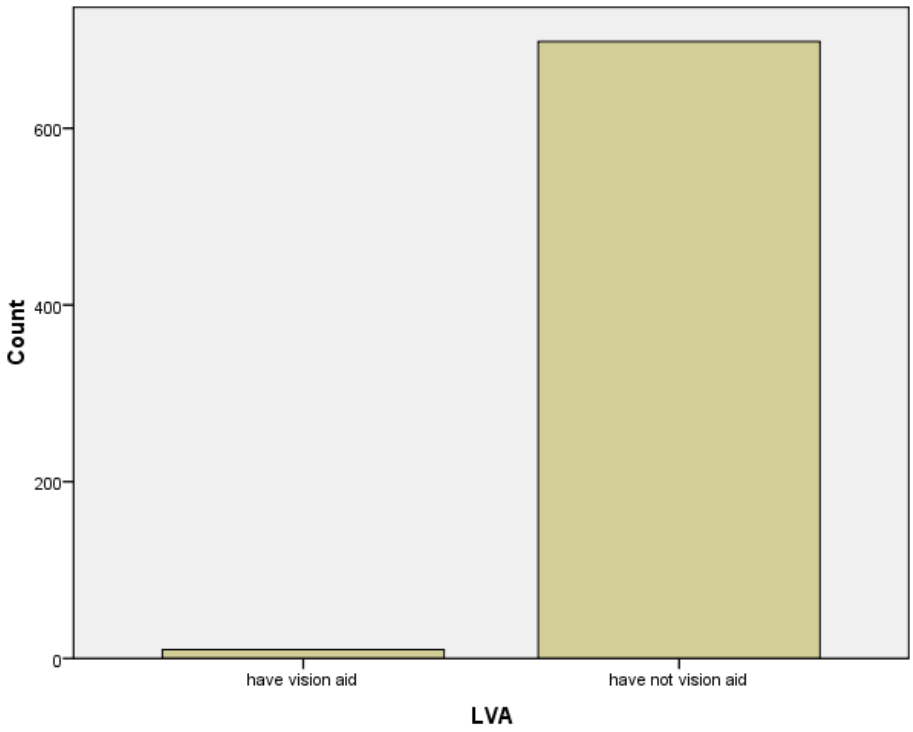

Figure 3. Having visual aids and not having these devices

ders in children is high. However, this issue needs more detailed investigations, including genetic studies.

The results showed that the majority of these children are deprived of having visual aids and using such devices and very few of them have them. Figure 3 shows this result well.

The use of visual aids, including optical and digital magnifiers, can be effective in improving near vision. Visual aids are magnifiers and by creating magnification, they can help a visually impaired person perform some close activities, such as reading and writing better. For example, a magnifying glass is a visual aid, and a visually impaired person may be able to solve some of their problems with this device. Today, the term visual aid is widely known among the visually impaired and blind population. These devices are currently not used in exceptional schools or the community. The visually impaired person should be examined by a low-vision specialist to determine whether these devices can improve vision or not.

One of the crucial results of this study showed that many blind and visually impaired children have physical movement problems and other diseases at the same time so that among the 708 shy children, 197 people have diseases other than vision.

The results showed that many visually impaired children had some degree of refractive errors. They have also appropriate eyeglasses. However, some children need new prescriptions due to changes in their refractive errors. Therefore, the prescription was made.

The educational status of the participants showed that 44.5% of people study in regular schools. A total of 31.2% of participants study in exceptional schools and 24.3% of participants have not arrived at school yet.

Based on the results of this study, 44.5 % of these children continue to study with vision despite low vision, 15% of the children study in exceptional schools with braille and 2.4% of these children study with both braille and vision.

A total of 160 participants live in Tehran Province, Iran, and 548 people live in other provinces where sampling was conducted.

Discussion

This study was conducted to investigate the causes of blindness and vision impairment in children. In addition, the following were also performed. A detailed investigation of the number of blind and visually impaired people under the age of 15 years, the cause of blindness and visu-

al impairment in the studied age groups, the role of family marriages in causing blindness and visual impairment, the level of public awareness about blindness and visual impairment, and holding appropriate training courses. By performing this project, a correct and accurate understanding of severe vision disorders (blindness and low vision) and their consequences in different aspects of life was achieved. This project increased the awareness and information of people and groups related to the blind and visually impaired, especially the employees working in government organizations and non-governmental organizations that provide services related to the issue. One of the vital actions of this team was to inform clients and their parents about the issue of blindness and low vision. For example, parents of blind and partially sighted children had many unanswered questions about their children. Many blind and partially sighted children did not have accurate information about the condition of their eyes. The information of the society regarding the recent developments in this population is very little and even very incomplete and wrong. Today, everyone asks what is an artificial eye. Where to get stem cells? What is an artificial retina? Is an eye transplant possible or not?

Therefore, in the education department, intensive meetings were held for parents of visually impaired children, and the information on this population was updated by presenting related brochures and question-and-answer sessions.

In the implementation of this study, the awareness of society about blindness and vision impairment increased, and the effort to transform schools into friendly schools for the blind and vision impairment and provide equal opportunities for these people was emphasized. It was suggested that localizing therapeutic interventions in the issue of blindness as well as increasing public participation should be seriously studied to properly manage the issue of vision impairment. It is necessary to create a suitable platform for future generations.

In this study, an effort was made to carefully examine children under 15 years of age in the whole country who have severe visual impairments and provide appropriate rehabilitation programs for their vision conditions. Due to the lack of cooperation of the relevant organizations, it was impossible to check all the provinces, and only in the Tehran, South Khorasan, and Isfahan Provinces, Iran, the examination team was arranged and sampling was done, due to the many notifications that were made, many referrals were completed from many provinces to the vision impairment center in Tehran Province, which initiated a significant number of blind and visually impaired children from all over the country to participate in this project. On the other hand, when the Jihadi camps were held by Jihadi groups, Abbas Riazi participated in these camps as an optometrist, and was able to complete another part of the sampling with this method. Therefore, sampling was done sporadically in the Kerman, Khuzestan, Sistan and Baluchistan, and East Azerbaijan Provinces, Iran. Sampling was done from Qom Province with the cooperation of one of the optometrist colleagues and many samples were referred to Tehran Province. The main examination center was the vision impairment clinic located in the rehabilitation faculty under the supervision of the rehabilitation research center. In the beginning of 2023, with the establishment of the Institute of Supporters of the Visually Impaired in Tehran Province by the project manager, more sampling was possible. Many blind and partially sighted children from different cities came to this institution and more samples were provided. On the other hand, this institution could take more samples by participating in Jihadi camps in deprived areas.

Among the causes of blindness and low vision, retinal disorders are the highest causes in these children, which are completely genetic and hereditary. These diseases cause severe vision loss and no specific treatment exists for these diseases. The causes of vision impairment in children are different in urban and rural areas, but generally and globally, the most common causes of low vision, severe vision impairment, and blindness in children are retinal disorders, glaucoma, corneal opacities (primarily caused by vitamin A deficiency), cataracts and cerebral visual impairment [23].

Our results showed that congenital retinal problems and diseases are common in a broad spectrum. So that it includes 42% of the causes of blindness and vision impairment in these children. Degenerative diseases and various retinal dystrophies are the main causes of blindness and low vision. Hereditary diseases, such as retinitis pigmentosa (RP) (9%) and Leber's congenital amorosis (LCA) were observed significantly in these children. Albinism, a congenital disease, was not very common (<1%) and attributed to a very small percentage of these causes. Refractive defects leading to vision impairment account for 9.5% of these causes. One of the rare causes of vision impairment is the causes related to the brain and visual pathways. This condition is known as cortical visual impairment and in this study, 13.6% of the causes of blindness and vision impairment were diagnosed. Cataract and glaucoma alone account for 7% of the causes of blindness and vision impairment in these children. Corneal opacity was also observed with

a prevalence of 1.7%. Non-pathogenic causes, such as trauma were observed in <1%. Considering diseases like retinitis pigmentosa (RP) and Leber's congenital amorosis (LCA) as retinal diseases, it can be concluded that the highest cause of blindness and vision impairment is hereditary retinal diseases. A study conducted in 2006 on 260 students in Mashhad City showed that the vital cause of vision loss was retinal problems (28.6%). Optic nerve atrophy, congenital cataracts, corneal opacities, congenital glaucoma, albinism, and globe problems are among others. It was also concluded that genetic disorders play a crucial role in children's vision impairment [24]. Another study was conducted from 2002 to 2003 in Tehran Province on the causes of severe vision impairment and blindness in children. A total of 362 students from three schools for the blind with an average age of 13.5 were selected at different times. Age, gender, family history of low vision, acuity, cause of vision impairment and blindness, and treatment measures were also recorded. The most common cause of vision impairment in these children was recorded. Retinal diseases were (51%). Cataracts, optic nerve atrophy, corneal and anterior chamber diseases, glaucoma, enophthalmia and eyeball structural disorders were other causes [25].

The most common cause of vision impairment in countries, such as England and America is brain and neurological disorders that affect the visual system. According to a study on vision disorders in 2000 on 493 British children, 40% of the causes of vision impairment are disorders of the cerebral visual pathways, 24% are retinal disorders (including retinopathy of prematurity [ROP], 23%), optic nerve, 6% the entire globe and anterior segment, 3% were corneal, lens and uveal defects, 2% were glaucoma and 2% were other causes [26, 27]. Vision impairment affects approximately 3 million children worldwide [28, 29]. The quality of life of visually impaired patients depends on their visual abilities. This decrease in vision negatively affects people's quality of life and causes depression increases the risk of falling and ultimately causes children's dependence and lack of independence, as well as negative effects on educational and employment issues in the future [30, 31].

Family marriage affects many polygenetic traits, such as height, size, intelligence quotient (IQ), and even cardiovascular characteristics [32]. Investigating these effects on vision and visual defects of children resulting from these marriages is of particular importance. The prevalence of this type of marriage varies according to the customs of different nationalities and ethnicities, not only in different parts of the world but also in the cities and villages of Iran. The studies conducted in the above research showed that 63% of these blind and visually impaired children were the result of parents' family marriage, which indicates a significant relationship between the occurrence of blindness and vision impairment and parents' family marriage. Regarding the type of marriages, the ratio of cousin-cousin marriages was 14% and the ratio of cousin's daughter marriages or vice versa was 16%. After that, cousin-son marriage was 20%, which constituted the highest percentage of family marriages, then far family marriage was 11%. The results showed that the marriages of the mother's family, i.e. the son of the cousin's daughter, are more than the other types of marriages. The marriages of the son of the cousin's daughter and vice versa are also high in percentage, and finally, the marriage of the paternal family is less than the others. Another type of family marriage is the marriage of distant relatives. It has been mentioned in several sources that consanguineous marriages lead to genetic disorders, and this issue is quite obvious in the case of vision.

In 1995, in a study conducted in Sri Lanka, among 226 blind students aged 6 to 15 years, Eckstein found the percentage of consanguineous marriages among the parents of these children was about 50% [32]. In 1996 in Lebanon, this amount was 28% [33], in 1985 in Saudi Arabia, it was 14% [7, 34] and in 1992 in Jordan, it was 29% [35]. In 1992, Elder obtained an average of 59% in different parts of the Gaza Strip [36]. In the study conducted by Hornby et al., which was conducted in 1999 among 1131 blind and partially sighted Chinese children aged 5 to 15 years, the percentage of family marriage was 7.3% among children living in villages and 2.8% among children living in cities [37].

In April 2002, the journal of genetic counseling reported that the average birth defect in children born to cousins is 0.2-1.1% higher than the average for children born out of wedlock [38]. According to research conducted in Iran in 2003 by Saadat et al. among 306 343 couples from 12 different ethnic groups in Iran, 38.6% of marriages were related and 27.9% of these marriages were between cousin and cousins' daughters. According to Saadat surveys, the rate of family marriage is different among different ethnic groups in Iran [39] This value was verified by Bhattacharjee in a study in the northern states of India, 6.4% among 376 blind students [40].

One of the crucial results of this study showed that many blind and visually impaired children have physical movement problems and other diseases at the same time so that among the 708 participants, 197 people have diseases other than vision. Considering that many

cases of blindness and vision impairment are related to consanguineous marriages, it is not far from the mind that other concomitant diseases may also be related to consanguineous marriages. Another crucial result of this study was that many children needed visual aids, while only 1.4% of these children had access to these devices. Another case of rehabilitation for blind and visually impaired children is darkroom training and child development center, many of these children did not have access to such facilities. In many cases where glasses were needed, the children had the right glasses.

Conclusion

The main cause of blindness and vision impairment is the presence of hereditary retinal diseases in these children. The high percentage of family marriage among the parents of these children has also increased the probability of blindness and low vision. Many of these diseases are genetic and no special treatment has been discovered for them, therefore you have to live with these conditions for the rest of your life. However, informing the families about the importance of genetic tests before marriage and investigating the possible risks resulting from it requires special attention from the responsible institutions. The lack of proper vision rehabilitation facilities in schools and children's lack of access to vision aids make the residual vision not used in the child's critical age and lost over time. Therefore, the need to expand vision impairment rehabilitation services is a necessity. For example, dark room exercises for severely visually impaired children under the age of 5 years and the establishment of a blind and visually impaired child development center are necessary to compensate for the developmental delay of these children.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of the Iran University of Medical Sciences (Code: IR.IUMS.REC.1399.728).

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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