Prevalence of Abnormal Vision in One-Year-Old Thai Children, Based on a Prospective Cohort Study of Thai Children (PCTC)

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Objectives: *To collect preliminary data on the prevalence of abnormal vision in one-year-old Thai children.*
Material and Method: *A retrospective study was conducted using data collected from a prospective cohort study of Thai children (PCTC) carried out during 2000-2002, to examine the prevalence of abnormal vision in one-year-olds. Data from five districts in five provinces were examined. One-year-old children in the present study underwent vision screening and eye examination performed by non-medical research assistants.*
Results: *There were records from 3,898 children in five districts, 49.7% females and 50.2% males. Their eye examinations showed very good vision in 77.8% (9.8cy/cm at 38 cm), good vision in 21.5% (6.5cy/cm at 38 cm), and fair vision in 0.7% (≤ 1.6 cy/cm at 38 cm). Normal ocular motility was found in 99.7% and 99.9% had normal anterior segment and lens. No strabismus was found in 99.4%, 99.9% had normal pupil light reflex, 99.8% had normal red reflex, 93.6% could fix and follow at 3 months of age, 85.7% could detect a falling object at 6 months, and 78.5% of mothers and 46.5% of fathers regularly played with the children.*

Logistic regression analysis indicated that some factors had statistical significance, such as "fix and follow" by 1 month of age, and lack of father-child interaction, but these were not clinically significant.

Using Kappa analysis, the authors combined groups 1 (very good vision) and 2 (good vision)to create a "normal vision" category. If children had 2 abnormal eye examinations (eye exam for strabismus, cornea, anterior chamber, lens, pupil and red reflex), the authors recommended sending them to a specialist. The sensitivity and specificity of the visual screening and eye examination instruments were 19.23% and 99.38%, respectively. The Kappa statistic was 0.17. These instruments are not appropriate for eye screening in one-year-old children.
Conclusion: *More than 99% of the children examined had normal results. The majority of children could fix and follow from 2-3 months of age. The early fix and follow development may be related to better visual acuity. The interaction between father and child may be associated with eye development. However, eye screening of one-year-old children by assistant researchers may be inappropriate due to lack of expertise and experience.*

Keywords: *Prevalence, Vision, Children*

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Vision is very important in the normal development and education of children. Visual impairment is a major setback for general development and motility skills, and developmental milestones are also delayed, emphasizing the importance of early detection, intervention and management of childhood eye problems. Sensory and motor functions develop together rapidly during the first months of life. There are various ways to assess visual function; for example visual evoked potential (VEP), preferential looking test, visual acuity, contrast sensitivity, stereopsis, or colour vision assessment, but application of these techniques in young

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children is difficult and reliable screening tests for accurate assessment of infant's vision are not yet available.

During development, abnormalities can occur in either sensory or motor areas. The prevalence of visual impairment in children is approximately 1 per 250 children, ranging from mild impairment to blindness. Most children have a moderate degree of visual impairment[1]. Among Thais, the prevalence of visual impairment in school age children varies from 38.5 to 74.2%[2,3]. These large differences are likely attributable to differences in study population and testing methods used. Some treatable ocular conditions, such as cataract and strabismus, should be screened for as well. Identification of infants with ocular abnormalities and visual problems is important, but ideally would use experienced, skilled examiners and complicated instruments not yet available. At present many children around the world are unable to have eye screening by ophthalmic professionals. Delayed diagnosis may result in permanent damage. Screening by trained non-medical personnel has been shown to be effective in screening for eye problems in children, and decreases the workload of ophthalmologists[4-7].

In the prospective study, visual acuity measurements using a modified preferential looking method, an eye examination guideline, and a questionnaire for parents were designed to evaluate the visual development of one-year-old children. The prospective cohort study of Thai children (PCTC) collected many things from one-year-old children and the authors were involved in part of the eye examination. So in this retrospective study the authors analyse data from them.

Material and Method

For the retrospective study the authors analysed data from the prospective cohort study of Thai children (PCTC) which is detailed below. One-year-old children in the prospective study received vision testing and screening for eye abnormalities performed by specially trained research assistants. The study included a total of 4,245 one-year-old children from Panomtuan District in Kanchanaburi, Thepa District in Songkla, Kranuan District in Konkaen, Muang District in Nan, and Bangkok.

The instruments used for eye screening were 4 Teller acuity cards, each with a different frequency and a test distance of 38 cm. The Teller acuity cards used were: card one = 1.6 cy/cm (all children can see), cards two = 3.2 cy/cm and three = 6.5cy/cm (one-year-old children can see both cards), and card 4 = 9.8cy/cm (too fine to see for children aged one and younger). The testing manual was designed for examination of strabismus, cornea, anterior chamber, lens, pupil, and red reflex. After preparing the Teller cards and the eye exam manual, the authors trained research assistants who then collected data from the children. Due to incomplete data from the eye examination, 347 children (0.08%) were excluded. The level of vision measurement was classified into three groups:

Group1 - very good; able to see all 4 cards.

Group 2 - good; able to see 3 cards including cards 1, 2 and 3

Group 3 - fair; no response or able to see only card 1

The X^2 and Fisher Exact test were used to find the association between the level of vision. For multiple factors analysis, and multiple logistic regression was applied. Kappa analysis was used to test for the sensitivity and specificity of the instruments.

The Prospective Cohort Study of Thai Children

Design: The prospective study was an observational, community-based study designed to follow all fetuses from the t 28th to 38th weeks gestational age from 4 selected districts in different regions and the Bangkok metropolitan area. The birth cohort, born over a one year period during 2000-2002 in each site, was observed and followed up until the children reached the age of 24 years. Time of recruitment varied by 1-3 months among sites.

Sampling: Expected number of children born at each site was 800-900, thus providing a total of 4,300 children and 8,600 parents. The first child was born in the Central District on October 15, 2000 and the last child was born at Ramathibodi Hospital in Bangkok on September 14, 2002. It is worth noting that although the study focused mainly on the children, their mothers, the identified subjects and pregnancies were observed as early as the 28th week and thus reliable data was collected. In addition, the father and the primary care takers were interviewed for important data regarding child rearing practices. In addition, community profile and changes over time were included in the study protocol.

Variables and data collection: The present study used both quantitative and qualitative methods. Different methods of data collection, appropriate to the variables, were applied. Relatively permanent characteristics, such as demographic data, were collected via interviews or extracted from existing records. High frequency data such as sleep and dietary patterns of the children were

collected using diary records. Medical and behavioral characteristics were measured by physicians and trained researchers.

Data management and analysis: Due to the huge quantity of data, the data management system was changed from double data entry procedure to distributed data entry using at scanner and Optimal Marked Recognition (OMR). Cleaning, editing, systemic verification, and other data quality assurance was performed by hand and using a statistical package. MysQL was used as the database server. The cleaned data were systematically sorted and saved in CD-rom format. Data integrity and logical check were performed before releasing for analysis. Three identical data sets were generated and kept in a separate office for security. All data sets for analysis were kept separately from the identification of the subjects for privacy. Before analysis, missing data were checked and completed by the researchers, otherwise, the data was managed by multiple imputations. Descriptive and analytic statistics were used for whole samples and samples by site.

Ethical clearance: The present study was approved by the National Ethical Committee, Ministry of Public Health. All families were informed about study procedures and possible risks before signing the consent form.

Results

A total of 4,245 children were included in the present study, but 347 had incomplete eye examination data, leaving 3,898 children for the final analysis. The data included 1,959 females (49.7%) and 1,939 males (50.2%), from Panomtuan district in Kanchanaburi Province, Thepa district in Songkla, Kranuan district in Konkaen, Muang district in Nan, and Bangkok 736 children (18.8%), 1,053 children (27.0%), 825 children (21.1%), 692 children (17.7%), and 592 children (15.1%), respectively (Fig. 1).

The eye exam and vision test at 38 cm showed 3,035/3,898 (77.8%) had very good vision (Group1, 9.8cy/cm), 837/3,898 (21.5%) had good vision (Group 2, 6.5cy/cm), and 26/3,898 (0.7%) had fair vision (Group 3, $\leq$ 1.6 cy/cm). Ocular motility was normal in 3,887 (99.7%), normal cornea was found in 3,896 (99.9%), 3,876 (99.4%) had normal pupillary light reflex**,** 3,895 (99.9%) had normal pupils, and 3,892 (99.8%) had normal red reflex. The data did not include any abnormal findings.

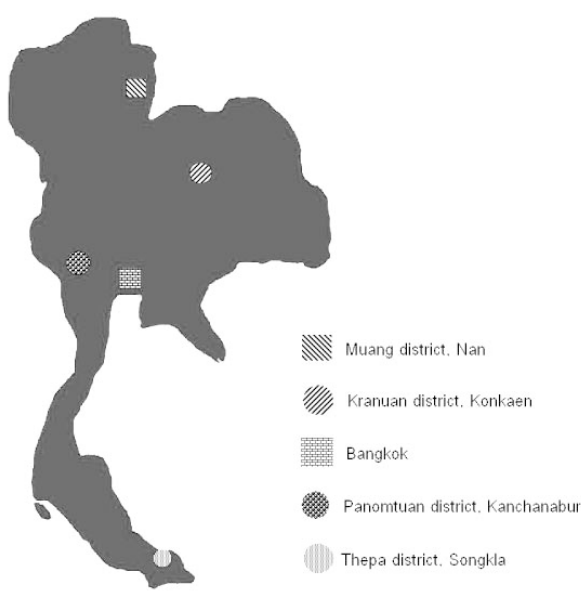

Fig. 1 Number of children from research s sites in this retrospective study

- 736 children (18.8%) from Panomtuan district Kanchanaburi
- 1,053 children (27.0%) from Thepa district Songkla
- 825 children (21.1%) from Kranuan district Konkaen
- 692 children (17.7%) from Muang district Nan
- 592 children (15.1%) Bangkok

For visual development, 49% of subjects in group one, 38.7% in group two, and 40.8% in group three had a history of fixing and following by 2 months of age, but this was statistically significant (p = 0.000) only in group three. However, in children from all groups combined, 46.7% could fix and followed by 2 months, 93.6% by 3 months, and 85.7% looked for a fallen toy by 6 months of age. This had a statistically significant relationship with vision (p = 0.000, p = 0.015). There was a statistically significant relationship between vision and frequency of contact with parents: 78.5% of children who had mother-infant interactions almost every day, and 46.5% who had father-infant interactions almost every day (p = 0.003, p = 0.000 respectively).

Logistic regression is shown in Table 2, comparing the very good and fair vision groups. Some factors could not be analyzed because the sample sizes were too small.

Using Kappa analysis the authors combined groups one and two into a normal vision category. If children had 2 abnormal eye examinations (examination for strabismus, cornea, anterior chamber, lens, pupil and red reflex), the authors recommended seeing a specialist. The sensitivity and specificity of the instruments were 19.23% and 99.38% respectively. The kappa analysis was 0.17.

Table 1. Eye examination and vision test classification at 38 cm in 3,898

Vision test	Number (%)
Very good vision (group 1)	3035 (77.8)
Good vision (group 2)	837 (21.5)
Fair vision (group 3)	26 (0.7)

Discussion

The development of visual perception is essential for children's general development, especially in the first year of life. Children are too young to tell us about their vision problems and parents have high expectations regarding eye care professionals including clinical competence, interaction with child, education/training, explanation in clear language, information about diagnosis, and personal connection[8]. Therefore, eye screening in young children is especially important in high risk groups such as children with prematurity, dysmaturity, neonatal pathology, a family history of ophthalmic anomalies[9-15]. Previous studies have demonstrated the efficacy of eye screening by well-trained non-medical personnel, practice that also reduces the ophthalmologists' workloads[4-6]. A modified Teller acuity test was used for screening infant vision, although use of this test must be accompanied by awareness of the relatively high rates of false positive results[16]. In the present prospective study the assistant researchers were trained in basic eye examination techniques, including assessment of visual acuity, strabismus, anterior segment, pupils, and red reflex. These basic tests screen for common eye disorders such as cataracts, corneal opacity, or some posterior segment abnormalities. The combined sensitivity and specificity of the 2 instruments (modified Teller acuity test and the eye examination guidelines instruments) were 19.23% and 99.38% respectively. The kappa analysis of the combined instruments was 0.17, meaning the instruments used in the present study were not sufficiently detailed for screening eye health in one-year-old children. This may be insufficient training of research assistants. These combined instruments are not adequately sensitive for use in screening eye health in one-year-olds.

Table 2. Multiple logistic regression for multiple factors

Factor	Very good vision versus fair vision RRR (95% CI)	Good vision versus fair vision RRR (95% CI)
Fix and follow by 1 month of age	0.2 (0.0-2.3)	0.0 (0.0-.9)**
Fix and follow by 2 months of age	1.3 (0.1-12.0)	0.8 (0.0-7.3)
Fix and follow by 3 months of age	0.7 (0.0-6.0)	0.6 (0.0-5.6)
Occasional father-child interaction	1.2 (0.3-5.4)	1.3 (0.3-5.9)
Almost daily father-child interaction	2.4 (0.5-11.2)	2.9 (0.6-13.5)
No father-child interaction	0.3 (0.0-1.5)	0.1 (0.0-.6)**
No father	0.2 (0.0-1.6)	0.3 (0.0-2.0)

** $p < 0.05$

The present study sampled children from 5 regions of Thailand. The results indicated that 99.3% of the children tested had good to very good visual acuity. Abnormalities were detected in less than 1%. These results are considerably better than, for instance, a study from India[18] which reported up to 13.6% of children younger than 15 years old needed a further comprehensive eye examination due to eye abnormalities. This discrepancy in results was likely due to differences in the population age group and the method of eye screening. However, in the Indian study the major causes of ocular morbidity were refractive error and strabismus, including binocular and accommodative. In addition, a study conducted in Uganda[19], about 50% of childhood blindness is caused by treatable conditions such as cataract and corneal abnormalities.In the present retrospective study, the authors found that most of the children (99.4-99.9%) had normal ocular motility, cornea, pupillary light reflex, lens, and red reflex. Some cases of refractive error may have been missed because the instruments did not test for this.

By 3 months of age 93.6% of children were reported to be able to fix and follow, which is earlier than was found by Molteno et al[20] who reported 13% of children had accurate fixation and focusing at 3 months of age, corresponding with the normal development of focusing around 6 months of age[21]. This discrepancy between studies may be attributable to differences in population groups and methods of data collection. Time of fixing and following in each group and looking for the fallen toy by 6 months of age have a statistically significant relationship with vision. However, the retrospective study had insufficient data for logistic regression analysis.

Regarding development and parents' roles, the absence of interaction between infants and fathers is associated with fair visual acuity, and the fathers in the present study seemed to spend less time on average with their children than has been found in other studies[22]. Although relationship was statistically significant, it may not have clinical significance. These results are supported by other studies investigating the role of parents in child development, although a Swedish study showed the degree of paternal involvement had no effect on preferences displayed on measures of attachment and afflictive behaviors[23]. Normally, the mother tends to be the main caregiver for a child, but encouraging the father to have more involvement could be of benefit to children's vision, as well as to social interaction[24-27].

There is currently no methodological gold standard for visual testing and eye examination in infants. A limitation of this retrospective study is that about 0.08% of children were excluded due to incomplete data. A further limitation is that the research assistants performing the examinations were non-medical personnel with limited training.

Conclusion

More than 99% of the children had normal eye examinations. The majority of the children could fix and follow by 2-3 months of age. Early fix and follow development may be related to better visual acuity. The interaction between father and child may be associated with eye development. However, eye screening tests of one-year-old children performed by research assistants may be of limited utility.

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ความชุกของภาวะผิดปกติทางตาในเด็กอายุ 1 ปีจากโครงการวิจัยระยะยาวในการติดตามเด็กไทย

สุภาภรณ์ เต็งไตรสรณ์, เพ็นนี สิงหะ, จันทร์เพ็ญ ชูประภาวรรณ

วัตถุประสงค์: *เพื่อศึกษาความชุกของความผิดปกติทางตาในเด็กวัย 1 ปี*

วัสดุและวิธีการ: *การศึกษาแบบการวิจัยย้อนหลังข้อมูลที่เก็บในโครงการวิจัยระยะยาวในการติดตามเด็กไทยปี พ.ศ. 2543-2545 ซึ่งตรวจหาความผิดปกติของการมองเห็นและความผิดปกติทางตาในเด็กอายุ 1 ขวบ จาก 5 พื้นที่ โดยผู้ช่วยวิจัย*

ผลการศึกษา: *เด็กจำนวน 3,898 คน จาก 5 พื้นที่เป็น หญิงร้อยละ 49.7 ชายร้อยละ 50.2 ตรวจตาพบว่ามีเด็กที่ตรวจพบมีการมองเห็นดีมากร้อยละ 77.8 (9.8cy/cm ที่ 38 ซม.) การมองเห็นดีร้อยละ 21.5 (6.5cy/cm ที่ 38 ซม.) และการมองเห็นไม่ดีร้อยละ 0.7 (≤ 1.6 cy/cm ที่ 38 ซม.) มีการกลอกตาปกติร้อยละ 99.7 กระจกตา ช่องหน้าลูกตา และแก้วตาปกติ ร้อยละ 99.9 ตาตรงร้อยละ 99.4 ปฏิกิริยาของรูม่านตาปกติร้อยละ 99.9 Red Reflex ปกติร้อยละ 99.8 เด็กร้อยละ 93.6 มองตามไปมาได้เมื่ออายุ 3 เดือน เด็กร้อยละ 85.7 มองของตกได้เมื่ออายุ 6 เดือน ประวัติการเล่นกับลูกช่วงอายุ 6 เดือนแรก มารดาร้อยละ 78.5 จะเล่นของเล่นให้ลูกดูหรือฟังเกือบทุกวัน ส่วนบิดาร้อยละ 46.5 จะเล่นของเล่นให้ลูกดูหรือฟังเกือบทุกวัน*

การวิเคราะห์ข้อมูลหลายตัวแปรโดยวิธี logistic regression เมื่อเทียบกลุ่มที่สายตาดีกับกลุ่มที่สายตาไม่ดีพบว่ามีบางปัจจัย เช่น การมองตามวัตถุได้ตั้งแต่อายุ 1 เดือน หรือการที่พ่อไม่เล่นกับลูก มีผลต่อการพัฒนาทางตาอย่างมีนัยสำคัญทางสถิติแต่ไม่มีนัยสำคัญในทางคลินิก

การวิเคราะห์เครื่องมือตรวจคัดกรองความผิดปกติทางตาในรายงานนี้ ใช้ Kappa เมื่อรวมกลุ่มที่การมองเห็นดีมากและการมองเห็นดีเข้าด้วยกัน เปรียบเทียบกับกลุ่มที่การมองเห็นไม่ดี และใช้ความผิดปกติทางตาอื่น ๆ 2 อย่าง จากการตรวจ ตาเข กระจกตา ช่องหน้าลูกตา แก้วตา ม่านตาและ red reflex พบว่า เครื่องมือมีความไวร้อยละ 19.2 ความจำเพาะร้อยละ 99.3 ค่า kappa 0.17 ซึ่งแสดงว่าเครื่องมือนี้อาจจะไม่เหมาะกับการตรวจคัดกรองหาความผิดปกติทางตาในเด็กอายุ 1 ปี

สรุป: *เด็กมีสภาพตาปกติ มากกว่าร้อยละ 99 เด็กส่วนใหญ่เริ่มมองตามไปมาได้ตั้งแต่อายุ 2-3 เดือน การที่เด็กมองได้เร็วค่อนข้างจะบ่งชี้ว่าเด็กน่าจะมีสายตาดีกว่ากลุ่มที่มองตามได้ช้า ปัจจัยที่อาจจะมีผลต่อพัฒนาการทางสายตาคือการที่พ่ออยู่บ้านเล่นกับลูก อย่างไรก็ตามการตรวจคัดกรองความผิดปกติทางตาในเด็กอายุ 1 ปี โดยผู้ช่วยวิจัยอาจจะได้ผลไม่ดี*