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Binocular Vision Status in Normally-Sighted Business Administration College Students using Digital Devices

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ABSTRACT

Purpose: The rapid increase in digital device use among university students has raised concerns regarding its impact on binocular vision. This study aimed to evaluate the relationship between screen time and binocular vision status in normally-sighted Business Administration students.

Methods: A prospective, cross-sectional study was conducted on 340 students stratified into three groups based on daily screen exposure: <2 hours, 2–4 hours, and >4 hours. Data were collected on gender distribution, symptom severity using the Convergence Insufficiency Symptom Survey (CISS), ocular alignment status, and accommodation/vergence anomalies. Descriptive and comparative analyses were performed across groups.

Results: Females predominated in the <2-hour group (65%), whereas gender distribution approached parity with increased exposure (>4 hours: 48% male, 52% female). Symptom severity varied across groups: moderate symptoms remained stable, severe symptoms peaked in the 2–4 hour group (26%), and mild symptoms predominated among >4-hour users (45%). Orthophoria was the predominant ocular alignment, with exophoria (14.2–16.3%) as the only deviation, slightly increasing with screen time. Convergence insufficiency was the most frequent vergence anomaly (33.3–40.4%), while accommodative dysfunctions were less common (10.6–18.3%) but showed higher prevalence in moderate to high users. Vergence dysfunctions were more widespread than accommodative anomalies, affecting over 80% of participants across groups.

Conclusion: Prolonged screen use is associated with increased visual symptoms and a high prevalence of vergence dysfunctions, particularly convergence insufficiency. Routine binocular vision assessment and preventive strategies, including visual hygiene practices and structured breaks, are essential to safeguard ocular health in students with heavy digital demands.

Keywords: *Menopause, Mental health, Hormonal fluctuations, Mood disorders, Anxiety, Depression.*

1. INTRODUCTION

The widespread use of digital devices has transformed how students study, communicate, and manage academic tasks. College learners, particularly those in business administration programs, often spend long hours working on laptops, smartphones, and tablets for coursework, presentations, and research. Such continuous near-work activities create a sustained demand on the visual system, especially on accommodation and binocular vision [1,2].

Binocular vision is essential for clear, comfortable, and single vision. It relies on accurate coordination between the accommodative and vergence systems, and any disruption in this interaction may result in symptoms such as eyestrain, blurred vision, headaches, or difficulty sustaining near tasks [3]. Even in individuals with normal sight, extended exposure to digital screens can unmask latent binocular anomalies, leading to visual discomfort and reduced efficiency in academic performance [4,5].

Digital eye strain (DES), also referred to as computer vision syndrome, has emerged as a major public health concern worldwide. Reports suggest that between half and two-thirds of regular digital device users experience symptoms such as ocular fatigue, burning sensation, or diplopia, many of which are linked to binocular or accommodative dysfunctions [6]. The risk appears particularly high among college students because of their intensive engagement with screens, often without sufficient visual breaks or ergonomic considerations [7].

Although there is an increasing number of studies on binocular vision problems among health sciences and technology students, limited evidence exists for business administration students [8,9]. This group is noteworthy because, while they are normally sighted, they spend significant time on digital platforms for academic and extracurricular requirements, placing considerable stress on their binocular vision system.

With the rising trend of prolonged near-work exposure and the global concern of visual fatigue among young adults, it becomes critical to investigate how digital device use affects binocular vision in college populations [10,11]. Understanding the status of binocular functions in business administration students can help in designing preventive strategies, awareness initiatives, and vision screening programs tailored to this population.

Therefore, the present study is undertaken to **evaluate the binocular vision status of normally-sighted business administration students** and to **analyze the influence of digital device use on their visual comfort and efficiency**.

2. MATERIALS AND METHODS

This study was designed as a prospective, cross-sectional observational investigation carried out in the Faridabad district of Haryana, India. The research focused on college students pursuing business administration courses, with the aim of assessing binocular vision status in relation to digital device use. A total of 476 students were initially screened, of whom 340 participants were eligible and selected for the study as per the criteria. The age range of the study group was between 18 and 30 years.

Participants were required to meet specific eligibility criteria to be included in the study. They needed to have a best-corrected visual acuity of 6/9 or better in both eyes, undergo a complete binocular vision evaluation prior to any vision therapy intervention, and provide reliable information regarding their near-work activities and daily screen use. Exclusion criteria included any history of ocular surgery, trauma, or retinal laser procedures, as well as the presence of neurological conditions, systemic diseases affecting vision, significant refractive changes exceeding ±0.50 diopters, strabismus, or amblyopia. Individuals presenting with ocular abnormalities were excluded from analysis and directed to appropriate clinical care.

Daily use of digital devices was documented both in terms of activity type and duration. Screen-related activities included mobile phone use, laptop use, reading, or a combination of these tasks. Average daily exposure was further classified into three groups: less than two hours, approximately four hours, or more than four hours per day. Symptom assessment was performed using the Convergence Insufficiency Symptom Survey (CISS), a validated tool for identifying visual discomfort and binocular vision anomalies. Based on established scoring guidelines, results were categorized as mild (≤21), moderate (22–32), or severe (≥33), as described in earlier validation studies.

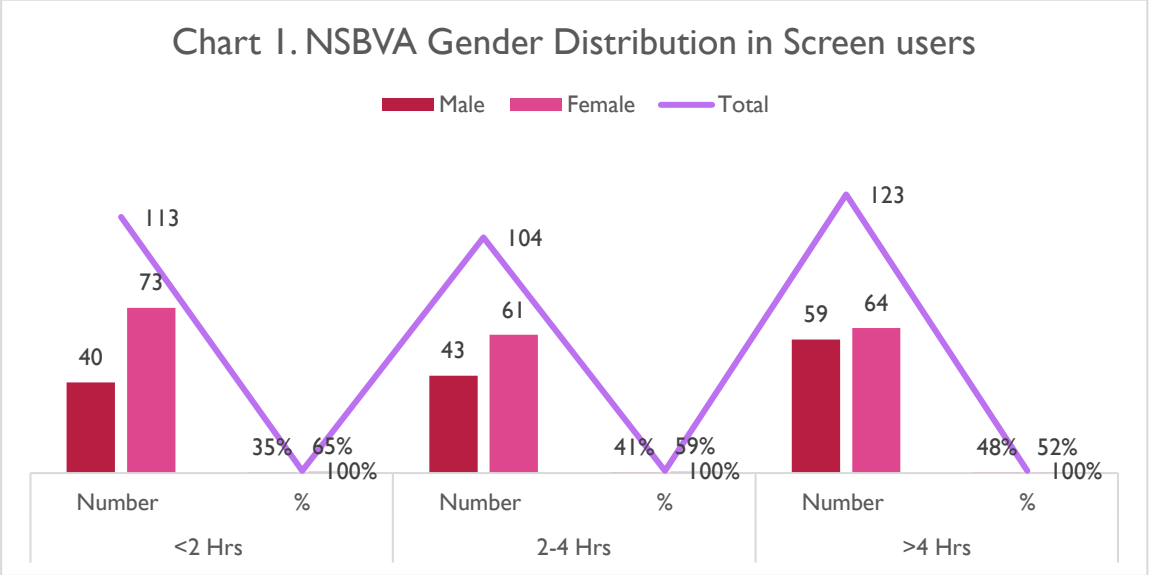
Data collection also included demographic details such as age, gender, height, weight, and place of residence, along with clinical information like refractive error, visual acuity, duration of near work, daily hours of screen exposure, and time spent on outdoor activities. Each participant underwent a complete ocular examination, which began with basic screening tests including visual acuity measurement, static retinoscopy, and ocular motility assessment using the Broad H test. Binocular vision evaluation was then performed for both distance (6 m) and near (40 cm) fixation tasks. The battery of tests comprised prism cover test, near point of convergence (NPC), near point of accommodation (NPA), monocular estimation method retinoscopy, accommodative and vergence facility, negative relative accommodation (NRA), positive relative accommodation (PRA), accommodative convergence to accommodation (AC/A) ratio, stereopsis, and the CISS questionnaire. Normative values and diagnostic criteria were interpreted in accordance with the Convergence Insufficiency Treatment Trial (CITT) protocol.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to data collection.

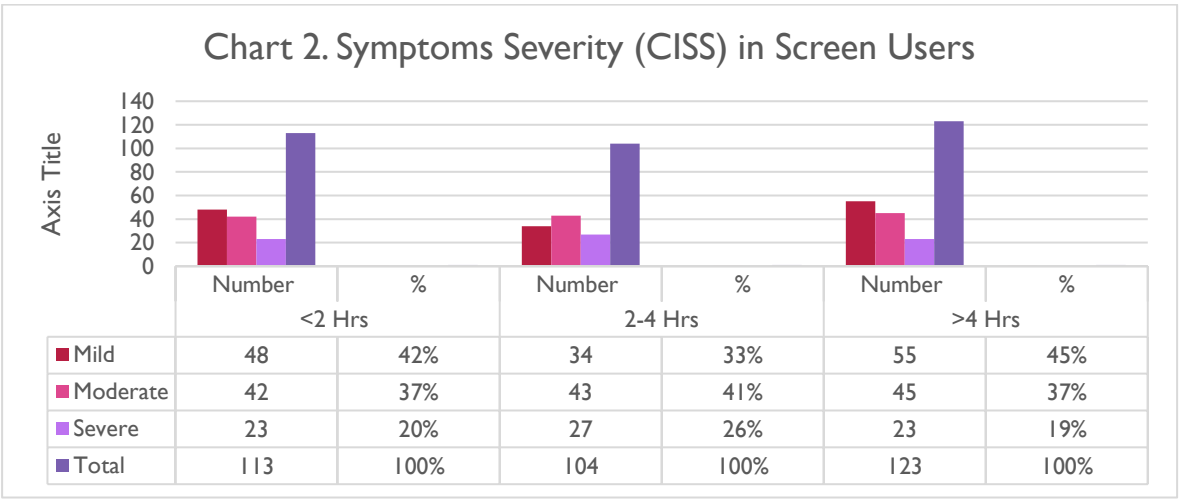
3. RESULT

Out of 476 students who were initially screened, 340 were eligible for the study as per the criterion and were included in the final analysis. The age range of the study group was between 18 and 30 years. The distribution of screen use among Business Administration students, stratified by gender, is illustrated in **Chart 1**. A total of 340 students were assessed across three daily screen-time categories (<2 hours, 2–4 hours, and >4 hours). In the group reporting less than 2 hours of screen exposure, 40 participants (35%) were male and 73 (65%) were female. Among those with 2–4 hours of usage, 43 students (41%) were male and 61 (59%) were female. In the group exceeding 4 hours of screen time, 59 (48%) were male and 64 (52%) were female. Although females were more predominant in all three categories, their proportion was highest in the lowest screen-

time group. As daily exposure increased, the gender distribution approached near parity, with males and females almost equally represented in the >4 hours group.

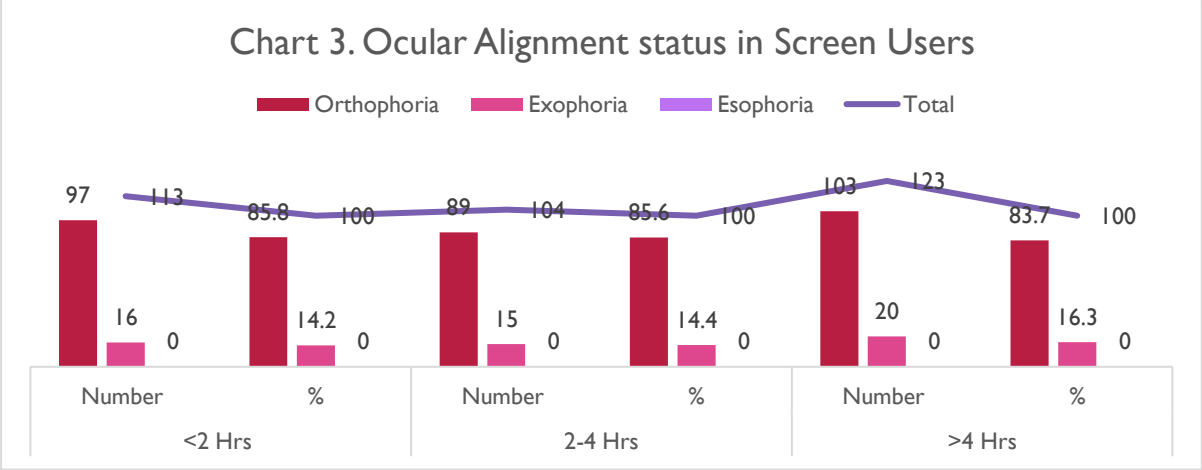


The severity of binocular vision–related symptoms, as assessed by the Convergence Insufficiency Symptom Survey (CISS), varied across different levels of screen exposure among the 340 students studied (Chart 2). In the group using digital devices for less than two hours per day, 42% reported mild symptoms, 37% reported moderate symptoms, and 20% reported severe symptoms. Among those with 2–4 hours of daily screen use, 33% experienced mild symptoms, 41% reported moderate severity, and 26% reported severe symptoms, representing the highest proportion of severe cases. In the group exceeding four hours of screen exposure, 45% reported mild symptoms, 37% moderate symptoms, and 19% severe symptoms. Overall, moderate symptoms were relatively stable across all groups, while severe symptoms peaked in the 2–4hour category. Interestingly, those with more than four hours of daily screen use were more likely to report mild rather than severe symptoms, suggesting that the relationship between symptom severity and screen time may not follow a simple linear trend.



	<2 Hrs		2-4 Hrs		>4 Hrs	
	Number	%	Number	%	Number	%
Mild	48	42%	34	33%	55	45%
Moderate	42	37%	43	41%	45	37%
Severe	23	20%	27	26%	23	19%
Total	113	100%	104	100%	123	100%

The ocular alignment status of students across different screen-time groups is presented in **Chart 3**. Orthophoria was the predominant finding in all categories. Among students with less than two hours of daily screen use (n=113), 97 (85.8%) demonstrated orthophoria, while 16 (14.2%) presented with exophoria; no cases of esophoria were detected. In the 2–4 hours group (n=104), 89 students (85.6%) were orthophoric and 15 (14.4%) showed exophoria, again with no esophoria recorded. In the >4 hours category (n=123), orthophoria was observed in 103 students (83.7%), while 20 (16.3%) exhibited exophoria, with no evidence of esophoria. Overall, exophoria was consistently observed as the only deviation from orthophoria, with its prevalence showing a slight increase with longer daily screen exposure, rising from 14.2% in the <2 hours group to 16.3% in the >4 hours group.



Accommodation and vergence anomalies were observed across all screen-time categories, with vergence dysfunctions presenting more frequently than accommodative dysfunctions (Table 1). Among students with less than two hours of daily screen exposure (n=113), convergence insufficiency (35.4%) was the most common finding, followed by convergence insufficiency with accommodative insufficiency (27.4%). Infrequent conditions included accommodative insufficiency (0.9%) and accommodative excess (1.8%). For those reporting 2–4 hours of use (n=104), convergence insufficiency was again the predominant anomaly (40.4%), accompanied by convergence insufficiency with accommodative excess (17.3%) and convergence insufficiency with accommodative insufficiency (16.3%). In the >4 hours group (n=123), convergence insufficiency remained the most frequent (33.3%), followed by convergence insufficiency with accommodative insufficiency (24.4%) and convergence insufficiency with accommodative excess (17.9%).

Table 1. Accommodation & Vergence Anomalies in Screen Users

	<2 Hrs		2-4 Hrs		>4 Hrs	
	Number	%	Number	%	Number	%
A INF	5	4.4%	3	2.9%	0.0	0.0%
AE	2	1.8%	3	2.9%	4.0	3.3%
AE CI	3	2.7%	5	4.8%	3.0	2.4%
AI	1	0.9%	4	3.8%	5.0	4.1%
AI CI	1	0.9%	4	3.8%	7.0	5.7%
CI	40	35.4%	42	40.4%	41.0	33.3%
CI AE	21	18.6%	18	17.3%	22.0	17.9%
CI AI	31	27.4%	17	16.3%	30.0	24.4%
CI A INF	9	8.0%	8	7.7%	11.0	8.9%
Accommodation DYS	12	10.6%	19	18.3%	19	15.4%
Vergence DYS	100	88.5%	85	81.7%	104	84.6%
Total	113	100%	104	100%	123	100%

When grouped into broader diagnostic categories, accommodative dysfunctions (ACC DYS) were identified in 10.6% of students with <2 hours of screen use, 18.3% with 2–4 hours, and 15.4% with >4 hours. In contrast, vergence dysfunctions (VERG DYS) were substantially more prevalent, affecting 88.5% of the <2 hours group, 81.7% of the 2–4 hours group, and 84.6% of the >4 hours group. Overall, convergence-related anomalies, particularly convergence insufficiency, were the most consistent findings across all screen-time categories, while accommodative dysfunctions appeared less common but showed a trend toward higher prevalence in moderate to high screen users.

4. DISCUSSION

This study investigated the relationship between digital device use and binocular vision status in normally-sighted Business Administration students. The findings indicate that prolonged screen exposure is associated with notable variations in symptom severity, ocular alignment, and accommodation/vergence anomalies.

The gender distribution across screen-time categories showed a predominance of female participants in the lower exposure groups, with the distribution approaching near-equality as screen time increased. This shift may suggest that both genders are equally likely to engage in extended screen use, a finding consistent with recent reports highlighting the rising prevalence of prolonged digital engagement among university students regardless of sex.

Symptom severity, as measured by the Convergence Insufficiency Symptom Survey (CISS), did not follow a strictly linear relationship with screen time. While moderate symptoms were stable across groups, severe symptoms were most prevalent among students with 2–4 hours of daily use, whereas those exceeding 4 hours reported a higher proportion of mild symptoms. This could be explained by adaptive mechanisms in frequent users, or possibly underreporting of discomfort due to habituation. Previous studies have reported similar variability, noting that subjective symptoms do not always correlate directly with hours of exposure, but are influenced by factors such as posture, lighting, and visual ergonomics.

Ocular alignment status further supported these trends, with orthophoria being predominant across all groups, and exophoria observed as the only deviation. Interestingly, the proportion of exophoria increased slightly with greater screen time, rising from 14.2% in the <2 hours group to 16.3% in the >4 hours group. This finding aligns with the established view that sustained near work imposes greater demands on the vergence system, predisposing individuals to exophoric tendencies. Although the increase was modest, it highlights the potential risk for developing symptomatic binocular vision anomalies with extended screen use.

Accommodation and vergence anomalies revealed convergence insufficiency as the most consistent finding across all exposure categories, with the highest prevalence observed in the 2–4 hour group (40.4%). This aligns with existing literature identifying convergence insufficiency as the most common binocular vision disorder associated with prolonged near work and digital device use. Vergence dysfunctions were notably more prevalent than accommodative dysfunctions, affecting over 80% of participants in each group. Accommodative dysfunctions, though less common, showed a trend toward higher prevalence in moderate to high users, particularly accommodative insufficiency and accommodative excess. These results underscore the significant role of digital visual demands in precipitating or exacerbating binocular vision anomalies, consistent with prior studies on computer vision syndrome and digital eye strain.

Taken together, these findings suggest that while both symptom severity and objective measures of binocular function are affected by digital device use, the relationship is complex and not purely dependent on duration of exposure. The high prevalence of vergence-related anomalies, particularly convergence insufficiency, emphasizes the need for routine binocular vision assessment in students with high digital demands. Preventive strategies, such as visual hygiene practices, regular breaks, and targeted vision therapy, may help mitigate the impact of prolonged screen use on binocular vision health

5. CONCLUSION

This study highlights the impact of digital device use on binocular vision status in normally-sighted Business Administration students. While gender distribution approached parity with increased screen exposure, the severity of binocular vision–related symptoms demonstrated a variable pattern, with moderate symptoms remaining consistent and severe symptoms peaking in moderate users. Orthophoria was the predominant ocular alignment across all groups, with exophoria emerging as the only deviation and showing a slight increase with longer screen use. Convergence insufficiency was identified as the most common vergence anomaly, while accommodative dysfunctions were less frequent but tended to rise in prevalence among students with higher exposure.

Overall, the findings emphasize that prolonged screen time is associated with both subjective visual discomfort and measurable binocular vision anomalies, particularly vergence-related dysfunctions. These results underscore the importance of routine binocular vision screening in students with heavy digital demands and highlight the need for preventive strategies, such as visual hygiene education, structured breaks, and vision therapy, to reduce the risk of digital eye strain and maintain optimal binocular vision health.

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