

“A study to assess the efficacy of duochrome test in attaining optimum refractive correction among patient with refractive errors at SMVMCH, Puducherry.”

Dr.G.Muthamilselvi¹, Ms.K.Abinaya², Mr.B.Phavalan³, Ms.S.Preetha⁴ & Ms.G.Priyenga⁵,

¹Principal, Sri Manakula Vinayagar Nursing College, Puducherry – 605 107

²Tutor in Nursing, Dept of Medical Surgical Nursing, Sri Manakula Vinayagar Nursing College, Puducherry – 605 107

³⁻⁵B.Sc.,Nursing, Sri Manakula Vinayagar Nursing College, Puducherry –605107.

Corresponding Author: Dr.G.Muthamilselvi

Abstract

Refractive errors are common visual problems that affect visual acuity and quality of life. This study aimed to assess the effectiveness of the Duochrome test in achieving optimum refractive correction among patients attending the Ophthalmology OPD at SMVMCH, Puducherry. A descriptive comparative design was used among 30 patients selected by consecutive sampling. The Duochrome test was effective in **80%** of participants, while 13.3% had unclear outcomes and 6.7% were overcorrected. Significant associations were found with gender ($p = 0.022$) and hours of sleep ($p = 0.0395$). The study concludes that the Duochrome test is a simple, effective, and useful method for refining refractive correction.

Keywords: Duochrome test, refractive errors, subjective refraction, visual acuity, optimum refractive correction.

I. INTRODUCTION

The human eye enables vision by focusing incoming light through the cornea and lens onto the retina. The retina contains specialized photoreceptor cells called rods and cones. These cells convert light into electrical nerve signals. The signals are then transmitted to the brain through the optic nerve for visual interpretation. Clear vision depends on the precise focusing of light on the retina. When this focusing is disrupted, refractive errors occur. Common types include myopia, hyperopia, astigmatism, and presbyopia. These conditions lead to blurred vision, eye strain, and difficulty in focusing. Refractive errors are easily diagnosed through eye examinations. They can be effectively corrected using spectacles, contact lenses, or refractive surgery. Clinical tools like the duochrome test help in refining accurate and comfortable visual correction.

OBJECTIVES

- To assess the level of visual acuity among patients with refractive errors.
- To evaluate the efficacy of duochrome test to attain optimum refractive correction among patient with refractive errors.
- To associate the efficacy of duochrome test among patient with refractive errors with their selected demographic variables.

HYPOTHESIS

H₁: There is a significant difference in refractive correction after application of the duochrome test among patient with refractive error.

H₂: There is a significant association between the efficacy of duochrome and selected demographic variables of patient.

II. METHODOLOGY

A descriptive comparative research design was used among 30 patients selected through convenience sampling. Tools included a demographic questionnaire, Snellen chart for visual acuity assessment, and the duochrome test to determine final spherical correction. Data were analyzed using descriptive statistics and Chi-square test.

DEVELOPMENT AND DESCRIPTION OF THE DATA COLLECTION OF TOOLS:

Section A: Socio-demographic and Clinical Variables

This section includes age, gender, educational status, occupation, residential area, socioeconomic status, type and duration of refractive error, spectacle use, family history, and previous eye examination.

Section B: Snellen Chart

The Snellen chart was used to assess **visual acuity**. It consists of letters or symbols of decreasing size and helps identify the degree of visual impairment and refractive errors.

Section C: Duochrome Test

The Duochrome test was used to **refine spherical refractive correction** based on chromatic aberration.

Patients viewed black letters against red and green backgrounds, and the test was considered optimal when both appeared equally clear.

SCORE INTERPRETATION

VISUAL ACUITY	INTERPRETATION
6/6 (20/20)	Normal vision
6/9 (20/30)	Slightly reduced vision
6/12 (20/40)	Mild vision loss
6/18 (20/60)	Moderate vision loss
6/24 (20/80)	Low vision
6/36 (20/120)	Severe impairment
6/60 (20/200)	Legally blind threshold

Table:1 Frequency and Percentage Distribution of Demographic Variables among Patients with Refractive Errors
(N= 30)

S.NO	Demographic Variable	Category	Frequency (n)	Percentage (%)
1	Age (years)	18–35 years	1	3.3%
		36–45 years	6	20.0%
		46–55 years	19	63.3%
		More than 55years	4	13.3%
2	Gender	Male	11	36.7%
		Female	19	63.3%
3	Religion	Hindu	12	40.0%
		Christian	8	26.7%
		Muslim	10	33.3%

Table 1: The table shows the frequency and percentage distribution of demographic variables among patients with refractive errors. Regarding to age, the majority of patients belonged to the 46–55 years age group 19 (63.3%), followed by 36–45 years 6 (20.0%), more than 55 years 4 (13.3%), and 18–35 years 1 (3.3%). Regarding gender, most of the participants were females 19 (63.3%), while males constituted 11 (36.7%). In terms of religion, 12 (40.0%) were Hindus, 10 (33.3%) were Muslims, and 8 (26.7%) were Christians.

Table:2 Frequency and Percentage Distribution of Demographic Variables among Patients with Refractive Errors at SMVMCH, Puducherry
(N= 30)

S.NO	Demographic Variable	Category	Frequency (n)	Percentage (%)
1	Family History of Refractive Error	Yes	1	3.3%
		No	29	96.7%
2	Screen Time	<3 hours	18	60.0%
		≥ 3 hours	12	40.0%
3	Hours of Sleep	≤ 5 hours	3	10.0%
		6 hours	10	33.3%
		7 hours	13	43.3%
		≥ 8 hours	4	13.3%
4	Associated Illness	Yes	5	16.7%

		No	25	83.3%
5	Bad Habits	No	30	100.0%

Table 2: The table shows the frequency and percentage distribution of demographic variables among patients with refractive errors. With respect to family history of refractive errors, 29 (96.7%) had no family history, whereas only 1 (3.3%) reported a positive family history. Concerning screen time, 18 (60.0%) had less than 3 hours of screen exposure per day and 12 (40.0%) had 3 or more hours. Regarding hours of sleep, 13 (43.3%) slept for 7 hours, 10 (33.3%) slept for 6 hours, 4 (13.3%) slept for 8 or more hours, and 3 (10.0%) slept for 5 or less hours. In relation to associated illness, 25 (83.3%) had no associated illness while 5 (16.7%) reported having associated illness. Finally, none of the participants 30 (100.0%) reported any bad habits

Table :3 Frequency and Percentage Distribution of Level of Visual Acuity among Patients with Refractive Errors

(N= 30)

of Level of Visual Acuity	Right Eye	Right Eye	Left Eye	Left Eye
	(n)	(%)	(n)	(%)
Normal Vision	4	13.3%	0	0.0%
Mild Visual Impairment	11	36.7%	11	36.7%
Moderate Visual Impairment	15	50.0%	19	63.3%
Severe Visual Impairment	0	0.0%	0	0.0%
Total	30	100.0%	30	100.0%

Table 3 presents the **frequency and percentage distribution of visual acuity levels** among patients with refractive errors (N = 30). In the **right eye**, the majority had **moderate visual impairment (50.0%)**, followed by **mild visual impairment (36.7%)** and **normal vision (13.3%)**, with **no cases of severe impairment** reported. In the **left eye**, most patients had **moderate visual impairment (63.3%)**, while the remaining **36.7% had mild impairment**. Notably, **no patients exhibited normal vision or severe visual impairment in the left eye**. Overall, the findings indicate that **moderate visual impairment predominates in both eyes**, with the left eye showing comparatively poorer visual acuity.

(N= 30)

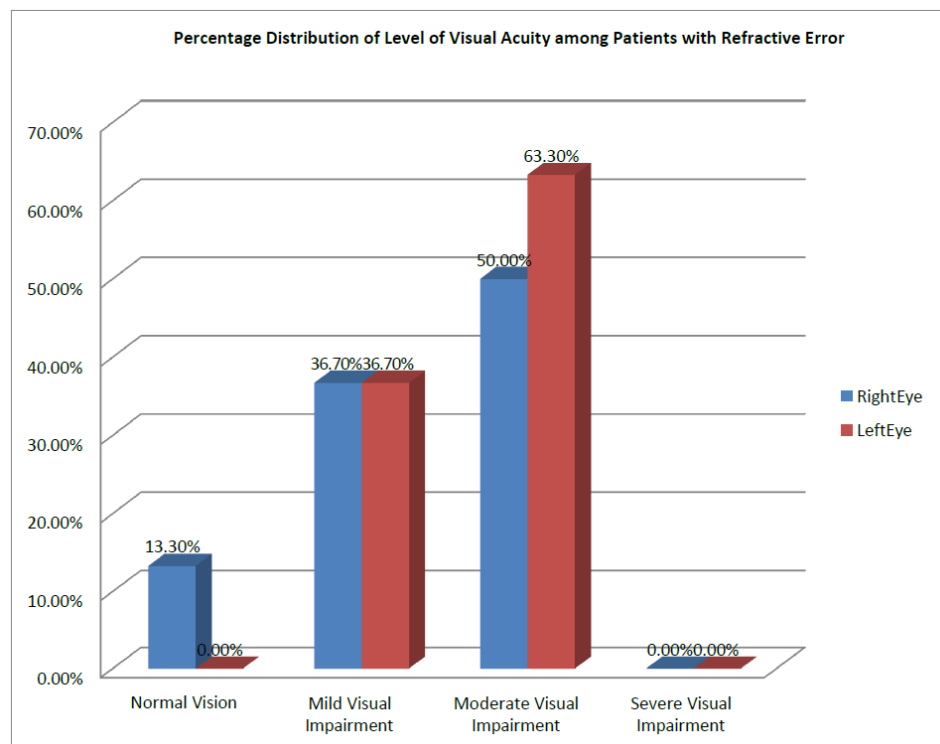


Figure 2: Distribution of Level of Visual Acuity among Patient with Refractive Error

Table No: 4 Mean and Standard Deviation of Level of Visual Acuity among Patients with Refractive Errors

(N= 30)

Variable	Mean	Standard Deviation
Right Eye Visual Acuity Score	14.90	6.890
Left Eye Visual Acuity Score	19.10	8.576

Table 4: depicts the mean and standard deviation of visual acuity scores among patients with refractive errors at SMVMCH, Puducherry (N = 30). The mean visual acuity score of the right eye was 14.90 with a standard deviation of 6.890, whereas the mean visual acuity score of the left eye was 19.10 with a standard deviation of 8.576.

Table: 5 Frequency and Percentage Distribution of Level of Duochrome among Patients with Refractive Errors a MVMCH, Puducherry

(N= 30)

Duochrome Level	Right Eyen	Right Eye%	Left Eyen	Left Eye %
Optimal correction	10	33.3%	14	46.7%
Slight over-correction	8	26.7%	10	33.3%
Under-correction	12	40.0%	6	20.0%
Total	30	100.0%	30	100.0%

Table 5: shows the frequency and percentage distribution of the level of duochrome among patients with refractive errors at SMVMCH, Puducherry (N = 30). In the **right eye**, 10 patients (33.3%) achieved optimal correction, 8 patients (26.7%) showed slight over-correction, and the majority, 12 patients (40.0%), had under-correction. This indicates that under-correction was more commonly observed in the right eye compared to optimal and over-correction levels. In the **left eye**, 14 patients (46.7%) attained optimal correction, 10 patients (33.3%) had slight over-correction, and 6 patients (20.0%) exhibited under-correction. Unlike the right eye, optimal correction was more frequently achieved in the left eye. Overall, the findings suggest that the duochrome test helped in identifying variations in refractive correction, with a higher proportion of optimal correction observed in the left eye, whereas under-correction was more common in the right eye among the study participants.

(N= 30)

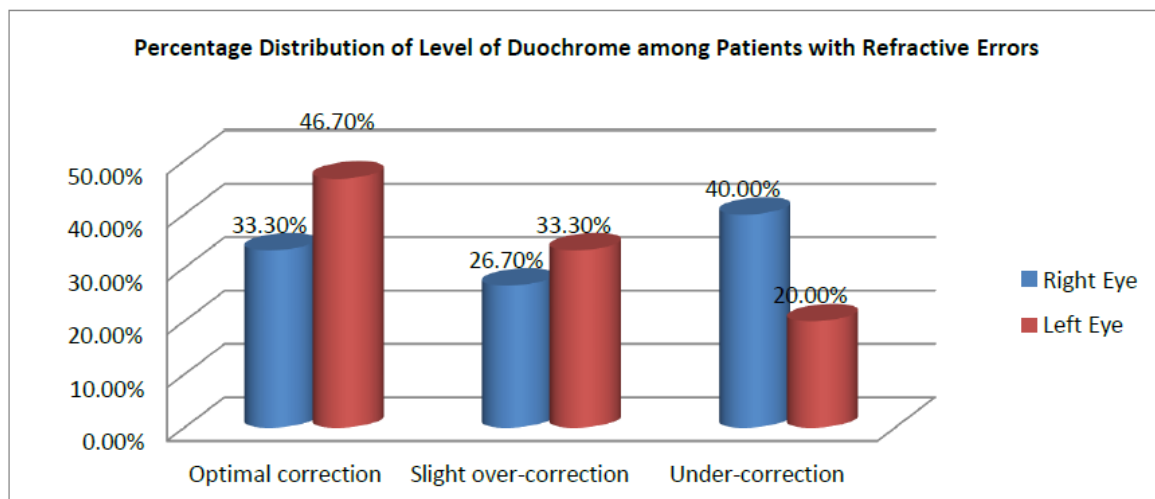


Figure 3: Distribution of Level of duochrome among Patient with Refractive error.

Table: 6 Mean and Standard Deviation of Level of Duochrome among Patients with Refractive Errors (N= 30)

Eye	Mean	Standard Deviation
Right Eye– Duochrome Score	1.07	0.868
Left Eye–Duochrome Score	0.73	0.785

Table 6: presents the mean and standard deviation of duochrome scores among patients with refractive errors (N = 30). The mean duochrome score for the **right eye** was **1.07 ± 0.868**, whereas for the **left eye**, it was **0.73 ± 0.785**. The slightly higher mean score in the right eye indicates comparatively greater variation in correction levels when compared to the left eye. The standard deviation values for both eyes suggest moderate variability in duochrome scores among the patients. Overall, the findings reflect minor differences in duochrome correction levels between the right and left eyes.

Table 7: Association between Right Eye Visual Acuity Level and Selected Demographic Variables among Patients with Refractive Errors at SMVMCH, Puducherry (N= 30)

S.N O	Demographic Variables	Category	Normal Vision	Mild Visual Impairment	Moderate Visual Impairment	χ^2	df	p-value
			n (%)	n (%)	n (%)			
1	Age (years)	18–35yrs	0 (0.0%)	1 (9.1%)	0 (0.0%)	12.769	2	0.007*S
		36–45yrs	1 (25.0%)	2 (18.2%)	3 (20.0%)			
		46–55yrs	3 (75.0%)	6 (54.5%)	10 (66.7%)			
		>55yrs	0 (0.0%)	2 (18.2%)	2 (13.3%)			
2	Gender	Male	0 (0.0%)	4 (36.4%)	7 (46.7%)	2.962	2	0.227
		Female	4 (100.0%)	7 (63.6%)	8 (53.3%)			
3	Religion	Hindu	1 (25.0%)	6 (54.5%)	5 (33.3%)	2.270	4	0.686
		Christian	1 (25.0%)	3 (27.3%)	4 (26.7%)			
		Muslim	2 (50.0%)	2 (18.2%)	6 (40.0%)			

*Significant p<0.05

Table 7: The table shows The association between right eye visual acuity level and selected demographic variables revealed that **age** ($\chi^2 = 12.769$, df = 2, p = 0.007) showed a statistically significant association. Other variables such as gender ($\chi^2 = 2.962$, df = 2, p = 0.227), religion ($\chi^2 = 2.270$, df = 4, p = 0.686),

Table 8: Association between Right Eye Visual Acuity Level and Selected Demographic Variables among Patients with Refractive Errors (N = 30)

S.NO	Demographic Variables	Category	Normal Vision	Mild Visual Impairment	Moderate Visual Impairment	χ^2	df	p-value
1	Nature of Work	Desk Work	0 (0.0%)	1 (9.1%)	3 (20.0%)	3.065	4	0.547
		Field Work	4 (100.0%)	9 (81.8%)	12 (80.0%)			
		Household Work	0 (0.0%)	1 (9.1%)	0 (0.0%)			
2	Family History	Yes	0 (0.0%)	1 (9.1%)	0 (0.0%)	1.787	2	0.409
		No	4 (100.0%)	10 (90.9%)	15 (100.0%)			
3	Screening Time	<3hrs	2 (50.0%)	7 (63.6%)	9 (60.0%)	0.227	2	0.893
		≥3 hrs	2 (50.0%)	4 (36.4%)	6 (40.0%)			

*Significantatp<0.05

Table 8 shows that there is **no statistically significant association** between right eye visual acuity level and selected demographic variables among patients with refractive errors. The variables such as nature of work ($\chi^2 = 3.065$, p = 0.547), family history ($\chi^2 = 1.787$, p = 0.409), and screening time ($\chi^2 = 0.227$, p = 0.893) all have p-values greater than 0.05. This indicates that these factors do not significantly influence the right eye visual acuity levels in this study population. Hence, the null hypothesis is accepted for all selected variables.

Table 9: Association between Left Eye Visual Acuity Level and Selected Demographic Variables among Patients with Refractive Errors at SMVMCH, Puducherry

(N= 30)

S.NO	Demographic Variables	Category	Mild Visual Impairment	Moderate Visual Impairment	χ^2	df	p- value
			n (%)	n (%)			
1	Age (years)	18–35	0 (0.0%)	1 (5.3%)	6.014	3	0.111
		36–45	1 (9.1%)	5 (26.3%)			
		46–55	10 (90.9%)	9 (47.4%)			
		>55	0 (0.0%)	4 (21.1%)			
2	Gender	Male	2 (18.2%)	9 (47.4%)	2.556	1	0.110
		Female	9 (81.8%)	10 (52.6%)			
3	Religion	Hindu	8 (72.7%)	4 (21.1%)	7.859	2	0.020* S
		Christian	1 (9.1%)	7 (36.8%)			
		Muslim	2 (18.2%)	8 (42.1%)			

*Significantat $p < 0.05$

Table shows the **association between demographic variables and visual impairment levels** among patients with refractive errors. There is **no statistically significant association** between age ($\chi^2 = 6.014$, $p = 0.111$) and gender ($\chi^2 = 2.556$, $p = 0.110$) with levels of visual impairment, as their p-values are greater than 0.05. However, **religion shows a statistically significant association** with visual impairment ($\chi^2 = 7.859$, $p = 0.020$), indicating that variation in impairment levels differs across religious groups. Hence, the null hypothesis is rejected for religion and accepted for age and gender.

Table 10: Association between Left Eye Visual Acuity Level and Selected Demographic Variables among Patients with Refractive Errors at SMVMCH, Puducherry.(N = 30)

S.NO	Demographic Variables	Category	Mild Visual Impairment	Moderate Visual Impairment	χ^2	df	p- value
1	Education	Literate	1 (9.1%)	2 (10.5%)	0.038	2	0.981
		Primary	5 (45.5%)	9 (47.4%)			
		Higher Secondary	5 (45.5%)	8 (42.1%)			
2	Family Monthly Income	<5000	1 (9.1%)	1 (5.3%)	0.403	3	0.940
		5001–10000	2 (18.2%)	5 (26.3%)			
		10001–15000	7 (63.6%)	11 (57.9%)			
		>15000	1 (9.1%)	2 (10.5%)			
3	Dietary Pattern	Vegetarian	0 (0.0%)	1 (5.3%)	0.599	1	0.439
		Non-veg	11 (100.0%)	18 (94.7%)			

*Significantat $p < 0.05$

The table shows the **association between selected demographic variables and levels of visual impairment** among patients with refractive errors. There is **no statistically significant association** between education ($\chi^2 = 0.038$, $p = 0.981$), family monthly income ($\chi^2 = 0.403$, $p = 0.940$), and dietary pattern ($\chi^2 = 0.599$, $p = 0.439$) with visual impairment, as all p-values are greater than 0.05. This indicates that these variables do not influence the severity of visual impairment in this study group. Hence, the null hypothesis is accepted for all selected variables.

NURSING IMPLICATIONS

The findings of study have scope in following area nursing education, nursing practice, nursing administration and nursing research

NURSING EDUCATION

- Nursing students and optometry students should be taught the optical principles of the Duochrome test (chromatic aberration) to understand how to refine spherical correction.
- The curriculum should include practical training on administering subjective refraction tests to identify over-misusing or under-plusing in prescriptions.

- Effort should be made to improve and expand nursing curriculum to provide more content in the area of standard infection control measures.
- Students should be provided with adequate opportunities in developing skills in standard infection control measures.

NURSING PRACTICE

- Ophthalmic nurses and practitioners can routinely utilize the duochrome test as a standard endpoint verification tool in the outpatient department.
- Nurses play a vital role in explaining the procedure to patients (e.g., distinguishing which color appears sharper) to ensure accurate responses, especially for patients with unclear results.
- Understanding the link between fatigue (sleep) and visual testing results can help nurses schedule or prepare patients better for eye examinations.

NURSING ADMINISTRATION

- Nurse administrators can ensure that vision testing rooms in the OPD are equipped with proper duochrome charts and adequate lighting conditions.
- Protocols can be established to include subjective refinement (duochrome) for all patients receiving spectacle prescriptions to reduce cases of visual discomfort.

NURSING RESEARCH

- The findings of the study add to the scientific body of professional knowledge upon which future research can be built.
- This study can serve as a baseline for conducting comparative studies between the duochrome test and other methods like the fogging technique or cross-cylinder test.
- The results support further investigation into how physiological factors like sleep deprivation affect subjective refraction outcomes.

RECOMMENDATIONS

- A similar study can be conducted with a **larger sample size** to improve the generalizability of the findings.
- Experimental studies may be conducted in treatment facilities.
- A comparative study may be conducted between the nurses and other high health care personnel.
- Further research can be carried out to evaluate the **reliability of the duochrome test among geriatric populations** and in patients with **color vision deficiencies**.
- Future studies may explore the **association between sleep duration and refractive testing accuracy**, which could contribute to the development of improved clinical guidelines.

III. Discussion

The study findings describe the **demographic characteristics of patients with refractive errors (N = 30)**. The majority of participants belonged to the **46–55 years age group (63.3%)**, and most were **females (63.3%)**, while males constituted 36.7%. In terms of religion, **40.0% were Hindus**, and regarding education, nearly half (**46.7%**) had **primary level education**. Most participants (**60.0%**) had a **family monthly income between ₹10,001–15,000**, and a large majority (**96.7%**) followed a **non-vegetarian diet**.

With respect to occupational status, most participants (**83.3%**) were involved in **field work**. The majority (**96.7%**) had **no family history of refractive errors**, and **60.0%** reported **less than 3 hours of screen time per day**. Regarding sleep pattern, the highest proportion (**43.3%**) slept for **7 hours** daily. Most participants (**83.3%**) had **no associated illness**, and notably, **none of them (100.0%) reported any bad habits**. These findings provide a clear overview of the demographic profile of the study population.

IV. CONCLUSION

The present study concludes that the majority of patients attending the Ophthalmology OPD had **mild to moderate visual impairment** and required **myopic correction**. The findings show that the **duochrome test is highly effective**, with **80% of patients achieving optimum refractive correction**. It also helped identify **overcorrection in 6.7% of cases**, indicating its clinical usefulness. Overall, the study emphasizes that **subjective verification using the duochrome test is essential for accurate prescriptions and improved patient comfort**.

Reference

- [1]. American Academy of Ophthalmology. Clinical optics and refraction (BCSC). San Francisco: AAO; 2022. p.90–110.
- [2]. Baig RS. Comparative efficacy of duochrome test versus +1 blur test in detecting refractive error across different ages. *Healer J Physiother Rehabil Sci*. 2025;5(2):368–373.
- [3]. Chukwuyem EC, Musa MJ, Zeppleri M. Duochrome test and its clinical applications in subjective refraction. StatPearls Publishing; 2023. p.1–6.
- [4]. Duan Z, Tang N, Wang Y. Comparison of dynamic visual acuity in spectacles prescribed to 0.05D versus 0.25D steps: A randomized study. *Photonics*. 2025;12(7):692. p.1–12.
- [5]. G Muthamilselvi et al. A study to assess the patient’s perception on factors affecting gender role in nursing care among patients admitted in SMVMCH at Puducherry. *Quest J Med Dent Sci Res*. ISSN (Online): 2394.
- [6]. G Muthamilselvi et al. Pandemic pedagogy: Perception of nursing students: A cross-sectional study. *F1000Research*. 11.
- [7]. Holden BA, Fricke TR, Wilson DA, et al. Global prevalence of refractive errors and vision impairment. *Ophthalmology*. 2021;128(2):208–215.
- [8]. Kim JY, Park SH. Effect of pupil size and illumination on duochrome test outcomes. *Korean J Optom Vis Sci*. 2023;15(2):45–52.
- [9]. Lu W, Ji Y, Ding X, Tian Y, Long K, Guo Y, et al. Agreement and repeatability of central and peripheral refraction by multispectral refractor. *Front Med (Lausanne)*. 2021;8:777685. p.1
- [10]. Mrs. G. Sathyavathy, “A Study to Assess the Level of Knowledge of **Standard Protocol for Infection Control** Among Health Care Assistant Working in Different Clinical Area at SMVMCH, Puducherry”. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* e-ISSN: 2320–1959, p- ISSN: 2320–1940, Volume 12, Issue 3 Ser.5 (May. – June. 2023), PP 17-22. <https://www.iosrjournals.org/iosr-jnhs/papers/vol12-issue3/Ser-5/C1203051722.pdf>
- [11]. Naqvi S, Ansari Z, Chaurasiya RK, et al. Effect of illumination on duochrome test reliability. *J Clin Ophthalmol Res*. 2025;13(2):154–157.
- [12]. Naqvi S, Ansari Z, Chaurasiya RK, Kumar A, Chauhan L, Agarwal P. Reliability of duochrome test among different refractive errors under different lighting conditions. *J Clin Ophthalmol Res*. 2025;13(2):154–157.
- [13]. Sankaridurg P, Tahhan N, Kandel H, et al. IMI impact of myopia report. *Invest Ophthalmol Vis Sci*. 2021;62(5):2–10.
- [14]. Sathyavathy. G “A study to assess the effectiveness of a structured teaching programme on knowledge and practice of Nasogastric tube feeding to adult patients among nursing personal working in selected hospitals, Bangalore”. *Galore International journal of science and humanities*, vol: 6, Issue: 1, Jan- March 2022, PP:33-43. https://www.gijash.com/GIJASH_Vol.6_Issue.1_Jan2022/GIJASH-Abstract06.html
- [15]. Tideman JW, Snabel MCC, Tedja MS, et al. Association of axial length with refractive error. *JAMA Ophthalmol*. 2021;139(3):237–245.
- [16]. Wolffsohn JS, Flitcroft DI, Gifford KL, et al. IMI clinical management guidelines report. *Invest Ophthalmol Vis Sci*. 2021;62(5):5–20.
- [17]. World Health Organization. World report on vision. Geneva: WHO; 2021. p.1–180.