Vision Screening in Schoolchildren: Two Years Results

Napaporn Tananuvat MD, Anita Manassakorn MD*,
Apaporn Worapong BS*, Jarassri Kupat BA*,
Jenjitr Chuwuttayakorn MD*, Sopa Wattananikorn MD*

** Department of Ophthalmology, Chiang Mai University*
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Objective : *To assess the prevalence of visual impairment and ocular abnormalities among schoolchildren in Chiang Mai.*
Design : *A community-based survey.*
Subjects and Method : *The vision screening project was conducted from June 2000 to March 2002. Students in grade I in the Chiang Mai municipal area were examined for visual acuity (VA), color vision, ocular alignment, anterior segment and fundus. Subjective refraction was done in students with subnormal vision (VA 20/30 or less). Referral to the hospital for further evaluation and treatment was made for students with strabismus, amblyopia and other ocular abnormalities.*
Results : *A total of 3,431 and 3,467 students were enrolled in 2000 and 2001, respectively. The prevalence of normal vision (VA 20/20), VA 20/30 or better in at least one eye and 20/40 or less in at least one eye were similar in both years (87%, 5.7%, 7.3% and 85%, 6.4%, 8.7%, respectively). There was no statistically significant difference in visual acuity among boys and girls in either year (p = 0.6 and p = 0.2). Prevalence of abnormal color vision was 4.2%. Other causes of visual impairment in both years included strabismus (1.5% and 6.2%), amblyopia (1.1% and 1.4%) and some congenital abnormalities. Most cases of amblyopia were due to uncorrected refractive errors.*
Conclusion : *The authors found that over 10% of school-aged children had subnormal vision. The important causes of visual deterioration came from refractive errors, strabismus and amblyopia. The authors concluded that vision screening is a cost-effective way of reducing visual morbidity from preventable visual impairment, which is a tragedy that cannot be ignored.*

Keywords : *Vision screening, Refractive error, Schoolchildren, Amblyopia, Strabismus*

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Visual disorder is the most prevalent handicap in children. Important vision disorders include amblyopia, strabismus, significant refractive error, ocular disease, and color vision deficits. Amblyopia, one of the functional consequences of different types of visual deficits, is generally defined as uniocular or less commonly binocular decreased of best-corrected visual acuity that cannot be attributed directly to the effect of any structural abnormality of the eye or the posterior visual pathway. Although the neurophysiologic mechanism that underlies amblyopia is far from clear, animal research indicates that cortical plasticity is limited to a period early in life[1]. Calling for early screening and treatment of these disorders would ultimately maximize a child's visual potential.

Vision screening to detect eye problems has been recommended as a cost-effective way to identify children who would benefit from further vision care[2]. Recommendations for health-related screening programs, developed by the World Health Organization[3], require that a disorder suitable for mass screening should have a high prevalence in the population, result in significant impairment to the individual, and be treatable at the time of its detection.

Correspondence to: Tananuvat N, Department of Ophthalmology, Chiang Mai University, Chiang Mai 50200, Thailand. Phone: 0-5394-5512 Fax: 0-5321-7144, E-mail: ntananu@mail.med.cmu.ac.th

Vision screening has been mandated for many years as part of several federal programs in many developed countries[4,5].

In Thailand, vision screening for school-children has been recommended by the Ministry of Public Health, however, implementation has lagged. The authors hereby present results from a vision screening program carried out among school-aged children in grade I in the Chiang Mai Municipal area.

Subjects and Method

The Vision Screening Project was conducted by the Department of Ophthalmology, Chiang Mai University from June 2000 to March 2002 to screen eye problems in school-aged children. The subjects were students in grade I, aged 6-7 years old, in the Chiang Mai municipal area. There were 20 primary schools enrolled in this project. Information sheets were sent to the student's parents and informed consent for examination was obtained. The screening team included ophthalmologists, orthoptists and ophthalmic assistants.

The testing and examination protocol included visual acuity (VA) measurements, ocular motility and alignment evaluation, color vision testing, the external eye, anterior segment and fundus examination. Autorefraction and subjective retinoscopy were selectively done in students with subnormal vision (VA of 20/30 or less in at least one eye) (Fig. 1).

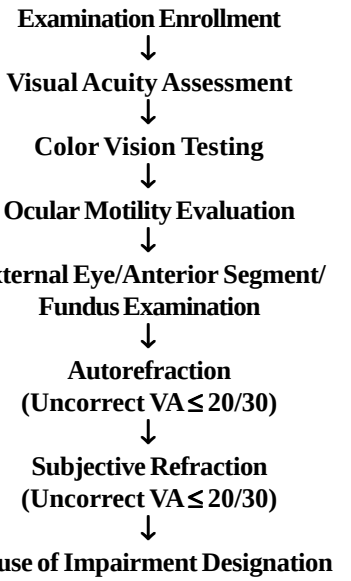

Fig. 1 Ophthalmic Examination Flow Diagram

Distance visual acuity was measured with a retro-illuminated Snellen's chart, with numbers on each line. If the student was illiterate,the tumbling "E" game was used. The right eye was tested first, then the left one, occluding the fellow eye each time. Pin-hole visual acuity was measured if a subnormal VA was obtained first, either without or with glasses.

Color vision was tested by Ishihara pseudochromatic plates. Abnormal color vision was considered if the student could read less than 8 of 12 plates.

Strabismus was diagnosed with cover and alternate cover tests, and then quantified with corneal light reflex both distance and near. The external eye, anterior segment and fundus were examined using a penlight and direct ophthalmoscope. Specific abnormalities were noted.

Manifest autorefraction was carried out in the students with an uncorrected or undercorrected VA of 20/30 or worse in either eye using a hand-held Retinomax K-plus (Nikon Corporation, Tokyo, Japan). Subjective refraction was performed in the students with an uncorrected or undercorrected VA of 20/40 or worse in either eye, using the autorefraction value as a starting reference. A prescription for spectacles was given if subnormal vision was caused by a significant refractive error.

After the screening process was completed, the results of the examination were sent to the student's parents. Arrangements to attend the hospital were made for students with strabismus, amblyopia or other ocular abnormalities for further evaluation and treatment.

Amblyopia was defined as a difference in visual acuity of one line or more between eyes with best-correction and no appearance of an organic lesion. Visual acuity among boys and girls in each year were compared by the Chi-square test. Epi info and SPSS programs were used for data analysis.

Results

A total of 3,431 and 3,467 students were enrolled in the year 2000 and 2001, respectively. In each year, the prevalence of normal vision (VA 20/20), VA 20/30 or better in at least one eye, VA of less than 20/30 in at least one eye was 2,988 (87%) and 2,945 (85%), 195 (5.7%) and 221 (6.4%), 248(7.3%) and 301(8.7%) respectively. There was no statistically significant difference between the range of VA in both years (P-value = 0.6 and 0.2), which was the same as

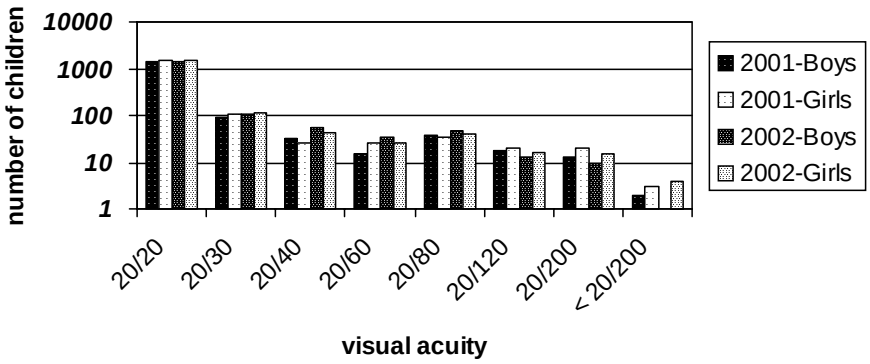

Fig. 2 Visual Acuity among Boys and Girls in Two Years

the prevalence between boys and girls in both years, as shown in Table 1, and Fig. 2.

There were 12 of 15 students with corrective spectacles in the first year and 26 of 35 in the second who had VA of 20/30 or worse in at least one eye.

In the year 2000, amblyopia was found in 38 of 3,431 students (1.1%). Thirty four of 38 (89.4%) were due to refractive error, and the other causes were strabismus (1/38), ptosis (1/38) and nystagmus (2/38). In the year 2001 we found that amblyopia occurred in 49 of 3,467 children (1.4%). Among these students, at least 35 of 49 (71.4%) demonstrated refractive amblyopia, which was the most common cause. The type of amblyopia could not be identified in the remaining 14 children who had appointments at the hospital, because they were lost to follow up.

Other ocular abnormalities in the year 2000 and 2001 are demonstrated in Table 2. Among which, strabismus was the most common cause of the ocular abnormalities. Table 3 demonstrates the different types of strabismus. Students with heterophoria and heterotropia were 19 and 31, 181 and 35 in the first and second year respectively. Exodeviation was the most common type of strabismus in each year.

Color vision examination was performed in 3,056 students in the year 2001. Two thousand nine hundred and twenty eight students (95.81%) were found to have normal color vision, but 128 students (4.2%) demonstrated abnormal color vision. Among the students with abnormal color vision, 114 (3.7%) were boys and 14 (0.5%) were girls (Table 4).

Discussion

Clinical evidence suggests that refractive errors, along with amblyopia and strabismus, are common in children. Refractive error can place a substantial burden on the individual. School-aged children constitute a particularly large group, because uncorrected refractive errors may have a dramatic impact on learning capacity and educational potential. Still, it is difficult to fully evaluate the impact of refractive errors or amblyopia on individuals and the

Table 1. Results of visual category among male and female schoolchildren in two years

Visual acuity	2000			2001		
	Boys (%)	Girls (%)	Total (%)	Boys (%)	Girls (%)	Total (%)
20/20, both eyes	1,420(41.39)	1,568(45.70)	2,988(87.09)	1,410(40.67)	1,535(44.27)	2,945(84.94)
≥ 20/30, one eye	91(2.65)	104(3.03)	195(5.68)	107(3.09)	114(3.29)	221(6.38)
< 20/30 to ≥ 20/40, worse eye	33(0.96)	25(0.73)	58(1.69)	53(1.53)	42(1.21)	95(2.74)
< 20/40 to ≥ 20/60, worse eye	15(0.44)	25(0.73)	40(1.17)	35(1.01)	25(0.72)	60(1.73)
< 20/60 to ≥ 20/80, worse eye	38(1.11)	35(1.02)	73(2.13)	47(1.36)	41(1.18)	88(2.54)
< 20/80 to ≥ 20/120, worse eye	18(0.53)	21(0.61)	39(1.14)	13(0.37)	16(0.46)	29(0.83)
< 20/120 to ≥20/200, worse eye	13(0.38)	20(0.58)	33(0.96)	10(0.29)	15(0.43)	25(0.72)
< 20/200, worse eye	2(0.05)	3(0.09)	5(0.14)	0(0.00)	4(0.12)	4(0.12)
Total	3,431		3,431	3,467		3,467

Table 2. Other ocular abnormalities

Ocular abnormalities	2000	2001
Strabismus	50	216
Eyelid abnormalities	6	3
Congenital cataract	1	0
Nystagmus	2	1
Pseudophakos	1	0
Retionopathy of prematurity	1	0
Optic disc anomaly	0	1

Table 3. Types of strabismus

Types of strabismus	2000	2001
Exophoria	19	142
Esophoria	0	39
Intermittent exotropia	7	8
Exotropia	12	17
Esotropia	11	7
Hypertropia	1	2
Total	50	216

Table 4. Results of color vision examination

Color vision score	number of children (%)
≥ 8/12	2,928(95.81)
4-7/12	48(1.57)
1-3/12	41(1.34)
0/12	39(1.28)
Total	3,056(100)

community. Data from the Australian Blue Mountain Eye Study showed that 2-line reduction in visual acuity is associated with a 1.6 fold increased risk of car accident[6]. In children, there is evidence that school performance based on reading is not impaired by amblyopia, when intelligence is controlled, although parents report otherwise[2]. On the other hand, it is reported that amblyopes are more than twice as likely than the general population to lose vision in the healthy eye, due, in more than half the cases, to work-related trauma[7].

Recently, the World Health Organization introduced the global initiative, known as "Vision 2020", for elimination of avoidable blindness by the year 2020. Refractive errors, one of the five priority areas for vision 2020, has been chosen in part because they are so very common, and because corrective spectacles provide a remedy that is inexpensive, effective, and associated with a huge functional improvement[8,9].

Despite the recognized importance of correcting refractive errors in children, population-based data on this issue are limited. Moreover, there is a large global variation in the prevalence of refractive error. Recently, there has been a multi-country survey of refractive errors in children in Chile, China, and Nepal[10-13]. The studies have been conducted in selected age groups of children. These data revealed that there are very significant geographic differences in the prevalence of refractive errors. The prevalence of an uncorrected visual acuity of 20/40 in at least one eye was 15.8%, 12.8% and 2.9% in Chilean, Chinese, and Nepalese children, respectively. The main cause was due to refractive errors (56.3%, 89.5% and 56%, respectively) and myopia was the principal type. In 5 -year-old children, the prevalence of myopia was 3.4% in Chile and less than 3% in Nepal. Data is not available for that age cohort of Chinese children. The prevalence of myopia did not increase with age in Nepal, but it did increase in Chile and staggeringly in China (19% and 15%, 37% and 55% in boys and girls aged 15 years old in the last two groups, respectively). An ophthalmic survey conducted in India found that 13.2% of schoolchildren aged 4-12 years had a vision of less than 20/20 in one or both eyes, and 22.9% were caused by refractive errors[14].

In Thailand, there have been a few studies regarding refractive errors in schoolchildren. One survey on visual function among primary school-children, aged 6 to 15 years[15] found that 15.8% had hyperopia and 11.6% had myopia, while another study[16] demonstrated that hyperopia exceeded myopia (61.3%, and 12.6%, respectively). The prevalence of amblyopia was 2% in the former study and 1% in the latter. The difference in prevalence of refractive errors in both studies may be partly due to the difference in population and methods of measurement. As noted, it remains particularly difficult to compare the prevalence of refractive error in each study for a number of reasons: definition of emmetropia, myopia, and hyperopia are not uniform across studies; procedures used for assessment and representative populations also contribute to possible error. Depending on the visual criteria used, the prevalence of amblyopia reported in the literature varied from 1-4%[2]. The present study demonstrated that the prevalence of visual acuity of 20/40 or worse in at least one eye was 7.3% and 8.7% in the first and second year, respectively. The authors found that the

prevalence of hetertropia was about 1% in each year, while that of heterophoria varied from 0.6% in the first year to 5% in the second one. The difference in% of heterophoria in both years may be partly caused by the inter-examiner variation and the co-operation of the child. These children were advised to re-evaluate with ophthalmologist in 6 months. About 1% of students had amblyopia in each year, and in most cases, it was, due to uncorrected refractive errors. The prevalence of color vision deficit was 4.2% (3.7% in males and 0.5% in females), which was comparable to previous reports[17]. Even though congenital color deficit may not affect the daily activity of each individual, it potentially limits them from doing some activities. This finding could be helpful as a guide for educational and career planning.

Vyas DB, et al[18] had studiedamong Asian-Pacific Islander school-children and found that color-vision deficiency was prevalent among 2.8% of males, extraocular muscle imbalance was 3.0%,and amblyopia 1.0%.

It seems clear that all children should be screened during pre-school or at the beginning of their school years for amblyopia or its risk factors, as well as ocular diseases, such as cataract. As a result, pre-school vision screening has been mandated as part of several federal programs in developed countries. Data from a survey of vision screening in the United States found a variety of screening methods across the country[4,5]. However, fundamental questions remain about specific issues, ranging from screening methodology to quantitative measures of both the efficacy and cost-effectiveness of such screening.

The purpose of this vision screening was to screen for eye problems and treat them at the time of detection. The authors selected students in grade one because at this age they co-operate well and screening tests, such as Snellen VA and Ishihara color plates, are not so complicated as those for pre-school children. Ideally, refraction should be done in all children, since the prevalence of refractive errors from correctable visual acuity deficit can differ substantially from that obtained through direct measurement. For example, hyperopic children may accommodate, or those with myopia may squint to improve their vision. Therefore, this may underscore children with visual impairment caused by refractive errors or abnormal binocular vision. Nevertheless, the presented results can also be used as the baseline data to evaluate the relative success of strategies in decreasing the amount of preventable visual impairment resulting from uncorrected refractive errors. Further studies are needed to evaluate the screening guidelines in order to ascertain whether they are effective in identifying children who do or do not require further management.

In summary, the present study provides the information necessary both to understand the eye care needed, and improve access to eye care in this rapidly growing population, who lean themselves easily to cost-effective intervention. The authors conclude that vision screening is a cost-effective way of reducing visual morbidity from preventable visual impairment, which is a tragedy that cannot be ignored.

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การสำรวจภาวะสายตาผิดปกติในเด็กวัยเรียน: ผลการศึกษาสองปี

นภาพร ตนานุวัฒน์, อนิตา มนัสสากร, อาภาภรณ์ วรพงษ์, จรัสศรี คูพัฒน์, เจนจิต ชูวุฒยากร, โสภา วัฒนานิกร

วัตถุประสงค์ *: เพื่อศึกษาถึงความชุกของการมองเห็นที่ผิดปกติ รวมทั้งความผิดปกติทางตา ของเด็กนักเรียนในชุมชน*
วิธีการศึกษา *: เป็นการศึกษาในชุมชน โดยการออกหน่วยตรวจระดับการมองเห็น ตรวจตาบอดสี และความผิดปกติทางตาในเด็กนักเรียนระดับชั้นประถมศึกษาปีที่ 1 ในจังหวัดเชียงใหม่ ตั้งแต่เดือนมิถุนายน ปี พ.ศ. 2543 ถึง มีนาคม พ.ศ. 2545 โดยเด็กที่มีระดับการมองเห็น (VA) ที่ต่ำกว่าปกติ (น้อยกว่าหรือเท่ากับ 20/30 ในอย่างน้อยหนึ่งตา) จะได้รับการวัดสายตา ในเด็กที่พบว่ามีตาเข, สายตาขี้เกียจ หรือความผิดปกติอื่น ๆ จะได้รับการส่งไปที่โรงพยาบาลเพื่อตรวจวินิจฉัยเพิ่มเติม และรักษาต่อไป*
ผลการศึกษา *: ในปี พ.ศ. 2543 และ 2545 มีเด็กนักเรียนที่เข้าร่วมการศึกษาจำนวน 3,431 และ 3,467 คน ตามลำดับ พบว่า ความชุกของนักเรียนที่มีระดับการมองเห็นปกติ (VA 20/20), VA 20/30 หรือดีกว่าในอย่างน้อยหนึ่งตา, และ VA 20/40 หรือแย่กว่า ในอย่างน้อยหนึ่งตา ในทั้งสองปี คือ ร้อยละ 87, 5.7, 7.3 และ ร้อยละ 85, 6.4, 8.7 ตามลำดับ โดยไม่พบว่ามีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ระหว่างระดับการมองเห็นในเด็กผู้ชายและเด็กผู้หญิง (p = 0.6 และ 0.2) นอกจากนี้ยังตรวจพบเด็กที่มีตาบอดสี ร้อยละ 4.2 ส่วนความผิดปกติอื่น ๆ ที่พบในทั้งสองปี ได้แก่ ตาเข (ร้อยละ 1.5 และ 6.2), ภาวะสายตาขี้เกียจ (ร้อยละ 1.1 และ 1.4), และที่เหลือเป็นความผิดปกติแต่กำเนิด สาเหตุส่วนใหญ่ของภาวะสายตาขี้เกียจ เกิดจาก ภาวะสายตาผิดปกติที่ไม่ได้รับการแก้ไข*
สรุป *: การศึกษาครั้งนี้ พบมีเด็กนักเรียนจำนวนกว่าร้อยละ 10 ที่มีการมองเห็นผิดปกติ ส่วนใหญ่เกิดจากสายตาผิดปกติ, ตาเข และ สายตาขี้เกียจ ผลการศึกษานี้ สรุปว่าการสำรวจความผิดปกติทางตา เป็นวิธีการที่มีประโยชน์ และคุ้มค่าในการตรวจหาความผิดปกติของสายตาในเด็กบางอย่าง ที่นำไปสู่ความพิการทางตา ซึ่งสามารถป้องกันได้ หากได้รับการวินิจฉัย และรักษาตั้งแต่อายุยังน้อย*