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Pattern of Ametropia among Presbyopic Patients in North-West Nigeria

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Abstract

Background: Presbyopia is a physiological age-related irreversible reduction in the eyes' ability to change their focus to see objects that are near, resulting in the need for a reading addition to assisting in near vision–related tasks.**Aim:** This is a retrospective cross-sectional study aimed at evaluating the pattern of ametropia among presbyopic patients in North-West Nigeria. **Methods:** This study was conducted using the sampling folder technique on 41240 patients from the health records office of various selected hospitals. Clinical records of patients aged (36>70) years over a period of one year (January – December 2021). Clinical records of patient folders, data, record forms, case notes, paper and pen were used as research materials. Data was collected from clinical records of patients folders such as age, gender, refractive error, reading addition and other departures from normal structures of the eyes (diagnoses). Patients were grouped according to age range, collected data were stored and analysed using Statistical Package for Social Science (SPSS) version 20 and analyses of the relationship between gender and assessment were tested in chi-square with a value 0.005 less than 0.050 considered significant. **Results:** The major causes of ametropia were refractive error 8425 (20.43%). Astigmatism of various types 1838 (53.5%) was the most predominant refractive error among presbyopic individuals. The mean age of the patients was 53.65 with a standard deviation of 10.53 years, males 1573 (45.8%) and females' 1864 (54.2%). The prevalence of presbyopia was 8.33%. **Conclusion:** This study established that the major causes of ametropia were refractive error with astigmatism of various types as the most predominant refractive error among presbyopic individuals. Hypermetropic presbyopia had the highest frequency 23.73 % (939) while antimetropic presbyopia had the lowest frequency 1.90 % (65). There is a low prevalence of presbyopia in the study population with females having a slightly higher prevalence than males indicating that presbyopia was significantly associated with gender. We therefore suggest that individuals aged 36 years and above should undergo an annual comprehensive eye examination for early detection of ametropic presbyopia hence early intervention reducing the burden of presbyopia in our society.

Keywords: Pattern, Ametropia, Presbyopia, North-West, Nigeria
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Introduction

Presbyopia is a vision condition in which the shape of the crystalline lens of the eye changes. These changes make it difficult for the eye to focus on close objects, it usually becomes noticeable in the early to mid-40s but reduction of focus starts as early as childhood according to the American Optometric Association (AOA. Org). This is a natural part of the ageing process of the eye. It is not a disease and cannot be prevented (AOA.org). Presbyopia, not a refractive error,

is a physiological reduction in amplitude of accommodation which brings deterioration in near vision. It is an irreversible loss of the accommodative ability of the eye. One cannot escape presbyopia, even if one has never had a vision problem before. Usually, it begins between the ages of 40-45 years but varies with profession, working distances, lighting and many factors. A number of treatment approaches have been established to provide solutions to this age related condition. The reading addition still remains the most extensively prescribed method. Other optical management techniques like bifocals, multifocal, progressive lenses, contact lenses, monovision technique and corneal inlays are also popular and though less popular, surgical procedures are also available these days. There have been many advances in presbyopia management and this has helped people spend their presbyopic ages with comfort. (Raju Kaiti *et al*.,2020). Emmetropia is a state of refraction where a point at an infinite distance from the eye is conjugate to the retina. Ametropia is a state where refractive error is present or when distant points are no longer focused properly on the retina. (Schwiegerling, 2004) There are three types of ametropia; hypermetropia, myopia and astigmatism

When the axial length of the eye is too long or the optical powers are too strong, light is focused before it reaches the retina, causing near-sightedness (Marilyn & Gray 2010). The American Optometric Association (AOA) defined three grades of myopia as follows. Low myopia where the error is between ≤ -3.00DS; moderate myopia where the error is between – 3.00 to – 6.00DS and high myopia where the error is ≥ - 6.00DS.

When the axial length is too short or the optical powers are too weak, light focuses behind the retina (Marilyn & Gray 2010). Based on aetiology, hypermetropia may be axial, curvature, index, positional or due to the absence of crystalline lenses. The American Optometric Association (AOA) has defined three grades of hypermetropia as follows; Low hypermetropia when the error is < +2.00DS, moderate hypermetropia when the error is between + 2.00 to + 5.00DS and high hypermetropia when the error is >+5.00DS. Astigmatism occurs when refraction varies in different meridians making the rays of light entering the eye not to converge on the focus point, but to form focal lines (Khurana, 2015). When the surfaces of the cornea and or the crystalline lens are not perfectly sphered the image formed is distorted (Marilyn and Gray, 2010) Regular Astigmatism is classified into With the Rule Astigmatism, Against the Rule Astigmatism and Oblique Astigmatism. Data released in April 2022 by the United Nations estimated that 7.9 billion people are living in the world (worldometers.info/world population, 2022). In 2015, it was determined that approximately 1.8 billion people were presbyopic (Fricke *et al*., 2018) Accordingly, 26% of the world's population is currently presbyopic. Prevalence of presbyopia in the United States ranges from 83.0% to 88.9% for adults aged 45 years old and older, (Bredahl *et al*, 2020) and there was an estimated total of 123 million presbyopes in the country in 2020. There are more than 1.5 million cases per year in Nigeria (College of Medicine Ibadan). Few population-based studies (Nwosu, 1998 & Kio, Osita 2003) carried out in Nigeria reported a prevalence of 33% - 53.5%, majority of reported studies being institutions according to the World Health Organization (WHO, 2015). Refractive error was one of the priority diseases of VISION 2020: The Right to Sight, a global initiative to eliminate avoidable blindness by the year 2020 (WHO, 2015).

Uncorrected ametropia has a negative social and economic effect on the individual and the community. It can reduce the quality of life. It restricts education and employment opportunities for otherwise healthy individuals. It limits the productivity of individuals (Kovin, *et al*., 2014). Adults with uncorrected ametropia may have difficulty completing tasks at work, which may lead to unnecessary delays and queries. Despite the adverse effects of not wearing their spectacles, patients have been observed to still not obtain their spectacles (Kovin, *et al*., 2014).

Understanding the pattern of Ametropia in presbyopic patients will assist eye care stakeholders (state ministries of health) in North-West Nigeria in formulating effective strategies to provide efficient and effective eye care services to reduce the burden of patients with ametropia and presbyopia.

Globally WHO reported uncorrected refractive error (43%) as the major cause of visual impairment (Pascolini and Mariotti, 2012). Uncorrected refractive error is the leading cause of eye problems worldwide and the second cause of blindness (Fricke, *et al*., 2012). Worldwide, about 2.3 billion people have refractive error with only 1.8 billion able to access eye care services that are affordable with corrections. Presbyopia was estimated to affect more than 1.8 billion people globally in 2015 with more than half unable to access necessary eye care services to overcome the associated vision impairment (Fricke, *et al*., 2018).

A total of 244 million cases were associated with a potential productivity loss of US$11.02 billion (0.016% of global GDP). If all those people aged <65 years are assured to be productive, the potential productivity loss would be US$25.367 billion or (0.037% of global GDP). Clinic and population-based studies done locally in Nigeria showed a high prevalence of presbyopia. Ashaye *et al* reported that presbyopia was one of the most common ocular problems seen among staff aged 30 years and above in a Federal Institution based in Lagos (Ashaye& Asuzu 2005). A population-based study of presbyopia in Gwagwalada, Nigeria by Muhammad *et al* among adults 40 years and older found a prevalence of 53.4%. Female gender and increasing age were associated with presbyopia and presbyopia was more severe in females. Population and clinic-based studies among other African populations reported a prevalence of presbyopia between 48% and 65 %(Burke *et al*., 2006) In other parts of the world prevalence values range from 53.3%(South India)(Nirmalan *et al*.,2006) to 68.2% in Finland (Laitinen *et al*.,2005)

Ametropia and Presbyopia affect the individual occupations, professions and activities of daily living. Few population-based studies exist on the pattern of ametropia in presbyopic patients in North–West Nigeria as most studies in our environment have been limited to distance vision. This is because presbyopia is presumed to be unimportant in places where reading and writing are not primarily important functions (Burke *et al*, 2006) hence little attention has been paid to presbyopia in areas where literacy rates are low. Therefore, the present study investigated the pattern of ametropia among presbyopic patients.

Materials and Methods

The present study was conducted as a retrospective cross-sectional examination of presbyopic patients aged 36 years and above with Ametropia in Aminu Kano Teaching Hospital Tarauni Local Government Area, Rasheed Shekoni Federal University Dutse Teaching, Hospital, Dutse Local Government area, Federal Medical Center, Birnin Kudu and General Hospital Birnin Kudu Local Government from January 2021 to December 2021. Aminu Kano Teaching Hospital and Makkah Eye Specialist Hospital in Kano State cover a total land area of 20,760 square Kilometers with a population of 9, 383,682 and 44 Local Government Areas. Kano State is bordered to the Northwest by Katsina to the Northeast by Jigawa to the Southeast by Bauchi State and to the Southwest by Kaduna State. The Federal University Dutse Teaching Hospital, Federal Medical Center Birnin–Kudu and several General Hospitals are in Jigawa State covering a total land area of 23, 154 square kilometres (8, 940 miles) with a population of 5, 828, 200 as officially estimated by the 2016 census and 27 Local Government Areas.

The ametropic conditions investigated were myopia, hyper-metropia and astigmatic presbyopes. A total of 3437 patients were used for this study. Presbyopia was more predominant in females 1864 (54.2%) than in males 1573 (45.8%).

Instruments used for data collection included: extraction from record offices of various selected hospital clinical records of participants, data record forms, case notes, paper and pen to indicate the diagnosis. Proper documentation of data such as age, gender, ametropia, diagnoses, reading additions and corrective lenses.

The collected data was filtered, recorded and stored safely. Patients were grouped according to age range, and collected data was analyzed using the statistical package of social science (SPSS software) version 20. Quantitative data were summarized with mean standard deviation and tables. Qualitative data were summarized using frequency and percentages as presented in tables. Statistical test of differences and associations was conducted on variables of interest.

Ethical clearance was obtained from the research and ethical committees of the Kano and Jigawa State ministries of health (Ministry of Health Jigawa State, (MDH/SEC/1/S664/VI), Federal Medical Centre, Birni Kudu, Jigawa State (FMC/HREC/APP/CLN/001/1/225), Rasheed Shekoni Specialist Hospital (RSSH/GEN/226/V.II), Kano State of Nigeria, Ministry of Health (SHRF/C/2022/3158).

Refractive errors were classified as: presbyopic patients with Myopia ≥ 0.50D5 presbyopic patients with hypermetropia ≥ 0.50DS and presbyopic patients with Astigmatism (minus cylinder format) ≥ -0-25DC.

Results

The total number of participants folder seen was forty–one thousand two hundred and forty (41240) with three thousand, four hundred and thirty-seven (3437) having presbyopia with refractive errors. The prevalence of presbyopia among ametropia in Northwest Nigeria was 8.33%. The age range was thirty-six to above seventy (36>70) years.

Table 1: *Demographic Distribution of Age and Gender*

Age Group (Years)	Gender		Frequency (n)	Percentage (%)
	Male	Female		
36-40	136	162	298	8.7
41-45	320	380	700	20.4
46-50	247	292	539	15.7
51-55	220	261	481	14.0
56-60	197	233	430	12.5
61-65	174	206	380	11.1
66-70	157	186	343	10.0
>70	122	144	266	7.7
Total	**1573**	**1864**	**3437**	**100.0**

Table 1 showed that the age group (41–45 years) had the highest frequency of Ametropic presbyopia 700(20.4%) while the age group (> 70 years) had the lowest frequency 266 (7.7%), indicating that most presbyopic patients presented with physiological changes at mid–stage of their life. The females 1864 (54.2%) had a higher frequency than males 1573 (45.8%) with an approximate ratio of 1:1.2 respectively.

Table 2: *Distribution of Patients Reading Additions*

Reading Addition (+)	Frequency(n)	Percentage (%)
1-1.50	1311	38.1
1.75-2.25	1261	36.7
2.50-3.00	838	24.4
>3.00	27	0.8
Total	**3437**	**100.0**

Reading Addition (+1.00–+1.50) had the highest frequency at 1311 (38.1%) while (>+3.00) had the lowest frequency at 27 (0.8%).

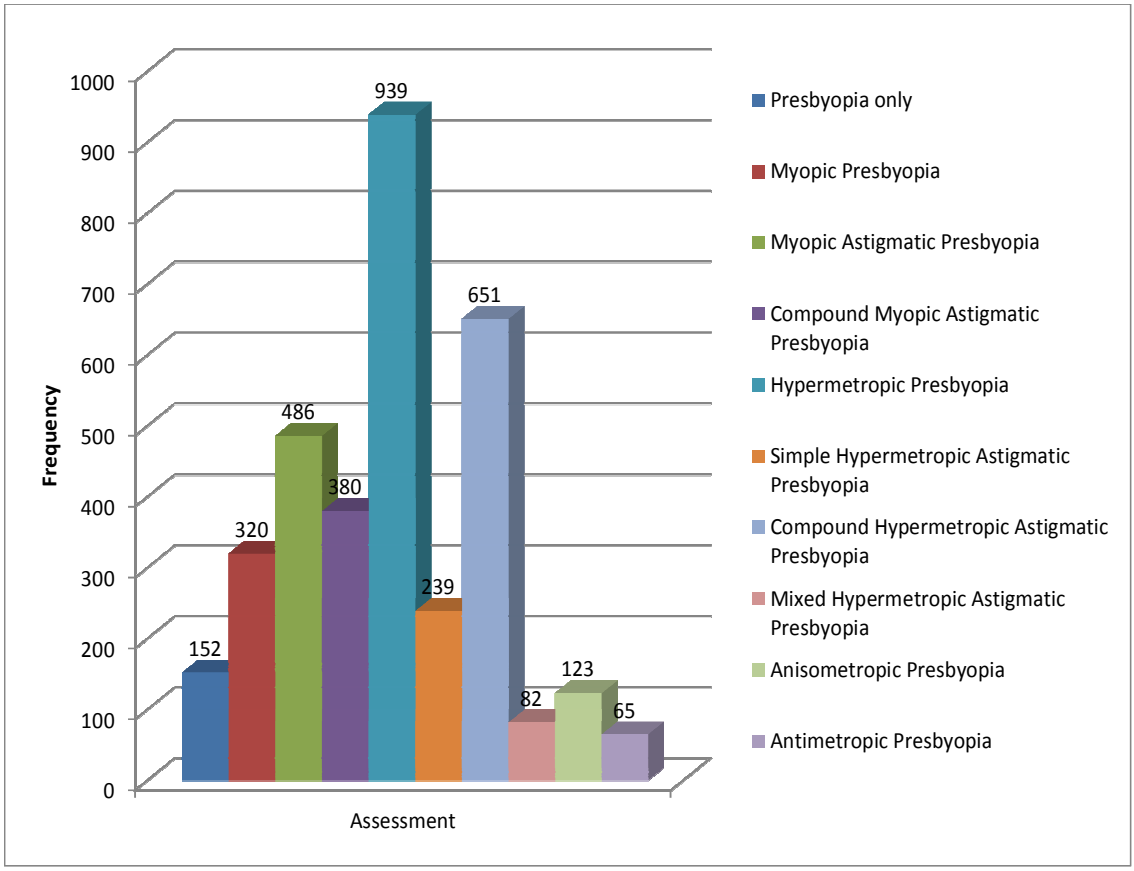

Fig 2. Distribution of Presbyopic Patients According to Refractive Errors

Hypermetropic presbyopia had the highest frequency 939 (23.73%) while antimetropic presbyopia had the lowest frequency 65 (1.9%).

Table 3. *Distribution of Presbyopic Patients Refractive Errors by Gender*

Refractive Error	PO	MP	MAP	CMAP	HP	HAP	CHAP	MHAP	ANSP	ANTP	TOTAL
Female (Frequency)	64	166	285	191	587	145	267	75	50	34	1864
Male (Frequency)	88	154	201	189	352	94	384	07	73	31	1573
Total	152	320	486	380	939	239	651	82	123	65	3437

Keys:
PO = Presbyopia Only
MP=Myopic Presbyopia
MAP=Myopic Astigmatic Presbyopia
CMAP=Compound Myopic Astigmatic Presbyopia
HP=Hyperopic Presbyopia
HAP=Hyperopic Astigmatic Presbyopia
CHAP=Compound Hyperopic Astigmatic Presbyopia
MHAP=Mixed Hyperopic Astigmatic Presbyopia
ANSP=Anisometropic Presbyopia
ANTP=Antimetropic Presbyopia

Hypermetric presbyopia had the highest frequency in females 587 and the second highest in males 352.

Table 4: Statistical Tests for Relationship between Gender and Assessment

	Value	Df	P value
Chi-Square	146.735	9	0.005

This test showed that presbyopia was more predominant in females than in males and a P value of 0.005 was statistically considered significant P <0.05 with a degree of freedom (df) 9.

Discussion

This study investigated the pattern of ametropia among presbyopic patients in Northwest Nigeria for twelve (12) months, with 3437 patients examined. The age distributions of the majority of patients were between the age group of (41-45) years with a mean age of 53.65 ≠ 10.53. This correlated with the mean age of 53.59 reported by (Muhammed *et al*., 2015) in Zamfara State, Nigeria, and 54.4 by (Onyinye *et al*., 2020) in Port Harcourt with a slightly lower standard deviation of 9.4. This research finding was close to 52.0 years found by (Shunmugan *et al*., 2013) in South Africa Obajolowo *et al*., (2016) in Kwara State reported lower than 57 ≠ 12 years while Ebeigbe and Uwagboe (2021) in Edo State reported 57.0 years. Uche *et al*., (2014) in Enugu reported a similar standard deviation of 11.1, with a slightly lower mean Age of 49.0 years. Lawan *et al*., (2014) in Kano State Ejimadu and Onua (2014) in Port Harcourt and Fai *et al*., (2013) in Eritrea reported a lower mean Age and Standard Deviation but differs from studies done by Julius *et al*., (2017) in Ogun State, Koroye – Egbe *et al*., (2010) in Bayelsa State, Ayanniyi *et al*., (2010) in Ekiti State and Khalid *et al*., (2015) in Pakistan, all reported a lower mean age but higher standard deviation. The variation in mean age and standard deviation might be due to the age criteria of selecting patients by various researchers.

The prevalence of presbyopia in North-West Nigeria was 8.33% higher than 2.1% reported by Aba *et al*., (2017) in Zaria, and 1.83% reported by Aguwa *et al*., (2020) at Elele, Rivers State. This study prevalence is similar to the 10.9% reported by Lawan *et al*., (2014) in Kano State but differs from the studies of Uche *et al*., (2014) in Enugu State, 63.4%, Ejimadu and Onua (2014) in Port Harcourt 63.3%, which is higher than 8.33%. This

could be due to variations in geographical area and population Characteristics.

The female 1864 (54.2%) predominance than males 1573(45.85%) in this study is based on the socio-demographic distribution with a ratio of 1.2:1. In this study, there was a significant relationship ($p<0.05$) observed between females and males with the degree of freedom (df) 9 on ametropic presbyopes. This is in agreement with the studies reported in Kano State by Lawan *et al*., (2014) Aba *et al*., (2017) in Zaria, Julius *et al*., (2017) in Ogun State, Uche *et al*., (2014) in Enugu State, Ajibode *et al*., (2016) in Nigeria.

On the contrary, (Koroye–Agbe *et al*., 2010) in Bayelsa State reported that males with presbyopia were more than females.

The greater acceptance of reading Addition ranging from (1.00-1.50D) may be due to a higher number of patients in the age range of (41-45 and 46-50) years. This was similar to the studies of Koroye – Egbe *et al*., (2010) in Bayelsa State.

The major causes of Ametropia were refractive error and astigmatism of various types was the most predominant refractive error among presbyopic individuals. This finding agreed with studies reported by (Lawan *et al*., 2014) in Kano State, Julius *et al*., (2017) in Ogun State, Koroye-Egbe *et al*., (2010) in Bayelsa and Maria *et al*., (2013) in Brazil.

Participants for this study were from institutions in Kano State and Jigawa State coming from Northwest, therefore findings may not be generalized for the North–Western Zone of Nigeria.

Conclusion

This study established that the major causes of ametropia were refractive error with astigmatism of various types as the most predominant refractive error among presbyopic individuals. Hypermetropic presbyopia had the highest frequency 23.73%(939) while antimetropic presbyopia had the lowest frequency 1.90%(65). There is a low prevalence of presbyopia in the study population with females having a slightly higher prevalence than males indicating that presbyopia was significantly associated with gender. We therefore suggest that individuals aged 36 years and above should undergo an annual comprehensive eye examination for early detection of ametropic presbyopia hence early intervention reducing the burden of presbyopia in our society.

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