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Original Research Article

NON-STRABISMIC BINOCULAR VISION DYSFUNCTION IN MEDICAL AND PARAMEDICAL STUDENTS IN A TERTIARY CARE HOSPITAL: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Aim: To study NSBVD among medical and paramedical students of a tertiary care hospital. **Objective:** 1. To estimate the prevalence of NSBVD in medical and paramedical students. 2. To assess the association of electronic device use with the types of NSBVD. 3. To assess the association of anemia with the types of NSBVD. **Materials and Methods:** A cross-sectional study was carried out among 434 medical and paramedical students aged 18 to 25 years. Students who had manifest squint, intraocular diseases, or previous eye surgeries were excluded. Detailed binocular vision evaluations were conducted to identify different types of Non-Strabismic Binocular Vision Dysfunction (NSBVD). Information on refractive errors, screen usage time including mobile phone usage, anaemia status, and eye-related symptoms was gathered through questionnaires and clinical examinations. **Result:** NSBVD was detected in 204 students (47%). Convergence insufficiency was the most common subtype (35.30%), followed by accommodation excess (25%) and accommodation insufficiency (21.57%). NSBVD prevalence was slightly higher in females than males and greater in students aged 22–25 years. Longer daily electronic device use (>5 hours) and compound myopic astigmatism were found to be strongly associated with higher NSBVD prevalence. Ocular symptoms such as visual fatigue and headache were more commonly reported among students with NSBVD than those without. No significant association was observed between anaemia and NSBVD. **Conclusion:** This study highlights a high prevalence of undiagnosed NSBVD among medical and paramedical students, with convergence insufficiency being the most frequent subtype. Excessive screen time and certain refractive errors appear to contribute to its occurrence. Routine binocular vision screening and early corrective measures are recommended to reduce visual discomfort and improve academic performance in this population.

INTRODUCTION

Binocular single vision is the coordinated use of both eyes to perceive one single image, achieved by the brain combining the slightly different images from each eye into one unified picture through a process called fusion. When focusing on close objects like during reading, the eyes move inward together (convergence) while the eye's focusing mechanism (accommodation) increases to maintain clear vision. This active coordination allows for clear, single vision during near tasks.

Non-Strabismic Binocular Vision Dysfunction (NSBVD) results from a failure in the proper coordination of the eyes' visual mechanisms. This condition often leads to symptoms like eye strain, headaches, blurred vision, and difficulty concentrating on close tasks, which can seriously affect daily functioning which can be corrected if diagnosed and treated effectively.

The increasing engagement with near and intermediate visual tasks—such as extensive computer work, reading, and watching television—puts significant strain on the external eye muscles. This often results in eye fatigue and may cause various binocular vision problems, especially affecting accommodation and convergence. Although these symptoms are commonly labeled as

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"computer vision syndrome" during initial examinations, a detailed assessment can reveal underlying non-strabismic vergence disorders that might be missed otherwise.[1,2]

Non-strabismic binocular vision dysfunctions (NSBVD) are generally classified into two main groups: accommodative anomalies and vergence anomalies. The classification system introduced by Scheiman and Wick in 2008 categorizes accommodative dysfunctions into three major types: accommodative insufficiency, accommodative infacility (also known as accommodative inertia), and accommodative excess (or accommodative spasm). Meanwhile, seven different types of vergence anomalies are recognized within this framework.[3]

Numerous research studies have reported a range of symptoms linked to non-strabismic binocular vision anomalies. These commonly include blurred vision, difficulty focusing at various distances, headaches, ocular discomfort, and particular challenges with focusing during tasks such as reading and writing. Among these, headaches are the most frequently experienced symptom, followed by visual fatigue and eye strain. These symptoms can significantly interfere with near work activities, often requiring detailed binocular vision testing for accurate diagnosis and effective treatment.[4,5,6] Several research studies have confirmed that these dysfunctions are commonly encountered in ophthalmic practice; however, there is considerable variation in the prevalence rates reported by different researchers. This discrepancy highlights the differences in study populations, diagnostic criteria, and methodologies used across these studies.[7,8,9,10]

In recent years, the increased dependence on near-vision activities—such as reading, desk work, and using electronic devices like laptops, tablets, and smartphones—has placed added strain on the eyes' accommodation and vergence systems, heightening the risk of non-strabismic binocular vision dysfunction (NSBVD). The reliance on digital devices for activities such as reading, participating in classes, and conducting research increased significantly during and following the COVID-19 pandemic. This trend has continued to accelerate in educational settings. Medical and paramedical students often spend long periods on close-up tasks and electronic devices, increasing their risk of NSBVD.

To date, less research has been conducted in costal Andhra Pradesh to assess binocular visual performance in medical and paramedical students.

This study aims to determine the prevalence of NSBVD among medical and paramedical students at a tertiary health care institute in A.P.

Table 1: Details of accommodative anomalies

Anomaly	Definition	Key features
Accommodative excess	Spasms of accommodative system due to ciliary muscles	Low NRA
		Lead of accommodation
		Variable results in objective and subjective refraction
		Low MEM retinoscopy finding
		Negative flipper test with plus lenses
		Low base-in to blur at near
Accommodative insufficiency	Consistently reduced accommodative ability compared to the expected level for the individual's age	Low PRA
		Low AOA for age
		High MEM retinoscopy finding
		Negative flipper test with minus lenses
		Low base-out to blur findings at near
Accommodative infacility	Impaired ability to effectively stimulate and relax accommodation, resulting from reduced accommodative responsiveness	Low PRA and NRA
		Negative both monocular and binocular flipper test with plus and minus lenses
		Low base-out to blur findings at near
Ill sustained accommodation	Normal accommodative amplitude, but repeated stimulation of accommodation causing fatigue	Normal AOA on first administration then decreases with repeated testing
		High lag of accommodation
		Low PRA
		Fails flipper test with minus lenses

AOA-Amplitude of accommodation, PRA-Positive relative accommodation, NRA- Negative relative accommodation.

Table 2: Details of vergence anomalies

Anomaly	Definition	Key features
Convergence insufficiency	A condition with higher exophoria at near and receded NPC	Receded NPC
		Exophoria of greater degree at near than at distance
		Low AC/A ratio
		Reduced PFV at near
Divergence insufficiency	A condition with high esophoria at distance than at near with normal versions and reduced divergence at distance	Normal NPC
		Esophoria of greater degree at distance than near
		Low AC/A ratio
		Below normal NFV for distance

Convergence excess	A condition with high esophoria at near than at distance	Esophoria greater for near than at distance
		High AC/A ratio
		Below normal NFV at near
Divergence excess	A condition in which eye turns out intermittently	Exophoria of greater degree at distance than at near
		High AC/A ratio
		Normal PFV for near and distance
		No refractive error
Fusional vergence dysfunction	A condition with low or no degree of phoria but lower fusional vergence reserves at distance and near	Normal phoria for distance and near
		Normal AC/A ratio
		Less fusional vergence reserves for near and distance
		Low PRA and NRA
Basic esophoria	A condition in which tonic vergence is high and AC/A ratio is normal	Equal degree of esophoria for distance and near
		Normal AC/A ratio
Basic exophoria	A condition in which tonic vergence is low and AC/A ratio is normal	Receded NPC
		Equal esophoria at distance and near
		Normal AC/A ratio

AC/A- Accommodative convergence over accommodation ratio; NPC-Near point of convergence; PFV-Positive fusional vergence; NFV-Negative fusional vergence; PRA-Positive relative accommodation; NRA-Negative relative accommodation.[3]

Aim

To study prevalence of NSBVD among medical and paramedical students of a tertiary care hospital in Andhra Pradesh.

Objectives

1. To estimate the prevalence of NSBVD in medical and paramedical students.
2. To assess the association of screen time with the types of NSBVD.
3. To assess the association of anaemia with the types of NSBVD.
4. To assess the association of ocular symptoms with type of NSBVD

MATERIALS AND METHODS

The study followed a cross-sectional design and took place between July 2025 and September 2025 among medical and paramedical students of a tertiary hospital in Govt general Hospital, Machilipatnam, Andhra Pradesh. Ethical review and approval were obtained from Institutional Ethics Committee and followed the ethical guidelines outlined in the Declaration of Helsinki. Students who gave written and informed consent were enrolled in the study and underwent examination in the Outpatient Department of Ophthalmology., GGH, Machilipatnam.

Sample size: Based on an estimated average prevalence of binocular dysfunction of 40%, as reported by Rohit Tiwari et al, and assuming a precision (absolute error) of 5%, the required sample size was calculated to be 434 using Cochran's formula.[11]

Inclusion Criteria: Medical and Paramedical students with 18-25 years of age who were willing to give written and informed consent.

Exclusion Criteria: Students presenting with history of squint surgery, intraocular pathology, or any prior intraocular procedures such as cataract surgery were excluded from the study.

Study Method: A comprehensive history was gathered from all medical and paramedical students, including details such as age, gender, and whether they lived in rural, urban, or metropolitan areas. Information about any previous eye surgeries and the presence of asthenopic symptoms—such as headaches, eye strain, blurred vision, and tearing while reading, studying, or using electronic devices—was also collected, along with any signs of anaemia if reported. Additionally, students completed a survey using a structured form to record the daily duration and regular usage time of electronic devices like mobile phones, laptops, computers, and tablets.

A hemoglobin estimation test was conducted to detect anemia in students. For this, a 2 ml blood sample was drawn from the anterior cubital vein of one arm and collected in an EDTA tube. The sample was then sent to the laboratory for analysis, where hemoglobin levels were measured using the cyanmethemoglobin method with a hemoglobin analyzer. This method involves converting hemoglobin to a stable colored compound, which is quantified spectrophotometrically to determine the hemoglobin concentration accurately (Erba Elite H360 Canada).

After written informed consent, a comprehensive ophthalmic examination has been done for every student including:

Cycloplegic refraction. done after assement of visual acuity, tharough examination by Slit Lamp and Binocular vision was assessed by Hirschberg corneal reflex test, worth 4 dot test, Prism Bar Cover Test (PBCT), Accommodative Convergence/Accommodation (AC/A) ratio using gradient method, Near point of accommodation (NPA) and Near point of convergence (NPC) measured with RAF rule

Synaptophore was used to measure primary and secondary deviations, objective and subjective angles of deviation, range of fusion or vergence and grades of Binocular vision (ASP902 221, Appasamy Associate, Chennai).

Statistical Analysis

The collected data was systematically entered into a standardized proforma and subsequently transferred to Excel Office 365 for organization and management. Statistical analyses were performed utilizing Epi Info software version 7.2.5 to ensure accurate and reliable results.

To compare the daily screen time between students diagnosed with non-strabismic binocular vision dysfunction (NSBVD) and those without the condition, a Student's t-test was applied. This test enabled the assessment of differences in mean screen exposure between the two groups.

Additionally, the Chi-square test was used to examine the association between varying durations of screen exposure and the presence of NSBVD. The strength of these associations was determined by evaluating p-values, with a value less than 0.05 considered statistically significant.

RESULTS

DISTRIBUTION OF VARIOUS NSBVD IN STUDENTS

Table 3: Distribution of several types of NSBVD among medical and paramedical students

NSBVD	Medical students	Paramedical students	Total
Convergence insufficiency	50	22	72
Convergence insufficiency associated with secondary accommodation excess	14	4	18
Accommodation Insufficiency	29	15	44
Accommodation insufficiency associated with secondary convergence insufficiency	9	4	13
Accommodation excess	39	12	51
Unilateral Accommodation excess	5	1	6
Total students with NSBVD	146	58	204

Among the 204 students diagnosed with NSBVD, the most common subtype was Convergence Insufficiency, found in 72 students (35.30%)—50 from the medical group and 22 from the paramedical group. This was followed by Accommodation Excess (25%) and Accommodation Insufficiency (21.57%). Overall, 146 medical students and 58 paramedical students were diagnosed with various forms of NSBVD.

No significant difference exists in NSBVD subtype distribution between medical and paramedical students (P=0.82), despite higher overall NSBVD prevalence in medical students. All subtypes—convergence insufficiency (most common), accommodation anomalies, and excess—occur proportionally similarly across groups, suggesting shared mechanisms like near work demands rather than course-specific subtype risks.

GENDER DISTRIBUTION OF NSBVD AMONG STUDENTS

Table 4: Gender distribution of NSBVD among students

Students	No. of students with NSBVD (n=204)	No. of students without NSBVD (n=230)
Male	91	118
Female	113	112
Total	204	230

Out of 434 students, there were 209 males and 225 females participated in the study. Among males, 91 were diagnosed with NSBVD, while 118 did not exhibit the condition. In the female group, 113 students had NSBVD, and 112 were without it. The prevalence of NSBVD was greater among female students (55.39%) than their male counterparts(44.60%).

Table 5: Age-wise prevalence of NSBVD

Age	Total students	Students with NSBVD (n, %)
18-21 years	257	104 (40.47%)
22-25 years	177	100(56.48%)

Among the 434 students, the age group of 18–21 years included 257individuals, of whom 104 (40.47%) were diagnosed with NSBVD. In comparison, the 22–25 years age group comprised 177 students, with 100 (56.48%) affected by NSBVD. This indicates a higher prevalence of NSBVD in the older age group.

OCULAR SYMPTOM PROFILE IN STUDENTS

Table 6: Prevalence of ocular symptoms among students with/without NSBVD.

Ocular symptoms	NSBVD positive students	Non-NSBVD students
Students with ocular symptoms present	76	26
Students without ocular symptoms	128	204
Total	204	230

Ocular complaints are present in 102 students (23.50%) among the total students participated in this study and among those the predominant ocular complaint was visual fatigue, noted in 34 participants (9%)

Among the NSBVD diagnosed 204 students, 76 (37.25%) reported experiencing ocular symptoms, while 128 (62.74%) did not. In contrast, among the 230 non-affected students, only 26 (11.30%) reported ocular symptoms, with the remaining 204 (88.69%) being asymptomatic. These results suggest that ocular symptoms were more commonly reported among students affected with NSBVD compared to those without the condition.

Chi-square test confirmed a highly significant association between NSBVD status and ocular symptoms (χ^2=39.06, df=1, P=4.10×10^{-10}). Fisher's exact test yielded OR=4.66 (P=1.96×10^{-10}), indicating NSBVD-positive students have 4.66 times higher odds of symptoms.

NSBVD strongly predicts ocular symptoms, with 37% prevalence among NSBVD-positive students versus 11% in NSBVD-negative students. This robust association underscores NSBVD as a key driver of symptoms like eye strain and discomfort in student populations.

REFRACTIVE ERROR PROFILE OF STUDENTS

Table 7: Pattern of refractive error among students in the present study

Refractive defect	NSBVD positive students (n=204)	Non-NSBVD students (n=230)	Total students
Simple Myopia	25	67	92
Simple myopic astigmatism	17	18	35
Compound myopic astigmatism	61	22	83
Simple hyperopia	-	-	-
Simple hyperopic astigmatic	-	-	-
Compound hyperopic astigmatism	-	-	-
Mixed astigmatism	2	3	5
No refractive error	99	120	219
Total	204	230	434

The most common refractive error was compound myopic astigmatism, seen in 61 students (329.90%) among 204 students who were diagnosed with NSBVD. This was followed by simple myopia in 25 (12.25 %) students and simple myopic astigmatism in 17 students (8.33%). Notably, 99 students (48.52%) with NSBVD had no refractive error.

In the group without NSBVD (230 students), simple myopia was the most frequent refractive error, found in 67 students (29.13%), followed by compound myopic astigmatism in 22 students (9.56%) and simple myopic astigmatism in 18 students (7.82%) and . A majority, 219 students (95.21%), had no refractive error.

Refractive errors such as hyperopia and Hypermetropic Astigmatism were not observed in

present study. The findings reveal that compound myopic astigmatism is more commonly observed in students with NSBVD, whereas simple myopia was more common among those without NSBVD.

The chi-square test demonstrated a significant association between refractive error type and NSBVD status (χ^2=38.32, df=4, P<0.0001), with post-hoc Fisher's exact tests revealing markedly higher NSBVD odds in compound myopic astigmatism (OR=7.43 vs simple myopia, OR=3.36 vs no error; both P<0.0001). This pattern, with 73% prevalence in the compound group versus 27-49% elsewhere, indicates that combined myopic-astigmatic errors substantially elevate NSBVD risk through amplified binocular stress during near work.

DISTRIBUTION OF STUDENTS BY DAILY SCREEN TIME AND NSBVD STATUS

Table 8: Comparison of Electronic Device Usage Duration in NSBVD and Non-NSBVD Students

Daily screen time	NSBVD positive students	Non-NSBVD students	Total
<3 hours	36	77	113
3-5 hours	55	92	147
>5 hours	113	61	174
Total	204	230	434

Among students who reported using electronic devices for more than 5 hours per day, 113(%) were diagnosed with NSBVD, while 61 (34.6%) were not.

In the 3–5 hours group, 55 students (28.9%) had NSBVD, and 92 students (71.1%) did not. Among those who used devices for 0–3 hours daily, 36

students (35.4%) had NSBVD, whereas 77 students (64.6%) did not.

This trend indicates that a longer duration of electronic device use per day is associated with a higher prevalence of NSBVD.

The chi-square test revealed a significant association between daily screen time and non-strabismic binocular vision dysfunction (NSBVD) status (χ^2=38.31, df=2, P<0.0001), with post-hoc Fisher's exact tests confirming no difference between <3h and 3-5h exposure (OR=0.78, P=0.36) but substantially lower NSBVD odds for these groups versus >5h (OR=0.25 and 0.32, respectively; both P<0.0001).

This dose-response pattern indicates prolonged screen time markedly elevates NSBVD risk, likely due to sustained near-focus demands straining binocular coordination, as consistently observed in student populations.

Table 9: Association of anemia with NSBVD

Students	No. of students with anaemia	No. of students without anaemia	No. of students with NSBVD	No. of students without NSBVD
Medical students	30	243	151	132
Paramedical students	25	136	53	98
Total	55	379	204	230

This study population, 30 (10.98 %) were medical students with anaemia, and 25 (15.52 %) were paramedical students with anaemia using following criteria-

Normal Haemoglobin levels (WHO) – Adult male: 13g/dl or higher

Non-pregnant female: 12g/dl or more

Pregnant female: 11g/dl or more

This suggests a higher prevalence of anaemia in para medical students with NSBVD compared to medical students.

The analysis yielded a chi-square value 2.66 with p-value as 0.103. As the p-value is more than 0.05, the association between anaemia and the occurrence of NSBVD was not found to be statistically significant. This suggests that, within the studied population, the presence of anaemia does not have a significant relationship with the likelihood of experiencing NSBVD.

DISCUSSION

This research sought to identify the prevalence of unrecognised non-strabismic binocular vision anomalies among medical and paramedical students at a tertiary care institution. NSBVD describes the unexplained asthenopic symptoms developed in the younger age group which may get neglected and can result in long-term strain in the eyes and subsequent difficulty in reading.

The intention of this study is to detect NSBVD and its type in these students and to create awareness among ophthalmology practitioners to advocate for corrective measures to them.

PREVALENCE AND COMMONEST TYPE OF NSBVD

In the present study, out of 434 participants, 204 (47.00%) were identified with NSBVD and among those, convergence insufficiencies (35.30%) emerged as the most prevalent anomaly followed by accommodation excess (25%) and accommodation insufficiency (21.57%). Given that NSBVDs are known to be common in the general population, as supported by earlier studies,[12] a high occurrence within this group was anticipated because of extended near-vision activities, for example- reading, attending virtual lectures, academic research, digital assessments, microscope-based work etc. Also, this study shows the significant correlation among prolonged screen time with the prevalence of NSBVD.

Tiwari R. P et al in related research, found a prevalence of 42.27% among MBBS and nursing students in Maharashtra, which is consistent with the current study. Notably, accommodation excess found more prevalent among their sample.[11]

When compared to, Atiya A et al reported a slightly higher prevalence of 55% among ophthalmology trainees in Chennai, with convergence insufficiency also being the most common NSBVD.[13] Similarly, Mondal A and Soumiya et al,[12] observed an even higher prevalence of 76% among paramedical students in Mangalore, again with convergence insufficiency as the predominant issue. These elevated figures may reflect more intensive near work or screen time in those cohorts.

1. A markedly lower prevalence was reported by Shrestha P et al,[14] among medical students in Kathmandu, Nepal (27.81%), and in a study of Tayki C et al,[15] with optometry students in Ghana (34%), where accommodative fatigue was more common. This suggests that environmental, cultural, and academic influences may significantly impact NSBVD occurrence and pattern.

2. Interestingly, the study by Dahal M et al,[16] on engineering students in Kathmandu showed an alarmingly high prevalence of 71.41%, with accommodation insufficiency being most frequent. This further supports the link between visually demanding academic disciplines and the development of binocular dysfunctions.

Table 10 shows the related studies in different student population with variation of prevalence and dominant type of NSBVD across them and convergence insufficiency consistently emerges as the most common dysfunction in several academic settings. These findings highlight the importance of routine binocular vision screening and early intervention, especially in high-risk student populations.

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Table 10: Prevalence and commonest NSBVD subtype found in various related studies

Study	Place of study	Study participants	Prevalence of NSBVD	Most common NSBVD found
Present study (2025)	Tertiary care hospital, Machilipatnam , AP	MBBS, Paramedical Students	47.00%	Convergence insufficiency
Luxmi sarma et al	Tertiary care centre Rayalaseema of AP	MBBS Optometry and Nursing Students	45.83%	Convergence insufficiency
Atiya A et al., (2020) [7]	Tertiary eye care centre, Chennai	Ophthalmology trainees	55%	Convergence insufficiency
Tiwari R. P. et al., (2022) [8]	Teaching Hospital in Thane, Maharashtra	MBBS and nursing students	42.27%	Accommodation excess
Mondal A and Soumiya., (2020) [9]	Mangalore	Paramedical students	76%	Convergence insufficiency
Darko-Tayki C et al., (2016) [10]	Ghana	Optometry students	34%	Accommodative fatigue
Shrestha P et al., (2022) [11]	Kathmandu, Nepal	Medical students	27.81%	Convergence insufficiency
Dahal M et al., (2021) [12]	Kathmandu, Nepal	Engineering students	71.41%	Accommodation insufficiency
Hussaindeen JR et al., (2016) [13]	Chennai, Tamil Nadu (BAND Report II)	School children	36.2%	Convergence insufficiency
Ali J et al., (2020) [14]	Gorakhpur	School children	36%	Convergence insufficiency
Porcar E et al., (1997) [15]	Spain	University students	32.3%	Accommodation excess

VARIATION IN NSBVD PREVALENCE ACROSS AGE GROUPS

In current study, age-wise analysis revealed a notable difference in the prevalence of NSBVD across two age groups. Among students aged 18–21 years, 104 out of 257 (40.47%) were diagnosed with NSBVD. In contrast, the 22–25 years age group showed a higher prevalence, with 100 out of 177 students (56.48%) affected. In a similar study by Tiwari R. P. et al. the prevalence of NSBVD was 41.17% in students younger than 20 years, 40.29% among those aged 21–25 years, and increased to 66.66% in the 26–30 years group. These results, along with previous studies, suggest a trend toward higher NSBVD prevalence with increasing age.

This increase may be associated with the longer duration of electronic device usage observed in this group. Supporting this, data from the present study showed that among students using electronic devices for more than 5 hours daily, 113 out of 174 (58.4%) had NSBVD, compared to 90 out of 260 (34.61%) among those using devices for 5 hours or less (see Table.9).

These findings suggest that prolonged exposure to mobile screens over time may contribute to the higher incidence of NSBVD in the older age group.

OCULAR SYMPTOM PROFILE IN STUDENTS

According to the findings of this study, a strong association was observed between the presence of ocular symptoms and NSBVD where among students diagnosed with NSBVD, 37.25% reported experiencing ocular complaints like eye strain, visual blur or reduced focusing ability. When compared with, only 11.30% of students without NSBVD reported such symptoms.

The remaining 62.75% students with NSBVD were asymptomatic, highlighting that a significant proportion of affected individuals may not report obvious discomfort despite having clinically detectable dysfunctions which underscores the importance of routine screening, as NSBVD may go undetected without clinical assessment.

DISTRIBUTION OF REFRACTIVE ERROR IN STUDENTS IN THE STUDY

Current research also analysed distribution of refraction abnormalities among students with or without NSBVD where, in students diagnosed with NSBVD (204 students) the most prevalent refractive error was compound myopic astigmatism (32.90%) and in the group without NSBVD (230 students), simple myopia was most common, seen in 29.13%, suggesting that certain types of refractive errors, particularly compound myopic astigmatism may predispose individuals to develop binocular vision dysfunctions. Conversely, simple myopia appeared to be more prevalent in those without NSBVD, indicating that not all refractive errors exert the same level of impact on binocular visual function. These findings highlight the importance of evaluating binocular vision status even in patients with seemingly mild refractive errors or emmetropia, as a significant proportion of students with NSBVD had no refractive correction needs.

ASSOCIATION OF NSBVD WITH ANAEMIA

In the course of this research, the relationship between anaemia with NSBVD was explored to assess whether systemic health factors might influence binocular vision anomalies. Among the total participants, 55 students were identified with anaemia, of whom 30 belonged to the medical group and 25 to the paramedical group. chi-square test was done to determine if there is a significant association of whether the rates of anaemia and non-strabismic binocular vision dysfunction (NSBVD) differed significantly between medical and paramedical students. The association between anaemia and the occurrence of NSBVD was not found to be statistically significant (P = 0.55).

Medical students demonstrated a notably higher rate of non-strabismic binocular vision dysfunction

(NSBVD) compared to paramedical students, with statistical analysis showing this difference is unlikely to be due to chance ($\chi^2 = 10.46$, P = 0.0012). This suggests that the demands of medical education, which involve extensive near work such as prolonged reading and screen use, may contribute to the increased incidence of NSBVD. Such intense visual tasks can strain binocular eye coordination, leading to symptoms commonly seen in NSBVD. In contrast, paramedical students experience a lighter visual workload, which likely accounts for their lower prevalence of this condition.

While anaemia has been previously implicated in contributing to general fatigue, reduced concentration, and ocular discomfort, the findings of this study imply that its direct impact on binocular vision function may be limited or masked by other more influential factors such as visual habits, refractive errors, and screen time. Nonetheless, further research with a larger anaemic subgroup may help clarify whether subtle or long-term effects exist.

CONCLUSION

The study investigated the prevalence and types of non-strabismic binocular vision dysfunction (NSBVD) among medical and paramedical students. It found an overall prevalence of 47%, with convergence insufficiency being the most common subtype. Medical students had a significantly higher prevalence of NSBVD compared to paramedical students, likely due to more intense near visual demands. Prolonged daily screen time was strongly associated with increased NSBVD risk. Compound myopic astigmatism was identified as a refractive error that significantly predisposes students to NSBVD. NSBVD-positive students also reported significantly more ocular symptoms such as eye strain and visual discomfort. No significant association between anaemia and NSBVD was found. Subtype distribution of NSBVD was similar between medical and paramedical students.

Strengths
- Comprehensive assessment of NSBVD prevalence, subtypes, and associated ocular symptoms in a relevant student population.
- Inclusion of both medical and paramedical students allowed comparative insights related to academic demands.
- Systematic evaluation of refractive errors and their relationship to NSBVD contributes to understanding visual risk factors.
- Use of validated statistical tests for associations and subgroup analyses enhances robustness.
- Addressed screen time as a modern lifestyle factor influencing binocular vision dysfunction.

Demerits
- Cross-sectional design limits causal inference between screen time, refractive errors, and NSBVD development.

- Potential confounders such as exact duration of near work, lighting conditions, or use of visual aids were not extensively controlled.
- Absence of hyperopic refractive errors reduced generalizability to populations with diverse refractive profiles.

Future research directions for non-strabismic binocular vision dysfunction (NSBVD) should focus on longitudinal studies to understand how binocular vision function changes over time, especially in relation to academic workload and screen time. Larger and more diverse population samples, Interventional studies testing visual therapy, ergonomic adjustments, and screen time management could provide evidence-based strategies for prevention and treatment. This comprehensive approach will address current gaps and support improved ocular health in student populations and beyond.

REFERENCES

1. Flax N. General issues. In: Scheiman M, Rouse M, editors. Optometric management of learning-related vision problems. St. Louis: CV Mosby; 1994. p. 138-43.
2. Behlm C, Vishnu S, Khattak A, Mitra S, Yea RW. Computer vision syndrome: a review. Surv Ophthalmol. 2005; 80:253-62.
3. Takyi CD, Khan NE, Nirghin U. A review of the classification of nonstrabismic binocular vision anomalies. Optometry Reports. 2016 Jun 17;5(1):1–7. doi: 10.4081/optometry.2016.5626.
4. Shin H, Park S, Park C. Relationship between accommodative and vergence dysfunctions and academic achievement for primary school children. Ophthalmic Physiol Opt. 2009;29(6):615-24.
5. García-Muñoz L, Carbonell-Bonete S, Cantó-Cerdán M, Cacho-Martínez P. Accommodative and binocular dysfunctions: prevalence in a randomized sample of university students. Clin Exp Optom. 2016;99(4):313-21.
6. Marran L, Land P, Nguyen A. Accommodative insufficiency is the primary source of symptoms in children diagnosed with convergence insufficiency. Optom Vis Sci. 2006;83(55):281-9.
7. Hussaindeen J, Rakshit A, Singh N, George R, Swaminathan M, Kapur S. Prevalence of non-strabismic anomalies of binocular vision in Tamil Nadu: report 2 of BAND study. Clin Exp Optom. 2017;100(6):642-8.
8. Cacho-Martínez P, García-Muñoz L, MR. Do we really know the prevalence of accommodative and nonstrabismic binocular dysfunctions? J Optom. 2010;3(4):185-97.
9. Porcar E, Martinez-Palomera A. Prevalence of general binocular dysfunctions in a population of university students. Optom Vis Sci. 1997;74(74):111-3.
10. Jang J, Park I. Prevalence of general binocular dysfunctions among rural schoolchildren in South Korea. Taiwan J Ophthalmol. 2015;5(4):177-81.
11. Tiwari RP, Barot RK, Sawant V, Wagh U, Maknikar B, Kanetkar M. Clinical profile of non strabismic binocular vision anomalies in MBBS and nursing students in a teaching hospital: a cross-sectional study. J Clin Diagn Res. 2022;16(6):NC19-NC23.
12. Mondal A, Soumiya. Prevalence of non strabismic binocular vision disorder in college students. Int J Innov Sci Res Technol. 2020;5(12):435-38.
13. Atiya A, Hussaindeen JR, Kasturirangan S, Ramasubramanian S, Swathi K, Swaminathan M. Frequency of undetected binocular vision anomalies among ophthalmology trainees. J Optom. 2020;13(3):185-90.
14. Shrestha P, Kaiti R. Non-strabismic binocular vision dysfunction among the medical students of a teaching

hospital: a descriptive cross-sectional study. JNMA J Nepal Med Assoc. 2022 Aug 1;60(252):693-6. doi: 10.31729/jnma.7615.

15. Darko-Tayki C, Owusu-Ansah A, Appiah-Eduenu C, Abu EK, Boadi-Kusi SB, Osei-Akoto Y. Refractive and binocular vision status in Optometry students, Ghana. J Med Biomed Sci. 2016;5(2):24-29.

16. Dahal M, Kaiti R, Shah P, Ghimire R. Binocular vision dysfunction among engineering students in Nepal. Med Surg Ophthal Res. 2021;3(2):000559.

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