Original Article

Comparison of Refractive Error and Visual Impairment between Native Iban and Malay in a Formal Government School Vision Loss Prevention Programme

Nurul Farhana Abu Bakar[1], Ai-Hong Chen[1], Abdul Rahim Md Noor[1], Pik-Pin Goh[2]

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[1] *Department of Optometry, 17th Floor, Faculty of Health Sciences, Universiti Teknologi MARA Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia*

[2] *Clinical Research Centre, c/o Third Floor, Dermatology Block, Hospital Kuala Lumpur, Jalan Pahang, 50586 Kuala Lumpur, Malaysia*

Abstract

Background: **The epidemiological study of vision problems is important for developing national strategies for the prevention of visual impairment. There was a lack of information regarding vision problems among school children in East Malaysia. The purpose of this study was to compare the refractive errors and degrees of visual impairment between Native Iban and Malay school children who participated in a formal government vision loss prevention programme conducted in a rural area of Betong Division, Malaysia.**

Methods: **In total, 293 Native Iban and Malay school children (Standard 1, Standard 6, and Form 3) received refractive assessments by an optometrist after failing tests in the formal government school vision screening programme in 2008. A criterion for referral was a visual acuity of 6/9 or worse in either eye. Assessments of the refractive errors of the children were performed using dry retinoscopy and subjective refraction techniques at community clinics.**

Results: **The overall prevalences of refractive error and visual impairment among the sampled populations were 47.7% and 3.5%, respectively. Approximately 97.1% of reported cases were myopia. The Malay sample population was found to be more myopic than the Native Iban population (U = 8240.50, P < 0.05, r = 0.14), but no significant association was found between myopia and ethnicity (χ^2 = 2.66, P > 0.05). Both Native Iban and Malay children in education levels higher than Standard 1 were more likely to have myopia (P < 0.05). Myopia was found to be more likely to affect females than males at a statistically significant level among Native Iban children (χ^2 [1.N = 170] = 6.279, P < 0.05, odds ratio = 2.327, 95% CI = 1.184–4.575). There was no statistically significant association between visual impairment and ethnicity (χ^2 = 1.60, P > 0.05). Approximately 94.1% of children with refractive errors suffered from having either the wrong prescription (7.8%) or having uncorrected refractive errors (92.2%).**

Conclusion: **The Native Iban population was found to be less myopic than the Malay population despite having a similar frequency of myopia. The proportion of children with myopia increased with the level of education in both ethnicities. A high percentage of untreated refractive error problems among Native Iban and Malay children in the Betong Division indicates that there is a need for government intervention for the purpose of economic and healthcare improvements.**

Keywords: *child, myopia, optometry, refractive errors, visually impaired persons*

Introduction

The prevalence of refractive error varies (2.9% to 22.1%) depending on the population studied, the sample selection, and the definitions that are used for its classification (1–6). In Malaysia, refractive error became an important health issue because it was a major cause of preventable visual impairment (7), and it was the most commonly reported vision problem among Malaysian children; its prevalence ranged 5.8%–33.3% (8–11). Extensive studies of myopia were conducted due to its high prevalence and its progression that occurs along with ocular development. A higher prevalence of myopia was found among the Chinese population compared with both in Caucasian populations and in other Asian populations (1–6). Refractive error studies in Malaysia showed a similar distribution (8–14). Among children, myopia was reported to affect

the Chinese population most frequently (with a prevalence between 42.0%–45.3%), followed by Indian (15.5%–16.0%), Malay (3.5%–13.9%), and indigenous populations (1.5%). In contrast, the highest prevalence of hyperopia was reported among the indigenous population (29.4%), followed by Malay (14.3%), Indian (1.7%), and Chinese populations (0.9%).

Ethnicity, geographical location, environmental factors, and age may have contributed to the prevalence and distribution pattern of refractive errors, particularly those of myopia (1–14). When comparing the prevalences of myopia in Malays in Kelantan, in a suburban area of the Gombak District, and in Singapore, it was determined that the prevalence of myopia was somewhat higher in better socio-economic or urban locations (9). A study (14) of vision problems among members of indigenous ethnic populations in a rural area of Selangor also demonstrated a low prevalence of myopia (1.5%). These results were similar to results from studies conducted in other countries (15–17). Myopia and urban location were independent of other conventional myopia risks such as ethnicity, parental myopia, degree of near work, and outdoor activity (9,17). The lower prevalence of myopia in Australia relative to its prevalence in Asia suggested that lifestyle and schooling might influence the development of myopia (18,19). In Malaysia, The National Eye Survey 1996 (7) reported that the prevalence of refractive error in a population of young people was higher among children between 10 and 19 years old (1.4%) than it was among children younger than 10 years old (0.3%). The prevalence of myopia was reported to be lower in pre-school children, 3.5% (11), than in school-aged children, 5.4% to 33.3% (8–10). The effect of gender on the prevalence of myopia was inconclusive (6–13).

Previous studies (8,9) have also reported visual impairment (with 0.7%–2.7% prevalences) among school-aged children in Malaysia. The causes of visual impairment were amblyopia, corneal diseases, congenital anomaly, and other unexplained factors. No significant differences in visual impairment due to uncorrected refractive error were found among the Malay, Chinese, Indian, and indigenous populations in Malaysia (7).

Previous studies in Malaysia were conducted in West Malaysia (the peninsular region) and predominantly focused on 3 main ethnic groups (Malay, Chinese, and Indian). Less information about vision problems among populations in the rural areas of East Malaysia, which had a different ethnic composition, was reported. This study aimed to compare refractive error and visual impairment between Native Iban and Malay school children who participated in a formal government vision loss prevention programme conducted in a rural area of the Betong Division, Malaysia. The associations between myopia and ethnicity, gender, and level of education were also investigated. Native Iban and Malay populations are among the largest ethnic populations in East Malaysia. Data from this study will provide a valuable addition to the information about vision problems among school children in Malaysia; this information is important for both the development and enhancement of a preventative vision programme at the national level.

Materials and Methods

In 2008, a formal government vision screening programme was conducted in 105 primary schools (Standard 1 and Standard 6) and 12 secondary schools (Form 3) in the Betong Division of Sarawak, Malaysia. Children who failed the vision screening were referred to an optometrist at a community clinic for further assessment. This cross-sectional study was based on the screening data collected from August 2008 to October 2008, and the analysis included only Native Iban and Malay children. This project adhered to the ethical considerations that were put forth in the Declaration of Helsinki, 1975. Approval to conduct the visual examinations was obtained from the Betong Department of Education and the Betong Department of Health.

Malaysia comprises 2 geographically distinct areas, West Malaysia and East Malaysia, which are separated by South China Sea. West Malaysia is attached to the main continent (the peninsular region), while East Malaysia is located on the island of Borneo. Betong is a division of Sarawak, which is a state in East Malaysia. The Betong Division administrative area consists of 2 districts and 7 subdistricts. The population of the Betong Division consists of approximately 100 000 people living within a 4000 km^2 area, and it can be divided into 4 main ethnicities: Malay (51%), Native Iban (42%), Chinese (5%), and others (2%) (20).

Vision screening was conducted by assistant medical officers or nurses using Snellen visual acuity (VA) charts, and the criterion for referral to a community clinic was having a VA of 6/9 or worse in either eye. At these clinics, optometrists performed further vision assessments. Due to our study objective, only findings from VA and

refractive assessments will be reported here. VA was tested monocularly using alphabetical or tumbling E Snellen acuity charts at a distance of 6 m. Each child's refractive status was assessed using dry retinoscopy and subjective refraction. Children who did not achieve a best-corrected VA (BCVA) of 6/6 using dry retinoscopy and subjective refraction techniques were referred to an eye clinic for further evaluation. In the eye clinic, cycloplegic refraction was performed by an optometrist using 1.0% cyclopentolate; 2 drops were administered 5 minutes apart, and a 3rd drop was administered 20 minutes later. After 15 minutes, the degrees of pupil dilatation and cycloplegia were evaluated, and cycloplegia was considered to be complete when the pupil was dilated to a width of 6 mm or more (8). Myopia was defined as having a refractive error with a spherical equivalent (SE) of at least −0.50 D, and hyperopia was defined as having a refractive error with an SE of +1.50 D or more (8). Children were classified as having visual impairment if their BCVA after cycloplegic refraction was 6/12 or worse in either eye (8). Visual impairment was categorised into 3 groups: 1) bilateral visual impairment (BCVA of 6/12 in the better eye), 2) unilateral visual impairment (BCVA of 6/12 or worse in either eye), and 3) low vision (BCVA of 6/18 or worse in the better eye). The exclusion criteria included incomplete data and unavailability of a child's medical record during the study period. Children who were referred to an optometrist for reasons other than failing a VA test and children with congenital unilateral blindness or blindness due to injury were also excluded. Each child's ethnicity was determined according to his or her birth certificate.

Data entry and analysis were performed using SPSS version 15.0 (SPSS Inc., Chicago, IL, US). A non-parametric Mann–Whitney U test was used in the analysis of the degree of refractive error because the data were not normally distributed. The associations between myopia and ethnicity, gender, and level of education were investigated using logistic regressions.

Results

Demographic information about the subjects was shown in Table 1. In total, 293 children (174 Native Iban, 59.4%, and 119 Malay, 40.6%) each received a refractive assessment by an optometrist. Eight children were excluded from this study because they had incomplete medical records or failed to attend a follow-up appointment (4 cases), they had unilateral blindness (2 cases), or they were referred for reasons other than failing the VA assessment (2 cases).

The overall prevalence of refractive error in the studied population was 47.7%. In total, 132 children were found to be myopic (72 Native Iban, 60 Malay), and 4 children were hyperopic (3 Native Iban, 1 Malay). The distribution of refractive errors was shown in Table 2. The SE ranged from −0.50D to −10.50D for the myopic group and from +2.00D to +4.50D for the hyperopic group. The mean (SD) spherical equivalent in the right eyes of Native Iban and Malay children were −0.77 D (SD 1.37) and −1.12 D (SD 1.52), respectively; and in the left eyes, −0.70 D (SD 1.45) and −0.96 D (SD 1.45), respectively. A Mann–Whitney U test of the right eye data indicated that the Malay sample population was more myopic than the Native Iban sample population (U = 8240.50, P < 0.05, r = 0.14); however, no significant difference in refractive error between the 2 populations was found for the left eye.

The distribution of visual impairment among Native Iban and Malay children according to

Table 1: Demographic data of the study subjects

Level of education	Gender	Native Iban (n = 170)		Malay (n = 115)	
Standard 1	Male	18	(10.6)	8	(7.0)
	Female	19	(11.2)	9	(7.8)
Standard 6	Male	19	(11.2)	17	(14.8)
	Female	34	(20.0)	39	(33.9)
Form 3	Male	21	(12.3)	10	(8.7)
	Female	59	(34.7)	32	(27.8)

Data are presented in number (percentage).

the children's level of education, associated refractive error conditions, and severity of visual impairment was shown in Table 3. Ten children (3.5%) were unable to achieve a BCVA of 6/12 or better following assessment with cycloplegic refraction. The proportion of children with visual impairment was not found to correlate with ethnicity ($\chi^2 = 1.60$, $P > 0.05$), and all of the children with visual impairment also had refractive error problems. Children with visual impairment were found to have either anisometropia or high astigmatism. The number of children with visual impairment was relatively higher in male children than in female children, and this number was also higher among children with lower levels of education than among children in Form 3 in both ethnicities. Both cases of visual impairment in Form 3 children belonged to the Native Iban ethnic group.

Fourteen children wore corrective visual aids on the day of the examination, but 10 of them had visual acuities poorer than 6/12 while wearing their current glasses. Approximately 94.1% of children with refractive errors suffered from either having the wrong prescription (7.8%) or from uncorrected refractive errors (92.2%). The distribution of improperly treated refractive problems according to the type of refractive error, ethnicity of the child, and level of education was shown in Table 4. Two children who had incorrect prescriptions were visually impaired, and the other 8 children with visual impairment did not have any type of visual correction.

Because myopia accounted for 97.1% of the refractive errors, further evaluation of the data from children with myopia was conducted. Information regarding the ethnicity, gender, and level of education of children with myopia was shown in Table 5. Among Native Iban children, female children were 2 times more likely to have myopia than male children (χ^2 [1.N = 170] = 6.279, $P < 0.05$, odds ratio = 2.327, 95% CI.= 1.184–4.575]. Myopia was also found to be more common in children with education levels higher than Standard 1 in both Native Iban (χ^2 [1.N = 170] = 17.406, $P < 0.05$, odds ratio = 3.819, 95% CI = 1.433–10.176) and Malay (χ^2 [1.N = 115] = 9.231, $P < 0.05$, odds ratio = 6.500, 95% CI = 1.787–2.644) children.

Table 2: Distribution of refractive error in Native Iban and Malay children according to severity

Variable	Level of education	Native Iban (n = 170)				Malay (n = 115)			
		Right eye		Left eye		Right eye		Left eye	
High myopia	Standard 1	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
(>–5.00 D)	Standard 6	1	(0.6)	1	(0.59)	2	(1.7)	1	(0.8)
	Form 3	0	(0.0)	0	(0.0)	2	(1.7)	2	(1.7)
Moderate myopia	Standard 1	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
(–2.00 D to –5.00 D)	Standard 6	15	(8.8)	13	(7.6)	11	(9.5)	7	(6.0)
	Form 3	16	(9.4)	14	(8.2)	12	(10.4)	11	(9.5)
Low myopia	Standard 1	3	(1.7)	6	(3.5)	2	(1.7)	4	(3.4)
(–0.50 D to –1.75 D)	Standard 6	14	(8.2)	17	(10.0)	17	(14.7)	19	(16.5)
	Form 3	13	(7.6)	19	(11.2)	14	(12.2)	12	(10.4)
Emmetropia	Standard 1	34	(20.0)	31	(18.2)	15	(13.0)	13	(11.3)
(+1.25 D to –0.25 D)	Standard 6	23	(13.5)	20	(11.8)	25	(21.7)	29	(25.2)
	Form 3	50	(29.4)	46	(27.1)	14	(12.2)	17	(14.7)
Low hyperopia	Standard 1	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
(+1.50 D to +2.00 D)	Standard 6	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
	Form 3	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
Moderate hyperopia	Standard 1	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
(+2.25 D to +5.00 D)	Standard 6	0	(0.0)	2	(1.2)	1	(0.8)	0	(0.0)
	Form 3	1	(0.6)	1	(0.6)	0	(0.0)	0	(0.0)

Data are presented in number (percentage). Refractive errors are given in spherical equivalent.

Table 3: Distribution of visual impairment in Native Iban and Malay children according to gender, level of education, associated refractive error conditions, and severity

Variable	Native Iban (n = 170)	Malay (n = 115)
Gender		
Male	4 (2.4)	2 (1.7)
Female	3 (1.8)	1 (0.9)
Level of education		
Standard 1	1 (0.6)	1 (0.9)
Standard 6	4 (2.4)	2 (1.7)
Form 3	2 (1.2)	0 (0.0)
Associated refractive error condition		
Astigmatism (≥ 2.00 D)	4 (2.4)	2 (1.7)
Anisometropia (≥ 2.00 D)	3 (1.8)	1 (0.9)
Severity of visual impairment		
Low vision (BCVA ≥ 6/18 in the better eye)	0 (0.0)	1 (0.9)
Bilateral visual impairment (BCVA ≥ 6/12 in the better eye)	3 (1.8)	0 (0.0)
Unilateral visual impairment (BCVA ≥ 6/12 in the worse eye)	4 (2.4)	2 (1.7)

Data are presented in number (percentage). Abbreviation: BCVA = best-corrected visual acuity.

Table 4: Distribution of improperly treated refractive problems according to the type of refractive error, ethnicity, and level of education

Variable	Wrong prescription (n = 10)	Uncorrected refractive error (n = 118)
Type of refractive error		
Myopia	10 (100.0)	114 (96.7)
Hyperopia	0 (0.0)	4 (3.3)
Ethnicity		
Malay	6 (60.0)	54 (45.7)
Native Iban	4 (40.0)	64 (54.2)
Level of education		
Standard 1	2 (20.0)	8 (6.8)
Standard 6	5 (50.0)	53 (44.9)
Form 3	3 (30.0)	57 (48.3)

Data are presented in number (percentage).

Discussion

Native Iban children were found to be less myopic than Malay children, which suggested that ethnicity might have contributed to the distribution pattern of myopia. Previous researchers have suggested that differences in lifestyle between different ethnic groups might contribute to differences in the progression of myopia (19), as there is no evidence to support an association between axial length and ethnicity despite the hereditary nature of myopia (21). It has also been reported that excessive axial length is a major cause of myopia in children regardless of their ethnicity (21).

Table 5: Frequency of myopia according to ethnicity, gender, and level of education

Variable		Total	Myopia		Odds ratio	*P* value
			n	(%)		
Ethnicity						
Native Iban		170	72	42.4	1.455	0.103
Malay		115	60	52.2		
Gender						
Native Iban	Male	60	17	10.0	2.327	0.014*
	Female	110	55	32.3		
Malay	Male	35	16	13.9	1.451	0.360
	Female	80	44	38.2		
Level of education						
Native Iban	Standard 1	37	6	3.5		
	Standard 6	53	32	18.8		
	Form 3	80	34	20.0	3.819	< 0.001*
Malay	Standard 1	17	4	3.5		
	Standard 6	56	28	24.3		
	Form 3	42	28	24.3	6.500	0.010*

* Significant difference with $P < 0.05$ by chi-square test.

Despite the fact that the Malay population was more myopic than the Native Iban population, both ethnic groups were found to have similar proportions of myopia. Previous studies in Malaysia reported a relatively lower prevalence of myopia among indigenous people in a rural area (14) compared with those of other ethnicities in urban area (8–10,12,13). An increased prevalence of myopia was also found to be associated with a better socio-economic or urban location (9,15–17). Geographical location and environmental factors might predispose these 2 ethnicities to have similar prevalences of myopia. Both Native Iban and Malay children in this study lived in similar locations and were possibly exposed to similar environments. This result also supported the notion that the association between myopia and geographical location was independent of other confounding factors such as ethnicity (17).

The proportion of children with myopia was found to increase with their level of education. Children in education levels higher than Standard 1 were more likely to have myopia. These findings suggested that vision screenings in rural areas should be performed more regularly, rather than being given only to children in Standard 1, Standard 6, and Form 3 as they are in the current school health programme. Although the present approach might be adequate for children in more urban areas due to its cost effectiveness and practicality, a different approach might be more appropriate for children in rural areas because these children have limited access to eye health services. Regular vision screening allows for the early detection of vision problems that can prevent further, and possibly irreversible, vision loss.

Myopia was found to be associated with female Native Iban children; however, there was no significant association between myopia and gender in Malay children. These findings supported the varied and inconsistent outcomes of other studies (6–13). It has been suggested that different preferences between genders regarding their daily activities might influence the result more than gender itself; specifically, female children might prefer more indoor activities and tasks that require near vision than male children.

This study also revealed that 3.5% of the children were both visually impaired and had uncorrected refractive errors. The frequency of visual impairment was similar between Native Iban and Malay children, and this finding

supported a previous study (7) that suggested that visual impairment might occur in children regardless of their ethnicities.

The high percentage of improperly treated refractive error problems among school-aged children in the Betong Division of Malaysia suggested that the visual health programme should be improved. A national strategy for the ocular health programme should be more concerned with both vision loss prevention programmes, such as ocular health education and vision screening, and the improvement of eye care facilities. Otherwise, children who fail vision screenings and are diagnosed with vision problems will not be able to obtain appropriate treatment or intervention.

This study of refractive error among Native Iban and Malay children in the rural area of Sarawak, Malaysia, supports the existing data and provides information for planning improvements in the national health programme. Screening for refractive error is important for preventing visual impairment among children, but the current vision loss prevention programme may not be adequately equipped to resolve these problems. It has been suggested that screening for these conditions should initially be conducted in preschool-aged children and then regularly throughout the schooling period to prevent undetected visual impairment in children and to offer them an opportunity to receive early treatment. There is also a need to improve eye health services in rural areas; the need for better facilities and preventative strategies is particularly profound.

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Obtaining of funding: NFAB, AHC, ARMN
Provision of study materials, collection and assembly of the data, statistical expertise, administrative, technical, or logistic support: NFAB
Analysis and interpretation of the data, drafting and critical revision of the article: NFAB, AHC, PPG
Final approval of the article: NFAB, ARMN

Correspondence

Nurul Farhana Abu Bakar
B Optom (Hons) UKM
Department of Optometry, Faculty of Health Sciences
17th Floor, Building FSK 6
Universiti Teknologi MARA, Puncak Alam Campus
42300 Bandar Puncak Alam
Selangor, Malaysia
Tel: +603-3258 4310
Fax: +603-3258 4597
Email: farhana_sb@yahoo.com

References

1. Pokharel GP, Negrel AD, Munoz SR, Ellwein LB. Refractive error study in children: results from Mechi Zone, Nepal. *Am J Ophthalmol*. 2000;**129(4)**: 436–444.

2. Murthy GV, Gupta SK, Ellwein LB, Munoz SR, Pokharel GP, Sanga L, et al. Refractive error in children in an urban population in New Delhi. *Invest Ophthalmol Vis Sci*. 2002;**43(3)**:623–631.

3. Zhao J, Pan X, Sui R, Munoz SR, Sperduto RD, Ellwein LB. Refractive error study in children: Results from Shunyi District, China. *Am J Ophthalmol*. 2000;**129(4)**:427–435.

4. Maul E, Barosso S, Munoz SR, Sperduto RD, Ellwein LB. Refractive error study in children: Results from La Florida, Chile. *Am J Ophthalmol*. 2000;**129(4)**: 445–454.

5. El-Bayoumy BM, Saad A, Choudhury AH. Prevalence of refractive error and low vision among schoolchildren in Cairo. *East Mediterr Health J*. 2007;**13(3)**:575–579.

6. Giordano L, Friedman DS, Repka MX, Katz J, Ibironke J, Hawes P, et al. Prevalence of refractive error among preschol children in an urban population: The Baltimore Pediatric Eye Disease Study. *Ophthalmology*. 2009;**116(4)**:739–746.

7. Zainal M, Ismail SM, Ropilah AR, Elias H, Arumugam G, Alias D, et al. Prevalence of blindness and low vision in Malaysian population: Results from the National Eye Survey 1996. *Br J Ophthalmol*. 2002;**86(9)**: 951–956.

8. Goh PP, Abqariyah Y, Pokharel GP, Ellwein LB. Refractive error and visual impairment in school-age children in Gombak District, Malaysia. *Ophthalmology*. 2005;**112(4)**:678–685.

9. Hashim SE, Tan HK, Wan-Hazabbah WH, Ibrahim M. Prevalence of refractive error in Malay primary school children in suburban area of Kota Bharu, Kelantan, Malaysia. *Ann Acad Med Singapore*. 2008;**37(11)**:940–946.

10. Reddy SC, Hassan M. Refractive errors and other eye diseases in primary school children in Petaling Jaya, Malaysia. *Asian J Ophthalmol*. 2006;**8(5)**:195–198.

11. Hussin DA, Omar R, Knight VF. Causes of visual impairment among pre-school children in Sitiawan District, Perak, Malaysia. *Sains Malaysiana*. 2009;**38(6)**:959–964.

12. Chung KM, Mohidin N, Yeow PT, Tan LL, O'Leary D. Prevalence of visual disorders in Chinese school children. *Optom Vis Sci*. 1996;**73(11)**:695–700.

13. Mohidin N, Mohd Akhir S, Mohd Ali B, Mohammed Z, Sharanjeet K, Chung KM. The association between myopia and gender in Indian schoolchildren in Kuala Lumpur. *Jurnal Sains Kesihatan Malaysia*. 2005;**3(2)**:49–54.

14. Norlaila MD, Mohd Ali B, Mohammed Z, Bashirah I, Sharanjeet K, Mohidin N, et al. Prevalens kesalahan refraktif satu sampel populasi orang asli di Malaysia. *Jurnal Kesihatan Masyarakat*. 2002;**8 Spec**:43–45.

15. Goss DA. Development of ametropias. In: Benjamin WJ, editor. *Borish's Clinical Refraction*. 2nd ed. Philadelphia (PA): Butterworth-Heinnemann Elsevier; 2006. p. 56–92.

16. He M, Zheng Y, Xiang F. Prevalence of myopia in urban and rural children in main land China. *Optom Vis Sci*. 2009;**86(1)**:40–44.

17. Ip JM, Rose KA, Morgan IG, Burlutsky G, Mitchell P. Myopia and the urban environment: Findings in a sample of 12-year-old Australian school children. *Invest Ophthalmol Vis Sci*. 2008;**49(9)**:3858–3863.

18. Rose KA, Morgan IG, Smith W, Burlutsky G, Mitchell P, Saw SM. Myopia, life style, and schooling in students of Chinese ethnicity in Singapore and Sydney. *Arch Ophthalmol*. 2008;**126(4)**:527–530.

19. Junghans BM, Crewther SG. Little evidence for an epidemic of myopia in Australian primary school children over the last 30 years. *BMC Ophthalmol*. 2005;**5**:1.

20. Population distribution and basic demographic characteristics report 2010 [Internet]. Putrajaya (MY): Department of Statistics Malaysia; 2011 [cited 2012 Mar 21]. Available from: www.statistics.gov.my.

21. Zadnik K, Mutti DO. Incidence and distribution of refractive anomalies. In: Benjamin WJ, editor. *Borish's Clinical Refraction*. 2nd ed. Philadelphia (PA): Butterworth-Heinnemann Elsevier; 2006. p. 35–55.