Comparison of vision disorders between children in mainstream and special education classes in government primary schools in Malaysia

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INTRODUCTION The visual status of children with learning disabilities has not been extensively studied. This study aimed to compare vision disorders between children in mainstream classes and those with learning disabilities attending special education classes in government primary schools in Malaysia.

METHODS In this cross-sectional comparative study, 60 school children (30 from mainstream classes and 30 from special education classes) who were matched in age (6–12 years old) and ethnicity (Malay, Chinese and Indian) were examined. The subjects were recruited using non-probability convenience sampling. A complete eye examination was performed to detect three major vision disorders, namely refractive error, lag of accommodation and convergence insufficiency.

RESULTS The overall prevalence of refractive error, lag of accommodation and convergence insufficiency was found to be 65.0%, 43.3% and 35.2%, respectively. Convergence insufficiency (χ^2 = 24.073, p < 0.001) was found to be associated with children in special education classes. No association was found between refractive error and lag of accommodation (p > 0.05) with the type of classes.

CONCLUSION Children in special education classes are more likely to have convergence insufficiency compared to children in mainstream classes. Thus, vision screening programmes for children in special education classes may need to be modified.

Keywords: learning disabilities, refractive error, school children, vision disorders, vision screening
Singapore Med J 2012; 53(8): 541–544

INTRODUCTION

It is compulsory for children in Malaysia to receive six years of primary education. Choices of primary education include government schools, private schools or homeschooling. Government-funded primary education is free of charge. However, children who are identified by medical professionals as having learning disabilities are entitled to rehabilitative services from the Department of Social Welfare (DSW) and educational services by the Ministry of Education (MOE). DSW provides services through community-based rehabilitation programmes and institutional care, while MOE provides services through special education programmes, such as special schools and integrated programme in mainstream schools.[1]

Refractive error has been identified as a major cause of vision problems among school children in Malaysia.[2,3] The prevalence of refractive error was reported to be 20.6%–33.3%, with a higher prevalence of myopia than hyperopia.[2,3] Myopia was found to be associated with (but not limited to) age, ethnicity, schooling system and prolonged near work.[2-5] The association between hyperopia and children with learning disabilities is inconclusive.[6-9] The prevalence of refractive error was reported to be 25.0%–30.0% among children with Down syndrome in two different studies.[10,11] One study found a higher prevalence of hyperopia compared to myopia (20% vs. 10%),[10] whereas the other showed a higher prevalence of myopia compared to hyperopia (29.2% vs. 25.0%);[11] however, the low percentage of successful cycloplegic refraction (34%) limits the claims of the latter study.[11]

Evaluation of binocular vision assessment is important for children, as vergence and accommodative deficiencies are associated with poor academic performance. The prevalence of convergence disorders was found to be higher among children with autism[12] and attention deficit hyperactive disorders (ADHD).[13] Symptomatic convergence insufficiency was also reported to be associated with learning problems.[14] However, no relationship was found between accommodative facility and learning ability.[8] In another study, the amplitude of accommodation was found to be decreased among disabled readers, but there was no difference in the lag of accommodation and accommodation facility.[9] The lag of accommodation was reported to be increased in children with a higher degree of myopia.[15-17]

Studies on vision problems among normal school children[2,3,18] as well as among children with Down syndrome have been published,[10,11] but reports on vision disorders affecting children with other types of learning disabilities are lacking. This study aimed to compare vision problems between children in

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Table I. Demographic data of patients (n = 60).

Demographic	No. (%)
Age (yrs)*	
6	2 (3.3)
7	8 (13.3)
8	0 (0.0)
9	14 (23.3)
10	12 (20.0)
11	14 (23.3)
12	10 (16.7)
Ethnicity†	
Malay	48 (80.0)
Chinese	4 (6.7)
Indian	8 (13.3)
Gender†	
Male	33 (55.0)
Female	27 (45.0)

*Aged 6 years 1 day to 12 years 11 months 30 days based on birth certificates.
†As stated in birth certificates.

mainstream classes and children with learning disabilities attending special education classes in integrated government primary schools. The latter group may have less severe learning disabilities and different characteristics of vision problems compared to children with learning disabilities in rehabilitation centres.

METHODS

In this cross-sectional comparative study, 60 school children (30 from mainstream classes and 30 from special education classes) aged 6–12 years were recruited. The subjects were matched in age and ethnicity, and were selected using non-probability convenience sampling from four primary schools in Kuala Lumpur. Children in special education classes were classified as children with learning disabilities by the MOE, Malaysia, and included children with Down syndrome, mild autism, ADHD, attention deficit disorders (ADD), mild mental retardation and specific learning disabilities such as dyslexia.[19] This study was approved by the Research Ethics Committee, Universiti Teknologi MARA, Malaysia in accordance with the Declaration of Helsinki of 1975. Informed consent was obtained from the children's parents prior to this study.

Detailed eye examinations were performed by an optometrist in order to detect three types of vision disorders, namely refractive error, lag of accommodation and convergence insufficiency. Dry retinoscopy and subjective refraction were performed in refractive assessment, and visual acuity (VA) was assessed using either the modified Early Treatment Diabetic Retinopathy Study with Sloan letters (catalogue C110, Lighthouse International, New York, NY, USA) or Cambridge Crowding Cards (catalogue 4116022, Clement Clarke International, London, UK), according to the children's abilities. The assessment of convergence insufficiency included prism cover test, step vergence test and near point of convergence using the Royal Air Force rule (model CE 0120, Clement Clarke International). Monocular estimated method (MEM) retinoscopy was performed for the evaluation of lag of accommodation.

Table II. Information on refractive error, lag of accommodation and convergence insufficiency of all the children.

Vision disorder	No. (%)	Odds ratio	p-value (χ2)
Refractive error (n = 60)			
Mainstream	22 (36.6)	2.103	0.176
Special education	17 (28.3)		
Lag of accommodation (n = 60)			
Mainstream	14 (23.3)	1.312	0.600
Special education	12 (20.0)		
Convergence insufficiency (n = 54)*			
Mainstream	2 (3.7)	0.029	< 0.001
Special education	17 (31.5)		

*Six children were excluded from evaluation as they had strabismus.

Myopia was classified as spherical equivalent of at least −0.50 dioptre (D), hyperopia as +1.50D or more in either eye,[2] and lag of accommodation if MEM retinoscopy results show > +0.75D.[20] The subject was classified as having convergence insufficiency based on at least two of three signs: exophoria at near of at least 4 prism dioptres (Δ) greater than the distance heterophoria; insufficient positive fusional vergence (failing Sheard's criterion of at least 15Δ to base-out break); and near point of convergence > 7.5 cm break or 10.5 cm recovery.[21]

Statistical analysis was performed using the Statistical Package for the Social Sciences version 15.0 (SPSS Inc, Chicago, IL, USA). Non-parametric test was used in the analysis of the amount of refractive error, as the data was not normally distributed. The association of refractive error, lag of accommodation and convergence insufficiency with type of classes was investigated using logistic regression. A child who was diagnosed as having low vision or blindness was excluded from this study. Children who were sick on the day of the eye examination or unwilling to undergo the examination due to fear were also excluded even if their parents had authorised the examination.

RESULTS

All 60 subjects attended the eye examination. The demographic data of the children are shown in Table I. Children in special education classes comprised slow learners or those with minimum intellectual impairment (30.0%), ADD/ADHD (26.7%), Down syndrome (23.3%), cerebral palsy (6.7%), dyslexia (6.7%) and autism (6.7%). The distribution of vision disorders among children in mainstream classes and special education classes is shown in Table II. The prevalence of refractive error, lag of accommodation and convergence insufficiency in this study population was 65.0%, 43.3% and 35.2%, respectively. Approximately 94.8% of refractive error was myopia, while about 5.2% was hyperopia. Mean spherical equivalents of the right eye for children in mainstream classes and special education classes were −0.64D ± 1.80D and −0.95D ± 2.31D, respectively, and those for the left eye were −0.75D ± 1.57D and −0.73D ± 2.71D, respectively. Mann-Whitney test showed no significant difference in the total mean refractive error between the two types of classes for both eyes ($p > 0.05$).

Children in special education classes are more likely to have convergence insufficiency compared to those in mainstream classes [χ^2 (1.N = 54) = 24.073, $p < 0.001$, odds ratio 0.029, 95% confidence interval 0.005–0.158], while refractive error and lag of accommodation were not found to be associated with the type of classes the children attended. Six children from the special education classes were excluded from the evaluation of convergence insufficiency, as they were found to have strabismus.

DISCUSSION

Ethnicity, age and other environmental factors[2-5] might contribute to the prevalence of refractive error, but not the learning ability of children. Refractive error among school children in this study population was not found to be associated with the type of classes they attended, since all the children were matched in age, ethnicity and attended similar schools. Previous studies conducted in age-matched subjects have shown similar findings,[8,9] whereas studies that compared different age groups showed contradictory results.[22]

Different exposure to vision tasks may have contributed to the different patterns and distributions of refractive error. For example, in rehabilitation centres, children may receive more training on performance of daily living activities, while those in primary schools have to learn how to read and write. Although hyperopia has been reported to be more common than myopia in children with learning disabilities[7,10] due to the failure of emmetropisation,[7] children involved in these studies were recruited from both rehabilitation centres and primary schools. In contrast, the present study found that myopia is the most common refractive error problem for both groups of children, which is similar to the results of previous studies involving children with learning disabilities in regular schools.[8,9] There was no significant difference in the total amount of refractive error between children in mainstream and special education classes, suggesting that myopia progression may be the result of learning activities that involve more near-vision tasks in the regular school system.[5]

Refractive status may generally be associated with the lag of accommodation in children rather than learning ability.[15,16] As previously reported by Evans et al, the lag of accommodation was not found to be associated with the learning ability of the children.[9] A high prevalence of myopia may have contributed to the high prevalence of lag of accommodation found among children in both types of classes.[15,16] However, this may not represent a causative relationship, as a recent study reported that changes in the accommodative lag were only found in children after the onset of myopia, suggesting that the lag of accommodation is likely a consequence of, rather than a predictive factor for, myopia.[17]

Convergence insufficiency is more likely to affect children in special education classes, as supported by previous research.[12,13] This vision disorder may be caused by medications, as reported in children with ADHD,[23] or due to the increase in interpupillary distance, which is associated with ADHD and Down syndrome.[13,24] Although the loss of concentration seen in autism and ADHD may be confused with a breakdown of existing exophoria in convergence insufficiency, further evaluation is required if it is associated with symptoms. Therefore, screening for convergence insufficiency should be considered in children with learning disabilities, as the presence of visual symptoms may affect their learning and quality of life.[14]

In conclusion, children in special education classes are more likely to have convergence insufficiency compared to those in mainstream classes. However, they have an equal likelihood of developing refractive error and lag of accommodation problem as children in mainstream classes. Thus, modifications to the current vision screening programmes may be required for children in special education classes.

ACKNOWLEDGEMENTS

We would like to thank the Director General of Health, Malaysia for the permission to publish this paper and Research Management Institute of Universiti Teknologi Mara (UiTM) for the Excellence Fund grant. We are also grateful to the Ministry of Education, Malaysia and Department of Optometry, UiTM for their assistance in this project.

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