Determinants of Early Refractive Error on School-Going Children (10-12 Years) in Dhaka City, Bangladesh

Tanjina Rahman[1], Sumaiya Chowdhury[2], Foyjunnaher Sultana[2], Mohammad Asadul Habib[3], Akibul Islam Chowdhury[3], Mohammad RahanurAlam[1], Tazul Islam[1]

[1]Assistant Professor, [2]Student, Department of Public Health, North South University, Bangladesh, [3]Student, Department of Food Technology and Nutrition Science, Noakhali Science and Technology University, Noakhali-3814, Bangladesh

Abstract

Background: Refractive Error is a common health issues among young school-aged children in Bangladesh. Present study focused on determinants of refractive error among school-going children (class II-V) and the associated factors.

Method: Data were collected from 200 school-going children and their parents in a cross-sectional study using purposive sampling from Cambrian School, Dhaka city. A semi-structured questionnaire was administered to collect socio-demographic, behavioral and clinical information related to prevalence of refractive error at this age of children.

Results: Study revealed that, among 200 participants, 54.5% children had refractive error and the younger a child is, the more there was possibility of having this issue. A positive association was found between meal intake, duration of using computer games or watching television and genetic factor (parents' wearing spectacles) with the occurrence of having this error in children ($p<0.05$).

Conclusion: Findings of this study revealed, unhealthy life-styles and physical inactivity at this age may lead to refractive error among school aged children and early detection with medical advice as well as life-style modification might play a significant role not only in improving children's learning ability but also in reducing the incidence of refractive error in this age group in Bangladesh.

Keywords: *Refractive Error, Nutritional deficiency,School-going children.*

Introduction

Eyes are the reflection of the spirit and the body's window to the rest of the world. The target of learning starts in youth and the exactness of a kid's vision can massively influence or adjust his/her learning limit. School going years are considered as miracle years in an individual's life just as the early stages that decide one's physical, scholarly, and personal conduct standard. Any issue in vision during early stages can hamper the scholarly turn of events, development, and execution of an individual in future life.[1] Refractive error (RE) is an important component of the priority disease "childhood blindness" (CB) within the vision 2020' initiative to eliminate avoidable blindness.[2] The World Health Organization (WHO) has internationally assessed that there are roughly 314 million individuals living with vision hindrance. The World Health Organization has prescribed to its part nations to screen grade school going youngsters with the goal that refractive mistake could be distinguished and overseen successfully.[3] Refractive blunder could be considered as an avoidable condition among different conditions prompting visual inabilities

Corresponding Author:
Akibul Islam Chowdhury
Department of Food Technology and Nutrition Science, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
Contact No.: +8801521-331515
e-mail: akibul433@gmail.com

in kids. Subsequently the VISION 2020 activity to wipe out avoidable visual deficiency has given high need to revision of refractive mistake and includes set it inside the classification of "Childhood blindness".[4]

Prevalence of refractive error in school-aged children (RESC) in numerous investigations is exceptional as they utilize various definitions, diverse estimation techniques, distinctive announcing frameworks and affiliations utilizing diverse gathering of ages. Some compared age, gender and ethnicity, others associated it with socioeconomic status, geographic areas (urban, rural) and categorised them differently.Bangladesh has an estimated of 1.3 million blind children, more than any other country in the world.[5] Even though this represents a small fraction of the total blindness, the control of blindness in children is one of the priority areas of the World Health Organization's (WHO) "Vision 2020: the right to sight" program.[6]To estimate the prevalence of blindness in Bangladesh, a survey was conducted by the National Institute of Ophthalmology (NIO) in 2002 found that 40,000 children (about 8 per 10,000 children) were blind and 1.3 million children had refractive errors.[7] In 2002, another study was also conducted among children aged 5 to 15 years in Khulna district of Bangladesh, it was estimated that the prevalence of refractive error among male and female was to be 1.1% and 0.95% respectively and low vision was 0.15%. In the same study, it was shown that the prevalence of refractive error was to be 1.38% in 11 to 15 years group children compare with 0.62% in age group 5 to 10 years.[8]

Significance of early location and treatment of visual debilitation (Refractive Error) in youngsters is significant part of our screening program. Early recognition and rectification of refractive blunder bring about an abatement in the quantity of younger students with helpless sight.[9]Visual impairment due to myopia is the commonest type of refractive error in school going children and its timely and proper correction saves permanent ocular morbidity (POM). [10]Uncorrected refractive errors are the main cause of vision impairment in children ages 5-15 years group.[11] Correction of refractive errors including provisions of spectacles even in low prevalence of reduced vision in school-age children is to be considered a public health perspective.[12]

Major causes of childhood blindness are easy to detect and approximately 40% are preventable. School children are a captive audience and can be reached more easily in comparison to general population.[13, 14] Genetic factor is the main cause of refractive error on children. Other causes of refractive error among school going children are urbanization, visual experience, life style and diet.[15] Children eating habits are important factor for developing refractive error and it is found that myopes are significantly associated eating less fresh fruits, vegetables and whole grains in their daily diet.[16] Eating processed foods tend to have low food intake of protein, fat, vitamins and minerals and increase the consumption of high content of carbohydrates, starches or sugars that favour the development of myopia.[17, 18]

Other possible reasons related to developing myopia among school going children are hectic educational schedule[19], hours of sleeping[20], spendingmore time in watching television, playing video games and computer games.[21] Children with these types of behaviours are experiencing a variety of ocular symptoms including eyestrain, tired eyes, irritation, redness, blurred vision and double vision referred as computer vision syndrome.[21] Goh *et al* suggested that the prevalence of myopia was associated with older age, female gender and ethnicity.[22]

To our knowledge, a few numbers of studies on assessment on early refractive errors on school going children has been done in Bangladesh as well as in other countries all over the world. Hence, the present study was conducted to identify the factors influencing refractive error among the students (class 3 to 5) of Cambrian School of Dhaka city and to determine whether age and gender moderate the relationship between these factors and refractive errors.

Methodology

Study Design and Settings: A descriptive cross-sectional was conducted from September 2015 to January 2016 among students from class III to class V (elementary schools) at Cambrian School, Baridhara, Dhaka.

Sample Size: The target populations were 200 school-going children (60 students from class III, 70 from class IV and another 70 students from class V). All children (class III to class V*)* and their parents were included in the study. Students who did not bring back the questionnaire on the next day of delivering questionnaire were excluded from the study. Purposive sampling technique was used to choose the study participants.

Data Collection Tools: A semi-structured questionnaire was developed for collection of required information through face to face interviews. The interview schedule was pre-tested and necessary alteration and modification was made. All answered questions were checked for incompleteness (if any), correction (if required) and internal consistency to exclude missing or inconsistent data. The questionnaire was pretested before actual data collection and was modified accordingly. After data collection, 10% of the questionnaire was re-checked for the reliability and validity of the data. The purpose of the study was to identify the determinants of early refractive error on school going children in Dhaka city through describing the interaction between socio-demographic, behavioural, and clinical factors associated with early refractive error among young school-going children.

Statistical Analysis: The statistical analysis of the data was carried out by using software program SPSS version 20 and was done by the investigator. Data was coded, checked, cleaned, and edited properly before analysis. Chi-square test was performed to see the correlation of respondent's characteristics with refractive error. Multivariate logistic regression analysis was done to identify the factors associated with refractive error.

Results

The data comprised 200 school going children (class 3 to 5) in Dhaka city. The baseline characteristics of the participants, such as gender, mother's education, father's education, monthly income, expenditure on food, daily meal intake, using computer, duration of using computer/video games/watching television, sleeping hour, physical exercise/play outside, parents using spectacles, medication are described (Table 1).Among the 200 studied school going children, 109 (54.5%) have refractive error. Parents using spectacles, medication, meal intake, duration are found significant with refractive error considering 5% significance level.

Table 1: Baseline Characteristics of the Participants (n=200)

Variables	Categories	Refractive Error		Chi-square	P-value
		Yes	No		
Gender	Male	65	49	0.462	0.497
	Female	44	42		
Mother's education	<HSC	73	56	0.424	0.515
	>HSC	36	35		
Father's education	<HSC	49	37	0.219	0.64
	>HSC	60	54		
Monthly Income (BDT)	<50,000	52	55	2.741	0.098
	>50,000	57	36		
Expenditure on Food	<20,000	67	65	1.771	0.183
	>20,000	42	26		
Daily meal intake	3 times	45	54	7.302	0.026
	4 times	25	11		
	>4 times	39	26		
Using computer/Laptop	Yes	91	74	0.046	0.829
	No	18	17		
Duration of using computer, video games or watching television	<2 hours	37	22	13.01	0.001
	2 hours	44	59		
	>2 hours	28	10		
Sleeping hour	6 hours	8	7	4.464	0.107
	7 hours	16	5		
	≥ 8 hours	85	79		

Variables	Categories	Refractive Error		Chi-square	P-value
		Yes	No		
Physical exercise/play outside	Yes	79	66	1.4041	1.00
	No	30	25		
Parents using spectacles	Yes	89	19	71.313	<0.001
	No	20	72		
Medication	Yes	58	18	22.129	<0.001
	No	51	73		

Data were collected from 200 school-going children (60 students from class III, 70 from class IV and another 70 students from class V) from Cambrian School, Dhaka.

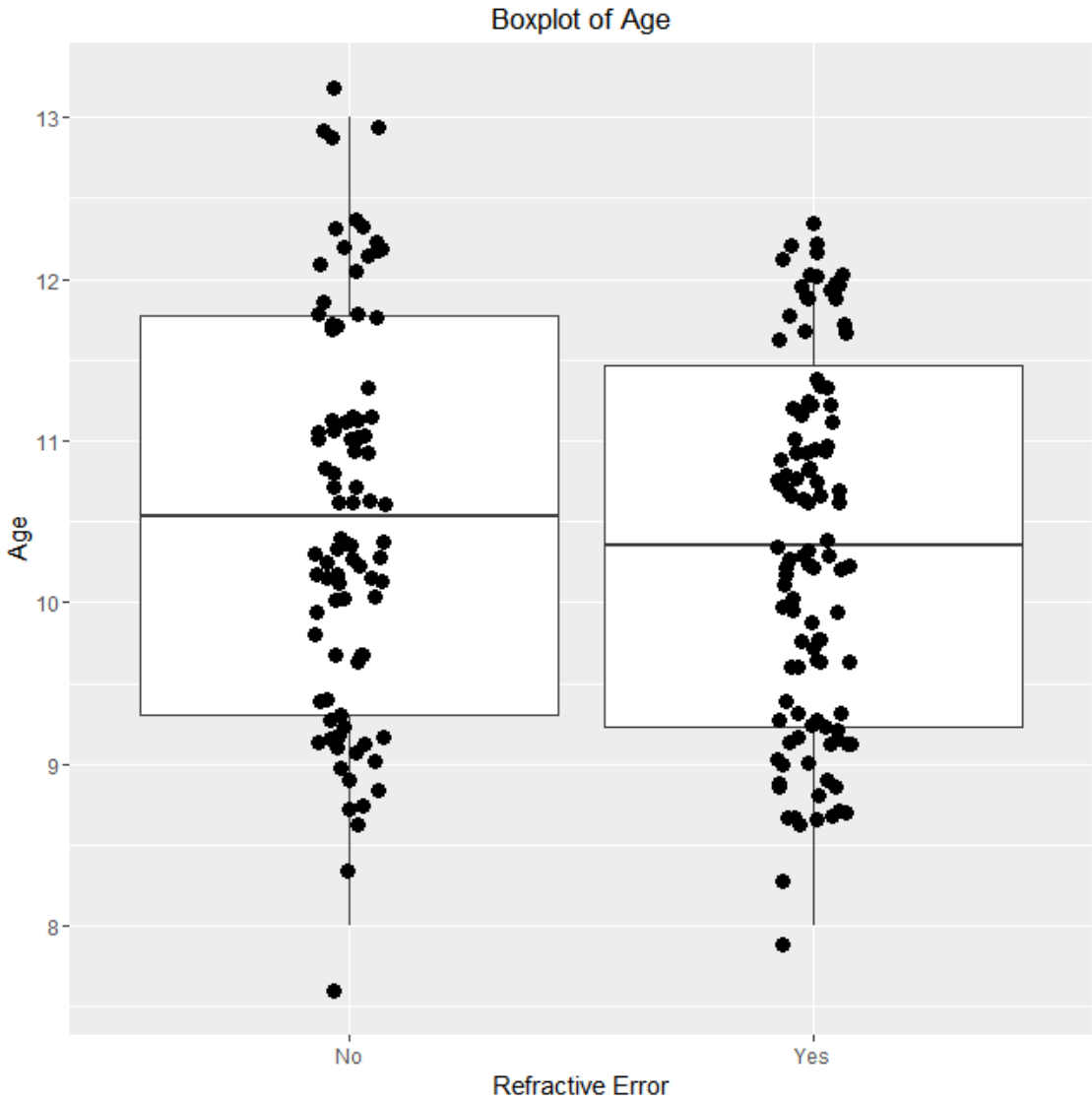

Figure 1: Interaction between age with Refractive Error

The age is considered as continuous variables and the box plots for age corresponding to refractive error are given in Figure 1. It appears from the figure 1 (boxplots for age) that younger school going children are more suffering from refractive error compared to older school going children.

Table 2: Association of Refractive Error with significant factors identified by Multivariate Logistic Regression

Significant Factors associated with Refractive Error	References	OR	LCL	UCL	P-value
Meal intake	4 times	4.879	1.28	20.549	0.024
	>4 times	0.268	0.062	1.098	0.046
Duration of using computer, video games or watching television	2 hours	0.336	0.111	0.947	0.044
Parents using spectacles	Yes	0.024	0.007	0.066	<0.001
Medication	Yes	0.067	0.019	0.196	<0.001

Data were collected from 200 school-going children (60 students from class III, 70 from class IV and another 70 students from class V) from Cambrian School, Dhaka

We fit a multivariate logistic regression model with refractive error (RE) after adjusting all the risk factors. The adjusted odds ratios (OR) for RE group is given in the Table 2. It appears that 95% confidence interval parents using spectacles (OR=0.024, CI=0.007, 0.066) is significant variable. In fact, the p-value is found <0.001 which indicates a significant relationship between parents using spectacles and RE at 5% significance level (Table 2). Again, the odds ratio explains that the odds of being RE is 0.024 times more for the parents those are using spectacles compared to the parents those are not using spectacles.

In addition, medication (0R=0.067, CI=0.019, 0.196, p-value <0.001) is significant variable. The odds ratio explains that the odds of being RE is 0.067 times more for the students having medication compared to the students not having medication. The meal intake (OR=0.268, CI=0.062, 1,098, p-value =0.046) and duration (OR=0.336, CI=0.111, 0.947, p-value =0.044) are found significant.

Discussion

The present study evaluated the prevalence of presenting refractive error among school going children and common possible factors associated with developing refractive error. In our study, refractive error among male were higher compared with female although the result was not significant. A cross-sectional descriptive study carried out among 2000 students in Bhaktapur and Lalitpur districts of Kathmandu valley examined that the prevalence of refractive error was 8.60% where the prevalence was significantly higher in female students than the male students (OR = 1.58 [95% CI 1.14-2.19]). [23]Another cross-sectional study conducted among children between 12-17 years of age in India found that 8.8% of the study population had refractive error (boys 51% and girls 49%). Myopia (7.17%) was the most common refractive error followed by astigmatism (2.17%) and hypermetropia (1.50%). This study showed that myopia is the most common refractive error (7.17%) followed by astigmatism (2.17%) and hypermetropia (1.50%)[24] although we did not measure myopia among students.

The present study did not show any significant relation between refractive error and parental education, sleep hours, expenditure on food, monthly income and using laptop/TV. Medicine use, parents using spectacles and duration of using laptop or watching TV showed significant correlation ($p<0.05$). Logistic regression analysis showed that parents using spectacles (OR=0.024, CI=0.007, 0.066, $P<0.001$) is one of the risk factors for refractive error. Previous studies showed that myopic parents can be the cause of myopia to their children.[25]

In this study, it was observed that, medication (0R=0.067, CI=0.019, 0.196, p-value <0.001) was a significant variable associated with childhood refractive error. Zhao JL, Pan XJreported that higher protein intake (OR: 0.94; 95%CI: 0.90, 0.99) and duration (OR=0.93, CI=0.89, 0.97) are significantly associated with refractive errors.[26]In our study, we had also found a positive association of refractive error with both the meal intake (OR=0.268, CI=0.062, 1,098, p-value =0.046) and duration of using computer or watching television (OR=0.336, CI=0.111, 0.947, p-value =0.044). Interestingly, prevalence and amount of myopia was associated with the self-reported intake of proteins such as milk, egg, beans and meat. This finding may be parallel to the results of study by Lim and colleagues[27], who examined 851 Chinese schoolchildren from Singapore and found that axial length was longest in the most noteworthy quartile gathering of complete cholesterol admission contrasted and the least (P=0.03)

and was longest in the most noteworthy quartile gathering of immersed fat admission contrasted and the most minimal (P=0.04).None of the nutrients, however, was associated with refractive error or a diagnosis of myopia. While the data from Lim's study may suggest that children with a higher cholesterol intake may have larger globes, potentially associated with a taller body height[28, 29], the finding of our study leads us to raise the question whether the association between meal intake and refractive error may be just another expression of the association between refractive error and educational and socioeconomic background of the parents.

In addition, It confirms recent studies by Rose et al. who found that a lower prevalence of myopia in Chinese children raised in Sydney as compared to Chinese children living in Singapore was associated with increased hours of outdoor activities[30, 31]. This group was the first to separate the effects of being outdoors and being physically active on the association with myopia. In this study, physical exercise or playing outside (p-value =1) was not significant, may be because there is limited place for physical activity in Dhaka city for this age group and our study was a cross-sectional one, rather an intervention study where majority of our participants were already having refractive error.

In our study, we found that, children with parents using spectacles were significantly more prone to have this issue in Dhaka city. Medication was also found as a significant factor associated with refractive error for the school-going children. It is not a pleasure to see children with spectacles at the age of three years and above. Out of twelve independent variables (such as gender, mother's education, father's education, monthly income, expenditure on food, daily meal intake, using computer, duration of using computer/video games/ watching television, sleeping hour, physical exercise/ play outside, parents using spectacles, medication), only four variables namely (parents using spectacles, medication, meal intake, duration of using computer/ video games/watching television) were found significantly associated with the refractive error in the study cohort. Additionally, when it comes to gender, male children are more dependent on machine-oriented activities than female children. The meal intake was also found to be significant in association with refractive errors. Therefore, we do have some limitation of this study, which may includes mall sample size, use of take-away questionnaire, lack of training among parents who filled up the questionnaire on behalf of their children, impact of missing data and time restrictions.

Conclusion

To avoid unhealthy lifestyle among children, parents may encourage their children to plan their daily time which will enable them to complete their daily task. They should take physical exercise or go outside for playing. It will help them to reduce the duration of using electronic devices. It will be also helpful for good sleep. Based on the important findings, the following recommendations are made, such as- children should take their meal properly to avoid the nutrition deficiency, duration of using computer, video games or watching television should be lessened with proper monitoring of the parents, social medias may also play a role to understand the behavioural factors and how these factors associated with early refractive errors to build up public awareness. Further study should be conducted in a larger scale in order tofind out the risk factors and draw generalization.

Ethical Approval: A standard research protocol of the Department of Public Health, North South University was followed. Written informed consent was taken from the respondents. No data was disclosed without the permission of the respondents. There was no forceful attempt to take interview of any unwilling respondent. Respondent's right to refuse and withdraw from the study anytime was accepted.

Conflict of Interests: The authors declare that they have no competing interests.

Sources of Financial Support: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Chronicle W. Data on blindness throughout the world. WHO Chron. 1979; 33: 275-83.
2. Gilbert C and Foster A. Childhood blindness in the context of VISION 2020: the right to sight. Bulletin of the World Health Organization. 2001; 79: 227-32.
3. WHO. Elimination of avoidable visual disability due to refractive errors: report of an informal planning meeting, Geneva, 3-5 July 2000. World Health Organization, 2000.

4. Resnikoff S, Pascolini D, Mariotti SP and Pokharel GP. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. Bulletin of the World Health Organization. 2008; 86: 63-70.
5. Gilbert C, Rahi J and Quinn G. Visual impairment and blindness in children. 2003.
6. WHO. Global initiative for the elimination of avoidable blindness. World Health Organization, 2000.
7. Bourne RR, Dineen BP, Ali SM, Huq DMN and Johnson GJ. Prevalence of refractive error in Bangladeshi adults: results of the National Blindness and Low Vision Survey of Bangladesh. Ophthalmology. 2004; 111: 1150-60.
8. Raihan A, Rahmatullah S, Arefin MH and Banu T. Prevalence of significant refractive error, low vision and blindness among children in Bangladesh. International Congress Series. Elsevier, 2005, p. 433-7.
9. Greenwald MJ. Refractive abnormalities in childhood. Pediatric Clinics of North America. 2003; 50: 197-212.
10. Chandra D, Swarup D and Srivastava R. Prevalence and pattern alongwith socio-economic factors of myopia in school going children-8 to 16 years. Indian journal of ophthalmology. 1982; 30: 517.
11. Dandona R and Dandona L. Refractive error blindness. Bulletin of the World Health Organization. 2001; 79: 237-43.
12. Pokharel GP, Negrel AD, Munoz SR and Ellwein LB. Refractive error study in children: results from Mechi Zone, Nepal. American journal of ophthalmology. 2000; 129: 436-44.
13. Rubin SE and Nelson LB. Amblyopia. Diagnosis and management. Pediatric Clinics of North America. 1993; 40: 727-35.
14. Rahi J, Gilbert C, Foster A and Minassian D. Measuring the burden of childhood blindness. British journal of ophthalmology. 1999; 83: 387-8.
15. Jones-Jordan LA, Sinnott LT, Manny RE, et al. Early childhood refractive error and parental history of myopia as predictors of myopia. Investigative ophthalmology & visual science. 2010; 51: 115-21.
16. Katz L and Lambert W. A New Look at Myopia Development: Possible Links With Childhood Stress & Diet. Journal of Behavioral Optometry. 2011; 22.
17. Semba RD. Nutritional Blindness (Vitamin A Deficiency Disorders). Handbook of Nutrition and Ophthalmology. 2007: 1-119.
18. Eulenberg A. The case for the preventability of myopia. University of Indiana. 1996; 3.
19. Saw SM, Hong RZ, Zhang MZ, et al. Near-work activity and myopia in rural and urban schoolchildren in China. Journal of pediatric ophthalmology and strabismus. 2001; 38: 149-55.
20. Loman J, Quinn GE, Kamoun L, et al. Darkness and near work: myopia and its progression in third-year law students. Ophthalmology. 2002; 109: 1032-8.
21. Yingyong P. Risk factors for refractive errors in primary school children (6-12 years old) in Nakhon Pathom Province. Medical journal of the Medical Association of Thailand. 2010; 93: 1288.
22. Goh P-P, Abqariyah Y, Pokharel GP and Ellwein LB. Refractive error and visual impairment in school-age children in Gombak District, Malaysia. Ophthalmology. 2005; 112: 678-85.
23. Adhikari S, Nepal BP, Shrestha JK and Khandekar R. Magnitude and determinants of refractive error among school children of two districts of Kathmandu, Nepal. Oman journal of ophthalmology. 2013; 6: 175.
24. Sethi S and Kartha G. Prevalence of refractive errors in school children (12-17 years) of Ahmedabad City. Indian journal of community medicine. 2000; 25: 181.
25. Williams C, Miller L, Gazzard G and Saw S-M. A comparison of measures of reading and intelligence as risk factors for the development of myopia in a UK cohort of children. British journal of ophthalmology. 2008; 92: 1117-21.
26. Zhao J, Pan X, Sui R, Munoz SR, Sperduto RD and Ellwein LB. Refractive error study in children: results from Shunyi District, China. American journal of ophthalmology. 2000; 129: 427-35.
27. Lim LS, Gazzard G, Low Y-L, et al. Dietary factors, myopia, and axial dimensions in children. Ophthalmology. 2010; 117: 993-7. e4.
28. You QS, Wu LJ, Duan JL, et al. Factors associated with myopia in school children in China: the Beijing childhood eye study. PloS one. 2012; 7: e52668.
29. Low W, Dirani M, Gazzard G, et al. Family history, near work, outdoor activity, and myopia in Singapore Chinese preschool children. British Journal of Ophthalmology. 2010; 94: 1012-6.

30. Rose KA, Morgan IG, Smith W, Burlutsky G, Mitchell P and Saw S-M. Myopia, lifestyle, and schooling in students of Chinese ethnicity in Singapore and Sydney. Archives of ophthalmology. 2008; 126: 527-30.

31. Rose KA, Morgan IG, Ip J, et al. Outdoor activity reduces the prevalence of myopia in children. Ophthalmology. 2008; 115: 1279-85.