Article • Prevalence of Non-strabismic Binocular Vision Dysfunction Among Optometry Students in Bangalore, India

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ABSTRACT

Purpose: Non-strabismic binocular vision dysfunctions (NSBVD) are common in the pre-presbyopic population, often resulting in less productivity in academic and other near vision-oriented tasks. Optometrists provide comprehensive vision care to the public and are often the first practitioners to examine patients with binocular dysfunctions. Optometrists must begin to acquire skills to diagnose and manage binocular dysfunctions through clinical experience during their education. This project aimed to determine the prevalence of NSBVD among optometry students, as well as their awareness of the condition.

Methods: Forty optometry students, ages 19 to 26, were recruited. Each subject was examined to investigate for the presence of NSBVD.

Results: The mean age of the patients was 22 ± 2.5 years. The prevalence of non-strabismic accommodative dysfunction was 55%, vergence dysfunction was 73%, and oculomotor dysfunction was 15%. The most common NSBVD was accommodative insufficiency (30%), followed by accommodative excess (20%).

Conclusion: This study indicates a high prevalence of accommodative and vergence dysfunction in the selected sample of optometry students. These preliminary results indicate a need for improved awareness, diagnosis, and management of binocular dysfunctions in order to increase the academic potential of these students and to enable their future participation in the clinical assessment of undiagnosed NSBVD.

Keywords: accommodative dysfunction, asthenopia, binocular vision dysfunction, oculomotor dysfunction, vergence dysfunction

Introduction

Many patients suffer due to an undiagnosed binocular vision disorder. The prevalence of accommodative and binocular vision disorders is 8.5 and 9.7 times greater than the prevalence of ocular disease in children between 6 and 18 years and between 6 months and 5 years, respectively.[1] The most frequently encountered disorders of the binocular vision system include convergence insufficiency/excess and divergence insufficiency/excess. Oculomotor dysfunction shows inaccurate and inefficient pursuits and saccades. Focusing problems frequently include accommodative insufficiency, excess/spasm, instability, infacility, and ill- sustained accommodation.

Non-strabismic binocular vision dysfunctions (NSBVD) are common in the pre-presbyopic population,[2,3] often resulting in less productivity in academic and other near vision-oriented tasks.[4-6] Undiagnosed binocular vision and oculomotor dysfunctions may present with discomfort, which can have a negative impact both on clinical training and

academic performance.[4-7] Several studies have evaluated the prevalence of NSBVD among optometry students. A study by Richman and Laudon[8] in optometry students from the New England College of Optometry found that 42% of the participants had binocular dysfunction (BD), with 25% of the BD group reporting asthenopia. Darko-Takyi et al.,[9] in a study on optometry students in Ghana, found the prevalence of NSBVD to be 34.3%. It is estimated that 7-10% of the general population has some type of problem with accommodation or binocular functioning.[10]

Non-strabismic binocular vision dysfunctions are prevalent among students and may not be detected by usual refractive analysis. Hokada et al.[11] in 1985 studied 119 patients in an optometry clinic; 42.9% had jobs with heavy deskwork demands and 39.5% were students. The prevalence of symptomatic general binocular dysfunctions was 16.8%, symptomatic near esophoria was 5.9%, and convergence insufficiency was 4.2%.

Porcar et al.[2] in 1997 studied the prevalence of general binocular dysfunction in 65 university students and found that 32.3% of the subjects showed general binocular dysfunctions. The prevalence of the various conditions was as follows: accommodative excess, 10.8%; convergence insufficiency with accommodative excess, 7.7%; accommodative insufficiency, 6.2%; and basic exophoria, 3.1%; convergence excess with accommodation insufficiency, basic exophoria, and fusional vergence dysfunction all showed the same prevalence of 1.5%.

Darko-Takyi et al.[9] conducted a cross-sectional study of 105 optometry students through a comprehensive optometric examination to investigate the refractive and non-strabismic binocular vision status. Prevalence of refractive error and non-strabismic binocular vision dysfunctions were 59.0% and 34.3%, respectively. Prevalence of specific refractive errors was 17.1% myopia, 19.0% hyperopia, and 22.9% astigmatism. Non-strabismic accommodative and vergence dysfunctions were 21.9% and 12.4%, respectively.

Garcia et al.[12] in 2016 undertook a cross-sectional study with a randomized sample of 175 university students aged 18 to 35 years. The overall prevalence of accommodation and binocular dysfunction was 13.5%, and refractive dysfunction was 45.14%.

We undertook this project to see the prevalence of NSBVD among optometry students in a tertiary eye care centre in Bangalore and secondarily to increase their awareness regarding the condition.

Methods

In this cross-sectional study, participants (n=40) were the optometry students (from 1st to 6th semester) of the Vasan Institute of Ophthalmology and Research (VIOR) in Bangalore, India. Optometry students who attended the tertiary eye care centre within a period of 6 months were recruited for the study.

The criteria for selection were the absence of significant uncorrected refractive error, healthy eyes, and no strabismus or amblyopia. Optometric clinical examination consisted of the following tests:

Visual acuity

Distance and near visual acuity was measured using Snellen visual acuity chart.

Objective refraction

Objective retinoscopy was performed without cycloplegia followed by subjective refraction. Although refraction was completed, all accommodative and binocular function tests were accomplished with the habitual prescription to simulate the usual conditions under which the subject functioned.

Binocular vision sensory status

Sensory status was evaluated for distance and near with the Worth 4-dot test[13] at 6 meters

and 40 cm, and stereopsis was evaluated using the two-pencil test.[14]

Motor evaluation

Motor function was assessed by:

- Ocular Motility (version) Test
- Cover/uncover and alternate cover test (in the absence of strabismus) to evaluate the presence, direction, and magnitude of heterophoria objectively.
- Modified Thorington Technique[15] to evaluate the presence, direction, and magnitude of heterophoria subjectively.

AC/A Ratio

AC/A ratio was calculated using the gradient method for measurement of AC/A ratio with the Howell near phoria card.[16]

Near Point of Convergence (NPC)

NPC was assessed with the vertical streak target on the Royal Air Force (RAF) ruler repeated 5 times. Objective (divergence of any one eye after suppression) and subjective (patient reports two vertical lines) findings were recorded.

Near Point of Accommodation (NPA)

NPA was measured monocularly and binocularly using the word target on the RAF ruler, each repeated 5 times. Patients were asked to read the near target one line above best-corrected visual acuity at 40 cm and to report when they saw blur.

Monocular Estimation Method Retinoscopy (MEM)

With distance correction on, the patient was asked to read the MEM card, retinoscopy was performed to assess the lead/lag of accommodation, and readings were recorded.

Negative and Positive Relative Accommodation (NRA and PRA)

NRA/PRA was performed at 40 cm with the help of plus (NRA) and minus (PRA) lenses. The patient was asked to keep the near target clear and single while the examiner increased the lenses in steps of 0.25 DS binocularly until the patient reported either the first sustained blur or diplopia.

Fusional Vergences [Base-in (NFV) and Base-out (PFV) Step Vergence Method]

A prism bar was placed in front of one eye, power was gradually increased, and the patient was asked to report when the target became blurry (blur), when it became double (break). The power of prism was decreased until the patient reported the target to be single again (recovery). All three values were noted for distance and near.

Accommodative Facility (AF)

AF was measured with ±2.00 DS flippers using the near accommodative rock card. The examiner asked the patient to call out the word after each flip of the lens. The test was performed for 1 minute. The cycles per minute (cpm) were calculated as the number of flips (1 cpm = 1 plus side clearance and 1 minus side clearance).

Vergence Facility (VF)

VF was measured using 3Δ Base-In (BI) and 12Δ Base-Out (BO) prisms. The test was performed for 1 minute, and cycles per minute were calculated as the number of flips.

Evaluation of Eye Movement

Saccades and pursuits were measured using the Maples Oculomotor Test.[1] The test included a standardized instructional set, a description of appropriate targets, instructions about the target placement, a standardized scoring system, and normative data.

Table 1. Expected Findings: Binocular Vision Testing (Scheiman and Wick)

Test	Expecteed Finding
Amplitude of accommodation Push-up test	18 – 1/3 age
Near point of convergence Accommodative target Gradient AC/A Ratio	Break/recovery: 5 cm/7 cm 4:1
Monocular accommodative facility 13-30 yr old	11 cpm
Binocular accommodative facility 13-30 yr old	10 cpm
Monocular estimation method retinoscopy	+0.50
Vergence facility testing (12 base- out/ 3 base- in)	15 cpm

Table 2. Optometric Extension Program Expected Findings

Case Finding	Expecteed
Distance lateral phoria	0.50 Exo
Near lateral phoria	6 Exo
Base-out (distance)	blur/break/recovery: 7/19/10
Base-in (distance)	break/recovery: 9/5
Base-out (near)	blur/break/recovery: 15/21/15
Base-in (near)	blur/break/recovery: 14/22/18
Negative relative accommodation	+1.75 to +2.00
Positive relative accommodation	-2.25 to -2.50

The results obtained from Amplitude of Accommodation, NPC, gradient AC/A, MAF and BAF, MEM retinoscopy, and vergence facility were compared with tables of established expected values by Scheiman and Wick (Table 1).[17] The results from distance and near lateral phoria, NFV, PFV, NRA, and PRA were compared with expected values from the tables of expected values by the Optometric Extension Program (Table 2).[18]

The results from the Maples Oculomotor Test were compared with minimal acceptable scores for saccades and pursuits by age and sex (Tables 3 & 4).[19]

Results

Forty optometry students with ages ranging from 19 to 26 years (mean age 22, SD 2.5) participated in the study. No participants were excluded; 21 (52.5%) were male and 19 (47.5%) were female. The prevalence of

Table 3. Maples Pursuit Test Minimal Acceptable Score by Age and Sex

Age	Ability		Accuracy		Head Mvmt		Body Mvmt	
Sex	M	F	M	F	M	F	M	F
≥14	5	5	5	4	4	4	5	5

Table 4. Maples Saccadic Test Minimal Acceptable Score by Age and Sex

Age	Ability		Accuracy		Head Mvmt		Body Mvmt	
Sex	M	F	M	F	M	F	M	F
≥14	5	5	4	3	3	4	5	5

non-strabismic accommodative dysfunction was 55% (n=22), vergence dysfunction was 73% (n=29), and oculomotor dysfunction was 15% (n=6). The prevalence of specific non-strabismic binocular vision dysfunctions were as follows: accommodative insufficiency (30%), accommodative excess (20%), accommodative infacility (5%), convergence insufficiency (17.5%), convergence excess (12.5%), divergence insufficiency (5%), divergence excess (2.5%), fusional vergence dysfunction (2.5%), basic exophoria (5%), basic esophoria (12.5%), vergence dysfunction with suppression (15%), high AC/A ratio (12.5%), and low AC/A ratio (77.5%). Thirty percent (n=12) reported symptoms such as headache, blur after reading, and asthenopia, while 70% (n=28) did not report any symptoms.

Discussion

It would seem reasonable to presume that optometrists and optometric students should have a low prevalence of unidentified and/or untreated accommodative, vergence, and oculomotor dysfunctions. This presumption is based on the thought that since they learn about the various visual problems, they should be more aware of their own visual abilities and disabilities. It is observed that the prevalence of NSBVD among optometry students of Bangalore was found to be higher compared to the 42% reported by Richman and Laudon,[8] the 32.3% by Porcar and Martinez-Palomera,[2] and the 34.3% by Darko-Takyi et al.[9]

In the present study of these binocular dysfunctions, at least 12 out of 40 students had corresponding symptoms that could negatively impact their performance as students and professional health care providers. Further, these students had in-depth knowledge that symptoms associated with sustained near work and accommodative and binocular dysfunction could be successfully managed with proper lens correction and/or vision therapy.

Conclusion

The findings indicate a need to increase the awareness, diagnosis, and management of binocular vision dysfunctions for not only prospective optometrists but also to any student suffering from these conditions. Proper treatment will positively impact their future and increase the productivity of life. These findings suggest that in optometry students, it is important to conduct a thorough eye and vision examination to detect NSBVD so that they, as potential primary eye care practitioners, not only become aware of their own visual status but also understand the magnitude of the problem so that as future clinicians, they can diagnose and manage these problems adequately. As optometrists change lives, we must offer to humanity the uniqueness of our professional services.

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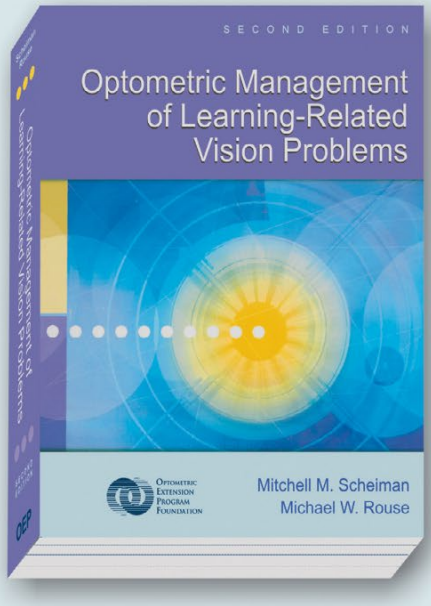

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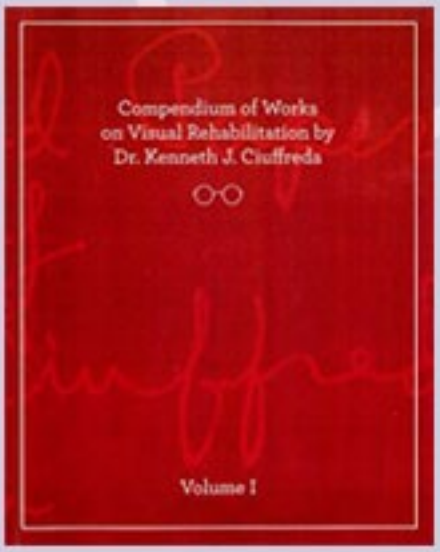

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