Original Research *Al-Razi Univ J Med Sci 2019; 3 (2)*

Al-Razi University Journal of

Medical Sciences

RUJMS

Causes of Visual Impairment and Blindness Among children in schools for the Blind in Yemen

Khalid A. Al-Mohammadi[1], Muhammad Babar Qureshi[2], Lea Hyvärinen [3], Mahfouth A Bamashmus[4*].

[1]Rehabilitation Centre for Hearing and Visually Impaired, Taiz, Republic of Yemen. [2]CBM International, Cambridge, England.[3]Faculty of Rehabilitation Sciences, Finland. [4]Eye Department, Faculty of Medicine and Health Sciences, Sana'a University, Republic of Yemen

***Corresponding author:** Dr. Mahfouth Bamashmus: email: bamashmus@hotmail.com*

Abstract

***Background:** Childhood blindness is increasingly becoming a major challenge worldwide. It is estimated that a child goes blind somewhere in the world every minute. **Aim**: To determine the causes of visual impairment and blindness in children in schools for the Blind in Yemen. Methods: Children attending 13 schools for the Blind in Yemen were examined during February and April 2009. A modified WHO/PBL eye examination record for children with blindness and low vision was used to categorize the anatomical and the etiological causes of visual loss. Data were analyzed by using the EPI-INFO 2004 programme. **Results:** A total of 453 students less than or equal to 16 years of age were examined in 13 schools for the Blind in 9 governorates of Yemen. Of the children examined, 120 (26.5%) were visually impaired (<3/9.5-≥ 3/60) and 288 (63.6%) were blind (<3/60-NLP). The major anatomical sites of visual loss were whole globe (30.0%) mainly buphthalmos, retina (26.6%), optic nerve (16.9%), lens (11.8%) and cornea (8.2%). The major etiology was hereditary in 50.0%, undetermined in 35.5% and postnatal/childhood factors in 13.5%. Nearly half of cases (49.2%) were considered to be potentially avoidable. The family history was positive in 229 (50.6%) and the products of consanguineous marriages was found in 199 (43.9%). In 39 children (8.6%), additional disabilities were present mainly mental retardation in 22 (4.9%). **Conclusions**: Hereditary diseases are the predominant causes of childhood visual loss in Yemen. Consanguineous marriages were highly observed in the parents of the children. The treatable conditions buphthalmos and cataract or poorly treated cataracts were the important leading causes of visual loss. Information about the causes of visual impairment and blindness is important for adequate provision of special services and for developing preventive strategies.*

Keywords: Etiology, Childhood Blindness, Heredity, Visual Impairment, Yemen.

Introduction

Childhood blindness remains a significant problem in many countries. There are 1.4 million blind children in the world[1] approximately 190000 of whom are the estimated blind children in Middle Eastern Crescent[1]. Visual loss in children can affect their development, mobility, education and employment opportunities[1]. Yemen is located at the southwest corner of the Arabian Peninsula. The estimated resident population in 2009 was

22,492,035 approximately 10,799,830 of whom are children less than or equal to 17 years of age which is almost 48% of the total Yemen population. The population is distributed in 20 governorates and the capital city of Sana'a[1].

Yemen is a poor country with a Human Development Index (HDI) of 0.431, which gives the country a rank of 133 out of 169 countries, placing Yemen below the average of HDI for the regional of Arab states. Life expectancy at birth of 63.9 years, multidimensional poverty index of 0.283, adult literacy rate (both sexes) of 63.2 and gross national income (GNI) per capita of 7.8[1]. Children under 5 years mortality rate is 66/1,000 live births with a rank of 48 out of 189, infant mortality rate (under 1 year) is 51/1,000 and the infant with low birth-weight is 32%[1].

There is a lack of accurate and reliable data on the causes of childhood blindness in Yemen, and only the reliable published data come from a hospital-based study on children attending an ophthalmic practice in the capital of Yemen[2] .

Aim of the study

The aim of the study was to determine the causes of visual impairment and blindness among children in schools for the blind in Yemen.

Subjects and Methods

Descriptive cross-sectional study was carried out among children attending schools for the Blind in Yemen during February and April 2009. Thirteen schools for the Blind in nine different governorates in Yemen were identified and selected in this study. The required permission for study was obtained by sending a written letter to "Child to Child Association" to the head masters of the schools for the blind outlining the purpose of the study and requesting permission to visit the schools and examine the children. The school authorities were requested to inform the parents of the children at the time of study. All students attending the schools for the blind and who were present on the days of the visit were examined and each child was seen with his or her class teacher and parent whenever possible. A brief history of the age of onset of the visual loss, family history, history of consanguinity, history of additional impairment (hearing loss/ mental retardation) and place of residence were taken by the ophthalmologist.

Visual acuity was measured by using Lea single symbol book at distance of three meters (3 m) and using near vision card 25% crowded at near of forty centimeters (40 cm) with available correction. Vision loss was classified according to the WHO categories of vision impairment[3]. The distance and near vision acuity was measured separately for each eye and with both eyes open.

Anterior segment examination was performed with a pen light and magnifying loupe. Posterior segment was examined after dilating the pupils when indicated and using a direct and/or indirect ophthalmoscope. Refraction was measured by retinoscope when possible and in case when objective refraction is not possible the refractive error estimated using subjective testing with lenses.

Intraocular pressure was measured by Shiotz when needed. Visual field was examined with confrontation test by Vice Versa.

Results of the examination were recorded and coded in the recording form of the modified WHO/PBL eye examination record for the children with blindness and low vision and used the definitions in coding instructions[3]. Conclusions was discussed and compiled by the study team.

Summary information about each child's condition was given to the school. Those children requiring further assessment or treatment were referred to local eye hospital or clinic.

Results

Thirteen schools for the Blind were identified and visited in nine governorates of Yemen and a total of 471 children aged ≤ 16 years were enrolled in the schools for the Blind, 453 were examined and 18 were absent. Among the children examined 238 (52.5%) were males and 215 (47.5%) were females. There were more females 85 (39.5%) in Sana'a governorate than in the other governorates (Table 1).

The majority 182 (40.2%) were the age of onset of the visual loss ranged from 9-12 year. Family history of the children examined was found to be present in 229 (50.6%) cases and not present in the remaining 224 (49.4%). A history of consanguineous marriage of the parents was positive in 199 (43.9%) cases, negative in 187(41.3%) cases and unknown in 67(14.8%) cases.

Majority of children 414 (91.4%) had no additional disability. Of the remaining (39 cases, 8.6%) the commonest associated disability was mental retardation in 22 (4.9%), physical handicap in 7 (1.5%), hearing loss in 2 (0.4%), epilepsy in 1(0.2%) and other disabilities in 7 cases (1.5%) (such as speech disorders). (Table 2).

Levels of WHO categories of vision for the 453 pupils that were examined in the school for the Blind are shown in Table 3. At presentation, 39 pupils (8.6%) had a visual acuity of 3/9.5 or better and therefore had no visual impairment. 80 pupils (17.7%) had visual impairment; 40 pupils (8.8%) had severe visual impairment, and 288 (63.6%) were blind(<3/60- No Light Perception NLP).

Vision tests were not performed on 6 pupils (1.3%) for lack of cooperation but other information and their diagnosis were recorded and those pupils were considered as believed blind.

Table 1: Distribution of pupils attending schools for the Blind in Yemen by governorate and gender

Governorate	Gender		Total
	Male	Female	
• Sana'a	96 (40.4%)	85 (39.5%)	181 (39.9%)
• Amran	38 (16.0%)	22 (10.2%)	60 (13.2%)
• Taiz	27 (11.3%)	28 (13.1%)	55 (12.1%)
• Al-Hodeida	27 (11.3%)	14 (6.5%)	41 (9.0%)
• Dhamar	9 (3.8%)	23 (10.7%)	32 (7.1%)
• Aden	16 (6.7%)	11 (5.1%)	27 (6.0%)
• Ibb	9 (3.8%)	13 (6.0%)	22 (4.9%)
• Hadramout	10 (4.2%)	12 (5.6%)	22 (4.9%)
• Lahj	6 (2.5%)	7 (3.3%)	13 (2.9%)
Total	**238 (100%)**	**215(100%)**	**453 (100%)**

Table 2: Distribution of pupils attending schools for the Blind in Yemen by age of onset of the visual loss and history

Variables	F	%
Age of onset of the visual loss		
• 4 to 8	127	28.0
• 9 to 12	182	40.2
• 13 to 16	144	31.8
Family history		
• Yes	229	50.6
• No	224	49.4
History of consanguinity		
• Yes	199	43.9
• No	187	41.3
• Unknown	67	14.8
History of additional impairment (hearing loss/ mental retardation)		
• Yes	39	8.6
• No	414	91.4

Table 3: Visual acuity in the better eye in children attending schools for the Blind

WHO category	Visual acuity in better eye	F	%
• No impairment	3/3 - ≥3/9.5	39	8.6
• Visual impairment	< 3/9.5 - ≥3/30	80	17.7
• Severe visual impairment	< 3/30 - ≥3/60	40	8.8
• Blind	< 3/60 - LP	94	20.8
• Blind	NLP	194	42.8
• Not tested (believed blind)		6	1.3
Total		**453**	**100**

LP= Light Perception, NLP= No Light Perception

From the 414 examined pupils who had low visual impairment and blindness, whole globe was the most frequent site of abnormality leading to visual loss, accounting for 30.0% of cases (Table 4). Of the 124 child with whole globe lesions 80 had buphthalmos. Retinal lesions were the second most frequent and were responsible for 26.6% of cases. Of the 110 children with retinal lesions 101 had retinal dystrophy mainly retinitis pigmentosa. Optic nerve lesions accounted for 16.9% of cases and were the third frequent lesions. Disorders of the lens accounted for 11.8% of cases. Untreated cataract or poorly treated cataract (aphakia and pseudophakia) accounted for 46 children. Globe appearing normal accounted for 3.4% of cases. Of the 14 child, 7 children had refractive errors mainly with myopic retinal changes and 7 children had amblyopia.

Aetiological categories of visual impairment and blindness are shown in table 5. The largest aetiological category of visual loss was hereditary factors in 50.0%, followed by could not be determined in 35.5%. In hereditary factors 203 of 207 children the underlying aetiology could not be specified (49.0%); in which there was only a positive family history of

another similarly affected individual and with insufficient information to determine the mode of inheritance. Acquired conditions of childhood factors were responsible for visual loss in 56 child.

Overall, 49.2% (204 children) in schools for the Blind lost their vision as a result of potentially avoidable causes. Preventable causes in 7.7% (32 child) and treatable causes in 41.5% (172 child). The main preventable causes were childhood meningitis which led to optic atrophy and vitamin A deficiency. Buphthalmos was the major treatable cause of visual loss followed by cataract or poorly treated cataract (aphakia and pseudophakia) and corneal dystrophy (Table 6).

Majority of children 414 (91.4%) had no additional disability. In the remaining cases (39, 8.6%) the commonest frequent additional disability was mental retardation in 22 (4.9%), physical handicap 7 (1.5%), hearing loss 2 (0.4%), epilepsy 1(0.2%) and other disabilities (speech disorders) in 7 (1.5%).

Table 4: Anatomical site of major causative pathology in children with visual impairment and blindness in schools for the Blind in Yemen.

Site of Abnormality	F	%	Causes	F	%
Whole globe	124	30.0	Buphthalmos	80	19.3
			Phthisis	12	2.9
			Anophthalmos	11	2.7
			Microphthalmos	13	3.1
			Removed	4	1.0
			Glaucoma	2	0.5
			Others	2	0.5
Cornea	34	8.2	Scar	12	2.9
			Dystrophy	13	3.1
			Keratoconus	1	0.2
			Others	8	1.9
Lens	49	11.8	Aphakia	21	5.1
			Cataract	19	4.6
			Pseudophakia	6	1.4
			Others	3	0.7
Uvea	13	3.1	Uveitis	11	2.7
			Aniridia	2	0.5
Retina	110	26.6	Dystrophy	101	24.4
			Albinism	4	1.0
			Retinopathy of prematurity(ROP)	1	0.2
			Others	4	1.0
Optic nerve	70	16.9	Atrophy	48	11.6
			Hypoplasia	22	5.3
Globe appear normal	14	3.4	Amblyopia	7	1.7
			Refractive errors	7	1.7
Total	**414**	**100**		**414**	**100**

Table 5: Aetiological classification of visual loss in children with visual impairment and blindness in schools for the Blind in Yemen.

Category	F	%	Causes	F	%
Hereditary diseases	207	50.0	Can not specify	203	49.0
			X- linked	4	1.0
Intra-uterine	3	0.7	Toxoplasmosis	3	0.7
Perinatal/neonatal	1	0.2	ROP*	1	0.2
Postnatal/childhood	56	13.5	Vitamin A deficiency	7	1.7
			Trauma	5	1.2
			Measles	2	0.5
			Neoplasm	2	0.5
			Meningitis	11	2.6
			Others	29	7.0
Cannot determine	147	35.5	Buphthalmos /Glaucoma	38	9.2
			Abnormality since birth	68	16.4
			Cataract	8	2.0
			Refractive error	7	1.7
			Others	26	6.3
Total	**414**	**100**		**414**	**100**

*ROP=Retinopathy of Prematurity**

Table 6: Avoidable causes of visual loss in children with visual impairment and blindness among 414 children in schools for the Blind in Yemen.

Preventable conditions	F	%
• Meningitis	11	2.7
• Vitamin A deficiency	7	1.7
• Toxoplasmosis	3	0.7
• Trauma	3	0.7
• Measles	1	0.2
• Other related	7	1.7
• ***Subtotal***	***32***	***7.7***
Treatable conditions		
• Buphthalmos	80	19.3
• Cataract and poorly treated cataract	46	11.1
• Corneal dystrophy	13	3.1
• Uveitis	11	2.7
• Refractive error	7	1.7
• Amblyopia	7	1.7
• Glaucoma	2	0.5
• Other lens	2	0.5
• Other whole globe	2	0.5
• Keratoconus	1	0.2
• ROP	1	0.2
• ***Subtotal***	***172***	***41.5***
Total avoidable	**204**	**49.2**

ROP=retinopathy of prematurity

Discussion

Children in the schools for the Blind may not represent blindness in children in the whole population. It is thought that in most developing countries only 10% of blind children are in Blind schools. Schools for the Blind rarely admit children of pre-school age or those with multiple disabilities in addition blind children from poor, remote rural areas are likely to be under-represented and the data are potentially biased[1].

The results of this study show the highest numbers of children examined were from Sana'a governorate 181 (39.9%). Sana'a governorate has three schools for the Blind and one of them is specialized for multi-disability children and the number of male students examined was more than female students (52.5% vs. 47.5%) despite the present of one special non-government association that supports the blind women in education development, rehabilitation and provides accommodation services. Male students tended to outnumber female students and this was also found in studies of children in schools for the Blind in India (male 61.5%,female 38.5%)[3], Saudi Arabia (male 54%, female 46%)[4], Pakistan (male 66.7%; female 33.3%)[5], China (male 65.9%; female 34.1%)[6], Ethiopia (male 64.4% ; female 35.6%)[7], Indonesia (male 57.6% ; female 42.4%)[8], Uzbekistan (male 59%; female 41%)[9], and in the Czech Republic (male 63.8%; female 36.2%)[10].

The consanguineous marriages are common and is an accepted tradition in Yemen and in other countries like Saudi Arabia (35%)[4], Pakistan (39.6%)[5] and Uzbekistan (33.2%)[9]. In the present study 8.9% of children had additional disabilities; this is because there is one center that accepts entry of the blind children with multi-disabilities. This finding is higher than other reported Blind school studies which in general does not accept students with multiple disabilities.

In our study, 39 (8.6%) child had visual acuity of 3/9.5 or better as a defined by WHO, despite the requesting a medical report of blindness. This is usually indicated that the child had uniocular visual impairment or had corrected refractive errors. Also some schools for the Blind offer free lodging and food to the children and their families; these might seek the parents to admission of their children to the school for the Blind. Admission of normal children was also found in studies of children in school for the Blind in Ethiopia (7.8%)[7], Uzbekistan (5.1%)[9] and in India (6.4%)[11].

In Eastern Mediterranean countries, the major anatomical sites of blindness in children are including retina (42.4%), lens (16.7%), globe (16.0%), optic nerve (7.4%), glaucoma (6.4%), cornea (5.8%), uvea (2.7%) and other (2.6%)[2]. In this study, whole globe (30.0%) was found to be the main anatomical site of visual loss. Within the whole globe group, buphthalmos (19.3%) (Mostly the advanced stage of congenital glaucoma) was the major cause of childhood visual impairment and blindness. This figure of buphthalmos is more than the figures in the studies carried out in China (9.0%)[6], Ethiopia (1.7%)[7], Indonesia (9.1%)[8] and in India (3.1%)[11].

The reasons may be the high rate of consanguineous marriage, poor eye care services for children and unfortunately the parents of many children with congenital glaucoma delay seeking medical advice until the disease had reached the end stage[12-13]. Retinal lesions (26.6%) mainly retinal dystrophies (24.4%) of retinitis pigmentosa were found to be the second main cause of childhood visual

impairment and blindness. This can be explained by the fact of consanguineous marriages are common in Yemen.

Retinal dystrophies are also the main causes of loss of vision in Saudi Arabia (54%)[4], Pakistan (31.3%)[5], China (15.8%)[6], Indonesia (20.6%)[8], and Uzbekistan (15.8%)[9]. Only one case of retinopathy of prematurity (0.2%) was seen in this study. This is probably the result of the much higher infant and under 5 years mortality rates in Yemen.

Optic nerve lesions (atrophy and hypoplasia) were also major causes and responsible for 16.9% of visual impairment and blindness which is higher than in Saudi Arabia (12%)[4], Pakistan (9.0%)[5], China (13.6%)[6], Ethiopia (9.8%)[7], Indonesia (6.1%)[8], Uzbekistan (6.7%)[9] and in India (10.6%; 5.4%)[3,11]. Many children gave a history of admission to hospital with fever diagnosed as meningitis before the onset of loss of vision. Due to lack of reliable medical history and records, the aetiology of optic nerve atrophy was remained unclear.

In rural Yemen the Case Fatality Rate (CFR) of childhood meningitis is 10% and the permanent neurological complications are 9.4%[12]. Still the complications of meningitis, malaria and viral encephalitis in children need further research in Yemen. In this study, the lens disorders were important causes and accounted for 11.8% of cases which is nearer to study in Indonesia (13.3%)[8] and in India (10.9%, 10.9%)[13,11] but lower than in China (18.8%)[6] and in Uzbekistan (29.1%)[9]. Untreated cataract or poorly treated cataract (aphakia and pseudophakia) were responsible for 11.1% of visual impairment and blindness. The late presentation, poor surgical skills, complications of surgery, and non-existent visual rehabilitation postoperatively could be the reasons have contributed to the visual loss in operated cataract children[14].

Corneal blindness was one of anatomical cause, being responsible for 8.2% of cases. Congenital corneal dystrophy, sclerocornea and keratectasia were most leading causes of visual loss and accounted for 5.0% of visual loss. A study in western Yemen found a high prevalence of clinical Vitamin A deficiency in children aged 1-5 years[13], however the causes of corneal blindness related to Vitamin A deficiency was under-represented in this study could be the reason behind that, the schools for the Blind were located in urbanite area of the capital city of Yemen. As known those children affected by Vitamin A deficiency are living in urban slums and poor communities in rural area[13].

Aetiological data although more difficult to obtain but are more useful for planning relevant intervention programmes. The aetiological classification of blindness in children in Eastern Mediterranean countries include hereditary diseases (55.1%), unknown (36.4%), childhood factors (6.1%), perinatal factors (1.3%) and intrauterine (1.1%)[14]. The results of this study show that hereditary factor (50.0%) was a predominance underlying aetiology for loss of vision. Unfortunately the mode of inheritance could not be specified, this is because of insufficient pedigree information to determine the mode of inheritance. This finding is similar to finding of the study done in Indonesia (42.4%)[8] and in Uzbekistan (54.5%)[9] .

In a significant proportion of cases, the underlying aetiology could not be determined (35.5%). The presence of this significant proportion of children with visual loss with unknown aetiology is consistent with the results from other studies[3,4,5,7] and reflects the limited investigations available and the

lack of examination of family members in many cases.

In this study, at least half of the children were visually impaired and blind from avoidable causes (49.9%). Preventable conditions accounted for 7.7% of cases and include meningitis and Vitamin A deficiency. These findings suggest the importance of promotion of general child health, nutrition education and early detection of eye diseases. Hereditary diseases with a high rate of consanguineous marriages could be prevented at least in part by genetic counseling and by discouragement of consanguineous marriages.

Causes which are potentially treatable were responsible for 41.5%. These include advanced stage of congenital glaucoma (buphthalmos), untreated cataract or poorly treated cataract (aphakia and pseudophakia), corneal dystrophy, uveitis, refractive error and amblyopia. The early detection, urgent referral of cases, surgery to be done by an experienced paediatric ophthalmologist, long term follow-up and management of aphakia are essential. In Yemen, there is regional variability of eye care services, with the concentration of ophthalmologists, nurses and ophthalmic beds in major population centers, and shortages in less populated areas. The ratio of ophthalmologists per population in Yemen is 1:96,000 which is lower than the desired level of 1:50,000[15].

Conclusion

The pattern of childhood blindness seen in this study almost reflects the importance of hereditary factors leading to visual loss. About half of the children lost their vision from potentially avoidable causes. The causes and problems identified indicate the necessary of both preventive public health strategies and the need for specialist paediatric ophthalmic services in the management of childhood blindness in Yemen. To address the issue of bias in this study key informant method should be used to identify the causes of blindness in children in the community. Key informant method is a method that can fulfill two important roles: providing data on the frequency and causes of blindness in children in the community and finding a large number of children who need services, whether clinical, educational, or rehabilitative by using local volunteers.

Acknowledgements

The authors are grateful to Christoffe Blindenmission (CBM) and "Child to Child Association" for their financial and logistic support of this study. We thank Miss. Reema Al-Amodi (low vision assistant) and Miss Abeer Al-Masoudi (low vision consultant) for their participation in this study. We thank all headmasters of the schools for the Blind and to all the pupils for their valuable help and consent to conduct this study. We thank Miss. Jalila Shujaldeen, the president of "Child to Child Association" for her continuous help and support.

Financial support: CBM international organization and "Child to Child Association" in Yemen

Competing Interest: No competing interests

Proprietary interest of products named: None

References

1. Republic of Yemen, Ministry of Planning and International Cooperation. Central Statistical Organization. Statistical Year Book 2017 .
2. Bamashmus M, Al-Akily S. Profile of childhood blindness and low vision in Yemen: a hospital-based study.

Eastern Mediterranean Health Journal 2010;16(4):425-428.
3. Gilbert C. Foster A. Childhood blindness in the context of VISION 2020 - The Right to Sight. Bull World Health Organ 2001; 79(3):227-232.
4. Kotb AA, Hammouda EF, Tabara KF. Childhood blindness at a school for the Blind in Riyadh, Saudi Arabia. Ophthalmic Epidemiol. 2006; 13(1):1-5.
5. Khan S J, Hassan A, Khalid L, Karim U, Hashmi E, Gul F, Jehan I. Blindness in children at the Ida Rieu School for the blind and deaf. J Pak Med Assoc. 2007;57(7):334-337.
6. Hornby SJ, Xiao Y, Gilbert CE, Foster A, Wang X, Liang X, Jing H, Wang L, Min W, Shi Y, Li Y. Causes of childhood blindness in the People's Republic of China: results from 1131 blind school students in 18 provinces. Br J Ophthalmol1999;83(8):929-932.
7. Kello AB, Gilbert C. Causes of severe visual impairment and blindness in children in schools for the Blind in Ethiopia. Br J Ophthalmol. 2003; 87(5):526-530.
8. Sitorus R, Preising M, Lorenz B. Causes of blindness at the "Wiyata Guna" school for the Blind, Indonesia. Br J Ophthalmol. 2003; 87(9):1065-1068.
9. Rogers NK, Gilbert CE, Foster A, Zahidov BO, McCollum CJ. Childhood blindness in Uzbekistan. Eye (Lond). 1999;13(1):65-70.
10. Kocur I, Kuchynka P, Rodný S, Baráková D, Schwartz EC. Causes of severe visual impairment and blindness in children attending schools for the visually handicapped in the Czech Republic. Br J Ophthalmol. 2001;85(10):1149-1152.
11. Bhattacharjee H, Das K, Borah RR, Guha K, Gogate P, Purukayastha S, Gilbert C. Causes of childhood blindness in the northeastern states of India. Indian J Ophthalmol. 2008; 56(6):495-499 .
12. Al Khorasani A, Banajeh S. Bacterial profile and clinical outcome of childhood meningitis in rural Yemen: a 2-year hospital-based study. J Infect. 2006;53(4):228-234.
13. Rosen DS, al Sharif Z, Bashir M, al Shabooti A, Pizzarello LD. Vitamin A deficiency and Xerophthalmia in western Yemen. Eur J Clin Nutr. 1996; 50(1): 54-57 .
14. Gilbert C, Muhit MA. Twenty years of childhood blindness: what have we learnt? J Comm Eye Helath 2008; 21(67):46-47.
15. Bamashmus M, Al-Akily S, Al-Barrag A. Human resources and infrastructure for eye care in Yemen: Current status. Middle East Journal Ophthalmol. 2006;13(4):154-157.