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Prevalence and causes of visual impairment in children aged seven years and below in a tertiary eye care centre in Malaysia

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Abstract

Purpose: To determine the prevalence and causes of visual impairment among children aged 7 years and below in a tertiary eye care centre in Kuala Lumpur, Malaysia.
Study design: Cross-sectional retrospective study.
Methods: Medical records of all children aged 7 years and below who attended the paediatric ophthalmology clinic in a tertiary eye care centre in 2020 were reviewed.
Results: In 2020, 2,460 children were seen in the clinic, of whom 549 (22.3%) presented with visual impairment. At the time of presentation, 73.2% of the visually impaired children were diagnosed with blindness; of these children, 62.8% were under 1 year old. The percentage of treatable causes of visual impairment was 38.4%, while 31.1% of them were preventable. The most common causes of visual impairment were cerebral visual impairment (24.2%), congenital cataract (16.6%), and retinoblastoma (6.2%).
Conclusion: More than half of the causes of childhood visual impairment were preventable or treatable. The majority of children were under 1 year old. Cerebral visual impairment was the main cause of visual impairment. This study highlights the importance of early screening and intervention programs to prevent childhood visual impairment.

Keywords: Malaysia, paediatric visual impairment, prevalence

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Prevalens dan punca-punca gangguan penglihatan dalam kalangan kanak-kanak berumur tujuh tahun dan ke bawah di sebuah pusat penjagaan mata tertiari di Malaysia

Abstrak

Objektif: Menentukan prevalens dan punca-punca gangguan penglihatan dalam kalangan kanak-kanak berumur tujuh tahun dan ke bawah di sebuah pusat penjagaan mata tertiari di Malaysia.
Reka bentuk kajian: Kajian keratan rentas secara retrospektif
Metodologi: Rekod perubatan semua kanak-kanak yang mengunjungi klink mata kanak-kanak di sebuah pusat penjagaan mata tertiari dalam tahun 2020 dikenalpasti dan data klinikal dikaji.
Keputusan: Sebanyak 2,460 kanak-kanak telah mendapat rawatan dalam tahun 2020, di mana 549 (22.3%) kanak-kanak didapati mempunyai gangguan penglihatan. 73.2% dari kanak-kanak tersebut didapati telah dikategorikan sebagai mengalami kebutaan. 62.8% kanak-kanak dengan gangguan penglihatan adalah berumur di bawah satu tahun. 38.4% dari punca gangguan penglihatan merupakan punca yang boleh dirawat, manakala 31.1% adalah yang dapat dielakkan. Punca-punca yang paling lazim ialah gangguan penglihatan serebral (24.2%), katarak kongenital (16.6%), dan retinoblastoma (6.2%).
Kesimpulan: Lebih daripada separuh punca gangguan penglihatan kanak-kanak dapat dirawati atau dielakkan. Kebanyakan gangguan penglihatan berlaku ke atas kanak-kanak yang berumur kurang daripada satu tahun. Gangguan penglihatan serebrum adalah punca utama gangguan penglihatan. Kajian ini menekankan kepentingan pemeriksaan dan program intervensi awal untuk mencegah gangguan penglihatan dalam kalangan kanak-kanak.

Kata kunci: gangguan penglihatan, *:* kanak-kanak, Malaysia, prevalens

Introduction

Visual impairment in childhood is a serious issue that needs to be addressed worldwide. It was estimated that 1.4 million children in the world are blind, and most of these children are living in Asia and Africa.[1] Studies found that an estimated 283,151 children in South East Asia were blind in 2020, of whom 27.3% were due to lesions of the whole eye, *i.e.*, microphthalmos, anophthalmos, or disorganized

eyes.[2] Other main causes include corneal conditions (*i.e.*, scarring, staphylomas, and phthisis from ulceration), lens abnormalities (*i.e.*, cataract and complications of surgery), and retinal conditions (*i.e.*, retinopathy of prematurity and retinal dystrophies).[2]

Visual impairment in childhood has a significant impact on a child's development, academic opportunities, employment, and social life.[3] It is also associated with a considerable lifelong burden of disability and cost on the nation's economy.[4] Previous studies have found that the majority of visual impairment in childhood is either preventable or treatable.[1,5] Preventable causes of visual impairment include measles infection, vitamin A deficiency, ophthalmia neonatorum, congenital rubella syndrome, and the use of harmful traditional eye medications, whereas treatable causes of visual impairment in childhood include glaucoma, retinopathy of prematurity, cataract, and selected cases of corneal scarring.[1]

There were a few studies conducted in Malaysia that estimated the prevalence and causes of visual impairment in childhood. The study with the largest sample size was conducted in Gombak District, a suburban area near Kuala Lumpur, involving 4,634 children aged 7 to 15 years old. It was found that 17.1% of the children had visual impairment and 2% of these children were blind.[6] Another study involving 100 indigenous children found that 40.9% of them had visual impairment,[7] while two studies conducted on preschool children aged 4 to 6 years estimated that the prevalence of visual impairment was 12.5% (n = 1,287)[8] and 5% (n = 400),[9] respectively. A study including 1,398 children below 4 years of age from two public tertiary referral hospitals in Selangor, Malaysia, found that 17.38% of the children were visually impaired.[10] In all the above studies, refractive error was the main cause of visual impairment.[6-10]

In Malaysia, there are five tertiary referral centres for paediatric ophthalmology service. To date, there is no data available on the prevalence of visual impairment from paediatric ophthalmology clinics in Malaysia. Therefore, this study was undertaken to determine the prevalence of visual impairment and its causes among children who attended the paediatric ophthalmology clinic of a tertiary eye care centre in Kuala Lumpur. This centre is located in the urban area of Kuala Lumpur, the capital city of Malaysia. By identifying the avoidable causes, relevant strategies could be implemented in the community and in the primary, secondary, and/or tertiary levels of health system, which may reduce the national health care burden.

Methods

This was a retrospective cross-sectional study. The target population was children aged 7 years and below who attended the paediatric ophthalmology clinic in the eye care centre. The majority of the attending patients in the paediatric oph-

thalmology clinic in this tertiary eye care centre was referred from downstream public healthcare providers and from the private sector. A referral from health care practitioners is required for registration at the clinic, hence the number of walk-in patients is very small. This study was conducted in accordance with the Declaration of Helsinki; consent and prior ethical approval was obtained from the Medical Research and Ethics Committee of the Malaysian Ministry of Health (NMRR ID NMRR-21-1768-60877).

The inclusion criteria of this study were all children aged 7 years and below who attended the paediatric ophthalmology clinic from January 2020 to December 2020, with best-corrected visual acuity worse than 6/18 in the better eye. Exclusion criteria were patients aged 8 years and above, and children aged 7 years and below without visual impairment.

The medical records of all eligible children were assessed to extract the necessary data. Data collected included the patients' demographical data (age, gender, and ethnicity), best-corrected visual acuity, and causes of visual impairment. The definitions of visual impairment used were based on the World Health Organization (WHO) classification: mild or no visual impairment is defined as visual acuity equal to or better than 6/18; moderate visual impairment is defined as visual acuity worse than 6/18 and equal to or better than 6/60; severe visual impairment is defined as visual acuity worse than 6/60 and equal to or better than 3/60; and blindness is defined as visual acuity worse than 3/60.[11]

The ocular diagnosis was extracted from the medical records. When there were two or more causes for visual impairment, the major cause that contributed to the visual impairment was selected. For instance, if both cataract and retinal abnormality coexisted, and removal of cataract did not restore the vision, the cause of visual impairment was considered to be retinal abnormality. The diagnosis was classified according to the WHO's anatomical classification and aetiological classification.[12] The anatomical classification of causes of visual impairment includes retina, cornea, whole globe, lens, optic nerve, glaucoma, uvea, and other causes.[12] The aetiological classification includes unknown, hereditary, childhood, perinatal, and intrauterine causes.[12] No identifiable information was extracted from the medical records.

All statistical analyses were performed using the Statistical Package for Social Science (SPSS) version 20.0 (SPSS Inc., Chicago, IL, USA). Descriptive data analysis was expressed as percentages.

Results

The medical records of 2,460 patients were reviewed during the study period. There were 549 (22.3%) patients who were visually impaired. The prevalence of visual impairment in the sample population was 2.2 per thousand: 73.2% of them presented with blindness at the time of diagnosis, 25.1% had moderate visual impairment, and 1.6% had severe visual impairment.

The majority of the visually impaired children were of Malay ethnicity (70.1%), followed by Chinese ethnicity (15.9%), Indian ethnicity (11.1%), aborigines (1.5%), and foreigners (1.5%). More than half of the visually impaired children were males (64.3%). The majority of the children who had visual impairment were under 1 year old (n = 345, 62.8%) at the time of diagnosis. As age increased, the incidence of visual impairment decreased (Fig. 1).

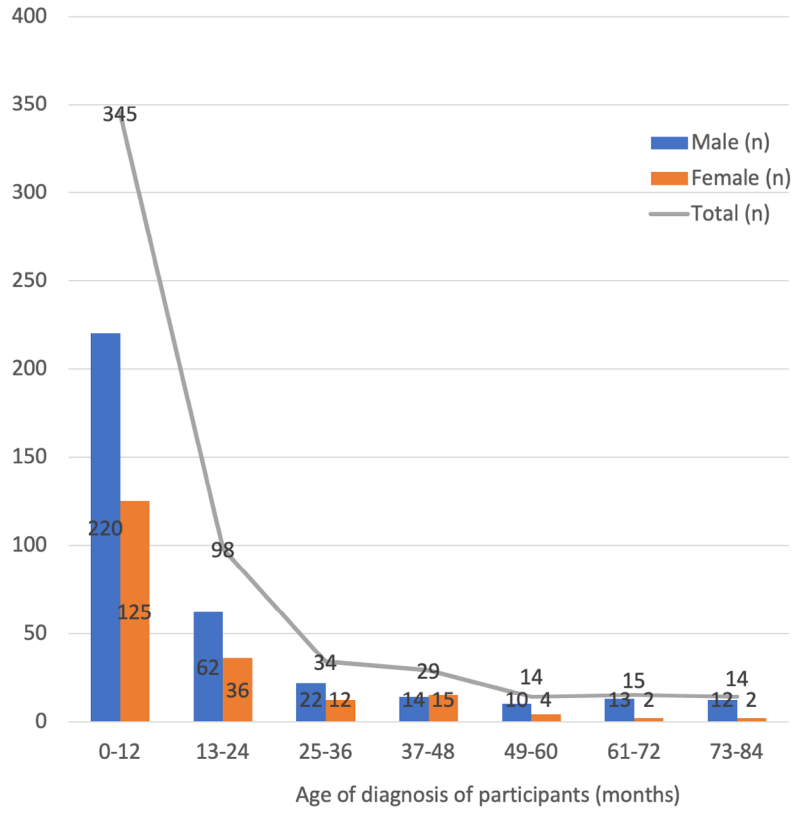

Fig. 1. Age of diagnosis and gender distribution of participants.

The primary causes of visual impairment are presented in Table 1. Most of these children had a normal eye globe (28.0%), followed by retinal causes (25.5%), and lens causes (18.9%). Using the WHO aetiological classification, 74.9% of the causes were unknown and 13.5% were childhood causes (Table 2). Of the causes, 38.4% were treatable, whereas 31.1% were preventable. Among the visually impaired children, 24.2% of them had cerebral visual impairment, 16.6% of them had congenital cataract, and 6.2% had retinoblastoma (Table 3).

Table 1. Anatomical causes of visual impairment in children

Anatomical causes	**Cases (%)**
Normal eye globe	154 (28.0)
Retina	140 (25.5)
Lens	104 (18.9)
Cornea	52 (9.5)
Glaucoma	33 (6.0)
Others	25 (4.6)
Optic nerve	23 (4.2)
Whole globe	18 (3.3)
Total	549 (100)

Table 2. Aetiological causes of visual impairment in children

Etiological causes	**Cases (%)**
Unknown	411 (74.9)
Childhood	74 (13.5)
Perinatal	27 (4.9)
Intrauterine	26 (4.7)
Hereditary	11 (2.0)
Total	**549 (100)**

Table 3. Anatomical causes of visual impairment in children

Type of visual impairment	Cases (%)
Cerebral visual impairment	133 (24.2)
Congenital cataract	91 (16.6)
Retinoblastoma	34 (6.2)
Corneal opacity with associated syndrome (anterior segment dysgenesis, Peter's anomaly, Goldenhar syndrome)	33 (6.0)
Retinal detachment	32 (5.8)
Retinopathy of prematurity (ROP)	25 (4.6)
Secondary glaucoma	20 (3.6)
Refractive error	14 (2.6)
Corneal opacity due to trauma, sclerocornea	14 (2.6)
Coats disease	13 (2.4)
Congenital glaucoma	13 (2.4)
Others	113 (20.6)

Discussion

From our study, the prevalence of childhood visual impairment aged 7 years old and below was 22.3%. This value is higher than most of the previous Malaysian studies, which are district-based and school-based. This may be due to the inclusion criteria of our study, which targeted a different sample population and age group.

As the subjects in our study were children who were referred to a specialized paediatric ophthalmology clinic from downstream healthcare institutions, the less complex or less severe cases may have been already dealt with by the primary health care providers and general ophthalmologists. This might have resulted in a discordance of prevalence of visual impairment compared to previous population studies, which were district-based (17.1%)[6] and school-based (12.5% and 5%).[8,9] The greater prevalence of childhood visual impairment in our study may also be attributed to the wider range of age, as we included children from birth to 7 years old, compared to from birth to 4 years old in a previous study conducted in two tertiary referral hospitals.[10]

Our study demonstrated a higher proportion of blindness (73.2%) at onset of diagnosis, compared to a previous study, in which most patients (49.0%) had moderate visual impairment at the time of diagnosis.[10] This might be attributed to the nature of our study site, which is the largest specialized national paediatric ophthalmology referral centre in the country; therefore, the study site might have received referrals of more complex cases with higher severity of visual impairment.

A change in the trend of main causes of visual impairment among children was noticed in this study. In our study, cerebral visual impairment (24.2%) overtook refractive errors as the main cause of childhood visual impairment, followed by congenital cataract (14.8%) and retinoblastoma (6.2%). Cerebral visual impairment is a condition in which there is damage to the retrochiasmatic pathway with normal or near-normal eye health.[13] It is often a diagnosis of exclusion, where the visual impairment could not be attributed to abnormalities in the anterior visual pathway. The above finding corresponds to a 2017 review on the epidemiology of blindness in children worldwide, which found that the most common cause of childhood blindness in middle-income and high-income countries was cerebral visual impairment.[14] Countries which have moved up from lower to middle socioeconomic strata also demonstrated a shift in the cause of visual impairment attributed to cerebral visual impairment and retinopathy of prematurity.[14] In the BCVIS2 study, the main cause of childhood visual impairment was also cerebral visual impairment (48%).[15] A recent study conducted in a tertiary eye care centre in south India also demonstrated similar results, of which cerebral visual impairment was the major cause of profound visual impairment in children below 3 years old (33%), followed by congenital cataract (13.1%), and retinopathy of prematurity (12.6%).[16]

Compared to previous Malaysian studies, the causes of childhood visual impairment were mainly refractive error and retinopathy of prematurity.[8-10,17] The low number of cases of refractive error in this study might be attributed to the nature of the study site being a national paediatric ophthalmology referral centre; hence, cases of refractive error may have been already dealt with by downstream healthcare practitioners. In this study, retinopathy of prematurity contributed to 4.6% of the causes of childhood visual impairment, which is lower when compared to previous local studies.[10,17] The reduction in the prevalence of retinopathy of prematurity might be explained by the increased efficacy of retinopathy of prematurity surveillance by ophthalmologists in the neonatal units.[18] More studies are needed to better understand the epidemiology of visual impairment of children in Malaysia.

Retinal causes were the second major cause of visual impairment in childhood (25.5%) in our study. In addition to retinoblastoma and retinopathy of prematurity, other retinal diseases include retinal detachment (5.8%), Coats disease (2.4%), persistent foetal vasculature (2.0%), familial exudative vitreoretinopathy (1.1%), macular scar (1.1%), retinal dystrophy (1.1%), vitreoretinal fibroplasia (0.4%), and Leber's congenital amaurosis (0.4%). Most of the retinal conditions are either idiopathic or hereditary, and often lead to severe visual impairment or blindness. A study on the health-related quality of life of children with hereditary retinal disorders found that children with retinal disorders reported a lower quality of life than those with congenital cataracts, likely attributed to the nature of it being untreatable *versus* cataract being a treatable condition.[19] It also demonstrated that retinal disorders led to an adverse impact on the quality of life of the entire family.[19]

These children usually require low vision aids and special assistance in schools, including front row seats, magnified fonts, and better lighting conditions.

Our study also found that the majority (62.8%) of the sample population was below 1 year of age when diagnosed with visual impairment. This corresponds to previous Malaysian studies that found that most children who are diagnosed with visual impairment are under 1 year of age (45.7%[10] and 48%,[17] respectively). Our study also demonstrated similar results to a recent study conducted in 89 hospitals and community centres across the United Kingdom, which found that the incidence of visual impairment in the first year of life was 5.19 per 10,000 children, and more than half (51%) of the children were diagnosed with visual impairment in their first year of life.[15] In our study, most of the cases of visual impairment below 1 year old were related to congenital disorders, such as congenital cataract (16.6%), corneal opacities with associated syndrome (6%), and congenital glaucoma (2.4%). Most of these cases were detected during newborn screening programs in health clinics, presenting as leukocoria, corneal opacity, and buphthalmos. Of the 91 cases of congenital cataract, ten were associated with intrauterine infection. Congenital cataract is a reversible ocular condition, which if detected and treated early, may improve the child's visual prognosis. This indicates the importance of integrating effective screening programs for visual impairment among children in their first year of life.

Among our sample population, 74.9% of the aetiologies of visual impairment were not attributed to any known cause, whereas 13.5% was attributed to childhood aetiology, including trauma, drug-induced, and infection. This corresponds to a previous nationwide Malaysian study in schools for the blind, which found that most of the causes of childhood blindness were unknown.[17] In our study, 38.4% of causes of visual impairment in childhood were treatable, whereas 31.1% of them were preventable. The treatable causes in this study include congenital cataract, corneal diseases, glaucoma, and retinopathy of prematurity, while preventable causes include trauma, drug allergy, and infection. A global epidemiological study on causes of childhood blindness demonstrated that the most common avoidable causes were retinopathy of prematurity, cataract, and corneal opacity,[14] which correlated with the findings of our study. These findings emphasize the importance of primary prevention, such as public health awareness, health parenting classes, and immunization. Secondary prevention is also crucial for early detection and intervention to reduce the lifelong burden of disability of visually impaired children.

Limitations

The results of this study should be interpreted with caution as the sample population is not representative of the entire population. Hospital-based surveys are not representative of the true prevalence of ocular diseases in the community. Asymptom-

atic patients might not present to health care institutions. However, this data can still provide valuable information on the causes of childhood visual impairment and blindness in the country, as the study site is a largest tertiary referral centre for paediatric ophthalmology service nationwide.

Conclusion

More than half of childhood visual impairment can either be prevented or treated. Cerebral visual impairment is the main cause of childhood visual impairment. This reflects the importance of primary and secondary prevention of childhood visual impairment in the country. Early screening and holistic intervention programs are crucial to prevent childhood visual impairment, especially among children below 1 year old. This could be achieved by improving awareness among paediatricians, family physicians, nurses, the public, and most importantly, among expectant mothers. Further research is required in establishing clinical guidelines to be incorporated into the national health program to reduce the national health care burden.

Declarations

Ethics approval and consent to participate
This study was conducted in accordance with the Declaration of Helsinki and, consent and prior ethical approval was obtained from the Medical Research and Ethics Committee of the Malaysian Ministry of Health (NMRR ID NMRR-21-1768-60877).

Competing interests
None to declare.

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