

Myopia Severity and Its Association with Convergence and Accommodative Insufficiencies: Implications for Vergence and Accommodative Function Among Young Adult Patients at the Vision and Eye Care Center, Centro Escolar University (Manila, Philippines)

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ABSTRACT

Myopia has increasingly been associated with binocular vision anomalies, yet the relationship between myopia severity and accommodative and convergence dysfunctions remains inconclusive. This study aimed to determine the prevalence of accommodative insufficiency (AI) and convergence insufficiency (CI) and examine their association with myopia severity among young adult myopic patients aged 18–26 years at the Vision and Eye Care Center, Centro Escolar University-Manila. A quantitative retrospective cross-sectional design was employed using 159 clinical records equally distributed among low, moderate, and high myopia groups. Accommodative function was assessed using Near Point of Accommodation (NPA), Amplitude of Accommodation (AA), and Positive Relative Accommodation (PRA), while vergence function was evaluated through Near Point of Convergence (NPC), phoria, Positive Fusional Vergence (PFV), and Accommodative Convergence/Accommodation (AC/A) ratio. Descriptive statistics and Chi-square tests were used for data analysis. Accommodative insufficiency was identified in 40.9% of the participants, while convergence insufficiency was observed in 32.7%. No significant association was found between accommodative insufficiency and myopia severity ($\chi^2 = 1.613$, $p = .446$). However, convergence insufficiency demonstrated a significant association with myopia severity ($\chi^2 = 7.944$, $p = .019$), with the highest frequency occurring among patients with high myopia. These findings highlight the importance of comprehensive binocular vision assessment in young adult myopic patients, particularly those with higher levels of myopia.

Keywords: *myopia severity, accommodative insufficiency, convergence insufficiency, binocular vision, vergence dysfunction, young adult myopes*

INTRODUCTION

Myopia has emerged as a major global public health concern, particularly in Asian populations where its prevalence continues to increase at an alarming rate. Epidemiological evidence indicates that both myopia and high myopia occur more frequently in Asia than in Western countries, with the prevalence of high myopia among young adults reaching as high as 21.6% in certain populations (Wong & Saw, 2016). This growing trend has led to the recognition of a “myopia epidemic,” raising concerns regarding its long-term ocular complications and its effects on functional visual performance.

A similar pattern is observed in the Philippines, where uncorrected refractive error remains one of the leading causes of visual impairment. The Philippine National Survey of Blindness and Eye Disease reported that approximately two million Filipinos experience visual impairment, with nearly 90% of refractive-related cases attributed to myopia (Cubillan, 2018). Moreover, visual impairment begins early in life and increases throughout the school years, highlighting the progressive nature of myopia and the importance of continued evaluation during young adulthood.

University-aged individuals represent a population particularly vulnerable to myopia progression because of prolonged near work, extensive digital device use, and limited outdoor activities. Recent studies have demonstrated that myopia prevalence remains high among university students and may continue to progress into early adulthood (Makhdoum et al., 2023; Ali et al., 2025). Consequently, this age group

provides an important opportunity to investigate not only refractive status but also the functional visual anomalies that may accompany increasing myopia.

Efficient visual performance depends on the harmonious interaction between the accommodative and vergence systems. Accommodation and convergence are interdependent components of the binocular visual system that function together to maintain clear and single binocular vision, particularly during near tasks. Stimulation of accommodation is normally accompanied by a corresponding convergence response, a relationship commonly described by the accommodative convergence to accommodation (AC/A) ratio (Iacobucci, 2015). This interaction forms the basis of stable binocular vision and efficient near visual performance, emphasizing that alterations in one system may directly influence the function of the other (Scheiman & Wick, 2014). Consequently, disturbances in accommodative function may contribute to vergence anomalies, while disruptions in vergence mechanisms may likewise affect accommodative performance.

Among the binocular vision disorders associated with near visual activities, accommodative insufficiency and convergence insufficiency are frequently encountered in clinical practice. Accommodative insufficiency is characterized by a reduced amplitude of accommodation relative to age-expected norms and may result in visual fatigue, difficulty sustaining near work, and reduced visual efficiency. Previous studies have suggested that accommodative dysfunctions occur more frequently among myopic individuals, indicating a possible relationship between refractive status and

accommodative performance (Abdi & Rydberg, 2005; Chen et al., 2016). Likewise, convergence insufficiency, a condition characterized by reduced ability to maintain binocular alignment during near tasks, has been associated with myopia, with altered accommodative demand and accommodative convergence mechanisms proposed as contributing factors (Wajuihian & Hansraj, 2015).

The functional relationship between accommodation and convergence may be further influenced by refractive status. In myopic individuals, sustained near visual activities and increased accommodative demand may produce adaptive changes in both accommodative and vergence responses, potentially affecting the stability and efficiency of binocular vision. Previous studies have demonstrated that accommodative and vergence parameters, including amplitude of accommodation and near point of convergence, are associated with myopic status, supporting the concept that these systems are functionally interrelated (Wijayati et al., 2022).

Although previous investigations have demonstrated associations between myopia and binocular vision anomalies, evidence regarding the influence of myopia severity on accommodative and convergence dysfunctions remains limited and inconsistent. Most available studies focus on pediatric populations or evaluate myopic individuals as a single group without considering refractive severity. Furthermore, there is a scarcity of locally generated evidence utilizing clinical records from Philippine optometric settings, where patient characteristics and visual demands may differ from those reported internationally.

Anchored on the principle that accommodation and convergence function as integrated components of the binocular visual system, the present study assumes that increasing myopia severity may be associated with measurable variations in accommodative and vergence performance, potentially contributing to the occurrence of accommodative insufficiency and convergence insufficiency. Therefore, this study sought to determine the prevalence of these binocular vision anomalies and examine their association with myopia severity among young adult myopic patients aged 18–26 years.

REVIEW OF LITERATURE

Myopia and Visual Demands in Young Adults

Myopia has become a significant global public health concern, with particularly high prevalence reported among Asian populations and young adults. A systematic review by Saw et al. (2014) demonstrated that myopia occurs more frequently in Asians than in other ethnic groups, while Wong and Saw (2016) reported increasing rates of both myopia and high myopia among adolescents and university-aged individuals. Studies conducted in China further suggest that myopia prevalence increases with age and educational attainment, indicating that prolonged academic demands and sustained near visual activities may contribute to its progression (We et al., 2023; Gao et al., 2026).

A similar trend has been observed in the Philippines. Zakrzewski et al. (2015) documented the presence of myopia among Filipino school children, while the Philippine

National Survey of Blindness and Eye Disease identified uncorrected refractive error as one of the leading causes of visual impairment. Among university students, prolonged screen exposure, intensive near work, and limited outdoor activities have likewise been associated with increased visual stress and refractive changes (Ali et al., 2025). Collectively, these findings suggest that young adults with myopia are continuously exposed to visual demands that may influence accommodative and binocular visual function.

Accommodative Insufficiency in Young Adults

Accommodative insufficiency (AI) is a non-strabismic accommodative dysfunction characterized by a reduced accommodative ability relative to the expected level for an individual's age. Clinically, affected individuals commonly experience symptoms during sustained near visual activities, including asthenopia, headaches, blurred near vision, difficulty concentrating, and visual fatigue (American Optometric Association [AOA], 2011; Scheiman & Wick, 2014). The condition has become increasingly relevant among young adults and student populations due to prolonged near work and extensive digital device use. Hashemi et al. (2019) identified accommodative insufficiency among university students, while Paul et al. (2018) associated accommodative dysfunction with asthenopic symptoms in computer users, suggesting that intensive near visual activities may contribute to accommodative stress.

Reduced amplitude of accommodation is widely recognized as the hallmark clinical sign of accommodative insufficiency.

However, Cacho et al. (2002) emphasized that diagnosis should not rely solely on accommodative amplitude but should also consider additional supportive findings, such as reduced positive relative accommodation and other accommodative measures. Furthermore, comparison with age-expected normative values, particularly Hofstetter's formula, has been recommended to improve diagnostic consistency and clinical interpretation of accommodative function (Pateras & Chrysanthopoulos, 2024).

Convergence Insufficiency in Young Adults

Convergence insufficiency (CI) is one of the most common non-strabismic binocular vision anomalies encountered among young adults and is frequently associated with symptoms during sustained near visual activities. Individuals with CI commonly experience asthenopia, headaches, blurred near vision, intermittent diplopia, difficulty concentrating, and visual fatigue, particularly during prolonged reading or digital device use (American Optometric Association [AOA], 2011; Scheiman & Wick, 2014). Recent studies have highlighted the growing clinical relevance of CI due to increasing near visual demands associated with computers, smartphones, and academic activities (Trieu & Lavrich, 2018). Likewise, investigations among university students and young adults have demonstrated that CI remains prevalent in visually demanding environments, particularly among individuals aged 18–25 years (Obioma-Elemba et al., 2021; Rampersad et al., 2026).

Receded near point of convergence (NPC), greater exophoria at near than at distance, and reduced positive fusional vergence

(PFV) are the clinical findings most consistently associated with convergence insufficiency (Scheiman & Wick, 2014). However, Gantz and Stiebel-Kalish (2022) noted that diagnostic criteria vary considerably across studies, with some relying on a single clinical sign and others utilizing multiple findings. Current evidence supports the use of combined clinical parameters, particularly receded NPC together with supporting vergence findings, to improve the reliability and consistency of convergence insufficiency diagnosis (AOA, 2011; Trieu & Lavrich, 2018).

Myopia Severity and Binocular Vision Anomalies

Several studies have suggested that myopia may influence both accommodative and vergence function, particularly during sustained near visual activities. Because accommodation and convergence operate as closely linked mechanisms, alterations in one system may affect the other, potentially influencing binocular visual performance among myopic individuals (Scheiman & Wick, 2014). Increased accommodative demand and prolonged near work have been implicated in myopia development and progression, with studies reporting associations between accommodative lag, near phoria status, and binocular vision function (Logan et al., 2021; Dutheil et al., 2023). Myopic individuals experiencing asthenopic symptoms have likewise been found to demonstrate reduced accommodative performance and abnormal binocular findings during near tasks (Singh & Kumari, 2025).

Vergence anomalies have also been associated with myopia. Previous

investigations reported that myopic individuals may exhibit receded near point of convergence (NPC), reduced positive fusional vergence (PFV), and greater exophoria at near compared with non-myopic individuals (Anderson et al., 2011; Alrasheed, 2025). In addition, convergence insufficiency has been observed more frequently among myopic populations, with some studies suggesting that increasing myopia severity may be associated with greater binocular vision dysfunction (Khan et al., 2026; Ray & Dioso, 2024). Syeda et al. (2023) further reported variations in binocular vision anomalies across different levels of myopia severity.

Despite these findings, evidence regarding the relationship between myopia severity and accommodative and vergence dysfunctions remains inconsistent because of variations in study populations, diagnostic criteria, and clinical parameters (Akram et al., 2018). Consequently, further investigation is needed to clarify how myopia severity relates to accommodative insufficiency and convergence insufficiency among young adult myopic patients.

Need of the study

Existing literature consistently demonstrates that myopia is increasingly prevalent among young adults exposed to prolonged near visual demands and intensive academic activities. Studies have shown that sustained near work and extended screen exposure may place significant stress on the accommodative and vergence systems, potentially affecting overall binocular vision performance. Accommodative insufficiency and convergence insufficiency are among the most frequently reported binocular vision anomalies associated with near visual

discomfort and reduced visual efficiency, particularly in student and young adult population.

Despite the growing body of evidence, important gaps remain. Previous investigations have employed varying diagnostic criteria for accommodative insufficiency and convergence insufficiency, resulting in inconsistencies across reported findings. Moreover, while accommodative and vergence dysfunctions have been individually studied, relatively few investigations have simultaneously examined both conditions across different levels of myopia severity. Existing literature has also largely focused on pediatric populations or generalized myopic groups, with limited attention given to young adult patients and the potential influence of low, moderate, and high myopia on binocular vision function. Furthermore, locally generated evidence from Philippine clinical settings remains scarce.

Addressing these gaps is clinically important, as a better understanding of the relationship between myopia severity and binocular vision anomalies may contribute to improved assessment and management of young adult myopic patients. Therefore, the present study sought to determine the prevalence of accommodative insufficiency and convergence insufficiency and examine their association with myopia severity using established clinical accommodative and vergence parameters.

METHOD

Aim of the study

This study aimed to determine the prevalence of accommodative insufficiency

and convergence insufficiency and examine their association with myopia severity among young adult myopic patients aged 18–26 years at the Vision and Eye Care Center, Centro Escolar University-Manila. Specifically, the study sought to evaluate accommodative and vergence function using established clinical parameters and determine whether variations in myopia severity are associated with the occurrence of these binocular vision anomalies.

Inclusion criteria

The study included clinical records of myopic patients aged 18–26 years who underwent comprehensive eye examinations at the Vision and Eye Care Center (VECC), School of Optometry, Centro Escolar University–Manila, during School Year 2024–2026. This age group was selected because of its increased exposure to sustained near visual activities that may influence accommodative and vergence function. Eligible records were required to contain complete documentation of subjective refraction and the accommodative and vergence parameters necessary for the study.

Exclusion criteria

Records were excluded if patients were outside the specified age range or had conditions that could influence binocular vision findings, including ocular pathology, amblyopia, strabismus, previous ocular surgery or trauma, or ongoing accommodative or vergence therapy. Habitual contact lens wearers were likewise excluded, as only patients evaluated under spectacle correction were included to maintain consistency in refractive and

binocular vision measurements. Records with incomplete or missing clinical data were also excluded from the analysis.

Procedure

A quantitative retrospective cross-sectional design was employed to examine the association between myopia severity and the occurrence of accommodative insufficiency and convergence insufficiency using existing clinical records. The study was conducted at the Vision and Eye Care Center (VECC), School of Optometry, Centro Escolar University–Manila, a clinical training facility where comprehensive eye examinations are performed by student clinicians under the supervision of licensed optometrists. The use of a retrospective record-based design allowed the evaluation of accommodative and vergence findings without direct patient interaction, utilizing previously documented clinical data collected during routine eye examinations.

Purposive sampling was employed, wherein only clinical records meeting the established inclusion criteria were considered eligible for the study. An a priori power analysis using G*Power determined that a minimum of 159 records was required to detect a moderate effect size ($f = 0.25$) at an alpha level of 0.05 and a statistical power of 0.80, corresponding to 53 records each for the low, moderate, and high myopia groups. Eligible records from School Year 2024–2026 were reviewed and consecutively selected within each refractive category until the required sample size was attained. Clinical records were screened according to the inclusion and exclusion criteria, classified based on myopia severity using the final subjective refraction, and systematically extracted and encoded for statistical analysis.

Data were obtained from the Centro Escolar University Case Record for Comprehensive Eye Examination, the standard clinical documentation form used at the Vision and Eye Care Center. Relevant information was extracted from the refraction, accommodative, and vergence sections of the records. Myopia severity was classified using the final subjective refraction expressed as spherical equivalent and categorized into low (-0.50 D to -3.00 D), moderate (-3.25 D to -6.00 D), and high myopia (greater than -6.00 D) following accepted clinical guidelines. Accommodative insufficiency was identified using established multiple-sign criteria based primarily on amplitude of accommodation, with supporting findings from near point of accommodation and positive relative accommodation. Likewise, convergence insufficiency was determined using receded near point of convergence together with supporting vergence findings, including near exophoria and reduced positive fusional vergence. Diagnostic interpretation was based on accepted normative values described by Donders, Hofstetter, and Scheiman and Wick, emphasizing multiple clinical findings rather than a single isolated measurement.

The study was conducted following the ethical principles governing the use of retrospective clinical records. Prior to data collection, the necessary institutional permissions and ethical approvals were secured from the appropriate offices of Centro Escolar University. Patient confidentiality was strictly maintained throughout the study, and all identifying information contained in the clinical records was replaced with alphanumeric codes

before data extraction and analysis to ensure anonymity and data privacy.

Analysis

Descriptive statistics were used to summarize the demographic characteristics of the participants and the accommodative and vergence clinical findings. Frequency, percentage, mean, median, and standard deviation were computed to describe the distribution of myopia severity and the prevalence of accommodative insufficiency and convergence insufficiency.

The association between myopia severity and the presence of accommodative insufficiency and convergence insufficiency was evaluated using the Chi-square test of independence. Statistical significance was established at an alpha level of 0.05. All data were encoded, processed, and analyzed using appropriate statistical software.

RESULTS

Demographic Profile

Table 1
Frequencies of Age

AGE	Counts	% of Total
18	14	8.8%
19	10	6.3%
20	12	7.5%
21	25	15.7%
22	30	18.9%
23	19	11.9%
24	16	10.1%
25	17	10.7%
26	16	10.1%

Table 1 presents the age distribution of the participants. The largest proportion belonged to the 22-year-old age group (18.9%), followed by 21-year-olds (15.7%). Participants aged 23 years accounted for 11.9%, while the remaining age groups showed relatively comparable distributions, indicating that the study population was primarily composed of young adults.

Table 2
Frequencies of Sex

SEX	Counts	% of Total
Female	92	57.9%
Male	67	42.1%

Table 2 presents the sex distribution of the participants. Females comprised 57.9% of the study population, while males accounted for 42.1%, indicating a greater representation of female patients in the retrieved clinical records.

Myopia Severity Distribution

Table 3
Refractive Error (VT 7) Among young Adult Myopic Patients

	VT 7
N	159
Missing	0
Mean	-4.101
Median	-4
Standard deviation	2.829
Minimum	-15
Maximum	-0.50

Table 3 summarizes the descriptive statistics of refractive error among the participants. The mean spherical equivalent was -4.101 ± 2.829 D, with a median of -4.00 D and values ranging from -0.50 D to -15.00 D,

reflecting a broad distribution of myopia severity.

Table 4
Subjective Refraction Findings of Low Myopia (-0.50D to -3.00D)

VT 7	Counts	% of Total
-0.5	17	10.7%
-1.5	19	11.9%
-2.25	10	6.3%
-3	30	18.9%

Table 4 presents the frequency distribution of low myopia. The most common refractive error was -3.00 D (18.9%), followed by -1.50 D (11.9%), while -2.25 D was the least frequently observed (6.3%).

Table 5
Subjective Refraction Findings of Moderate Myopia (-3.25D to -6.00D)

VT 7	Counts	% of Total
-4.25	19	11.9%
-5.5	8	5.0%
-6	19	11.9%

Table 5 shows the frequency distribution of moderate myopia. Refractive errors of -4.25 D and -6.00 D demonstrated the highest frequencies (11.9% each), whereas -5.50 D had the lowest frequency (5.0%).

Table 6
Subjective Refraction Findings of High Myopia (greater than -6.00D)

VT 7	Counts	% of Total
-7.5	20	12.6%
-8	11	6.9%
-9.25	3	1.9%
-10	1	0.6%
-13	1	0.6%
-15	1	0.6%

Table 6 presents the frequency distribution of high myopia. The most frequently observed refractive error was -7.50 D (12.6%), followed by -8.00 D (6.9%), while extremely high refractive errors such as -10.00 D, -13.00 D, and -15.00 D were minimally represented.

Accommodative Function of Myopic Patients

Table 7
Near Point of Accommodation (NPA) Among Young Adult Myopic Patients

	NPA - OD	NPA - OS
N	159	159
Mean	9.604	10.390
Median	9.000	9.330
Standard deviation	3.797	4.849
Minimum	2.500	2.500
Maximum	25.000	28.570

Table 7 presents the descriptive statistics of Near Point of Accommodation (NPA). Mean values were 9.604 cm for the right eye and 10.390 cm for the left eye, with measurements ranging from 2.500 cm to 28.570 cm, indicating variability in accommodative performance.

Table 8
Amplitude of Accommodation (AA) Among Young Adult Myopic Patients

	AOA - OD	AOA - OS
N	159	159
Mean	9.382	9.425
Median	9.500	9.250
Standard deviation	2.734	2.988
Minimum	3.000	1.750
Maximum	17.000	18.500

Table 8 summarizes the descriptive statistics of Amplitude of Accommodation (AA). Mean values were 9.382 D for the right eye and 9.425 D for the left eye, with findings ranging from 1.750 D to 18.500 D.

Table 9
Frequency Distribution of Positive Relative Accommodation (PRA) Among Young Adult Myopic Patients

PRA	Counts	% of Total
-4.00	1	0.6%
-3.75	1	0.6%
-3.50	1	0.6%
-3.00	3	1.9%
-2.75	5	3.1%
-2.50	18	11.3%
-2.25	16	10.1%
-2.00	29	18.2%
-1.75	19	11.9%
-1.50	16	10.1%
-1.25	28	17.6%
-1.00	15	9.4%
-0.75	4	2.5%
-0.50	3	1.9%

Table 9 illustrates the frequency distribution of Positive Relative Accommodation (PRA). The most common finding was -2.00 D (18.2%), followed by -1.25 D (17.6%), while -4.00 D and -0.50 D each accounted for 1.9% of the participants.

Table 10
Positive Relative Accommodation (PRA) Among Young Adult Myopic Patients

	PRA
N	159
Mean	-1.785
Median	-1.750
Standard deviation	0.647
Minimum	-4.000
Maximum	0.500

Table 10 presents the descriptive statistics of PRA. The mean PRA was -1.785 ± 0.647 D, with a median of -1.750 D and values ranging from -4.000 D to -0.500 D.

Convergence Function of Myopic Patients

Table 11
Frequencies of Distance Phoria

Phoria - Far	Counts	% of Total
0.5 exophoria	8	5.0%
1 exophoria	26	16.4%
1.5 exophoria	1	0.6 %
2 exophoria	24	15.1%
3 exophoria	22	13.8%
4 exophoria	17	10.7%
5 exophoria	11	6.9%
6 exophoria	7	4.4%
7 exophoria	2	1.3%
8 exophoria	1	0.6%
9 exophoria	2	1.3%
10 exophoria	2	1.3%
Orthophoria	32	20.1%
2 esophoria	1	0.6%
3 esophoria	1	0.6%
4 esophoria	1	0.6%
5 esophoria	1	0.6%

Table 11 presents the frequency distribution of distance phoria findings. Exophoria was the most common vergence posture, with 1Δ exophoria occurring most frequently (16.4%), followed by 2Δ (15.1%) and 3Δ (13.8%), while orthophoria accounted for 20.1% of the participants.

Table 12
Frequencies of Near Phoria

Phoria - Near	Counts	% of Total
1 exophoria	11	6.9%
2 exophoria	13	8.2%
3 exophoria	16	10.1%
4 exophoria	19	11.9%
5 exophoria	16	10.1%
6 exophoria	22	13.8%
7 exophoria	9	5.7%
8 exophoria	9	5.7%
9 exophoria	7	4.4%
10 exophoria	5	3.1%
11 exophoria	4	2.5%
12 exophoria	7	4.4%
13 exophoria	2	1.3%
15 exophoria	1	0.6%
16 exophoria	1	0.6%
20 exophoria	1	0.6%
Orthophoria	13	8.2%
1 esophoria	1	0.6%
7 esophoria	1	0.6%
10 esophoria	1	0.6%

Table 12 shows the frequency distribution of near phoria findings. The highest frequency was observed at 6Δ exophoria (13.8%), followed by 4Δ exophoria (11.9%), with orthophoria accounting for 8.2% of the participants.

Table 13
Frequencies of Accommodative Convergence/ Accommodation (AC/A) Ratio

AC/A	Counts	% of Total
10:1	1	0.6%
12:1	1	0.6%
1:1	10	6.3%
2:1	32	20.1%
3:1	55	34.6%
4:1	29	18.2%
5:1	17	10.7%
6:1	11	6.9%
7:1	1	0.6%
8:1	2	1.3%

Table 13 presents the distribution of AC/A ratio findings. The most frequently observed ratio was 3:1 (34.6%), followed by 2:1 (20.1%) and 4:1 (18.2%), while higher AC/A ratios were less commonly observed.

Prevalence of Accommodative Insufficiency

Table 14
Frequencies of Near Point of Accommodation (NPA)

NPA	Counts	% of Total
X	72	45.3%
/	87	54.7%

Table 14 presents the frequency distribution of Near Point of Accommodation findings. Abnormal NPA was observed in 45.3% of the participants, while 54.7% were classified within normal limits.

Table 15
Frequencies of Amplitude of Accommodation (AA)

AOA	Counts	% of Total
X	72	45.3%
/	87	54.7%

Table 15 presents the frequency distribution of Amplitude of Accommodation findings. Abnormal AA was identified in 45.3% of the participants, whereas 54.7% demonstrated normal accommodative amplitude.

Table 16
Frequencies of Positive Relative Accommodation (PRA)

PRA	Counts	% of Total
/	96	60.4%
X	63	39.6%

Table 16 presents the frequency distribution of Positive Relative Accommodation findings. Abnormal PRA was observed in 39.6% of the participants, while 60.4% were classified within normal limits.

Table 17
Frequencies of Accommodative Insufficient

Accommodative Insufficient?	Counts	% of Total
YES	65	40.9%
NO	94	59.1%

Table 17 presents the prevalence of accommodative insufficiency. Based on the established diagnostic criteria, 40.9% of the participants were classified as having accommodative insufficiency, whereas 59.1% demonstrated normal accommodative function.

Association of Accommodative Insufficiency with Myopia Severity

Table 18

Association Between Accommodative Insufficiency and Myopia Severity

Accommodative Insufficient?	Myopia			Total
	High	Moderate	Low	
YES	18	24	23	65
NO	35	29	30	94
Total	53	53	53	159

χ^2 Tests			
	Value	df	p
χ^2	1.613	2	.446
N	159		

Table 18 presents the association between accommodative insufficiency and myopia severity. Accommodative insufficiency was observed across all myopia classifications, with 23 low myopes, 24 moderate myopes, and 18 high myopes identified as having the condition. Chi-square analysis revealed no statistically significant association between accommodative insufficiency and myopia severity ($\chi^2 = 1.613$, $p = 0.446$).

Prevalence of Convergence Insufficiency

Table 19

Frequencies of Near Point of Convergence (NPC)

NPC	Counts	% of Total
X	85	53.5%
/	74	46.5%

Table 19 presents the frequency distribution of Near Point of Convergence findings. Abnormal NPC was identified in 53.5% of

the participants, while 46.5% were classified within normal limits.

Table 20

Frequencies of Phoria

PHORIA	Counts	% of Total
/	99	62.3%
X	60	37.7%

Table 20 presents the frequency distribution of phoria findings used in the diagnosis of convergence insufficiency. Abnormal phoria findings were observed in 37.7% of the participants, whereas 62.3% demonstrated normal findings.

Table 21

Frequencies of Positive Fusional Vergence (PFV)

PFV	Counts	% of Total
X	100	62.9%
/	59	37.1%

Table 21 presents the frequency distribution of Positive Fusional Vergence findings. Abnormal PFV was identified in 62.9% of the participants, while 37.1% were classified within normal limits.

Table 22

Frequencies of Accommodative Convergence/Accommodation (AC/A) Ratio

AC/A	Counts	% of Total
X	97	61.0%
/	62	39.0%

Table 22 presents the frequency distribution of AC/A ratio findings. Abnormal AC/A ratios were observed in 61.0% of the participants, whereas 39.0% demonstrated findings within normal limits.

Table 23
Frequencies of Convergence Insufficient

Convergence Insufficient?	Counts	% of Total
YES	52	32.7%
NO	107	67.3%

Table 23 presents the prevalence of convergence insufficiency. Based on the established diagnostic criteria, 32.7% of the participants were classified as having convergence insufficiency, while 67.3% demonstrated normal vergence function.

Association of Convergence Insufficiency with Myopia Severity

Table 24
Association Between Convergence Insufficiency and Myopia Severity

Convergence Insufficient?	Myopia			Total
	High	Moderate	Low	
YES	25	12	15	52
NO	28	41	38	107
Total	53	53	53	159

χ^2 Tests			
	Value	df	p
χ^2	7.944	2	.019
N	159		

Table 24 presents the association between convergence insufficiency and myopia severity. Convergence insufficiency was observed in 15 low myopes, 12 moderate myopes, and 25 high myopes. Chi-square analysis demonstrated a statistically significant association between convergence insufficiency and myopia severity ($\chi^2 = 7.944$, $p = 0.019$), with the highest frequency

observed among participants with high myopia.

DISCUSSION

The present study investigated the relationship between myopia severity and binocular vision dysfunctions, specifically accommodative insufficiency and convergence insufficiency, among young adult myopic patients. The study population consisted primarily of individuals within the peak years of academic and occupational visual demand, a group frequently exposed to prolonged near work and sustained digital device use. The broad distribution of refractive errors across the low, moderate, and high myopia categories provided an appropriate basis for examining variations in accommodative and vergence function according to myopia severity.

Accommodative findings demonstrated considerable variability among the participants. Nearly half of the respondents exhibited abnormal Near Point of Accommodation and Amplitude of Accommodation findings, while 39.6% demonstrated reduced Positive Relative Accommodation. Using the established multiple-sign diagnostic criteria, accommodative insufficiency was identified in 40.9% of the study population. Despite this relatively high prevalence, statistical analysis revealed no significant association between accommodative insufficiency and myopia severity. The findings suggest that accommodative dysfunction may occur across different refractive classifications and should not be attributed solely to the magnitude of myopia. This observation is consistent with the findings of Chen et al. (2016), who reported that accommodative

dysfunctions may be present among myopic individuals regardless of refractive severity, emphasizing the influence of sustained near visual demand rather than refractive error alone. Similarly, Scheiman and Wick (2014) described accommodative insufficiency as a multifactorial condition influenced by several clinical and functional factors beyond refractive status.

Vergence assessment likewise demonstrated variability among the participants. More than half of the study population exhibited abnormal Near Point of Convergence and Positive Fusional Vergence findings, while abnormal AC/A ratios were also frequently observed. Overall, convergence insufficiency was identified in 32.7% of the participants. Unlike accommodative insufficiency, statistical analysis demonstrated a significant association between convergence insufficiency and myopia severity. Although convergence insufficiency was observed across all refractive classifications, the highest frequency occurred among patients with high myopia. The distribution across the three refractive groups was not linear, with lower frequencies observed in the moderate myopia group; nevertheless, the findings suggest that highly myopic individuals may demonstrate a greater tendency toward vergence dysfunction. These results are generally consistent with previous investigations reporting greater convergence-related anomalies among myopic populations. Logan et al. (2021) proposed that alterations in accommodative-vergence interaction during sustained near tasks may contribute to binocular vision dysfunction among myopic individuals, while Akram et al. (2018) observed a greater

frequency of convergence insufficiency among higher myopic groups.

Taken together, the findings emphasize the importance of comprehensive binocular vision assessment among young adult myopic patients. While accommodative insufficiency may occur regardless of refractive classification, the significant association observed between convergence insufficiency and myopia severity suggests that vergence evaluation may be particularly important among individuals with higher degrees of myopia. The results further support the integration of accommodative and vergence assessment into routine optometric examination, particularly for young adults who are frequently exposed to prolonged near visual demands.

CONCLUSION

The present study demonstrated that accommodative and vergence dysfunctions are common among young adult myopic patients exposed to sustained near visual demands. Accommodative insufficiency was identified in a considerable proportion of the study population; however, no significant association was observed between accommodative insufficiency and myopia severity, suggesting that accommodative dysfunction may occur regardless of refractive classification. In contrast, convergence insufficiency showed a significant association with myopia severity, with the highest frequency observed among highly myopic individuals.

These findings highlight the importance of comprehensive binocular vision assessment in the routine evaluation of young adult myopic patients. While accommodative

function should be assessed across all levels of myopia, greater attention may be warranted for vergence evaluation among individuals with higher refractive error. Future studies involving larger and more diverse populations, as well as additional accommodative and vergence parameters, may further clarify the relationship between myopia severity and binocular vision anomalies.

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APPENDIX

Appendix A

Diagnostic Criteria Used in the Study

Table A1. Myopia Severity Classification

Classification	Spherical Equivalent (SE)
Low Myopia	-0.50 D to -3.00 D
Moderate Myopia	-3.25 D to -6.00 D
High Myopia	Greater than -6.00 D

Source: American Optometric Association (2021); American Academy of Ophthalmology (2020).

Table A2. Diagnostic Criteria for Accommodative Insufficiency

Clinical Parameter	Diagnostic Criterion
Amplitude of Accommodation (AA)	≥ 2.00 D below the age-expected minimum using Hofstetter's Formula ($15 - 0.25 \times \text{Age}$)
Near Point of Accommodation (NPA)	Receded relative to age-appropriate norms
Positive Relative Accommodation (PRA)	Less than -1.50 D
Final Diagnosis	Reduced AA accompanied by at least one additional abnormal accommodative finding

Source: Normative values based on Donders, Hofstetter, Cacho-Martínez et al. (2002), and Scheiman & Wick (2014)

Table A3. Diagnostic Criteria for Convergence Insufficiency

Clinical Parameter	Diagnostic Criterion
Near Point of Convergence (NPC)	Break >5cm or Recovery >7cm
Near Phoria	Exophoria greater at near than at distance
Positive Fusional Vergence (PFV)	Below expected normative values at near
AC/A Ratio	Considered as a supportive parameter
Final Diagnosis	Receding NPC accompanied by at least two additional abnormal vergence findings

Source: Normative values based on Scheiman & Wick (2014) and University of Iowa Department of Ophthalmology (2014)

Diagnostic classification was based on the overall interpretation of multiple clinical findings rather than reliance on a single isolated measurement to minimize diagnostic misclassification.

Appendix B

Conceptual Framework in the Study

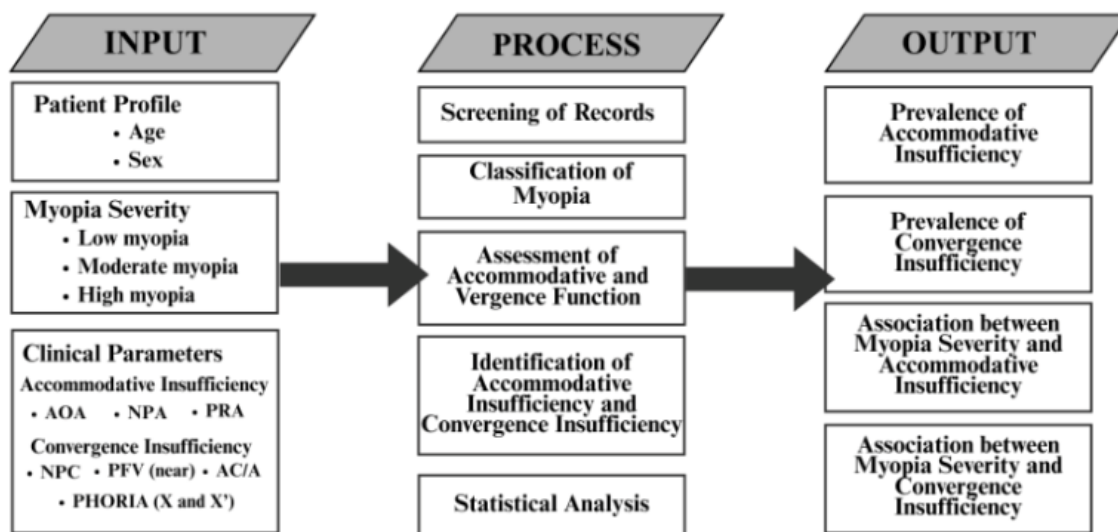


Figure B1. Conceptual framework illustrating the relationship between myopia severity and the occurrence of accommodative insufficiency and convergence insufficiency among young adult myopic patients.

The framework illustrates the proposed relationship between the independent variable (myopia severity) and the dependent variables (accommodative insufficiency and convergence insufficiency), using established accommodative and vergence clinical parameters obtained from retrospective clinical records.

Appendix C

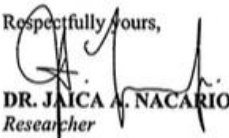
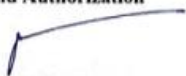
Institutional Permissions for the Use of Clinical Records

Prior to data collection, institutional permission was secured from the appropriate administrative offices of Centro Escolar University–Manila to ensure that the use of retrospective clinical records complied with institutional policies and patient confidentiality requirements.

Appendix C.1 Approval Letter from the Dean, School of Optometry



Appendix C.2 Approval Letter from the Clinical Coordinator, Vision and Eye Care Center (VECC)

	CENTRO ESCOLAR UNIVERSITY SCHOOL OF OPTOMETRY MANILA	
Dr. Marilyn H. Samson Clinic Coordinator Faculty, School of Optometry		
Dear Dr. Samson,		
Greetings!		
I am Jaica A. Nacario, a faculty member of the School of Optometry and a graduate student under the School of Advanced Education, Research, and Accreditation (SAERA).		
In partial fulfillment of my master's degree, I am conducting a research study entitled:		
“Myopia Severity and Its Association with Convergence and Accommodative Insufficiencies: Implications for Vergence and Accommodative Function Among Young Adult Patients at the Vision and Eye Care Center, Centro Escolar University (Manila, Philippines)”		
In this regard, I respectfully request permission to utilize clinical records from the Vision and Eye Care Center, School of Optometry, Centro Escolar University–Manila (SY 2024–2026) as part of my data collection.		
All data will be treated with strict confidentiality and will be used solely for academic and research purposes.		
Thank you for your consideration and support.		
Respectfully yours,  DR. JAICA A. NACARIO Researcher		
Approval and Authorization  DR. MARILYN H. SAMSON Clinic Coordinator, Vision and Eye Care Center		

Appendix D

G*Power Sample Size Analysis

An *a priori* power analysis was performed using G Power software to determine the minimum sample size required for the study. The analysis indicated that 159 clinical records (53 per myopia severity group) were required to achieve a statistical power of 0.80 at an alpha level of 0.05 with a moderate effect size

