

PREVALENCE AND MAGNITUDE OF PRESBYOPIA IN A COSMOPOLITAN NIGERIAN POPULATION

Ugochukwu A Eze¹, Thelma I Ndife², Murtala M Umar³, Shahir U Bello⁴, Chimezie G Obi-Mgbam⁵, Sunday S Bako⁶, Olufemi E Babalola⁷

¹Clinical Services Department, Katsina Eye Centre, Katsina, Nigeria

²Cataract and Glaucoma Department, National Eye Centre, Kaduna, Nigeria

³Vitreoretinal Department, National Eye Centre, Kaduna Nigeria

⁴Department of Ophthalmology Abubakar Tafawa Balewa University Teaching Hospital, Bauchi, Bauchi State, Nigeria

⁵General Ophthalmology Department, National Eye Centre, Kaduna, Nigeria

⁶Department of Mathematical Sciences, Kaduna State University, Kaduna, Nigeria

⁷Department of Ophthalmological Surgery, Bingham University, New Karu, Nassarawa State and Rachel Eye Centre, Abuja, Nigeria

Correspondence: Dr Ugochukwu A Eze. Clinical Services Department, Katsina Eye Centre, Katsina, Nigeria. Email-ugorexeze@gmail.com, ugochukwu.eze@npmcn.edu.ng

ABSTRACT

Aim: To determine the prevalence and magnitude of presbyopia in Chikun LGA of Kaduna State

Materials and methods: A population-based quantitative cross-sectional study was conducted from November 2017 to March 2018 at Chikun LGA, Kaduna State, Nigeria. Study involved 1,047 persons aged 35 years and above were examined in 63 clusters using multistage random sampling with probability proportional to size. All participants had distance and near visual acuity assessment, anterior and posterior segment examinations and near refraction. Any participant who could not read at N8 at 40cm was adjudged presbyopic. Data was collected in a standard questionnaire, transferred to Statistical Software for social science version 20 (SPSS Chicago Illinois) and analyzed, summarized in frequency and contingency tables, with a confidence interval and P-values significant at the $P < 0.05$ level using chi-square (X^2) test.

Results: There was 96.6% response rate (1047 out of enumerated 1084 were examined). The mean age of participants was 48.2 years \pm 8.194 SD (age range of 35 – 87 years). The number of females examined was significantly higher than males ($p = 0.041$). The prevalence of presbyopia was 85.6% (95% Confidence Interval: 85.58% - 85.62 %) which translates to a magnitude of 81,638. The prevalence of presbyopia increased with age. There is a significant prevalence of presbyopia in females ($P = 0.041$) and higher literacy levels (0.004).

Conclusion: There was a high prevalence and magnitude of presbyopia in Chikun LGA which was associated with age, female gender and literacy level.

Keywords: Prevalence; Magnitude, Presbyopia; Cosmopolitan, Nigerian.

Introduction

Presbyopia is an extremely common age related physiological condition in which there is progressive inability to focus at near distance.^{1,2} It is mainly due to sclerosis of the fibres of the crystalline lens and changes in its

capsule which causes steepening of its surface with contraction of the ciliary muscle.² It is a visual condition which becomes apparent especially in middle age and in which loss of elasticity of the lens of the eye causes defective

accommodation and inability to focus sharply for near vision.

Prior to 2010, there was paucity of data and interest in the subject matter seemed low but the trend has changed as awareness is high and the dynamics of the global data generated from various studies has generated wide spread interest.^{3,4} A systematic review, meta-analysis and modeling by Frickle et al estimated that from 2000 – 2015, 1.4 billion and 1.8 billion people which respectively represents 23% and 25% of the world's population suffered from presbyopia.⁵ A rise to 2.1 billion by 2030, momentary peak and decline to 1.9 billion by 2050.⁵

Population based studies in Northern Nigeria reported a prevalence of 30.4%,⁶ 42.4%⁷, 53.5%⁸. While in the south, studies reported of prevalence 63.4%⁹, 75.0%¹⁰, and 81.3%¹¹. Surveys in Ghana¹², Kenya^{13,14}, Tanzania^{15,16}, Brazil¹⁷, India¹⁸, The Philippines¹⁹ and China²⁰ reported a prevalence of 68.1%, 85.4%, 87.8%, 61.7%, 89.2%, 54.7%, 69.9%, 76.4% and 67.3% respectively.

Age is the single most important risk factor for development of presbyopia. Onset of presbyopia is variable but symptoms usually manifest between ages 35 – 40 years (usually earlier in women) but may occur earlier or later depending on the individual's refractive state, visual needs and depth of focus.²¹ Azonobi²² reported the earliest and mean age of onset to be 34 and 45.6 years respectively. Previous studies in Nigeria, have reported that presbyopia occur at age 32.²³ Early onset of presbyopia has been linked to feminine gender²⁴, living near the equator with exposure to higher ambient temperature and ultraviolet radiation²⁵, Hypermetropia and ocular conditions which damage and/or cause a change to the lens, zonules and ciliary muscles such as trauma, intraocular surgery and some

systemic diseases mellitus, myasthenia gravis, anaemia.²⁶⁻²⁸ It was also reported that 68% of smokers develop presbyopia before age of 40 years.²⁸

This paper seeks to highlight the prevalence and magnitude of presbyopia in a cosmopolitan Nigerian population. Data can be used for advocacy, policy formulation and better planning for presbyopic services in an integrated health care system.

Materials and Methods

Study Design

The study was a population-based cross-sectional quantitative survey of people 35 years and above conducted from November 2017 to March 2018 in Chikun LGA of Kaduna State, Nigeria

Study Area/Population

Chikun is one of the 23 Local Government Areas in Kaduna State, North-west Nigeria. Chikun LGA is located within the savannah belt of Nigeria and straddles rural, semi-urban and urban populations (which forms part of present day Kaduna metropolis). It lies between latitude 10°37'-N and longitude 7°15'-E. It plays host to virtually all ethnic groups in Nigeria and has a population of 484,376 with approximately 20% aged 35 years and above. It is made up of 12 administrative wards with 165 settlements. Inhabitants are farmers, traders, artisans, skilled craftsmen, civil servants and corporate career men and women.

Ethical Consideration

Ethical approval was obtained from the Human Research and Ethics Committee, National Eye Centre, Kaduna. Permission was also sought from the Kaduna State Ministry of Health and Human Services, Chikun Local Government Council and its traditional rulers. .

Sample Size Determination

The minimum sample size of 1084 was calculated using Leslie-Kish statistical formula²⁹,

$$\text{Sample size } (n) = Z^2pq/d^2$$

Where n= required sample size, Z= standard normal deviation, p= expected prevalence, q= (1-p), d= degree of accuracy

Z= Standard normal variant for level of confidence of 95% = 1.96

p= Previous prevalence of presbyopia = 30.4% (prevalence of presbyopia in Bungudu LGA of Zamfara State).⁶

$$q= 1-p = 1 - 0.304 = 0.696$$

d= precision estimate at 95% confidence = 0.05 (5%)

D= design effect =3

Inclusion Criteria:

Consenting participants who were aged 35years and above, with best corrected distance visual acuity of $\geq 6/18$ in both eyes

- Resident who has spent at least 6 months in the community continuously

Exclusion Criteria:

Individuals whose vision could not be tested, such as those with severe illness, mental illness, deafness.

Sampling Technique

Sampling was by multistage cluster random sampling with probability proportional to size. The sampling frame consists of clusters (towns and villages) of enumeration areas in Chikun LGA based as on National Population Commission (NPC) estimate for 2016. There were 165 clusters which represent the total communities/settlements in the LGA out of which 63 were selected for the study. The sampling interval (SI) was obtained by dividing the total population of Chikun LGA by the total

number of clusters ($SI = 484,376/165 = 2935$). A starting point of 377 was randomly selected using the table of random numbers and the SI systematically added to select a cluster. In each cluster, the estimated population of the selected locality/village was divided by the total population of the LGA and what was obtained was multiplied by the sample size of 1084. When a cluster was selected, a bottle was spun in the centre of the cluster to determine the direction and household to be enumerated where all eligible participants, were enumerated until the required sample was obtained.

Survey Team/Data collection protocol

A Principal Investigator, ophthalmic nurse, Two Enumerators, Village guide (in each cluster).

Training of the team and a pilot study was done at settlement not selected for the survey.

Demographic information such as age, sex, clusters and the household number were collected and recorded by the enumerator. Written informed consent was obtained. An anterior and posterior segment examination was done by the PI on all eligible participants with a pen torch and direct ophthalmoscope (Welch Allyn, USA) to detect any obvious ocular pathology. The distance visual acuity (VA) of each eye was measured by the ON using the Snellen tumbling E chart for all at 6metres in ambient indoor illumination (mostly classrooms), with the subject's corrective lens in place, if any. A subject with presenting VA of 6/6 was assumed to be emmetropic. Participants with presenting VA of $\leq 6/18$ had pinhole VA. Anyone with improvement by ≥ 1 line had objective and subjective refraction done by the PI. All those suspected to have astigmatism were referred to NEC, Kaduna. Uniocular and binocular near vision were tested using the LogMAR near E chart at 40cm under

ambient indoor illumination with best distance correction in place (where necessary). A 40cm string was attached to the near vision chart to ensure a measurement distance of 40cm from the forehead of each participant. Identification of 3 out of 5 characters constituted a successful reading of the line and the participant was permitted to move to the next line. The endpoint of near vision was N8 at 40cm. Any one unable to read N8 had plus spherical lens in 0.25 dioptre increment added until the participant read N8 or until additional lenses yielded no further improvement.

Data was collected in a standard questionnaire, data sheet created on EpiData and analyzed using Statistical Software for social science version 20 (SPSS Chicago Illinois) with a

confidence interval and P-values significant at the $P < 0.05$ level. Frequency and contingency tables were used to represent the distribution of data while the chi-square (X^2) test was used to test statistical significance for discrete variables. Multivariate analysis was used to predict factors associated with presbyopia

Results

Of the 1084 enumerated subjects, 1047 were examined, constituting 96.6% response rate. The mean age of participants was 48.2 years (SD= 8.194, range 35 to 87). The mean age was 48.3% (± 8.5 SD) and 48.7% (± 8.0 SD) for males and females respectively. The number of females 568 (54.3%) examined was higher than the number of males 479 (45.7%).

Table 1 Baseline characteristics of persons examined

Characteristics	Male N = 478 (%)	Female N = 569 (%)	Total N = 1047 (%)
Age range (years)			
35 – 44	158 (15.1)	174 (16.5)	332 (31.7)
45- 54	206 (19.7)	302 (28.9)	508 (48.6)
55 - 64	89 (8.5)	72 (6.9)	161 (15.4)
65 – 74	23 (2.2)	18 (1.7)	41 (3.9)
≥ 75	2 (0.2)	2 (0.2)	4 (0.4)
Total	478 (45.6)	569 (54.4)	1047 (100)
Literacy Level			
None	6 (0.6)	36 (3.4)	42 (4.0)
Qur'anic	3 (0.3)	0 (0)	3 (0.3)
Primary	70 (6.7)	84 (8.0)	154 (14.7)
Secondary	73 (7.0)	181 (17.7)	254 (24.3)
Tertiary	324 (31.0)	264 (25.2)	584 (56.2)
Informal	2 (0.2)	4 (0.4)	6 (0.6)
Total	478 (44.6)	569 (55.4)	1047 (100)
Occupation			
Unemployed	0 (0)	7 (0.7)	7 (0.7)
House wife	0 (0)	16 (1.5)	15 (1.5)
Farming	28 (2.7)	69 (6.6)	97 (9.3)
Other manual work	6 (0.6)	13 (1.2)	19 (1.8)
Skilled (Self- employed)	57 (5.4)	61 (5.8)	118 (11.3)
Civil/Public Servant	267 (25.5)	232 (22.2)	499 (47.7)
Retired Civil/Public Servant	49 (4.7)	38 (3.6)	87 (8.3)
Trader	72 (6.9)	132 (12.6)	204 (19.5)
	478 (45.6)	569 (54.4)	1047 (100)

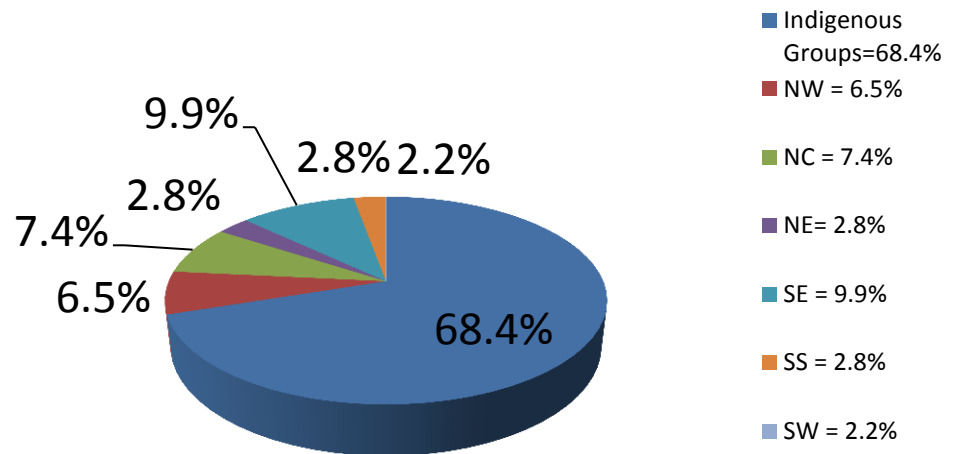


Fig 1: Distribution of Participants by Geopolitical zone

Table 2 Age distribution of presbyopes and non-presbyopes

Age (years)	Presbyopes N (%)	Non-presbyopes N (%)
35 -44	223 (67.2)	109 (32.8)
45 – 54	478 (93.9)	31 (6.1)
55 – 64	150 (93.2)	11 (6.8)
65 – 74	41 (100)	0 (0)
≥ 75	4 (100)	0 (0)
Total	896 (85.6)	151 (14.4)

Table 3 Distribution of onset of Presbyopia by gender

Gender	Onset(Years)								Total
	≤35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	
Male	45	130	135	68	6	6	3	3	396
Female	67	175	151	79	22	4	1	1	500
Total	112	305	286	147	28	10	4	4	896

P = 0.138

Females have a slightly higher chance of early onset of presbyopia (ie≤40 yrs) than males, but this did not achieve statistical significance. (OR 1.18 95% CI 0.91-1.54, P=0.21)

The prevalence of presbyopia for female was 88.0% (95% Confidence Interval: 87.98% -88.02%) while that among males was 82.7% (95% Confidence Interval: 82.68% - 82.72%)

Table 4 Presbyopia distribution by literacy level in 1047 participants

Literacy level	Presbyopes N (%)	Non-presbyopes N (%)
None	39 (92.86)	3 (7.14)
Quranic	3 (100)	0 (0.0)
Primary	146 (94.81)	8 (5.19)
Secondary	214 (84.25)	40 (15.75)
Tertiary	488 (82.99)	100 (17.01)
Informal	6 (100)	0(0.0)
Total	896 (85.6)	151 (14.4)

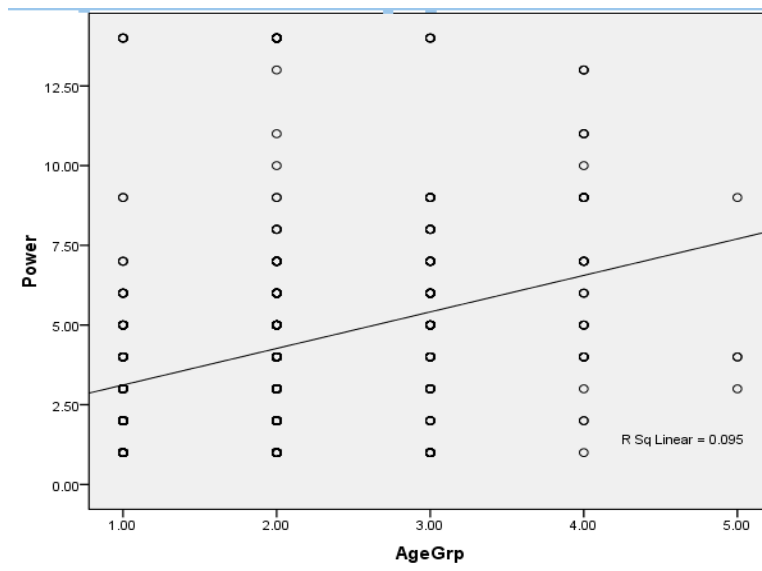


Fig. 2: Relationship between age and dioptric power of required presbyopic correction $r = 0.308$, $n = 896$, $p < 0.005$. Age group key 1 = 35-44, 2 = 45-54, 3 = 55-64, 4 = 65-74, 5 = 75 & above

Discussion

The mean age of the participants was 48.2 years which was slightly lower than that obtained in previous population-based studies in Northern Nigeria which reported 52.5 and 53.59 respectively.^{7,8} However, similar to the value obtained in Nike, Enugu (49 years).⁹ This is most likely due to same age cut-off of 35 years in both studies, as against 40 years that was used by in the previously mentioned studies. The number of Female participants was relatively higher than male counterparts (**P=0.041**). Similar to Idowu et al's finding in Ogun State⁷ due to the similar demographics *Jos Journal of Medicine, Volume 15, No. 1, 12-20*

(especially literacy level) in the two areas. This however was different from result obtained in Zamfara where more males were seen as socio-cultural practices affected the response rate of female participants.⁶

A prevalence of 85.6% (95% Confidence Interval: 85.5% - 85.7%) was found among adults aged 35 years and above. This translates to a magnitude of 81,638 which is about 16.9% of the total estimated population of Chikun LGA. Idowu et al reported a similar result in Ifo township Ogun State(81.3%) and so also did Mukuria in Lerosho area of Nairobi, Kenya which report a similar figures(87.8%).^{11,14}

However, a lower prevalence of 30.4% - 75% was reported in other population-based studies in Nigeria. It is believed that demography of the study population was responsible for the difference as majority the earlier studies in were conducted in a rural setting unlike this study and others with similar prevalence rates.^{6-10,11,14} The higher prevalence in this study could be adduced to the fact that it was conducted under ambient indoor illumination which may have induced some degree of mydriasis which eliminated the pinhole effect normally seen in outdoor examination conditions. This result is also similar to the study in Zanzibar which reported a prevalence of 89.2% and maintained indoor illumination throughout the study.¹⁶ Although this study and that in Bungudu, Zamfara State⁶ were both conducted indoors, the difference in prevalence 85.6% and 30.4% respectively is very marked. This is probably due to the disparity in proportion of female participants who are known to have higher prevalence^{8,13,26}

Also, participants in this study unlike other studies show a heterogeneous geographic spread across all regions of the country. This suggests that findings of this study to some extent represent presbyopia among the different ethnic localities in Nigeria who reside in Chikun LGA (**Fig 1**). Increasing age is a dependent risk factor for the commencement and progression of presbyopia (fig 2) which is consistent with finding of previous studies.^{21,30}

This study is not without its limitations as it is possible some people with early onset presbyopia could have been missed out due to the N8 cut off. Also, spinning the bottle method of sampling which had the propensity to include only those in the central part of the community was another limitation of this work.

Conclusion

There was a high prevalence and magnitude (81,638, which accounts for 17% of the total population) of presbyopia in Chikun LGA which was associated with age, female gender, and literacy level. We therefore recommend that eye care is incorporated into the primary health care system to establish a comprehensive eye service which includes refractive services at all level. Finally, there should be middle-level manpower such as nurses and CHEW refractionists in parts of Chikun LGA to bridge the existing gap.

References

1. Petal I WS. Presbyopia: prevalence, impact, and interventions. *Comm Eye Heal.* 2007;20(63):40-41. <http://www.cehjournal.org/article/presbyopia-prevalence-impact-and-interventions>.
2. Glasser A, Kaufman PL. Accommodation and Presbyopia. in Kaufman PL, Alm A, editors. *Adlers physiology of the eye, clinical application*, 10th ed. Philadelphia: Mosby: 2003:197-233.
3. WHO Media Centre. *Vision Impairment and Blindness.* 2017. <http://www.who.int/newsroom>
4. Holden BA, Tahhan N, Jong M, Wilson DA, Fricke TR. Towards better estimates of uncorrected presbyopia. 2015:156844.
5. Fricke TR, Tahhan N, Resnikoff S,

- Papas E, Burnett, Ho SM, Naduvilath T NK. Global Prevalence of Presbyopia and Visual Impairment from Uncorrected Presbyopia- Systematic Review, Meta-analysis, and Modelling. *j.ophta*. 2018. doi:https://doi.org/10.1016/j.ophta.2018.04.013.
6. Umar MM, Muhammad NAM. Prevalence of presbyopia and spectacle correction coverage in a rural population of North West Nigeria. *Clin Ophthalmol Dovepress J*. 2015;9:1195—1201.
 7. Odugbo O, Wade P, Velle L, Kyari F. Prevalence of Presbyopia, Refractive Errors and Usage of Spectacles among Commercial Intercity Vehicle Drivers in Jos, Nigeria. *African Journals Online (AJOL)*. 2012;6(1):37-41.
 8. Chiroma MR. Prevalence of presbyopia and the impact of uncorrected presbyopia on the quality of life in rural Gwagwalada, Abuja Nigeria. 2008;Chiroma R. http://www.lshtm.ac.uk/library/MSc_CEH/2007-8/473441.pdf.
 9. Uche JN, Ezegwui IR, Uche E, Onwasigwe EN, Umeh RE, Onwasigwe CN. Prevalence of presbyopia in a rural African community. *Rural Remote Health*. 2014;14(3):1-8.
 10. Seidu MA, Bekibele CO AO. Prevalence of presbyopia in a semi-urban population of southwest, Nigeria: a community-based survey. *Int Ophthalmol*. 2016.
 11. Idowu OO, Aribaba OT, Onakoya AO, Rotimi-Samuel A, Musa KO AF. Presbyopia and nearspectrum correction coverage among public school teachers in Ifo Township, South-West Nigeria. *Nig Post Grad Med J*. 2016;23(132 - 6).
 12. Kumah DB, Lartey SY. PRESBYOPIA AMONG PUBLIC SENIOR HIGH SCHOOL TEACHERS IN THE KUMASI METROPOLIS. 2011;(March):27-30.
 13. Sherwin JC, Keeffe JE, Kuper H, Islam FMA, Muller A, Mathenge W. Functional presbyopia in a rural Kenyan population: the unmet presbyopic need. *Clin Experiment Ophthalmol*. 2008;36(3):245-251.
 14. Mukuria M. *THE MAGNITUDE AND PATTERN OF*. Nairobi; 2009.
 15. Burke AG, Patel I, Munoz B, et al. Population-based study of presbyopia in rural Tanzania. *Ophthalmology*. 2006;113(5):723-727. .
 16. H. L. The prevalence of presbyopia and feasibility of community distribution of near adults in Zanzibar, East Africa. *Community Eye Heal*. 2007;209(64).
 17. Duaarte WR, Barros AJ, Dias-da-Costa JS CJ, Duaarte WR, Barros AJ D-CJC. Prevalence of near vision deficiency and related factors: a population-based study. *Cad Saude Publica*. 2003;19(2):551-559.
 18. Nirmalan PK, Krishnaiab S, Shamanna BR, Rao GN TR. Population-based assessment of presbyopia in the state of Andhra Pradesh, South India: The Andhra Pradesh Eye Disease study; *Invest Ophthalmol Vis Sci*. 2006;47:2324-2328.
 19. 105652 CN. Population based assessment of presbyopia prevalence,

- near - vision spectacle coverage and barriers to spectacle use in Burias Island, Masbate, Philippines. 2012. http://www.lshtm.ac.uk/library/MSc_CEH/2011-2012/105652.pdf.
20. Lu Q, He W, Murthy GVS et al. Presbyopia and near vision impairment in rural Northern China. *Invest Ophthalmol Vis Sci*. 2011;52:2300-2305.
 21. Elkington AR, Frank HJ GM. *Refraction by the Eye. Clinical Optics*. 3rd ed. Oxford: Blackwell Publication; 1999.
 22. Azonobi IR. Presbyopia in Yenagoa, Bayelsa State, Nigeria _ Azonobi _ Nigerian Journal of Ophthalmology. *Niger Niger J Ophthalmol* 2009; 1815-8. 2009;18:15-18.
 23. Adefule AO VN. Presbyopia in Nigerian. *East Afri Med J*. 1983;60(11):766-772.
 24. Pointer JS. Gender-related optical aspects of the onset of presbyopia. *Ophthal Physiol Opt*. 2002;22:126-129.
 25. Miranda MN. The geographic factor in the onset of presbyopia. *Trans Am Ophthalmol Soc*. 1979;77:603-621.
 26. Petal I, West S. CEH 2009 J 22(70): 27. Gender differences in presbyopia. *CEH*. 2009;22(70):27.
 27. Glaser A. Presbyopia_ Causes, Risk Factors, and Symptoms. <http://www.healthline.com/health/presbyopia#Overview1>. Published 2012. Accessed December 24, 2015.
 28. Khalaj M, Gasemi H, Barikani A, Ebrahimi M RS. Prevalence of presbyopia in a smoking population. 2014;1(1).
 29. Kish L. *Survey Sampling*. New York: John Wiley and Sons,; 1995.
 30. Eni EN, Oku A, Duke RE. Presbyopia and vision-related quality of life in Calabar South, Nigeria. *Ophthalmology Research: An International Journal*. 2019; 10(3):1-11.