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Research Article

Prevalence of Non Strabismic Binocular Vision Dysfunction Among Engineering Students in Nepal

Manish Dahal[1], Raju Kaiti[2]*, Purushottam Shah[3] and Rekha Ghimire[3]

[1]Consultant Optometrist, (Master of Optometry), Nepal Eye Hospital, Nepal

[2]Consultant Optometrist, Master of Optometry, Nepal Eye Hospital, Lecturer, National Academy of Medical Sciences, Nepal

[3]Optometry Student, National Academy of Medical Sciences, Nepal

***Corresponding Author:** Raju Kaiti, Consultant Optometrist, Master of Optometry, Nepal Eye Hospital, Lecturer, National Academy of Medical Sciences, Nepal.

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Abstract

Background: Engineering is one of the disciples of science which needs tedious near works, long run computer tasks and accurate focus and fixation. This study was carried out to assess the prevalence of non-strabismic binocular vision dysfunctions (NSBVD) among engineering students in Nepal.

Methodology: It was a cross-sectional study which was conducted among engineering students in different engineering colleges in Kathmandu valley (Kathmandu, Lalitpur and Bhaktapur districts), Nepal. Students in the age group of 18-30 years were included in the study. Each subject was examined to investigate for the presence of an NSBVD.

Results: Of the 210 participants of age group 18 to 30 years examined, 150 (71.41%) students presented some form of NSBVD. The prevalence of accommodative dysfunction, vergence dysfunction and oculomotor dysfunction was 21.42%, 28.57% and 10% respectively. The most common NSBVD was accommodative insufficiency (12.85%) followed by convergence insufficiency (11.42%).

Conclusion: The present study indicates that non strabismic binocular vision dysfunctions are prevalent among engineering students in Nepal and accommodative insufficiency was the most prevalent.

Keywords: Accommodative Dysfunction, Engineering Students, Oculomotor Dysfunction, Vergence Dysfunction

Introduction

Non-strabismic binocular vision dysfunctions (NSBVD) are visual disorders that affect the subject's binocular vision and visual performance, especially when performing tasks requiring near vision. They occur when the accommodative and/or vergence response of the visual system is defective. As a result, the visual system may suffer a loss of efficiency, hindering near vision activities [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. These dysfunctions are commonly associated with symptoms, including blurred vision, difficulty in focusing at different distances, headache and ocular pain, and difficulty with focusing particularly when reading and writing [1-3].

However, the symptoms that the subjects perceive may differ depending on the type of causative disorder [4].

NSBVD are common in the pre-presbyopic population which results in less productivity in academic and other near vision-oriented tasks [2-8]. Undiagnosed binocular vision and oculomotor dysfunction may present with discomfort which can have a negative impact on academic performance [2-8].

The prevalence of accommodative and binocular vision disorder is 8.5 and 9.7 times greater than the prevalence of ocular disease in children between 6 to 18 years and 6 months to 5 years, respectively[9]. It is estimated that 7-10% of the general population has some type of problem with accommodation and binocular functioning [10].

Several authors have shown that these disorders are commonly found in clinical practice, although there is some disparity in the prevalence reported in the various published studies [5,9,15].

Gracia., *et al.* [12]. in 2016 undertook a cross-sectional study on 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%.

Dahal., *et al.* [13]. in a study on optometry students in Bangalore India in 2019 found the prevalence of non-strabismic accommodative dysfunction to be 55%, vergence dysfunction to be 73% and oculomotor dysfunction to be 15%.

Engineering is one of the disciples of science which needs tedious near works, long run computer tasks and accurate focus and fixation. Excessive near work results in NSBVD which directly impact on academic performance of students [2-8]. This study was conducted to assess the prevalence of NSBVD among engineering students in Nepal.

Methodology

A cross sectional study was carried out among engineering students of age 18 to 30 year in different engineering colleges in Kathmandu valley (Kathmandu, Lalitpur and Bhaktapur districts), within a period of 6 months. The study began after taking permission from the college authorities and fixing the date for the evaluation of NSBVD of the students.

The criteria for selection were the absence of significant uncorrected refractive error, healthy eyes, and no strabismus or amblyopia.

Clinical setup was divided into two stations. The first station was for taking detail history on visual symptoms, measurement of visual acuity at distance and near, refraction (objective and subjective without dilation), sensory and motor evaluation. The tests included the measurement of stereopsis using stereo fly, worth-4-dot test, cover test at distance and near, prism bar cover test, measurement of AC/A ratio using gradient method and maples ocular motility test.

Second station included the assessment of accommodation and vergence. The different tests for accommodation were measurement of near point of accommodation (NPA) monocularly and binocularly using word target of using Royal Air Force (RAF) ruler each repeated 5 times, negative and positive relative accommodation (NRA and PRA), accommodative facility (AF) monocularly and binocularly and monocular estimation method retinoscopy (MEM).

The different tests for vergence were measurement of near point of convergence (NPC) by vertical streak target of RAF ruler repeated 5 times, base in fusional vergence (NFV) and base out vergence (PFV) and vergence facility.

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 Scheimann and Wick (Table 1) [16]. 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) [17]. The results from the Maples Oculomotor Test were compared with minimal acceptable scores for saccades and pursuits by age and sex (Table 3,4) [18].

Test	Expected Finding
Amplitude of accommodation	
Push-up test	18 - 1/3 age
Near point of convergence	
Accommodative target	Break/recovery: 5 cm/7
Gradient AC/A Ratio	Cm
	4:1
Monocular accommodative facility	
13-30 yrs. old	11 cpm
Binocular accommodative facility	
13-30 yrs. old	10 cpm

Monocular estimation method	
retinoscopy	+0.50
Vergence facility testing	
(12 base- out/ 3 base- in)	15 cpm

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

Case Finding	Expected
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

Table 2: Optometric Extension Program Expected Findings.

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

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

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

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

Written consent was taken from each subject before conducting this study. The study protocol adhered to the provision of the Declaration of Helsinki for research involving human subjects.

All data were entered into a Microsoft Excel database (Microsoft, version 2010) and analyses were done using SPSS (version 21.0 for Windows; SPSS Inc., Chicago, IL, USA).

Results

In the current study, 210 students were evaluated of age group 18-30 years (mean age 24). No participant was excluded; 147 (70%) were male and 63(30%) were female.

Out of 210 students, 150 students (71.41%) presented with non-strabismic binocular vision dysfunctions, 60 students (28.57%) were classified as normal. Of the 150 students with NSBVD, 45 students (21.42%) presented with accommodative dysfunctions, 60 students (28.57%) presented with vergence dysfunctions, 24 students (11.42%) had combined accommodative and vergence dysfunctions and 21 students (10%) presented with oculomotor dysfunction.

In terms of accommodative dysfunctions, there was a higher incidence of accommodative insufficiency (12.85%) than accommodative infacility (2.85%) and accommodative excess (15.71%). For vergence dysfunctions, the convergence insufficiency was the most prevalent (11.42%) compared to the convergence excess (5.71%), basic exophoria (7.14%) and fusional vergence dysfunction (4.28%). Of 24 students with combined accommodative dysfunction with vergence dysfunction, 12 (5.71%) had combined convergence insufficiency with accommodative insufficiency, 6 (2.85%) had convergence insufficiency with accommodative insufficiency and 6 (2.85%) had convergence excess with accommodative insufficiency. 21 students (10%) had oculomotor dysfunction. 75 students (35.71%) reported symptoms such as headache, blur after reading, and asthenopia while 135 students (64.28%) did not report any symptoms.

Table 5 shows the prevalence of NSBVD among engineering students.

Classification	N	%
Accommodative Dysfunctions	45	21.42
Accommodative insufficiency	27	12.85
Accommodative excess	12	5.71
Accommodative infacility	6	2.85%
Binocular dysfunctions	60	28.57

Convergence insufficiency	24	11.42
Basic exophoria	15	7.14
Convergence excess	12	5.71
Fusional vergence dysfunction	9	4.28
AD combination with BD	24	11.42
Convergence insufficiency with accommodative insufficiency	12	5.71
Convergence insufficiency with accommodative excess	6	2.85
Convergence excess with accommodative insufficiency	6	2.85
Oculomotor dysfunction	21	10
Normal	60	28.57
Total	210	100

Table 5: Prevalence of non-strabismic binocular vision dysfunctions.

Discussion

Non strabismic binocular vision dysfunctions is the growing problem, it is very important to know about the population at highest risk and its prevention and management as early as possible. Timely diagnosis of the conditions can improve the prognosis of binocular dysfunction. This condition is usually associated with prolonged near work [2,3,5,19].

In the current study, the overall prevalence of NSBVD was 71.41%. The major problem was accommodative insufficiency followed by convergence insufficiency and oculomotor dysfunction. In our study, the prevalence of NSBVD was distinguished from other studies. Numerous study results agreed that accommodative dysfunctions were more prevalent than vergence dysfunctions [2,19,20], whereas in the present study, the prevalence of vergence dysfunctions was higher. Hokada., *et al*. [20] in studied 119 patients; 42.9% of the patients had jobs with near workloads, and 39.5% of the patients were students with near workloads. In this particular study the prevalence of accommodative dysfunction was significantly higher than that of vergence dysfunction particularly accommodative insufficiency was the most prevalent. In addition, in Montes-Mico's[21] study with a significant number of participants, accommodative dysfunctions were more prevalent than vergence dysfunctions. However, in our study, vergence dysfunctions were more prevalent than accommodative dysfunction. Dahal., *et al*. [13]. in a study on optometry students in India found the prevalence of vergence dysfunction significantly higher than accommodative dysfunctions which supports our study.

Conclusion

The present study revealed a high prevalence of NSBVD among engineering students and 35.71% of the students were symptomatic. These findings suggest that in engineering students, it is important to conduct a thorough eye and binocular vision examination to detect NSBVD. Furthermore, these dysfunctions can be successfully managed through the art of lens prescribing and optometric vision therapy [22-26]. Therefore, timely diagnosis and management will positively impact their future and increase the productivity of life.

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