

# The Outcome Of Combining Home Based And Clinic Based Amblyopia Therapy Among Preschool Children

Rokiah Omar, PhD\*, Victor Feizal Knight, MHP\*\*, Duratul Ain Hussin, MSc\*\*\*

\*Optometry & Vision Science Programme, School of Healthcare Sciences, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, \*\*Faculty of Medicine & Defence Health, National Defence University of Malaysia, \*\*\*Department of Ophthalmology, Hospital Ampang, Kuala Lumpur, Malaysia

## SUMMARY

This study determined the outcome of combining home based and clinic based amblyopia therapy among preschool children. A total of 479 preschool children were randomly selected for vision screening. Amblyopic therapy was prescribed to children whose visual acuity (VA) could not be improved to <0.1 LogMAR after a 6 week adaptation period with glasses. Intensive near work activities were conducted daily at home for 12 weeks, monitored by parents while weekly therapy was conducted at the optometry clinic by an optometrist. Six preschool children were diagnosed with refractive amblyopia, spherical equivalent (SE) was -11.25D to +0.75D. Significant improvement was found in the VA of right eye,  $t(6) = 3.07$ , left eye  $t(6) = 3.07$  and both eyes  $t(6) = 3.42$   $p < 0.05$ , at the end of the 12 week therapy. Combining home based and clinic based amblyopia therapy among preschool children showed a positive improvement in VA after 12 weeks of therapy.

## KEY WORDS:

*Preschool children, visually impaired, amblyopia*

## INTRODUCTION

Amblyopia results from degradation of retinal images during the sensitive period of visual development, which historically has been thought to be the first 7 years of life. Degradation of retinal images, and the subsequent central suppression that leads to amblyopia, results from one of three causal processes which are strabismus, anisometropia and stimulus deprivation. Anisometropia is a difference in the amount of diopter refractive error between both eyes causing blurred images on the fovea over one eye while on the fovea of the other eye the image is focused and sharp. Strabismus occurs when ocular alignment is not parallel or when eye spatial deviation occurs causing the fovea of both eyes to receive different visual images and thereby causing suppression of the retinal image from one eye. Lastly, any form of stimulus deprivation such as ametropia, cataract, corneal opacity and ptosis which prevents the formation of a clear image on the retina<sup>1</sup> thereby causing an unclear image or the retina to be unstimulated and so causing suppression of the image or lack thereof.

Amblyopia is the most common cause of monocular vision loss in children<sup>1</sup>. The clinical features of amblyopia include a reduction of visual acuity (VA) in both eyes or difference of

two or more lines between the eyes with the best VA. Amblyopia occurs in the absence of organic causes or ocular pathology<sup>1,2,3</sup>. The prevalence of amblyopia in children aged 5-17 years is in the range of between 0.2% -5.3% depending on the study population. However amblyopia prevalence in school children aged 7-15 years has been found to be higher, i.e. between 2.0% - 12%<sup>4,5,6,7,8,9</sup>. On the other hand, the prevalence of amblyopia among preschool children in several countries has been found to be in a lower range of between 0.2% - 1.8%<sup>10,11,12</sup>. Unfortunately, the prevalence of amblyopia among preschool children in Malaysia is not known because there have been no specific studies on vision screening for preschool children conducted.

With regards the treatment of amblyopia, the Pediatric Eye Disease Investigator Group (PEDIG 2006) study has shown that there was an increase in the VA from base line, with a mean of 1.1 lines with the use of eye occlusion therapy for 2 hours a day for 16 weeks compared to only 0.5 lines ( $p = 0.01$ ) without any therapy<sup>13</sup>. However, the effect of occlusion was only effective if compliance with the occlusion period was followed. Another study showed that compliance with amblyopia therapy was poor when it was conducted only at home<sup>13</sup>. Therefore this study aimed to determine the outcome of combining home based and clinic based amblyopia therapy among preschool children.

## MATERIALS AND METHODS

The vision screening was conducted in the Sitiawan District in the state of Perak, Malaysia from January to October 2007. Twenty one kindergartens with a total of 596 children aged 4-6 years were selected randomly for this study. Vision screening information and consent forms were distributed to parents two weeks prior to the examination date. Only preschool children who returned the consent forms and were present on the day of examination were included in this study. 479 children participated with the consent of their parents. This study was approved by the Research and Ethics Committee for Medical Research, Universiti Kebangsaan Malaysia and assigned the project code FF- 107-2007. All study procedures were in compliance with the conditions set by the Declaration of Helsinki<sup>14</sup>.

The vision screening test include visual acuity testing using the Lea Symbols chart, cover test, Hirschberg's test, external observation and ophthalmoscopic examination. The referral

*This article was accepted: 11 April 2013*

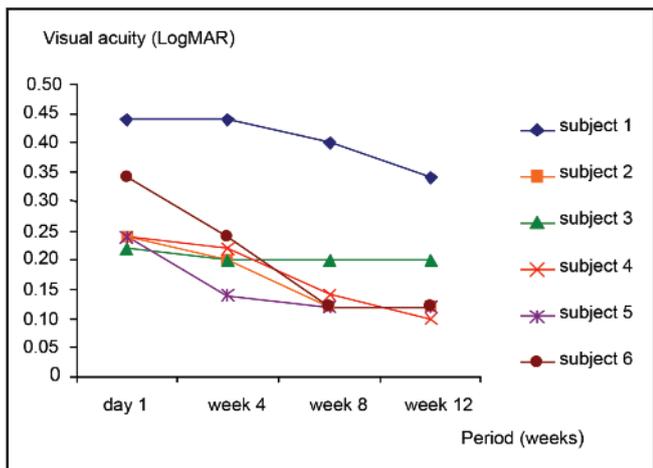
Corresponding Author: Rokiah Omar, Optometry & Vision Science Programme, School of Healthcare Sciences, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Wilayah Persekutuan, Malaysia Email: r\_omar@fsk.ukm.my

**Table I: Type of tests and fail criteria for preschool vision screening**

Type of Tests	Fail Criteria
Visual acuity test	> 0.3 logMAR
Cover test (distance & near)	Any ocular deviation
Hirschberg's test	Any corneal reflex deviation
External eye examination	Any external eye abnormalities
Ophthalmoscopy	Any fundus profile abnormalities

**Table II: Mean spherical equivalent (SE) and range of refractive error for preschool children by age group**

Age (Year)	Eye	
	RE (in D)	LE (in D)
4 (n = 2)	-5.13 ± 8.66 (+1.00, -11.25)	-5.19 ± 8.93 (+1.13, -11.50)
5 (n = 13)	-0.65 ± 1.22 (+1.50, -2.50)	-0.32 ± 1.45 (+3.00, -3.25)
6 (n = 13)	-0.83 ± 0.89 (+1.00, -2.50)	-0.74 ± 0.83 (+0.75, -2.13)



**Fig. 1:** Improvement of VA for the preschool children under going the combined home based and clinic based amblyopic therapy over a period of 12 weeks.

criteria are described in Table I. Those who failed the vision screening test were then referred to the Optometry Clinic for further examination. Spectacles were prescribed to those children who failed the vision screening. Amblyopic therapy was prescribed to those preschool children whose VA could not be improved to <0.1 LogMAR after 4 weeks of using and adapting to the new spectacles. Two hour eye patching with intensive near work activities was conducted daily at home monitored by the parents for 12 weeks. Concurrently, a weekly therapy session was conducted at the optometry clinic monitored by an optometrist. The VA, refractive error and stereopsis assessments were carried out at day 1, week 4, week 8 and week 12 at the clinic and the findings recorded.

The findings were analysed using SPSS version 14.0. Kolmogorov-Smirnov statistics was used to test the normality of the data distribution. Parametric tests were used for the data that was normally distributed. Otherwise, non-parametric tests were applied. For both the parametric and non-parametric tests, the alpha level used as reference was  $\alpha=0.05$ . The p-value <0.05 was used to define the level of statistical significance. All tests were 2-way and done on a significance level of 5%. Descriptive tests were used to analyse the vision screening data for the mean, standard deviation (sd), median, range and percentage. Correlation analysis was performed for mean spherical equivalent (SE) against age.

**RESULTS**

Out of 596 consent forms distributed, only 479 preschool children returned the consent form and were screened. The mean age was 5.3±0.7 years old. 52% of the preschool children were male. The predominant ethnic group was Malay (59.9%), followed by Chinese (30.1%), Indian (9.6%) and other ethnicities (0.4%). A total of 43 preschool children failed the vision screening and were referred to optometry clinic for further examination. Standard optometric examination found that 32 children (6.7% of the original subjects) were true positive and visually impaired. The remaining eight preschool children were found to be false positive for vision impairment while a further three preschool children were not cooperative and unable to undergo the standard optometric examination and therefore were excluded from the study.

*Refractive Errors*

A total of 28 out of the 32 true positive preschool children with vision problems were found to be due to uncorrected refractive errors. Therefore, the prevalence of refractive error was 5.8% of the overall age group. Overall, the mean SE for right eye (RE) was -0.69±1.98 D (range -11.25 D to +1.50 D) and left eye (LE) was -0.57±2.06 D (range -11.50 D to +3.00 D). The mean SEs for RE and LE by age group are described in Table 2. A total of 17 subjects were found to have myopia (3.5%) and the balance hyperopia. It was also found that myopia (SE>-0.50D) was present in the RE of 50.0% of the preschool children aged 4 years old. It then increased to 61.5% at the age of 5 years and 6 years. RE myopia correlation test was found significant for SE and age,  $r(28)=0.57, p=0.02$ . Astigmatism was found to occur in a range from -0.75 to +3.50DC. Most cases of astigmatism (77.5%) were due to 'with the rule' astigmatism (WTR). After wearing spectacles with prescription correction for 4 weeks, 6 preschool children were still not able to achieve 6/6 VA. These children were then referred for a combination of home based and clinic based amblyopic therapy.

*Amblyopic Therapy*

A total of 6 preschool children were identified and recruited for the amblyopic therapy. The prevalence of amblyopia in this study was found to be 0.8%. All these children followed the combination of home based and clinic based amblyopic therapy for 12 weeks. At follow-up, the visual acuity assessment was conducted on the eye with the worst VA or RE if the VA on both eyes were equal. Figure 1 shows the individual progress of each child's VA. As a whole the analysis showed that there was a significant improvement in the VA after the combination therapy was implemented where  $F(6)=6.67, p=0.01$  (effect size: 0.57, power: 80.0%). It

was also noted that significant VA improvement can be seen in the first 8 weeks after the combined home based and clinic based amblyopic therapy was started.

All the preschool children in this study but one had normal stereo acuity. A paired t-test was conducted on the stereo acuity findings of the six preschool children. The analysis showed that there was no significant difference,  $t(6)=1.00$ ,  $p=0.36$ , between the stereo acuity and the duration of the amblyopic therapy. This means that children's stereo acuity level did not change significantly through the therapy duration.

## DISCUSSION

Uncorrected refractive errors are one of the main causes of amblyopia especially among children. Therefore the role of VA correction using optical intervention in the management of amblyopia is very important. In this study, it was found that optical intervention i.e. wearing prescription spectacles was able to restore VA within 4 weeks to an optimum level of 0.1 LogMAR for the majority of the preschool children (85.0%). The mean VA improvement was 0.05 LogMAR. The improvement in the VA is the effect of the adaptation period after being prescribed spectacles which has played an important role in enabling these children to have a better prognosis for a normal VA<sup>16,17</sup>. The level of improvement was dependent on the base level of amblyopic VA and the magnitude of anisometropia. It should be noted that amblyopic therapy is recommended to commence with refraction treatment for at least 4 weeks before beginning occlusion therapy<sup>15</sup>. This stepwise progression facilitates amblyopic therapy and allows the children to appreciate their vision improvement over time.

Amblyopia prevalence (0.8%) in this study is not very different from the prevalence found in studies which have been reported elsewhere. For example, the prevalence was found to be 1.8% in Singapore<sup>18</sup>, 0.4% in South Korea<sup>19, 20, 21,22</sup> and 2% in the Netherlands<sup>10</sup>. It was also observed that the prevalence of amblyopia among preschool children is lower than its prevalence among school children. For example, the prevalence found in a study on refractive error among school children in Malaysia was 3.0%<sup>4</sup>, 12.0% in India<sup>5</sup>, 6.5% in Chile<sup>6</sup> and 9.0% in Nepal<sup>9</sup>. This study found that all the amblyopic children showed significant improvement  $F(6)=6.67$ ,  $p < 0.05$  of VA at the end of the amblyopic therapy. The improvement in VA can be seen after 8 weeks of occlusion using combined home based and clinic based therapy. This clearly proves that amblyopia can be treated successfully if it is detected at a preschool age such that intervention can be given during the critical period of visual development of a child before they reach 8 years of age<sup>1</sup>.

Assessment of stereo acuity showed no significant difference before and after the amblyopic therapy in this study. This is because at the beginning of therapy, only one child was found to have an abnormal level of stereo acuity. Furthermore, all six cases in this study only had moderate refractive amblyopia. Stereo acuity is not normally affected unless the level of amblyopia is severe, especially for the strabismus and anisometropia types of amblyopia<sup>23</sup>. This is

because of the adaptation that occurs to visual function through the mechanism named abnormal retinal correspondence results in a significant decrease in the stereo acuity level<sup>24</sup>. The stereo acuity test is a useful test to be carried out during follow-up assessment of the amblyopic therapy since it can give some indication of the state of binocularity.

Standard amblyopic management include prescription of optical devices such as glasses and occlusion therapy which was conducted by parents at home only (home based therapy). The children will be review at the clinic 3 monthly by the treating optometrist. In this study, we introduced the home based therapy as per standard protocol and clinic based therapy where the treating optometrists at the optometry clinic will provide occlusion therapy and monitor the children weekly for twelve weeks. Combining home based and clinic based occlusion therapy showed 100% improvement in the VA of all the preschool children in this study. This improvement was seen because the treatment was started at an early age where the visual system development was still within its range of plasticity. In addition, the majority of children in this study had refractive amblyopia with a moderate magnitude of high power correction and a low magnitude of anisometropia. The combined home based and clinic based intervention contained in a structured amblyopic therapy program featuring near work activities for two hours a day together with a weekly closely monitored session at the clinic by an attending optometrist. This promotes the compliance of the children with the amblyopic therapy to better ensure it's effectiveness. Although this program did incur relatively greater travel costs for the parents, but indirectly it did strengthen the motivation for parents and their children to comply with the amblyopic therapy to ensure a successful outcome.

This study only looks at the six preschool children (0.8%) identified from the 479 children who participated. While this prevalence appears to consistent with expected prevalence of amblyopia in the population as described in a number of studies (0.2% - 5.3%), it should be noted that this information is not available for a Malaysian population. As such generalisation to the general population should be done with caution. The successful outcome of the amblyopia treatment was from a small number of cases and may not truly reflect the efficacy of the treatment when used in the general population. The success of the treatment is also dependent of the access to trained professionals who are able to implement the treatment and the ability of the patients (and their families) to present for follow up sessions.

It is suggested that a broader study among a mixed population both urban and rural in this age group in Malaysia would be able to determine a more accurate prevalence of amblyopia among preschool children. This would then facilitate the conduct of a wider application of this treatment approach to better assess its efficacy. This further study should also look at the delivery mechanism of the treatment method with specific attention to patient access, the need for a screening program, the tools used for the near task training and program outcome assessment methods.

**CONCLUSION**

In conclusion, this study found that the prevalence of amblyopia among preschool children enrolled in preschool programs in Sitiawan was 0.8%. Home based and clinic based amblyopic therapy intervention can give a positive outcome in the management of preschool children with refractive amblyopia.

**ACKNOWLEDGMENT**

We would like to acknowledge all the preschool children, parents and preschool teachers who participated in this study.

**FUNDING**

This work was supported by The Yayasan Pendidikan Cheras, Malaysia [grant number NN-005-2007], The Yayasan Pendidikan Perak, Malaysia [grant number FF-007-2007].

**REFERENCES**

- Holmes JM & Clarke MP. Amblyopia. *Lancet* 2006; 367: 1343-51.
- Rosner J & Rosner J. *Pediatric optometry*. Boston: Butterworths Publishers 1990.
- AOA. 1994. *Optometric clinical practice guideline: Care of the patient with amblyopia*. St. Louis: American Optometry Association.
- Goh PP, Abqariyah Y, Pokharel GP & Ellwein, LB.. Refractive error and visual impairment in school-age children in Gombak district, Malaysia. *Ophthalmology* 2005;112 (4): 678-85.
- Trivedi V, Zalawadiya S, JV, B, T P & Kupmavat B. 2006. Prevalence of refractive errors in children (age group 7-15 Years) of rural and urban area of Gujarat: A population based study. Ahmedabad: Nagar School of Optometry, Nagari Eye Research Foundation Ahmedabad.
- Maul E, Barroso S, Munoz SR, Sperduto RD & Ellwein LB. Refractive error study in children: results from La Florida, Chile. *American Journal of Ophthalmology* 2000; 129(4): 445-54.
- Zhao J, Pan X, Sui R, Munoz SR, Sperduto RD & Ellwein LB. 2000. Refractive error study in children: results from Shunyi District, China.
- Zhao J, Mao J, Luo R, Li F, Munoz SR & Ellwein LB. The progression of refractive error in school-age children: Shunyi district, China. *American Journal of Ophthalmology* 2002; 134(5): 735-43.
- Pokharel GP, Negre AD, Munoz SR & Ellwein LB. Refractive error study in children: results from Mechi Zone, Nepal. *American Journal of Ophthalmology* 2000; 129(4): 436-44.
- Kvarnstrom G, Jakobsson P & Lennerstrand G. Visual screening of Swedish children: an ophthalmological evaluation. *Acta Ophthalmologica Scandinavica* 2001; 79(3): 240-4.
- Lim HT, Yu YS, Park SH, Ahn H, Kim S, Lee M, Jeong J, Shin KH & Koo BS. The Seoul metropolitan preschool vision screening programme: results from South Korea. *British Journal of Ophthalmology* 2004; 88: 929-33.
- Bardisi WM & Bin Sadiq BM.. Vision screening of preschool children in Jeddah, Saudi Arabia. *Saudi Medical Journal* 2002;23 (4): 445-9.
- Pediatric Eye Disease Investigator Group (PEDIG). A randomized trial to evaluate 2 hours of daily patching for strabismus and anisometropic amblyopia in children. *Ophthalmology* 2006; 113: 904-12.
- Declaration of Helsinki. 1964. Ethical principles for medical research involving human subjects Helsinki: World Medical Association Website: [http://www.wma.net/en/30publications/10policies/b3/index.html.pdf?print-media-type&footer-right=\[page\]/\[toPage\]](http://www.wma.net/en/30publications/10policies/b3/index.html.pdf?print-media-type&footer-right=[page]/[toPage]). Last accessed on 22th June 2011
- Moseley MJ, Neufeld M, McCarry B, Charnock A, McNamara R, Rice T & Fielder A.. Remediation of refractive amblyopia by optical correction alone. *Ophthalmic and Physiological Optics* 2002; 22(4): 296-9.
- Stewart-Brown SL & Snowdon SK. Evidence-based dilemmas in preschool vision screening. *Archives of Disease in Childhood* 1998; 78(5): 406-7.
- Stewart C, Moseley MJ & Fielder AR. Refractive adaptation in amblyopia: quantification of effect and implications for practice. *British Journal of Ophthalmology* 2004; 88: 1552-6.
- Lim HC, Quah BL, Balakrishnan V, Lim HC, Tay V & Emmanuel SC. Vision screening of 4 year old children in Singapore. *Singapore Medical Journal* 2000; 41(6): 271-8.
- Preslan MW & Novak A.. Baltimore vision screening project. *Ophthalmology* 1996; 103(1): 105-9.
- Kerr NC & Arnold RW. Vision screening for children: current trends, technology, and legislative issues. *Current Opinion In Ophthalmology* 2004; 15(5): 454-9.
- Klimek DL, Cruz OA, Scott WE & Davitt BV. Isoametropic amblyopia due to high hyperopia in children. *Journal of American Association for Pediatric Ophthalmology and Strabismus* 2004; 8(4): 310-3.
- Donahue SP, Baker JD, Scott WE, Rychwalski P, Neely DE, Tong P, Bergsma D, Lenahan D, Rush D, Heinlein K, Walkenbach R & Johnson TM.. Lions Clubs International Foundation Core Four Photoscreening: results from 17 programs and 400,000 preschool children. *Journal of American Association for Pediatric Ophthalmology and Strabismus* 2006; 10(1): 44-8.
- Wallace DK, Lazar EL, Melia M, *et al*. Stereoacuity in children with anisometropic amblyopia. *Journal of American Association for Pediatric Ophthalmology and Strabismus*. 2011; 15(5): 455-61.
- Evans BJW. *Pickwell's binocular vision anomalies*. Oxford: Butterworth-Heinemann 1997.