

# LITERATURE REVIEW

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## Current Eye & Vision Science Literature

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**Jorge J, Almeida JB, Parafita MA. Binocular vision changes in university students: a 3-year longitudinal study. *Optometry and Vision Science* 2008;85:999-1006.**

The authors of this study sought to examine the changes in various accommodation and vergence test findings after three years in university students and to find whether any of those test findings showed a correlation with refractive changes over the same time period. A total of 118 subjects (34 males and 84 females) remained in the study for the three years. The students were attending the School of Sciences at University of Minho in Braga, Portugal. Their ages ranged from 18 to 28 years and averaged 20.6 years. Test procedures used for analysis were subjective refractions under cycloplegic conditions, von Graefe phorias at 6 m and 40 cm, gradient AC/A ratios, horizontal fusional vergence ranges with Risley prisms, MEM dynamic retinoscopy, NRA, and PRA.

The mean change in spherical equivalent refractive error was  $-0.29$  D (SD=0.38). The prevalence of myopia (spherical equivalent of  $-0.50$  D or more minus) increased from 22% to 27.1% in the three years of the study, and the prevalence of hyperopia (spherical equivalent  $+0.50$  D or more plus) decreased from 49.2% to 39.8%.

The distance phoria averaged  $-0.4\Delta$  (SD=2.6) at the start of the study and  $-0.9\Delta$  (SD=3.0) at the

end of the three years (the negative value indicating exophoria). The mean near phoria was  $+0.4\Delta$  (SD=5.4) at the initial testing and  $-1.2\Delta$  (SD=5.4) at the end of the study. The changes in phorias were both statistically significant. The gradient AC/A ratio went from  $4.4\Delta/D$  (SD=2.2) to  $3.9\Delta/D$  (SD=2.1), not a statistically significant change.

Statistically significant ( $p<0.05$ ) increases in vergence findings occurred on the distance BI recovery ( $0.8\Delta$ ), distance BO recovery ( $2.6\Delta$ ), and near BO recovery ( $2.2\Delta$ ). Statistically significant decreases in vergence findings were found for the distance BI break ( $2.3\Delta$ ), distance BO break ( $1.7\Delta$ ), near BI blur ( $3.3\Delta$ ), near BI break ( $3.3\Delta$ ), and near BO break ( $1.7\Delta$ ). Vergence findings which did not vary significantly between start and end of the study were distance BO blur, near BI recovery, and near BO blur.

The NRA increased from  $+2.21$  D (SD=0.42) to  $+2.31$  D (SD=0.48), a significant difference ( $p=0.01$ ). The PRA also showed a significant ( $p<0.001$ ) increase, from  $-2.33$  D (SD=1.40) to  $-2.99$  D (SD=1.33). The lag of accommodation from MEM dynamic retinoscopy increased ( $p=0.01$ ) from  $1.12$  D (SD=0.42) to  $1.44$  D (SD=0.50).

To examine whether changes in refractive error were related to changes in binocular vision findings, the authors divided the subjects into a group that had refractive changes of 0.50 D or more and a group that changed less than 0.50 D. None of the changes in phorias, vergence ranges, NRA, PRA, or lag showed a statistically significant difference between the two refractive change groups.

Binocular vision findings at the start of the study were also examined for differences between the two refractive change groups. The initial distance BI break in the higher refractive change group,  $15.8\Delta$  (SD=6.8), was greater ( $p=0.012$ ) than the  $12.2\Delta$  (SD=3.6) for the lower refractive change group. The other test that was significantly different in the two refractive change groups was the near BI break, greater ( $p=0.041$ ) in the higher refractive change group,  $24.8\Delta$  (SD=5.5),

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compared to 22.4Δ (SD=5.2) in the lower refractive change group.

The authors thus demonstrated changes in some binocular vision tests over a three year period in university students. Their analysis did not show a relationship between those changes and change in refractive error. Subjects who had greater refractive change had higher BI breaks at distance and near at the start of the study. It appears that the higher refractive change group may have included both changes from hyperopia to emmetropia as well as changes into myopia or into more myopia. It would be interesting to know whether the binocular vision changes would have been different for those different types of refractive change.

**Roch-Levecq AC, Brody BL, Thomas RG, Brown SI. Ametropia, preschoolers' cognitive abilities, and effects of spectacle correction. Archives of Ophthalmology 2008;126:252-258.**

In this study, the authors compared pre-schoolers with uncorrected ametropia to a group of control subjects for their performance on standardized tests which are measures of cognitive abilities and which are predictive of academic achievement. The children in the ametropia group had significant amounts of hyperopia or significant amounts of astigmatism or both. The effect of six weeks of spectacle lens wear on test scores was also examined.

Subjects were three to five years old and were recruited from the children seen in the University of California San Diego mobile eye clinic serving children from low income families. The 35 subjects in the ametropia group had uncorrected bilateral hyperopia of at least +4.00 D, or astigmatism of at least 2.00 D if they were three years old, or astigmatism of at least 1.50 D if they were four to five years old. The 35 subjects in the control group had spherical refractive error of 2.00 D or less in both eyes and astigmatism of 1.00 D or less in both eyes. No subjects in either group had strabismus, amblyopia, cataract, glaucoma, or developmental problems on preschool health records. All subjects used either English or Spanish as their primary language. Sixty percent of the subjects were females, and 85.7% were Latino. The subjects in the two groups did not differ significantly on the Child-Behavior Checklist 1.5-5 English/Spanish for behavioral problems.

The primary outcome measure in the study was the score on the Beery-Buktenica Developmental

Test of Visual-Motor Integration (VMI). A secondary outcome measure was the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R).

Initially (before spectacle correction) the ametropia group scored significantly lower than normal and significantly lower than the control group on the VMI. Scores on the VMI did not correlate significantly with unaided visual acuity at far or at near.

At baseline the ametropia group also scored significantly lower than both normal values and the control group on the WPPSI-R performance scale. The ametropia and control groups did not differ significantly on the WPPSI-R verbal scale.

The next phase of the study involved providing spectacles to the ametropia group. Astigmatism was fully corrected. Hyperopia up to 7.00 D was undercorrected by 1.50 to 2.50 D, and hyperopia of 7.00 D or more was undercorrected by 3.00 D. Subjects in both groups were re-tested on the VMI and WPPSI-R after the ametropia group had worn spectacles for six weeks.

The ametropia group showed a significant improvement on VMI after six weeks, but the control group did not. After spectacle wear, the ametropia group and the control group did not differ significantly on the VMI. The ametropia group also showed improvement on the WPPSI-R performance scale. Their score after spectacle wear did not differ significantly from the control group at baseline.

The authors observed that possible explanations for the reduced test performance at study baseline are that "ametropia may be a risk factor for a neural alteration not yet understood" or that "ametropia may make near tasks uncomfortable, interfering with development of visual-motor coordination skills..." (p.257) The authors noted that the study results suggest that "early identification and correction should optimize cognitive development and learning..." (p. 258)

**Weizhong L, Zhikuan Y, Wen L, Xiang C, Jian G. A longitudinal study on the relationship between myopia development and near accommodation lag in myopic children. Ophthalmic and Physiological Optics 2008;28:57-61.**

The purpose of this study was to find whether a relationship between lag of accommodation and amount of increase in myopia in children could be demonstrated. The study was performed in China with 26 boys and 36 girls who were seven to thirteen years of age. At the beginning of the study subjects

had myopia between -0.50 and -3.00 D (spherical equivalent) and astigmatism no more than 1.00 D.

To determine the increase in myopia, cycloplegic autorefractometry was performed at baseline and after one year. A subjective refraction was also done at six months, and new lenses were prescribed if there had been a refractive change of more than 0.50 D. Accommodative response for a target distance of 33 cm was measured with an open view autorefractor at baseline and after one year. Subjects were asked to wear their glasses continuously.

The mean age of the subjects was 10.9 years (SD=1.6), and the mean beginning spherical equivalent refractive error was -1.70 D (SD=0.76). The average lag of accommodation was 0.74 D (SD=0.27) at the start of the study and 0.72 D (SD=0.36) after one year. The mean myopia progression in one year was -0.72 D (SD=0.37), with a range of -0.06 to -1.94 D.

The Pearson correlation coefficient of amount of myopia progression with the baseline lag of accommodation was  $r = -0.21$ . The negative value suggests a trend of greater myopia progression with higher lag but the correlation was not statistically significant ( $p=0.10$ ). In addition, the authors reported the correlation of amount of myopia progression with the average of the initial and final lags:  $r = -0.15$ . This also failed to reach statistical significance ( $p=0.25$ ).

In another analysis, the authors divided the study subjects into high lag and low lag groups, depending on whether their lags at baseline were higher or lower than the mean lag at the start of the study. The mean amount of myopia progression in one year was -0.76 D ( $n=32$ ,  $SD=0.30$ ) in the high lag group and -0.67 D ( $n=30$ ,  $SD=0.43$ ) in the low lag group. The difference in amount of myopia progression was in the expected direction but not statistically significant ( $p=0.36$ ).

Based on current theory and findings of some studies, higher progression was expected to be related to higher lags. While there appeared to be a slight trend in that direction, no statistically significant results were found. It is possible that the lack of significant correlation may not reflect incorrectness of theory, but rather the many variables that may affect myopia progression. For example, factors such as time spent reading, reading distance, changes in reading distance over time, fatigue effects, changes in lag over time, etc., may vary from subject to subject and affect amount of myopia progression. Perhaps lag of accommodation along with observations of reading behavior could be a fruitful area of study in relation to myopia progression.

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