

# Prevalence of Visual Impairment among 4- to 6-years-old Children in Khon Kaen City Municipality, Thailand

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**Objective:** To evaluate the prevalence of visual impairment of children aged four to six years in Khon Kaen City Municipality, Thailand.

**Material and Method:** The visual acuity test was performed on 1,286 children in kindergarten schools located in Khon Kaen Municipality. The first test of visual acuity was done by trained teachers and the second test by the pediatric ophthalmologist. The prevalence of visual impairment of both tests was recorded including sensitivity, specificity, likelihood ratio, and predictive value of the test by teachers. The causes of visual impairment were also recorded.

**Results:** There were 39 children with visual impairment from the test by the teacher and 12 children from the test by the ophthalmologist. Myopia is the single cause of visual impairment. Mean spherical equivalence is 1.375 diopters ( $SD = 0.53$ ). Median spherical equivalence is 1.375 diopters (minimum = 0.5, maximum = 4). The detection of visual impairment by trained teachers had a sensitivity of 1.00 (95% CI 0.76-1.00), specificity of 0.98 (95% CI 0.97-0.99), likelihood ratio for a positive test 44.58 (95% CI 30.32-65.54), likelihood ratio for a negative test 0.04 (95% CI 0.003-0.60), positive predictive value of 0.31 (95% CI 0.19-0.47), and negative predictive value of 1.00 (95% CI 0.99-1.00).

**Conclusion:** The prevalence of visual impairment among children aged four to six year old is 0.9%. Trained teachers can be examiners for screening purpose.

**Keywords:** Preschool visual screening, Visual impairment, Amblyopia, Amblyopia screening, Prevalence of visual impairment, Children

*J Med Assoc Thai* 2016; 99 (Suppl. 5): S132-S136

Full text. e-Journal: <http://www.jmatonline.com>

Amblyopia is one of the leading causes of blindness in childhood. The causes of amblyopia consist of strabismus, refractive error, and deprivation. The prevalence of amblyopia in US has been reported to be 2 to 5%<sup>(1,2)</sup>. The treatment of amblyopia should be initiated before the children is seven years old as early diagnosis and early treatment are the key of success in the management of this potential blindness causing condition. In Thailand, there is a visual screening program for children of seven years old but it is really too late to get a good visual outcome after initiating the treatment at the age of seven years. Other countries such as US, UK, and Australia have a visual screening program starting before the children become seven years old. Furthermore, the ophthalmologist is not the examiner for all of the screening programs. Nurses, teachers, and ophthalmic personnel can be the examiner with different screening methods. In the literature

review, we found three articles mentioning the prevalence of visual impairment in childhood in Thailand. Napaporn et al<sup>(3)</sup> reported the prevalence of visual impairment in school ages (6-7 years old) is 10%, refractive error is the main cause of visual impairment. However, at the age of six or seven year old, it is late to start the treatment in this age group. Supaporn et al<sup>(4)</sup> reported the cost effectiveness of visual screening program for primary school children. They also reported a prevalence of visual impairment of 8.8% in the age group six to 12 years old. Another report from Supaporn et al<sup>(5)</sup> reported that the prevalence of abnormal vision in one-year-old Thai children is 1%. This study aims to estimate the prevalence of visual impairment in the age group four to six years old, which amblyopia can be treated and a good outcome can be obtained. The secondary outcome is to clarify the diagnostic performance of the visual screening by the trained teacher to identify the children with visual impairment.

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## Material and Method

This study was approved by the Khon Kaen University Ethics Committee in Human Research before

beginning of the research procedures.

### Study population

The participants were from kindergarten schools located in Khon Kaen Municipality, age group between four and six years old. The exclusion criteria were (1) children with systemic diseases that cannot cooperate to complete visual acuity test such as severe mental retardation, (2) children with a history of allergy to cyclopentolate eyedrop, and (3) children with history of angle closure glaucoma.

### Study procedure

After written informed consent was obtained from the parents, the visual acuity test was performed by a trained teacher using Lea's chart. The children were categorized into normal vision if they can read all of the symbols but if the children cannot read to the 6/6 line of the chart or even miss only one symbol on 6/6 line, they were categorized as visual impairment group.

One week later, the ophthalmologist will re-examine all of the children to identify visual acuity and the cause of visual impairment including slit lamp examination, cycloplegic refraction, and fundus examination.

The training for the teachers started with two hours of lecture about anatomy of the eye, some of eye diseases that can be amblyogenic factors, and the method to measure visual acuity by using Lea's chart. This was followed with an hour of practice on measuring visual acuity. All of the certified teachers have to pass

the test before they can start measuring visual acuity.

### Statistical analysis

The demographic data were described in mean, SD, median, minimum, and maximum values. The prevalence was calculated. Then the diagnostic performance of the visual acuity test by the trained teacher was calculated based on the criteria of visual impairment compared with the test of ophthalmologist, which is assumed to be the gold standard method. The results described the sensitivity, specificity, likelihood ratio, and predictive value. The 95% confidence interval was calculated based on binomial exact distribution.

### Results

Between February 2013 and January 2014, 1286 children in kindergarten schools located in Khon Kaen Municipality met the eligible criteria. There were 728 boys and 558 girls.

The visual acuity test by trained teacher detected 39 children with visual impairment while 12 children with visual impairment were detected by the ophthalmologist. The prevalence of visual impairment in children aged four to six years is 0.9%. The study flow is shown in Fig. 1. The children with visual impairment consisted of five boys and seven girls, mean and median age is four years old (SD = 0) (min = 4, max = 6). Visual acuity of visual impaired children is shown in Table 1. Myopia is the single cause of the visual impairment in 12 children. Mean spherical equivalence of myopia is 1.375 diopters (SD = 0.53) and median spherical equivalence is 1.375 diopters (minimum = 0.5,

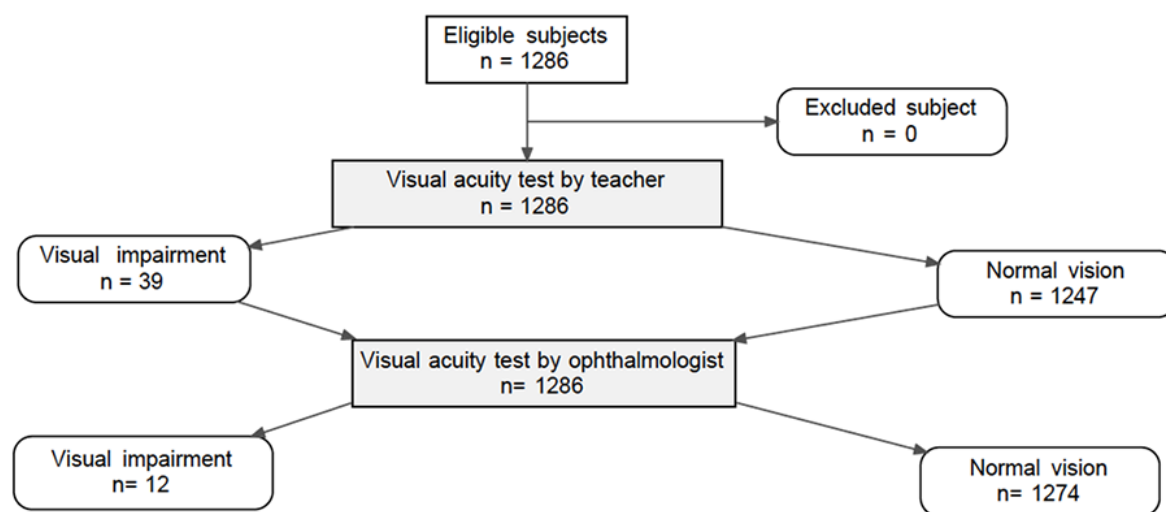


Fig. 1 Study flow diagram.

maximum = 4). The detection of visual impairment by trained teachers had a sensitivity of 1.00 (95% CI 0.76-1.00), specificity of 0.98 (95% CI 0.97-0.99), likelihood ratio for a positive test 44.58 (95% CI 30.32-65.54), likelihood ratio for a negative test 0.04 (95% CI 0.003-0.60), positive predictive value of 0.31 (95% CI 0.19-0.47), and negative predictive value of 1.00 (95% CI 0.99-1.00). The result of the diagnostic performance is shown in Table 2.

## Discussion

This study demonstrates the prevalence of visual impairment in children aged four to six years is 0.9%. It may not be representative of the true prevalence of visual impairment in this population because this study enrolled only the children who attended the kindergarten schools located in Khon Kaen Municipal area, which may not be representative of all children of the same age group in this area. The previous studies identified prevalence in the older children, which may not receive a good outcome from the amblyopic treatment<sup>(3,4)</sup>. One study reported the prevalence in one-year-old children is 1%, which is close to this study<sup>(5)</sup>.

**Table 1.** Visual acuity of visual impaired children

Subject number	Right eye	Left eye
1	6/12	6/9
2	6/24	6/24
3	6/36	6/24
4	6/18	6/24
5	6/9	6/9
6	6/12	6/9
7	6/36	6/24
8	6/18	6/12
9	6/36	6/9
10	6/9	6/12
11	6/12	6/12
12	6/9	6/9

**Table 2.** 2x2 table of the result of both tests

Visual acuity test by teacher	Visual acuity test by ophthalmologist		
	Visual impairment	Normal vision	Total
Visual impairment	12	27	39
Normal vision	0	1,247	1,247
Total	12	1,274	1,286

Because the children are younger, the prevalence of visual impairment may be incorrectly estimated because younger children may not cooperate well enough to identify the true level of their vision. For non-verbal child, ability to fix and follow is used as the method to test visual acuity as mentioned in the report of prevalence of visual impairment in one-year-old child. However, the accuracy of fix and follow test is lower than other test methods. Even though HOTV chart would seem to be the appropriate chart for measuring visual acuity of pre-school children, due to limited budget and the ease for transportation, Lea chart was used in this study<sup>(6)</sup>. In addition, while four to six year old children can communicate, they may not understand the number or the letter. Therefore, they can appreciate the images of Lea chart.

This screening algorithm has more benefit than other published methods<sup>(1-3,7)</sup>. The first benefit is availability of labor to do the test, when all children go to school and many teachers can be trained. The second benefit is the school based eye examination is more cost effective than examination by an ophthalmologist<sup>(8)</sup>. Another benefit is the children are familiar with their teacher so they do not feel fear from a stranger, which is a hindrance for the child of normal development at four to six years old. If the ophthalmologist is the examiner, the children will not communicate well with the stranger. When the teacher is the examiner, the result shows the diagnostic performance is preferable, which is appropriate for screening of visual impairment in children because the children with visual impairment will not be missed.

The other benefits for using teacher as the examiner is to reduce the work of ophthalmologist, the teachers can perform the test by themselves at a convenient time, and the children do not need to travel to the hospital to meet the ophthalmologists for visual screening.

The weakness of this study is the sampling method is not a systematic sampling because the cooperation of the teacher of each school is required. Therefore, the prevalence from this study may not be representative of the children with the same age group in this region.

## Conclusion

From the result, prevalence of visual impairment of the children four to six years old in the Khon Kaen Municipality is 0.9% and the teacher can be the examiner for the screening with good diagnostic performance.

**What is already known on this topic?**

There was no information about the prevalence of visual impairment in preschool children in Thailand.

**What this study adds?**

This study report the first prevalence of visual impairment in preschool children in Thailand and the teacher can be the person who carries out the screening test.

**Acknowledgements**

The authors would like to thank all of the teachers who contributed on the visual acuity test and the Center of Cleft Lip, Cleft Palate, and Craniofacial Deformities, Khon Kaen University in Association with Tawanchai Project for publication support.

**Potential conflicts of interest**

None.

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## การศึกษาหาความชุกของเด็กที่มีปัญหาการมองเห็นในเด็กชั้นอนุบาลในเขตเทศบาลนครขอนแก่น ประเทศไทย

พรรณทิพา ว่องไว, พัชรพรรณ อนุพงษ์อาจ, สิริยา สุวรรณราช, สมเกียรติ อัสวกริกรณ์

**วัตถุประสงค์:** เพื่อศึกษาความชุกของเด็กที่มีปัญหาการมองเห็นในเด็กอายุ 4-6 ปี ที่อาศัยอยู่ในเขตเทศบาลนครขอนแก่น

**วัสดุและวิธีการ:** เด็กอนุบาลในเขตเทศบาลนครขอนแก่นจำนวน 1,286 คน ได้รับการตรวจคัดกรองการมองเห็นเบื้องต้นโดยครูที่ได้รับการฝึกอบรมมาแล้ว หลังจากนั้นจะได้รับการตรวจอีกครั้งโดยจักษุแพทย์ผู้เชี่ยวชาญโรคตาในเด็กโดยจะหาความชุก ค่าความแม่นยำของการตรวจคัดกรองการมองเห็นโดยครูและสาเหตุของการมองเห็นที่ผิดปกติ

**ผลการศึกษา:** มีเด็กจำนวน 39 คน ที่ตรวจพบว่ามีปัญหาการมองเห็นด้วยการตรวจคัดกรองโดยครูและมีเด็กจำนวน 12 คน ที่ได้รับการวินิจฉัยจากจักษุแพทย์ผู้เชี่ยวชาญว่ามีปัญหาการมองเห็น ซึ่งสายตาสั้นเป็นสาเหตุหลักของเด็กที่มีปัญหาการมองเห็นโดยมีค่าเฉลี่ยของสายตาสั้นเท่ากับ 1.375 (SD = 0.53) การตรวจคัดกรองการมองเห็นเบื้องต้นโดยครูมีความไวเท่ากับ 1.00 (ช่วงเชื่อมั่นที่ 95 อยู่ระหว่าง 0.76-1.00) มีความจำเพาะเท่ากับ 0.98 (ช่วงเชื่อมั่นที่ 95 อยู่ระหว่าง 0.97-0.99) likelihood ratio for a positive test 44.58 (95% CI 30.32-65.54) likelihood ratio for a negative test 0.04 (95% CI 0.003-0.60), มีค่าพยากรณ์ผลบวกเท่ากับ 0.31 (ช่วงเชื่อมั่นที่ 95 อยู่ระหว่าง 0.19-0.47) และมีค่าพยากรณ์ผลลบเท่ากับ 1.00 (ช่วงเชื่อมั่นที่ 95 อยู่ระหว่าง 0.99-1.00)

**สรุป:** เด็กอายุ 4-6 ปีมีความชุกของมีปัญหาการมองเห็นเท่ากับ ร้อยละ 0.9 และครูที่ได้รับการฝึกอบรมในการตรวจคัดกรองสามารถทำหน้าที่ในการตรวจคัดกรองการมองเห็นได้

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