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Burden of Refractive Errors in Albania – Findings from an Urban Eye Clinic in Tirana

Errores Refractivos en Albania – Hallazgos de una Clínica Oftalmológica Urbana en Tirana

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Relevance: This study is essential for understanding the prevalence of refractive errors in Albania and their impact on visual health. It highlights the importance of access to eye care services, emphasizing disparities in urban and rural areas, thereby underscoring the need for improved nationwide eye health coverage.

Purpose: This study aims to evaluate the prevalence and impact of refractive errors in Albania focusing on subjects attending an urban eye clinic in Tirana.

Methods: Participants were recruited for this study during the first three quarters of 2024. All participants underwent a comprehensive examination to assess visual acuity, objective refraction using i-Profile Plus, and subjective refraction with the Automated Visuphor 500. A basic eye examination was conducted using biomicroscopy and ophthalmoscopy. Optometric management included optical services, such as glasses and contact lenses, provided within the facility, while referrals were made for subjects requiring specialist examination or surgical intervention, such as cataract surgery. Data were collected and analyzed using SPSS v28, following a format designed for comprehensive analysis.

Results: Data were obtained from 901 patients, including both children and adults. 56.24% patients were females and 43.76% were males. It was found that 32.29% (291) of the patients attended the eye clinic were having myopia, 33.08% (298) were having hyperopia, and 34.62% (312) were emmetropes. Furthermore, we found no sex differences between refractive errors. 13.3% of Anisometropia was reported in 13.3% of subjects. Eight out of ten patients achieved best-corrected visual acuity of 1.0(6/6) with refractive correction (either glasses or contact lenses), while two out of ten required further eye examination or surgical interventions for conditions such as cataracts.

Conclusions: Refractive errors are the leading cause of visits to eye clinics. Access to eye care services is crucial, as four out of ten individuals either do not receive correction or lack access to refractive services, which is particularly evident in urban areas and may be even more pronounced in the rural regions of Albania. Universal access to eye health coverage should be implemented nationwide in order to ensure equitable care.

Keywords: Burden, Refractive Errors, Myopia, Hyperopia, Astigmatism, Presbyopia, Albania.

Relevancia: Este estudio es crucial para comprender la prevalencia de los errores refractivos en Albania y su impacto en la salud visual. Resalta la importancia de acceder a servicios de atención ocular, evidenciando las desigualdades en áreas urbanas y rurales, lo que subraya la necesidad de mejorar la cobertura de salud ocular.

Propósito: Este estudio tiene como objetivo evaluar la prevalencia y el impacto de los errores refractivos en Albania, centrándose en los sujetos que asisten a una clínica ocular urbana en Tirana.

Material y Métodos: Los participantes fueron reclutados para este estudio entre los tres primeros trimestres de 2024. Todos los participantes se sometieron a un examen integral para evaluar la agudeza visual, la refracción objetiva utilizando i-Profile Plus y la refracción subjetiva con el Visuphor 500 Automatizado. Se realizó un examen ocular básico utilizando biomicroescopia y oftalmoscopía. El manejo optométrico incluyó servicios ópticos, como gafas y lentes de contacto, proporcionados dentro de la instalación, mientras que se realizaron derivaciones para los sujetos que requerían un examen especializado o intervención quirúrgica, como cirugía de cataratas. Los datos fueron recopilados y analizados utilizando SPSS v28, siguiendo un formato diseñado para un análisis exhaustivo.

Resultados: Con base en los datos de 901 pacientes, incluidos niños y adultos, el 56.24% de los pacientes eran mujeres y el 43.76% eran hombres. Se encontró que el 32.29% (291) de los pacientes que asistieron a la clínica ocular tenían miopía, el 33.08% (298) tenían hipermetropía y el 34.62% (312) eran emétropes. Además, no se encontraron diferencias de sexo entre los errores refractivos. Se reportó un 13.3% de anisometropía en los sujetos. Ocho de cada diez pacientes recibieron o pudieron lograr la mejor agudeza visual corregida de 1.0 (6/6) con corrección refractiva, ya sea con gafas o lentes de contacto, mientras que dos de cada diez requirieron un examen ocular adicional o intervenciones quirúrgicas para condiciones como las cataratas.

Conclusiones: Los errores refractivos son la principal razón de las visitas a las clínicas oculares. El acceso a los servicios de atención ocular es crucial, ya que cuatro de cada diez personas no reciben corrección o carecen de servicios refractivos, lo que es particularmente evidente en las áreas urbanas y puede ser aún más pronunciado en las regiones rurales de Albania. Se debe implementar un acceso universal a la cobertura de salud ocular a nivel nacional para garantizar una atención equitativa.studies are recommended.

Palabras clave: Carga, Errores Refractivos, Miopía, Hipermetropía, Astigmatismo, Presbicia, Albania.

INTRODUCTION

Refractive errors, including myopia, hyperopia, and astigmatism, represent the most common form of visual impairment globally. These conditions occur when the eye fails to focus light directly onto the retina, resulting in blurred vision. According to the World Health Organization (WHO) Report on Blindness and Vision Impairment, about 2.2 billion people are affected with near and distance vision impairment around the world. Of these, at least 1 billion cases could have been prevented or are yet to receive necessary treatment (1). Uncorrected refractive error (URE) is a widely overlooked but prevalent public health issue that severely affects quality of life and productivity (2).

Refractive errors, particularly myopia, are becoming increasingly prevalent globally. The European Eye Epidemiology (E3) Consortium reported that 30.6% of the European population is affected by myopia, 25.2% by hyperopia, and 23.9% by astigmatism, highlighting the significant burden these conditions represent on public health (European Eye Epidemiology Consortium, 2015) (3). Myopia is highly common in children and young adults in Asia (4,5). A cross-sectional study in 2022 showed that the prevalence of myopia among high school students in China reached 94% (6).

Albania is located in Europe which globally ranked the 3rd biggest region in the world with 17.3% of the population having vision loss (7). Refractive errors are the leading cause of vision impairment among eastern Europe as compared to central and western Europe (8). As Albania´s economy is continually improving (9) with the aim of improving healthcare in the coming years, thereby making the country healthier and sustainable compared to neighboring countries. Eye health like correcting refractive errors can significantly boost a country's economy by reducing productivity losses associated with visual impairment. Effective eye care services, such as the provision of affordable eyeglasses, can increase workforce participation and efficiency, especially in low-income countries. By improving access to vision correction, countries can reduce healthcare costs, enhance quality of life, and increase educational and employment opportunities, leading to long-term economic benefits. Furthermore, addressing uncorrected refractive errors helps to prevent additional social and economic burdens, thereby contributing to the alleviation of poverty (10).

Data on refractive errors is very limited in Albania. To

date, there are not any eye related studies covering national or sub-national levels that reported distance or near vision loss, nor any study presented at scientific conferences. Therefore, this study was conducted to comprehensively assess the prevalence of refractive errors in a clinical setting in urban Tirana.

METHODS

This was a cross-sectional observational study conducted from January to August 2024 after the approval of the Research Ethics Committee of Optika 1, Tirana dated 10th January 2024. A total of 930 patients aged 5 to 80 years, were assessed at the Zeiss Vision Center in Tirana. Of these participants, 56.2% were female and 43.8% were male. All assessments were performed by an Optometrist (MQ) in a clinical setting. Every subject underwent through a comprehensive eye examination beginning with the entry of patient data in the specified format designed for the designated clinics.

A complete history was taken for each patient, including chief and associated complaints, previous glasses and consultation history, systemic history, medical or surgical history and any known drug allergies history. Visual acuity was measured both with and without glasses and with the use of a pinhole using the available eye equipment in the clinic, including the Visuscreen 100 and Visuphor 500 (Carl Zeiss MediTech AG, Germany). Objective refraction was done via i.Profiler Plus (Carl Zeiss MediTech AG, Germany) and was the starting point for subjective refraction. Subject refraction followed the traditional endpoint of maximum plus for the best visual acuity followed by cross-cylinder refinement to locate the axis within ±5 degrees and its cylinder power within ±0.25 diopters. This was conducted using Visuphor 500 (Carl Zeiss MediTech AG, Germany) in Zeiss Vision Center and Visuref 500 (Carl Zeiss MediTech AG, Germany). Slit lamp examination was conducted using SL220 model (Carl Zeiss MediTech AG, Germany). Non-contact tonometry was performed using Visuplan 500 (Carl Zeiss MediTech AG, Germany) on all the patients aged 40 years or older, or when clinically indicated. Inter-pupillary distance measurement was taken from the refractometers print-outs and were confirmed by the optometrist (MQ) using MOSCOT PD Ruler (Moscot, NYC, USA) for both distance and near vision. Non-Mydriatic Fundus photography (Carl Zeiss MediTech AG, Germany) was taken for all those subjects who were having positive systemic history of Diabetes and hypertension, those aged 40 years and above, or in cases where no improvement in refraction was observed.

All subjects who visited the clinic during the study period and provided informed consent regardless of age or gender, were included in the study. Subjects who did not provide informed consent or whom diagnosis could not be made either due to pathology or other underlying cause, were excluded from the study.

Traditional clinical representations of refractive error, including sphere, cylinder, and axis, are not adequate for quantitative analysis. Therefore, spherocylindrical refractive results were converted into vector representations (M, J0 and J45) using Fourier analysis, as recommended by Thibos. Myopia was defined as <-0.50D, Emmetropia as spherical equivalent (SE) between >-0.50D and <+0.50D, and hyperopia as >0.50D. Data were collected from both eyes, but only right eye measurements were considered as being myopic, emmetropic or hyperopic. Presbyopia was defined as the inability to perform near work despite refractive correction at the age of 37 years or older, requiring a near add of at least +0.50DS.

Statistical Analysis

Data were collected in accordance with the Declaration of Helsinki, ensuring confidentiality through a unique coding system. Quantitative variables included age, refractive error, pathology, optical correction, and referrals, while qualitative variables included gender. Descriptive statistics (mean, standard deviation, frequency) and inferential tests (e.g. chi-square, t-test) were used for data analysis with IBM SPSS™ Software Version 28.

Ethical Considerations

Informed consent was obtained from all participants or their legal guardians (for minors) prior to the examination. Subject data were anonymized to maintain confidentiality.

RESULTS

Data from 901 subjects were collected with a mean age (mean + standard deviation) of 41.90+18.5 years, ranging from 6 to 83 years. Of these participants, 43.72% were male (394) with a mean age of 42.25¬+18.87 years and 56.27% were female (507) with a mean age of 41.10+17.86 years.

Descriptive Statistics for Spherical and Cylindrical Errors

Descriptive statistics of the refractive variables are presented as means and standard deviations. There was no significant difference between the right and left eyes (Mean difference in SE -0.04 D, p=0.64). Therefore, the right eye (RE) is presented in the results section. The

Clinical Measures	Mean	SD	Minimum	Maximum
Right eye Sphere	0.17	1.92	-15.00	8.5
Right eye SE	-0.10	1.94	-16.125	7.65
Right Eye Cylinder	-0.55	0.68	-5.00	-0.5
J0	0.03	0.38	-2.24	+2.00
J45	-0.01	0.20	-0.99	1.46

Table 1. Descriptive statistics for refractive variables
SD: Standar Deviation; SE: Spherical Equivalent; J45: Oblique astigmatism; J0: Primary Axis astigmatism

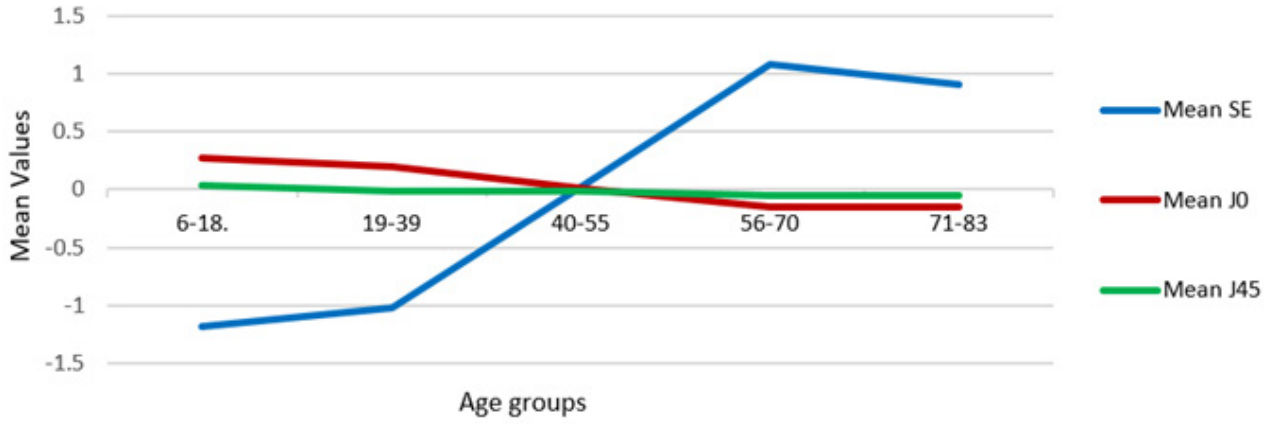

Figure 1. Age groups
SE: Spherical Equivalent; J45: Oblique astigmatism; J0: Primary Axis astigmatism

descriptive statistics of the RE sphere, SE, cylinder, Jo, and J45 are presented in Table 1.

Regarding gender, there was no statistically significant difference between males (SE -0.07 ± 1.96 D) and females (SE -0.13 ± 1.94 D), (mean difference -0.06 D, p = 0.54). Also, there was no statistically significant difference in the mean cylinder between males (-1.64 ± 0.82 D) and females (-1.60 ± 0.67 D), (mean difference: -0.036 D, p = 0.74). Furthermore, the J0 axis orientation did not exhibit a significant difference between males (mean 0.08 ± 0.52) and female (mean 0.04 ± 0.46) with a mean difference of 0.035 (p = 0.39). In addition, J45 showed no significant difference between males and females with mean difference of 0.005 (p = 0.81).

The SE trends across different age groups revealed a clear shift from myopia in younger age groups (0-18, 19-39) to hyperopia in older age groups (40-55, 56-70, and 71-83) with a notable transition observed after the age of 40. While J0 (off-axis astigmatism 0.90) showed a gradual decrease from positive (with the rule, WTR, astigmatism) in younger age groups to slightly negative (against the rule, ATR, astigmatism) in older age groups. In contrast, J45 (oblique astigmatism) remained stable around zero across different age groups, indicating minimal changes in oblique astigmatism with age (Figure 1).

Distribution of refractive errors

Myopia

Analysis of Myopia (SE ≤ -0.50D) showed no statistically significant difference between males and females (mean difference 0.068, p = 0.75). Myopia was present in 32.29% of total population (n=901) with a mean SE of -2.01 ± 1.74 D. Age group analysis indicated a higher prevalence of myopia in younger individuals, with 54.11% of subjects aged 19-39 years exhibiting myopia with a mean SE of -1.95 ± 1.70 D. Similarly, 51.68 % of subjects aged 6-18 years were found to be myopic. The prevalence of myopia decreased with advancing age, reaching 9.52 % in 71-83 years age group. (Table.2 & 3) (Figure 2)

Hyperopia

Hyperopia (SE ≥ +0.50D) was identified in 298 (33.08%) subjects of the total population (n=901) with mean hyperopia of 1.70 ± 1.24 D. As with myopia, no statistically significant difference in hyperopia was observed between males and females (mean difference: 0.024, p = 0.86). Age group analysis revealed hyperopia increased significantly with increasing age and was highest in 56-71 years age group subjects about 64.35% of individual

in this age group with mean SE of +1.70 ± 1.02 D. The highest mean SE +1.85 ± 0.97 D was recorded in 73-83 years age group individuals. (Table.2 &3) (Figure 2)

Emmetropia

Emmetropia (SE >-0.50 and <+0.50) was observed in 312 individuals, accounting for 34.62% of the total study population (n =901). 37.05 % of males and 32.74% of females were emmetropic. Age group analysis revealed that emmetropia was most prevalent in the 40-55 age group, with 43.94% (n = 105) of individuals in this category classified as emmetropic. The prevalence of emmetropia decreased in older age groups, with 21.29% in the 56-70 and 23.80% in the 71-83 years age group. (Table 2 & 3) (Figure 2)

Anisometropia

Anisometropia (SE difference between both eyes ≥ 0.75 or -0.75) was found in 120 individuals, representing 13.31% of total population with a mean SE of -0.33 ± 2.06 D. Although the mean SE was slightly higher in females, (-0.40 ± 2.11), no statistically significant difference was found between both genders (mean difference: 0.14; p=71). (Tables 2 & 3)

Distribution of Astigmatism types based on gender and age groups

Astigmatism types are presented in J0 (positive) WTR astigmatism, J0 (Negative) ATR astigmatism, and J45 oblique astigmatism. There was a significant difference between males and females in J0 (positive) WTR (p =0.04), whereas gender was not significantly associated with ATR astigmatism (J0 negative) (p = 0.34).

The prevalence of J0 WTR astigmatism was highest in the 19-39 years age group (44.98%) and declined with increasing age, reaching 18.82% in the 56-70 years age group (p=0.000005) In contrast, the prevalence of J0 (negative) ATR astigmatism increased with age, peaking in the 56-70 and 71-83 age groups, at 49.20% and 57.14%, respectively. A one-way ANOVA test revealed statistically significant differences across different age groups in both WTR and ATR astigmatism ($p < 0.05$). The prevalence of J45 oblique astigmatism remained relatively consistent across different age groups and the one-way ANOVA test did not find any significant difference across different age groups (p =0.67).

DISCUSSION

This study provides a comprehensive analysis of the distribution of refractive error in different age groups within the Albanian population in Tirana. Albania has very limited research in the eye care field. The findings of this study will contribute to the limited data on refractive errors in Albania and the broader Balkan region. By focusing on the clinical population in Tirana, this study addresses a critical gap in understanding the burden of refractive errors in this area, which is essential for improving vision care in this country.

The results of this study indicated a high prevalence of myopia in younger age groups (5-18 years, 51.11% and 54% in 19-39 years age group.). Our results on myopia prevalence were lower than those reported in a Hungarian study by Németh et al. (2022), which found 58.7% myopia prevalence in a slightly older young adult group (18-35 years) (11). Although their study focused on an older subset of young adults (18-35 years) the high prevalence rates in both studies suggest that early onset and progression of myopia continue into young adulthood. Statistical data on the prevalence of refractive errors in younger age groups in Eastern Europe is very insufficient.

A recent study conducted in Greece by Pateras and Kazakidou (2020) reported a myopia prevalence of 63.33% and hyperopia prevalence of 36.67% in the right eye, and 61.12% and 38.88% in the left eye (12). Similarly, a study conducted in Poland by Nowak et al. (2018) found that myopia was present in 28.7% and hyperopia in 21.8% in the age group 35-59 years of the population (13). While in comparison to the above-mentioned studies prevalence of Hyperopia in our study in the younger age group (5-18) was 11.24% and Myopia was 51.18 %. Regarding the distribution of refractive error by gender, this study found no statistically significant difference in myopia prevalence between males and females (p=0.75) based on SE measurements. While Czepita et al. (2019) noted a greater occurrence of myopia in Polish girls compared to boys, especially in older children (14). Similarly, We X et al. (2023) found that females in China had a higher frequency of myopia than males (15). Myopia findings of this study based on gender don't align with the above studies. In general myopia findings of this study align with previous studies that show a high prevalence of myopia in younger age groups (11,12,16).

Astigmatism was analyzed in vector form J0 and J45 (Table 3), J0 positive (WTR astigmatism) was more relevant in younger age groups, and J0 negative (ATR) was more common in older age groups. Axis astigmatism findings of this study align previous studies (17,18) which show a clear progressive shift of axis astigmatism, WTR astigmatism to ATR astigmatism with increasing age.

Currently, there are no reported national or sub-national level studies covering Tirana or Albania, nor any cross-sectional or clinical studies indicating the burden of blindness and visual impairment conditions like refractive errors. However, based on the findings in this study,

the high prevalence of refractive errors like myopia in Tirana's younger population highlights the need of early detection and intervention. School-based vision screening could help to identify those at risk and provide timely treatments. Public awareness campaigns are also essential to educate parents and children on the importance of outdoor activities and reducing screen time to prevent myopia progression.

This study was conducted in two vision centers in Tirana, which means the findings are representative of the urban population only, and rural populations were not included. Further research should expand to include a more diverse population across Albania.

Keeping in view to refractive errors as the leading cause of visual impairment across any country in the world, the overall prevalence of myopia found in this study is 32.43% and 51% in the younger age group 5-18 years, which seems to be very high, especially in younger age groups, in the population of urban Tirana. This situation is alarming and requires the initiation of immediate and comprehensive plans to effectively address preventable blindness and visual impairment.

Refractive Variables		All	Male	Female	Mean Difference	p value
Myopia (SE ≤ -0.50D)	Mean	-2.01	-1.97	-2.04	0.068	0.75
	SD	1.74	1.97	1.57		
	Range	(-0.50 to -16.25)	(-0.50 to -16.25)	(-0.50 to -10.75)		
	N	291	121	170		
	%	32.29	30.71	30.19		
Hyperopia (SE ≥ +0.50D)	Mean	1.70	1.72	1.69	0.024	0.86
	SD	1.24	1.22	1.25		
	Range	(0.50 to 7.62)	(0.50 to 7.62)	(0.50 to 6.00)		
	N	299	127	172		
	%	33.18	32.23	33.92		
Emmetropia (SE >-0.50 AND <+0.50)	Mean	-0.04	-0.04	-0.05	0.01	0.63
	SD	0.18	0.18	0.18		
	N	311	146	166		
	%	34.51	37.05	32.74		
Astigmatism (Cylinder ≥ -0.75D)	Mean	-1.30	-1.31	-1.29	-0.02	0.81
	SD	0.72	0.77	0.67		
	Range	(-0.75 to -5.00)	(-0.75 to -5.00)	(-0.75 to -3.75)		
	N	286	145	141		
	%	31.74	36.80	27.81		
Anisometropia (SE difference between both eyes ≥ 0.75 or -0.75)	Mean	-0.33	-0.26	-0.4	0.14	0.71
	SD	2.06	2.02	2.11		
	N	120	55	65		
	%	13.31	14	12.8		

Table 2. Gender Distribution of refractive error
SE: Spherical Equivalent

CONCLUSIONS

Refractive errors remain the leading cause of visual impairment worldwide although its burden varies from country to country and region to region. As a developing country, Albania requires a national and subnational plan to address the leading cause of blindness and visual impairment by ensuring universal access to eye health for all its citizens. Optometrists need to be made an important pillar of the eye care system thereby not only strengthen eye care system but also take a leading role in primary eye care across Albania.

Age Group	Myopia				Hyperopia				Emmetropia				
	Mean	SD	n	%	Mean	SD	n	%	Mean	SD	n	%	Total
6-18	-2.23	1.38	46	51.68	1.45	1.14	10	11.24	-0.06	0.19	33	37.08	89
19-39	-1.95	1.70	178	54.11	2.64	1.95	30	9.12	-0.12	0.17	121	36.77	329
40-55	-2.00	1.78	47	19.66	1.38	1.19	87	36.41	0.002	0.16	105	43.94	239
56-70	-1.80	1.93	16	7.29	1.70	1.02	143	64.35	0.02	0.18	43	21.29	202
71-83	-3.75	4.69	4	9.52	1.85	0.97	28	66.6	0.01	0.20	10	23.80	42
Total			292				298				312		901

Table 3. Age group Analysis of Refractive Conditions
SD: Standard Deviation

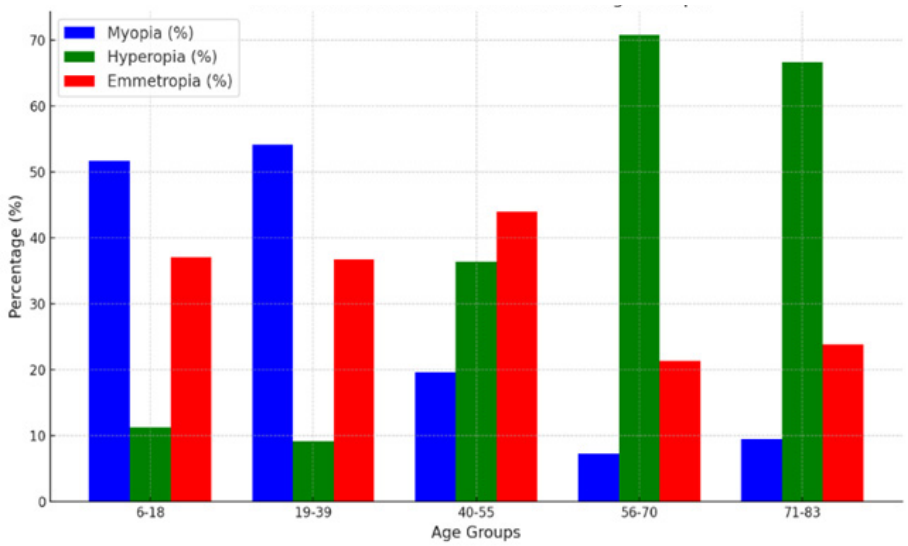

Figure 2. Distribution of Refractive Errors across Age Groups

Gender	J0 (Positive) WTR				J0 (Negative) ATR				J45 (oblique)			
	Mean	SD	N	%	Mean	SD	n	%	Mean	SD	n	%
Male	0.45	0.40	134	34.01	-0.33	0.27	121	30.71	-0.014	0.28	254	64.46
Female	0.36	0.34	163	32.14	-0.30	0.25	151	29.78	-0.019	0.23	314	61.93
MD, p	0.09, (<0.05)[a]				-0.03, (0.34)				0.005, (0.81)			
Age Groups												
5-18	0.51	0.45	36	40.45	-0.44	0.59	12	13.49	0.04	0.28	48	53.93
19-39	0.46	-0.41	148	44.98	-0.28	0.23	76	23.10	-0.01	0.26	224	68.08
40-55	0.29	0.28	69	28.24	-0.32	0.27	58	24.26	-0.01	0.25	127	53.14
56-70	0.29	0.29	38	18.82	-0.32	0.23	99	49.20	-0.04	0.24	137	67.82
71-83	0.41	0.27	9	21.42	-0.35	0.24	24	57.14	-0.04	0.24	33	78.57
ANOVA	F = 7.79 (p<0.01)[a]				F = 2.43 (p<0.05)[a]				F = 0.58 (p=0.67)			

Table 3. Gender and Age distribution of Astigmatism types

a: significant association; MD: mean difference; SD: Standard Deviation; J45: Oblique astigmatism; J0: Primary Axis astigmatism; WTR: with-the-rule astigmatism; ATR: against-the-rule astigmatism

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ABBREVIATIONS

- URE: Uncorrected Refractive Error
- D: diopters
- WTR: with-the-rule astigmatism
- ATR: against-the-rule astigmatism
- J45: Oblique astigmatism
- J0: Primary Axis astigmatism
- a: significant association
- MD: mean difference
- SD: Standard Deviation
- SE: Spherical Equivalent