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Editor-in-Chief

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Editor's Notes

The Journal of Nigerian Optometric Association (JNOA) is an official journal of the Nigerian Optometric Association (NOA). It is a peer-reviewed international journal that aims to promote the vision and the mission of the association. It also provides a platform for the advancement of the Optometry practice in Nigeria and beyond. This edition of the JNOA is a special edition as NOA celebrates its 50 years as an association. In this edition, we present NOA at 50, the National President perspective. Dr. Damian Echendu, the NOA National President, in his article titled "Fifty Years of Advancing Eye Care by Optometrist in Nigeria", did chronicle the history and achievements of the association for the past 50 years. Also to be found in this edition are some research reviews in Optometry and eye health. These researches were put together by a coterie of experts in various aspects and sub specialities in Optometry and vision sciences. Areas such as Eye Care/Vision Sciences and Public Health; Primary Care Optometry, Public Health Optometry, Rehabilitative Optometry and Low Vision Care, Paediatric Optometry, Corneal and Contact Lenses, Ocular Health, Orthoptics, Anatomy, Physiology, Epidemiology, Economics and Sociology of Vision and Blindness, Ocular Biomedics, Optics and Instrumentation have been highlighted.

Ovenseri-Ogbomo and Nosakhoro in their research titled Age, Amplitude of Accommodation and Near Addition Power of Adult Nigerians, established an inverse relationship between Amplitude of Accommodation (AA) and age and between AA and near add power for Nigerian adults. Egbeahie et al reported the result of a case-control study on the effect of combined intake of Garcinia kola and ascorbic acid on intraocular pressure of normotensive Nigerians.

Two public health optometry research in this edition, focused on barriers to accessing eye care services using different research methods. Okoye et al used a qualitative approach and called for involvement of all stakeholders in order to reduce the observed barriers in accessing eye care services in Anambra state, Nigeria, while Ibeneche et al, used quantitative method of data collection and identified no perceived need for eye care as the major barrier to accessing eye care services among adults in FCT, Abuja.

Ekpenyong et al presented the result of their study on ophthalmic skill assessment of primary health care workers in primary health care facilities and found out that majority of the workers could not perform basic ophthalmic skills. The Prevalence of concomitant onchocerciasis-malaria infection in Ahani-Achi community, Enugu State, Nigeria was investigated by Akujobi et al, who reported high prevalence of co-infection of onchocerciasis and malaria and recommended a more radical and integrated approach involving all stakeholders in other to control these diseases. Okonji and Darlington, in their research article that focused on low vision and rehabilitation of the elderly concluded that rehabilitation for outdoor activities should be the base of low vision care. Masiwa and Mhizha presented a case study on contact lens fitting in the presence of corneal ectasia post penetrating keratoplasty and cataract surgery, while Ahuama et al researched on ocular trauma and recommended the use of ocular trauma score as a tool in predicting prognosis of ocular trauma and counselling patients. Iyamu and Okukpon presented the relationship between central corneal thickness, vitreous chamber depth and axial length of adults in a Nigerian population.

We hope to maintain a high standard in the quality of articles and topical issues in eye care published in this journal. Articles are subjected to a fair peer-review process by a team of experts. We, therefore, invite submission of high-quality research on unique issues of public health importance in vision health which can improve Optometry practice thus enhancing the eye health of the public. We also call for editorials on contemporary issues of concern in Optometry in Nigeria. Our overall objective is to make the journal of Nigerian Optometric Association a high impact factor journal in Nigeria and globally.

Dr. Bernadine Nsa Ekpenyong
Editor-in-chief

Editorial

The 50 Years of Advancing Eye Care by Optometrists in Nigeria

Damian C. Echendu OD, LL.B, MSc, FNOA

President, Nigerian Optometric Association

On the occasion of her 50th anniversary, it is timely to review the Nigerian Optometric Association (NOA), which stands alone as the national face of optometry and her official voice in Nigeria. NOA is the national organisation for all licensed optometrists in Nigeria and its affiliates and as such it represents over 4000 grassroots optometrists spread across the 36 States of the Federation and the Federal Capital Territory (FCT) Abuja. NOA is their advocate before international organisations like the African Council of Optometry (AFCO), World Council of Optometry (WCO) and World Health Organisation (WHO). NOA is a national accelerant for their educational and legislative advancement and also a vehicle by which they participate directly or indirectly in humanitarian programs.

The development of optometry as a profession in Nigeria, from refractionist-optician to primary care clinician reflects the history of NOA and its predecessor organisations; the Association of Optical Practitioners in Nigeria (AOPN) and the Nigerian Optical Association. This development is founded on the efforts of early trained opticians (as they were then called) who grasped the need for optometry to share its resources and experience against the challenges common to every country where optometry has aspired to advance its standards of education and scope of practice. The NOA began in 1968, when **five** professional leaders from different parts of the country formed the Nigerian Optical Association for the purpose of “encouraging the science of optics and the art of the application of the science of optics to the improvement of human vision; and the protection of the members of the association from influences inimical to the prosperity of the profession of an optician.” The small founding membership was slowly augmented with new entrants such as Professor Paul Ogbuehi and like minds. With this influx, a fresh push was made towards the realignment of focus to embrace the tenets of professionalism. It was during this period of the significant paradigm

shift that the association was, at a meeting held in December 1976, rechristened the “Nigerian Optometric Association” (NOA). Nigerian Optical Association, for the first 8 years of its existence, made measured progress, partly attributable to the innate conservatism of the Europe-trained opticians, and partly due to an unwillingness to take optometry too far from its roots in refraction and optical dispensing. There was also the fear that any assertive push to expand optometry’s clinical role would be counter-productive because it would provoke a strong political backlash from organised medicine.

By early 1976, the future of the Nigerian Optical Association had become uncertain because its Eurocentric culture was unhelpful to the fledgling profession in Nigeria where a youthful, dynamic and assertive group necessitated a radical infusion of modernism into the operations of the association. Fortunately, the future of the NOA changed in 1986 with the election of Professor Paul Ogbuehi as the president of NOA. Ogbuehi brought in vigour and needed professionalism into the leadership of the organisation. The Ogbuehi team initiated a strategic planning process that step-by-step transformed the NOA into a dynamic, truly national association committed to upgrading standards of eye and vision care nationally. Among the initial steps were the drafting and adoption of a constitution for the association, and a renewed push for the legal recognition of optometry in Nigeria. First, the adoption of a constitution led to a proper organisational framework and ease of administration of the NOA. The organisational principle was ‘membership by full, associate, affiliate, honorary, external and life membership; governance by state chapter and the NOA national executive council comprising equal representation from the three zones of south east, south west and North in the Vice presidential position.

The push by the NOA leadership led to the legal recognition of optometry in Nigeria in 1989 with the signing into law of **Decree No 34 of 1989 on the 7th December 1989**

by the then military head of state, Gen. Ibrahim Badamosi Babangida, GCFR. The law established the Optometry and Dispensing Opticians Registration Board of Nigeria (ODORBN), and defined optometry based on the national needs for eye and vision care, models of education and training for optometrists, regulation and scope of practice, eye care service delivery models, eye care workforce needs, optical industry, research and national order. This definition was captured as “a health-care profession specialising in the art and science of vision care and whose scope of practice includes:-

- a. Eye examinations to determine refractive errors and other departures from the optimally healthy and visually efficient eye;
- b. Correction of refractive errors using spectacles, contact lenses, low vision aids and other devices;
- c. Correction of errors of binocularity by means of vision training (orthoptics);
- d. Diagnosis and management of minor ocular infections which do not pose a threat to the integrity of the ocular or visual system; and
- e. Ocular first aid”

Before the enactment of the law establishing optometry in Nigeria, NOA self-regulated the profession, led the fight against quackery, started championing continuing education as far back as 1976 and defined the desired direction of general professional development.

NOA entered into official relationship with the WCO, and was at the fore front in the recognition of Optometry as a health care profession by World Health Organisation (W.H.O) and the formation of the African Council of Optometry (AFCO). With the setting up of more training schools, NOA has since acquired the spread and strength to continually address professional interests and pursue set objectives, especially within the local health system. Through NOA, affiliates have been formed starting from the state chapters of the association, the Nigerian Optometric Students Association (NOSA), the Association of Nigerian Optometric Educators (ANOE), Association of Optometrists in Public Health Care of Nigeria (AOPHCN) and Women Optometrists in Nigeria (WON). These bodies have served to give unity, focus, aspiration,

and purpose to the profession at both state and national levels. The association has continued to grow, incorporating modern trends in its operation. Some of the major landmark achievements of the NOA include the articulation and adoption of the Code of Ethics for professional practice of optometry in 1995, collaborating with ODORBN to get the Government of Nigeria to abrogate the Bachelor of Science (BSc) Optometry Degree and replaced it with the Doctor of Optometry (OD) degree in all Nigerian training Universities (1989), to come up with the uniform OD benchmark for all practitioners (2000), approval of Civil Service Scheme for Nigerian optometrists and approval of call duty allowance for Optometrists at 4% of the basic Salary in 2003. Other land mark achievements include collaborating with the board, Optometrists and Dispensing Opticians Board of Nigeria and the World Council of Optometry (WCO) to establish the post graduate programme of the Nigerian College of Optometrists (NCO), with specialties in seven different disciplines, areas such as: Primary Care Optometry, Public Health Optometry, Cornea and Contact Lens Practice, Ocular Health, Rehabilitative Optometry and low vision care, Pediatric Optometry and also Orthoptics (2000), relocation of her national secretariat from Lagos to her current office in the Federal Capital Territory, Abuja (2014), Institution of Professional Indemnity, Group Life and Health Insurance Scheme, joining the Nigerian Union of Allied Health Professionals (2015), Institution of the Family of Optometry Mentoring program (2015), unbroken records of external auditing of its accounts and finances annually since 2015, capturing of optometrists in the Relativity Salary Structure and inclusion of interns in the call duty allowance by the National Salaries, Incomes and Wages Commission (2016), launch of the first Compendium on Optometry in Nigeria (2017), wooing of foreign investors to invest in Nigeria leading to the official entrance of one of the world leading manufacturers of lenses Essilor International into the Nigerian market (2017), registration of humanitarian arm of the profession, the Optometry Foundation of Nigeria (2017), sustaining an unbroken series of annual national scientific conferences since 1976, among others (See History of Optometry Book that will be launched during the NOA@50 event)

NOA is registered in Nigeria and her national secretariat is currently located at Jinifa Plaza Central Business

District Abuja where its humanitarian arm, Optometry Foundation of Nigeria is also housed. The Optometry Foundation of Nigeria raises resources to support NOA humanitarian, educational and other ancillary projects.

The objectives of NOA can be summarised as:

1. Setting professional standards to aid members in conducting patient care efficiently and effectively;
2. Conducting research and generating data on public eye care statistics to aid informed decisions on eye care and health policies and programmes;
3. Increasing awareness of key audiences, of the causes of avoidable blindness as well as offering innovative and cost-effective solutions to eradicating the scourge;
4. Advocating for and securing necessary resources for implementing the WHO Global Action Plan (2014-2019) and successive global eye care programmes in Nigeria;
5. Facilitating the planning, development and implementation of national VISION 2020/Eye Health programmes in Nigeria;
6. Lobbying government and key organizations towards adopting Optometry-friendly policies and programmes;
7. Delivering a unified voice about issues affecting the profession and advocating for the interest of Optometrists.

These objectives are pursued and implemented through nine major committees and four subcommittees: Major - Welfare, Education and Research, Legal and legislative, Finance and Budget, Public Health and Development, Disciplinary/Credential and Professional Practice, Election, Publication and Award ; Subcommittees- Advocacy, Children Vision, Political Action and Public Relations. These committees work closely with the national executive council to ensure that all NOA programmes are sensitive to local issues and needs.

Welfare

The welfare arm of the association is chaired by Dr. Maureen Igwe. This committee has three areas of focus. First, this committee develops programmes

that convey to optometrists that membership in the Nigerian Optometric Association is a cherished asset and vital to the continued existence of optometry. It also improves communication with members and non-members regarding the benefits of membership in the Nigerian Optometric Association. Second, it develops volunteer and leadership programmes that provide tangible returns to members. These afford and encourage all Nigerian optometrists to become involved in the Association and third, it maintains a position of readiness to respond to the needs of members in time of need; and report to the EXCO prior to the annual general meeting of any assistance rendered. Through the efforts of the committee, we have in place today professional indemnity, group life and health insurance for optometrists who want to protect and grow their business as well as have some benefits in times of bereavement and ill-health. The committee has not looked back in attending to the needs of members in difficulty. We thank God for the lives of Drs Ike Oforbuike and Dinne Kingsley among others whom today we rejoice with, for the remarkable transformation in their lives after going through life challenges.

Members have started benefitting from the leadership training which was first initiated during the 2017 conference in Benin, Edo state. Apart from plans to make this training regular during future conferences, it has been made a constitutional matter for every elected officer of the association to undergo leadership training immediately on assumption of office.

Other areas the committee has been instrumental includes:

1. Encouraging State Chapters to have more programmes at the state level that give more optometrists the opportunity to participate in activities and have a sense of belonging.
2. Motivating State chapters to develop welfare schemes that cater for the welfare needs of its members.
3. Supporting the Finance and Budget committee to raise funds from privileged members of the association and the general public. Recently, the association has benefitted immensely from such gestures especially from optometrists and ophthalmic industry

shakers. Such gifts have helped us in cutting down the cost of mentoring, conferences and continuing education programmes among others.

Education and Research

This committee is headed by the erudite Professor Okechi Amaechi, currently the Head of Department, School of Optometry, Abia State University, Uturu. This committee responds to growing educational and mentoring needs of members. Earlier headed by Associate Professor Ralph Akpalaba, it developed a strategic framework which addressed the following:

- a. Restructuring and developing current standards of optometric education
- b. Issues associated with a significant change to the optometric curriculum and clinical training model
- c. Funding for educational and clinical activities
- d. Research on needs and demands for optometric services vis-à-vis optometric workforce
- e. Promotion of research and production of good quality journals
- f. Review and selection of papers for NOA conference/AGM
- g. Commissioning of researches that impact on the practice of optometry in Nigeria
- h. Mutual relationship between optometry and ophthalmology
- i. Catching up with the rest of the world educationally
- j. Engage professionals in other specialties to teach optometry students
- k. Unified training model in all optometry schools
- l. Continuing professional education
- m. Educational materials to promote optometry to patients, the general public and members of both state and federal legislatures

The current national executives have been following this framework in carrying out its functions. Significant to mention are numerous actions taken in the area of publications including the launch of the Compendium on Optometry in Nigeria, the renewal and updating

of the NOA journal profile on the AJOL website, publication of higher quality journals that meet international standards, and the book on the History of Optometry in Nigeria; a first in the optometry's history in Nigeria.

To improve the quality of researches, the committee, prior to the 2015 NOA national conference, organised a workshop designed to equip optometrists with the requisite tools to conduct independent researches and report the outcomes appropriately such as can be presented in reputable conferences and/or published in peer-reviewed journals. Some of the workshop topics included Scientific Dissemination in Optometry, Making Sense of Data: Using SPSS Software for Data Analysis, etc. Through the education committee's support, we have initiated the Family of Optometric Mentoring Programme (FOM) which is being coordinated by the VP North. Nigerian optometrists can today acknowledge the role of FOM in uplifting the level of our practice and patient care. Through this programme, we have trained no fewer than 500 optometrists at both national and state levels. FOM workshops have become a regular feature of the NOA national conference. Its impact has generated several requests from optometry training institutions for this service to be availed to clinical students; an aspect we are looking forward to exploring.

The committee further has worked in the following areas:

- developed and integrated all levels of continuing education to meet the needs of our members and to parallel the legislative objectives. The educational goals have encompassed traditional optometric continuing education with an emphasis on patient care, clinical skills, and practice management as well as specific educational programmes leading to various levels of certification as provided by FOM.
- developed meaningful programmes that enhanced the clinical skills of optometrists and assisted in developing educational materials that promoted optometry to patients, the public and the members of state legislatures. We are happy to announce that Imo state has enacted a law that benefits primary care optometry, even as others states are towing the same line.

The committee is looking forward to working with the Nigerian College of Optometrists' to develop and issue Clinical Management Guidelines (CMGs), providing a reliable source for evidence-based information on the diagnosis and management of eye conditions that present with varying frequency in primary eye care.

Legal and Legislative

The Legal and Legislative committee is chaired by Dr. Ozed Okonokhua, a seasoned member and Fellow of the NOA. This committee exists to assist and expand monitoring of optometric activities in Nigeria ensuring that they meet the required standards as stipulated in the laws guiding the practice of optometry. It also advises the executive council on legal matters and has on various occasions liaised with our lawyers to ensure the continued corporate existence of the association. The committee has been alive to its responsibilities as far back as from 1984. Recently it has worked with other subcommittees to organise the first town hall meeting, which assisted the association in aligning and joining forces with other trade unions like Nigerian Union of Allied Health Professionals (NUAHP) and Joint Health Sector Unions (JOHESU), helped in developing several memoranda and position papers on key professional issues, and represented the association during public hearings at the national assembly on National Health Bill (NHB) and National Health Insurance Scheme (NHIS) Act.

The committee currently has been able to carry out the following:

- a. developed a standard clinical attire for optometrists
- b. worked tirelessly to ensure that we oppose draconian recommendations that is detrimental to the progress and existence of optometry in Nigeria
- c. Reviewed our code of ethics and rules of professional conduct
- d. Reviewed our constitution and byelaws to fit with developmental growth in optometry
- e. Developed guidelines for the training of optometry interns
- f. Provided information, guidance, advice, and legislative resource materials upon request

- g. Monitored laws and regulations dealing with patient access to eye care, non-discrimination against optometrists in insurance plans, hospital privileges, professional corporations and other forms of doing business.
- h. Monitored the impact of federal laws and regulations on optometry.
- i. Monitored legislative and regulatory issues specific to rural areas that are traditionally underserved, and encouraged and supported initiatives to include optometrists in the state rural health activities.
- j. Maintained a constant review and awareness of legal issues that might affect the NOA; investigating the merits of legal actions that may impact the profession of optometry, and provide legal counsel for members.
- k. Identified and promoted legislative agendas that serve to enhance and protect the visual health of our patients and the practice of optometry in Nigeria.

Finance and Budget

The mandate of this committee is to provide oversight of NOA activities pertaining to finance, budget, business development and generation of revenues from all sources. The committee currently headed by the financial secretary achieved the following:

- a. Annually reviewed and prepared financial and budget plans for the association.
- b. Initiated business development policies and procedures that promote optometry business
- c. Raised funds and material resources from individuals, corporate bodies, NGOs, government, parastatals, institutions, private bodies and so on for the Association.
- d. Reviewed, monitored and reported to the executive council on investment and business development opportunities.
- e. Reviewed and recommended to the executive council investments or business development projects and initiatives.
- f. Reviewed and reported to the executive council on the effectiveness and timeliness of management execution of specific projects that were approved by the executive council.

Public Health and Development

NOA has long known that there have been unacceptable inequalities in access to vision and eye care in Nigeria but for a number of reasons, Optometry has been historically excluded from the mainstream of public health efforts to correct these inequalities. However, the magnitude of global blindness is such that Optometry can no longer be ignored as a key stakeholder in the fight against blindness. The Public Health and Development Committee (PHDC) chaired by Dr. Bernadine Ekpenyong is charged with developing and supporting eye care initiatives that serve humanitarian needs in sight enhancement and blindness prevention. In particular, it is working towards aligning with WCO objectives as well as supporting WHO global initiative, Vision 2020: The Right to Sight, and the recent joint action by WHO and IAPB on Global Action Plan (GAP) of reducing avoidable visual impairment by 25% by 2019. Over the past years, this committee has championed these projects at national and state level both in capacity development and humanitarian services.

Recently the public health and development committee has taken giant strides in creating awareness on blindness prevention programmes, humanitarian services, public health research on vision and driving, children's vision and in the process developed Vision Standards for driving and Vision Screening Manual for teachers nationally. During these programmes carried out on World Sight Days (WSD), over 3500 drivers and 90,000 children were screened nationally in 2016 and 2017 respectively and relevant data generated. The committee has also strived to develop a strategic partnership with organisations sharing similar public health goals. Most of the activities carried out by the committee have seen the presence and partnerships of the Federal Road Safety Commission (FRSC), Society for Family Health (SFH), Lions Club, Brien Holden Vision Institute, Christoffel-Blinden Mission International (CBMI), Red Cross, World Health Organisation, Ministries of Health and Education at both State and National levels.

Disciplinary/Credential and Professional Practice

The Disciplinary Committee exists to receive, investigate

and make a pronouncement on disciplinary matters that violate professional ethics. Over the years, the committee has worked hand-in-hand with the regulatory board to instill discipline and decorum in the profession. Currently chaired by Dr. Sam Edu Ntem, a former NOA President and immediate past Registrar of ODORBN, the committee works hard to ensure disciplinary hearings are fair, just and comply with the procedures set out in the constitution and bye-laws of the association.

Election

The Election Committee is usually constituted in an election year, with the responsibility of superintending the NOA national elections. The committee presents candidates for election as executive officers of the association to the general membership and consequently conducts the election. In enhancing free, fair and credible elections, the NOA constitution recently empowers the House of Delegates to ratify the membership of the elections committee and also to constitute an Elections Petition Committee from among the delegates.

Publication

Publication Committee supervises and directs the production and circulation of the Association's publications; newsletters, journal, compendia, etc. The team is made up of the Editorial Board and Editorial committee. The editorial committee is chaired by Professor Frank Iwuagwu. The committee, headed by various persons in the past, has lived up to its bidding by ensuring that Nigeria Optometry and the NOA are well presented in all print and electronic media outlets. The Journal of the Nigerian Optometric Association, first published in 1985, is to this committee's credit. The journal provides an avenue for the dissemination of high-valuable information on vision care and health to a specialized audience and is listed in African Journals Online (AJOL).

Award

The award committee recognizes individual members of the Association or members of the public who has made an outstanding contribution to the fulfillment of the aims and objectives of the Association, Optometry or the community they live in. This committee has lived up to its expectation right from inception from early

90's. Quiet good number of optometrists and members of the public have in one way or the other been commended, given Optometrist of the year, the Fellow of NOA and Honorary award respectively. Currently, we have a 3-member award committee headed by a renowned Professor of Optometry, Professor Franklin Kio. The awards committee obtains nominations from the membership of the association; reviews and selects worthy candidates for special recognition; and reviews existing awards, revise criteria and create additional awards where necessary with the approval of the national executive council.

Advocacy Committee

This committee, though new, is very important and deserves mention. Before the creation of this committee, "NOA initially had advocacy on the pages of Newspapers, Radios, and Televisions mainly for enlightenment purposes but later on in 1984; this role was taken up by the legislative and legal committee" initially headed by Dr. Ronald Eyime. The later committee within a span of 12 years pursued with vigor majority of the developmental strides in the life of the association before the current advocacy committee was set up. The advocacy committee of the association is incidentally chaired by the immediate past president of WCO Dr. Christabel Uduak Udom who has brought in a clear message to reposition Optometry and eye health in Nigeria. Her relationships and experience helped to identify and source for key global role players in advocacy that trained members on empowering optometrists for a greater future. This training which took place on 6th and 7th November, 2015 was in partnership with the WCO and the Brien Holden Vision Institute and was aimed at building the necessary local capacity needed for a coordinated response to the challenges faced in delivering quality eye care services to Nigerians. Resource persons at this programme included the renowned Professor Kovin Naidoo (CEO) and Hasan Minto, (Director, Sustainable Services Development) at the Brien Holden Vision Institute.

This committee worked with the national executive council to establish platforms that are helping to

outline policies and actions vital in our partnerships with agencies of government and other NGOs. Currently, we have led a foundation for the future advancement of optometry and eye care in the country.

Key capacities that have been developed by the committee include:

- a. Strengthening of the ongoing advocacy, lobbying and networking of optometrists at all levels.
- b. Raising awareness among key stakeholders on the necessity of blindness prevention programmes.
- c. Collaborating with strategic partners to promote the integration of comprehensive eye health strategies into national health plans.
- d. Fitting our human resource and service developments, research activities and social enterprises into plans that can be adopted by government and entities.
- e. Raising awareness of vision impairment in our local communities and of the availability of appropriate care.
- f. Developing leadership and ownership in eye care delivery and education.
- g. Generating support from local health systems and educational institutions for our programmes.

In no distant time, our efforts would have developed local capacity for responsive, culturally appropriate and sustainable developmental efforts towards eradicating the visual impairment scourge in the country.

Strategic Planning

In recent years the NOA has tried to identify emerging issues for the profession. Some of the issues identified have been explored in an expanded forum, and the outcomes from such forum sent to committees for evaluation. The expectation is that the collective wisdom and national perspective of the committees will produce strategies which can help the profession turn daunting challenges into limitless opportunities. At the first session of her extraordinary expanded executive meeting (held outside of the NOA national conference) in Owerri, Imo State on 3rd and 4th March, 2016,

the NOA developed a strategic framework to address the following areas of concern-**finance/-funding, governance and organisational capacity, members and stakeholders, employment and conditions of service, training and manpower development, etc.** This framework has since started receiving attention both at committee and national executive council levels.

Conclusion

Nigerian Optometric Association has over the last 50 years developed as an organisation with the mission and appropriate strategies to improve the quality of eye and vision care in Nigeria. It has kept faith in this by utilising the services of educated, regulated, primary care optometrists. From the expository above it can be seen that a lot has been achieved by NOA, within the west coast of Africa, the African continent and globally. These achievements did not come with a wave of hand but from intense hard work on the part of the NOA even under

harassment, intimidation, and bullying from organised medicine. It also suffices that the general public is unaware of the difficulties we have faced clinically and politically, thus more need to be done as not too many members of the public know who the optometrist is, or the role of the optometrist in the society. The onus, therefore, lies on the Optometrists to continue to “tell the story” which no other can tell better. This reminder is of strategic importance given the tendency to either deviate from professional goals or rest on intermediate achievements, for as Seneca the Younger puts it: “if a man does not know (or remember) to what port he is steering, no wind is favourable to him.

Therefore, all optometrists should feel ownership of NOA and all should have a commitment to its mission to facilitate the enhancement and development of eye and vision care in Nigeria and the world in general. To prosper for a further 50 years, NOA needs continued personal sacrifice, support (both physical and financial) and volunteerism from its members to keep the pace and weather any attendant storm.

References

1. Advocacy in Optometry the Nigerian Example, Dr. Ronald Nze Eyime BSc., O.D., F.N.C.O President; Nigerian (Postgraduate) College Of Optometrists
2. A compendium of Optometry in Nigeria, Nigerian Optometric Association, first edition 2017.
3. Decree 34 of 1989/Cap. 340 Laws of the Federation of Nigeria 1990/Cap.09 Laws of the Federation of Nigeria, 2004.
4. Optometry in Nigeria: A history. Nigerian Optometric Association 2018
5. Franklin E. Kio, ‘Optometry in Nigeria: A Thirty-Year History’, (Personal possession) Department of Optometry, University Of Benin, Benin City) p3-8
6. Prevention of Blindness Program. Global Initiative for the Elimination of Avoidable Blindness: Vision 2020-The Right To Sight. Geneva: WHO, Fact Sheet 213,2000
7. The 75th anniversary of the World Council of Optometry, Seventy-five years of advancing eye care by optometrists worldwide, Damian P Smith Ph.D., AM, Clin Exp Optom 2002; 85: 4: 210-213

Age, Amplitude of Accommodation and Near Addition Power of Adult Nigerians

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Abstract

This study was undertaken to determine the relationship among age, amplitude of accommodation (AA) and near additional add power in Nigerian adults. A cross sectional study was undertaken in 297 adults comprising 158 (53.3%) males and 139 (46.8%) females and aged 33 – 89 years. Amplitude of accommodation was measured using the push up method and the near addition power was determined using the plus lens to clear near vision method. Multivariate analysis was used to determine the relationship among the age of the participants, amplitude of accommodation and near add power. The mean age of the participants was 52.9 ± 11.5 years (95% confidence interval = 51.6 – 54.2). The mean amplitude of accommodation was 2.07 ± 1.19 D (95% confidence interval = 1.93 – 2.21) while the mean add power was 2.06 ± 0.57 D (95 % confidence interval = 2.00 – 2.12). There was a strong negative correlation between AA and age ($r = -0.879$, $p < 0.001$), between AA and near add power ($r = -0.777$, $p < 0.001$) and a strong positive correlation between near add power and age ($r = 0.813$, $p < 0.001$). There is an inverse relationship between AA and age and between AA and near add power and a direct relationship between age and near add power for Nigerian adults

Keywords: Presbyopia, amplitude of accommodation, near addition power, age, Nigerians

Introduction

When an individual changes fixation from a distance to a near fixation target, the optical system of the eye has the ability to increase its focusing power. This enables the eye to bring the image of the object to a clear focus on the retina. This ability is referred to as accommodation¹⁻³ and the maximum amount of accommodation an individual is able to exert is known as the amplitude of accommodation (AA). Following the studies of Donders⁴, Duane⁵ and other researchers⁶⁻⁸, the amplitude of accommodation has been found to decrease with increasing age.

This age related decrease in amplitude of accommodation continues until such a point when the individual is unable to exert sufficient accommodation to bring a near fixated object to focus. This state is known as presbyopia, thus necessitating the need for an additional converging lens either as a spectacle addition or as presbyopic contact lens correction. Various authors⁹⁻¹² have reviewed the various methods of determining this additional power and have concluded that the additional power increases with increasing age as the amplitude of accommodation declines.

1. Ciuffreda K J. Accommodation, pupil and presbyopia. In: J Benjamin and I M Borish. Clinical Refraction: Principles and Practice. Philadelphia: Saunders, 1998:93 – 144.
2. Ciuffreda K J. Accommodation and its anomalies. In: W N Charman. Vision and Visual Dysfunction: Visual Optics and Instrumentation. London: MacMillan, 1991:231 - 279
3. Hofstetter H W, Griffin J R, Berman M S, Everson R W. Dictionary of vision science and related clinical terms. Boston: Butterworth-Heinemann, 2000:4.
4. Donders F C. On the anomalies of accommodation and refraction of the eye. London: New Sydenham Society, 1864.
5. Duane, A. Normal values of the accommodation of all ages. J Am Med Assoc, 1912;59:1010 - 1013.
6. Hofstetter H W. A longitudinal study of amplitude changes in presbyopia. Am J Optom Arch Am Acad Optom, 1965;42:3 - 8.
7. Charman W N. The path to presbyopia: straight or crooked? Ophthalmic Physiol Opt, 1989;9:424 - 430.
8. Koretz J F, Kaufman P L, Neider M W, Goeckner P A. Accommodation and presbyopia in the human eye - aging of the anterior segment. Vis Res, 1989;29:1685 -1692.
9. Goss D A. Studies comparing tests for presbyopic add power: a literature review. Optom Vis Perf, 2016;4(4):139 - 145.
10. Yazdani N, Khorasani A A, Moghadani H M, Yekta A A, Ostadimoghaddam H, Shandiz J H. Evaluating three different methods of determining addition in presbyopia. J Ophthalmic Vis Res. 2016;11(3):277 - 281.
11. Bittencourt L C, Alves M R, Dantas D O, Rodrigues P F, Santos-Neto E D. An evaluation of estimation methods for determining addition in presbyopia. 4, Arq Bras Oftalmol. 2013;76(4):18 - 20.
12. Antona B, Barra F, Barrio A, Gutierrez A, Piedrahita E, Martin Y. Comparing methods of determining addition in presbyopes. Clin Exp Optom. 2008;91(3):313 - 318.

Whereas studies have reported presbyopic addition correction for different population groups, there are few studies evaluating the relationship between age, the amplitude of accommodation and near addition for Nigerian subjects.

In a study of bifocal adds in Nigeria, Kragha reported that females had higher add powers compared to males; a result he attributed to the shorter stature of females compared to males rather than sex difference in amplitude of accommodation¹³. Defining the onset of presbyopia as “the need for an addition of +1.00D”, he reported the mean age of onset of presbyopia to be 38.4 years and 39.8 years for males and females respectively. This study was designed to investigate the relationship among age, the amplitude of accommodation and near addition power for correcting presbyopia for Nigerians adults.

A prospective cross-sectional study was undertaken to investigate the relationship among age, the amplitude of accommodation and near addition power in adult Nigerians. Participants for the study were drawn from the General Hospital and the Specialists Eye Centre, Agbor. These health facilities are the major referral hospital serving adults in Delta, Edo and Anambra States in South-East and South-South Nigeria. Every consecutive adult visiting the hospital over the study period who met the inclusion criteria and gave consent to participate were recruited for the study. Participants were included in the study if they complained of a difficulty reading fine prints and therefore requires near addition power, had no ocular pathology that precludes the measurement of AA and the prescription of near addition add power. Each study participant had a complete eye examination including comprehensive ocular history, distance and near visual acuity, ocular health examination as well as subjective refraction. The amplitude of accommodation

was measured while the patient was wearing full subjective correction for distance vision using the push-up method. A +2.00 D lens was placed in the trial frame so the patient could see the near point card (N6) which was used as the target. The amplitude of accommodation was measured by bringing the near point card toward the patients until the point of “first sustained blur” was reported by the patient. The measurement was made from the spectacle plane. Near addition was determined using the plus lens to clear near vision method¹⁴.

The procedures were carried out according to prescribed clinical protocols and the study was conducted in accordance with the guidelines of the Helsinki Declaration on research involving human subjects. The results of the age, AA and near add power was reported as a mean \pm standard deviation with the 95% confidence interval. The Student's t-test was used to test the sex difference in the measured variables. Multivariate analysis was used to examine the relationship among age, AA and near add power. Data analysis was performed using SPSS version 21.

A total of 297 subjects comprising 158 (53.2%) males and 139 (46.8%) females and aged 33 – 89 years with a mean age of 52.9 ± 11.5 years (95% confidence interval = 51.6 to 54.2) were examined for the study. The mean age of the male subjects was 55.6 ± 11.7 years (95% confidence interval = 53.8 to 57.5) and range from 35 – 89 years while that of the female was 49.8 ± 10.4 years (95% confidence interval = 48.1 to 51.6 years) and range from 33 – 86 years. There was a significant difference between the mean age of male and female subjects ($p < 0.0001$). Table 1 shows the age and sex distribution of the study participants.

The amplitude of accommodation ranged from 0.25 – 5.00 D with a mean of 2.07 ± 1.19 D (95% confidence interval = 1.93 to 2.21 D). The mean amplitude of accommodation for the males was 1.81 ± 1.09 D

13. Kragha I K O K. Bifocal adds in Nigeria. *Am J Optom Physiol Opt.* 1985;62(11):781 - 785.

14. American Optometric Association. *Optometric Clinical Practice Guideline: Care of the patient with presbyopia.* St Louis: American Optometric Association, 2011.

(95% confidence interval = 1.64 – 1.99 D) while that of the female was 2.36 ± 1.22 D (95% confidence interval = 2.16–2.57 D). The amplitude of accommodation of the female subjects was significantly more than that of the male subjects ($p < 0.0001$). The amplitude of accommodation by sex is presented in Table 2. The amplitude of accommodation declined from 4.19 D in the third decade of life to 0.42 D in the eight decades (Table 3).

The near add power of the 297 participants range from 1.00 – 3.50 D with a median of 2.00 D and a mean of 2.06 ± 0.57 D (95% confidence interval = 2.00 – 2.12 D). The mean near add power of the males was 2.16 ± 0.59 D (95% confidence interval = 2.07 – 2.27 D) while that of the females was 1.95 ± 0.52 D (95% confidence interval = 1.86 – 2.04 D). The range for both males and females was 1.00 – 3.50 D. There was a significant difference between the mean near add power of males and females ($p < 0.001$). (Table 4)

There was a strong negative correlation between the amplitude of accommodation and age ($r = -0.879$, $p < 0.001$) and a strong positive correlation between near add power and age ($r = 0.813$, $p < 0.001$). There was a strong negative correlation between the amplitude of accommodation and near add power ($r = -0.777$, $p < 0.001$). Univariate analysis showed that the amplitude of accommodation decline at a rate of 0.09 D per year while the near add power increased at a rate of 0.04 D per year. Figures 1 and 2 show the scatter plot of the amplitude of accommodation and near add power with age respectively.

Analysis of variance indicated that there was a significant difference in the mean near add power with age group. Table 5 shows the mean near add power for different age group.

Table 6 shows the multivariate analysis of association among near add power, age and amplitude of accommodation.

Near add power = $0.83 + 0.028(\text{age}) - 0.131(\text{AA})$

Discussion

Population and clinical studies on presbyopia in Nigeria have largely examined its epidemiology^{13, 15-16} and age of onset^{13,15}. The present study examined the relationship among age, AA and near addition power in Nigerian adult population.

There were 297 subjects in this study with AA declining from a mean of 4.17 ± 0.54 D in those aged 30 – 39 years to 0.42 ± 0.18 D in those aged 70 – 79 years while the mean add power increased from $+1.34 \pm 0.23$ D in those aged 30 – 39 years to $+2.95 \pm 0.31$ D in those aged 70 – 79 years. One subject each was aged 83 years and 86 years with a near add power of $+2.25$ D and $+3.00$ D respectively though both have an amplitude of accommodation of 0.25 D. It has been reported¹⁷ that for all intents and purposes, the AA is believed to decline to zero at about age 60 years and any measured AA thereafter is a measure of depth of focus rather than AA.

There was a significant difference in AA and near add power for males and females. This difference reflects the difference in the mean age of males and females as the females were significantly younger than the male subjects in this study. As Kragha¹³ has pointed out the difference in near add between males and females is not related to any gender difference in AA but as a result of the smaller stature of females compared to males which necessitate female to read at a comparably closer working distance than male. This is further supported by the fact that females required relatively lower add power compared to males who were reported to be significantly older and therefore had lower AA compared to the females in this study.

On the average, the study showed that the add power changed by approximately 0.30 D every ten years with the highest change occurring between 40 – 49

13. Kragha I K O K. Bifocal adds in Nigeria. *Am J Optom Physiol Opt.* 1985;62(11):781 - 785.

15. Olurin O. Refractive errors in Nigeria: hospital clinic study. *Ann Ophthalmol.* 1973;5:971 - 976.

16. Ikonne E U, Amaechi O U, Uzodike. E B. Presbyopic content of a community-based eyecare programme in Imo State, Nigeria. *J Nig Optom Assoc.* 2010;16:3 - 5.

17. Pensyl, C D and Benjamin, W J. Ocular motility. In: W J Benjamin. *Borish's Clinical Refraction.* St Louis, Missouri: Butterworth-Heinemann, 2006:356 - 399.

and 50 – 59 years (0.58 D). There was a dramatic change for subjects in the age group 70 – 79 and 80 – 89 years. In this case there was a change of – 0.07 D. The relative lower add power recorded for participants aged 80 – 89 years compared to those aged 70 – 79 years may relate to the so-called “second sight” which is due to senile miotic pupils leading to slightly improved vision in the elderly. Blyston reported that the near add increased rapidly in patients from age 40 to 50 years and more slowly after 50 years¹⁷. Though the present study revealed this pattern of a less rapid increase in add power in the older subjects, the decline was not uniform in this study. This may be due to different sample sizes used in the studies. Pointer noted that there was a deceleration in add power requirement beyond an individual’s mid-fifties¹⁸.

The add power reported in this study appear to be slightly higher compared to other studies in Iran

and among Caucasians^{19,20}. In Iran, the mean add power for subjects with a mean age of 50.2 years was 1.57 D with add power ranging from 0.29 D for subjects 35 – 40 years to 2.57 D for those aged 66 – 70 years. This difference may be due to the different methods employed in determining the near add power. Yekta, et al¹⁹ calculated the add power by deducting half the measured AA from 3.00 D (the accommodative demand for a 33 cm test distance). In the present study, the add power was determined using the minimum plus required to clear near vision¹⁴. This method gave the actual near addition power rather than the calculated add power employed in the Iranian study. For the Caucasian study, the add power was 2.59 D and 2.71 D for males and females respectively in subjects 76 – 80 years²⁰.

Conclusion

This study reported the relationship between age, AA and near add power among Nigerian adults in Ika South Local Government Area of Delta State. The study demonstrated the inverse relationship between AA and age as well as between AA and near addition power for Nigerian adults. The near addition power was found to be somewhat higher compared to studies for other populations. There was a difference in near add power and AA in male and female subjects which was related to the difference in the age of male and female.

14. American Optometric Association. Optometric Clinical Practice Guideline: Care of the patient with presbyopia. St Louis: American Optometric Association, 2011.

17. Pensyl, C D and Benjamin, W J. Ocular motility. In: W J Benjamin. Borish's Clinical Refraction. St Louis, Missouri: Butterworth-Heinemann, 2006:356 - 399.

18. Blyston P A. Relationship between age and presbyopic addition using a sample of 3,645 examinations from a single private practice. J Am Optom Assoc. 1999;70(8):505 - 508.

19. Pointer J S. The presbyopic add. I. Magnitude and distribution in a historical context. Ophthalmic Physiol Opt. 1995;15(4):235 - 240.

20. Yekta A A, Hashemi H, Ostadomoghaddam H, Jafarzadehpur E, Salehabadi S, Sardari S, Norouzirad R, Khabazkhoob M. Amplitude of accommodation and add power in an adult population of Tehran, Iran. Iranian J Ophthalmol. 2013;25:182 - 189.

Table 1
Age and sex distribution of study participants

Age group (years)	Sex		Total n (%)
	Male n (%)	Female n (%)	
30 – 39	5 (3.2)	18 (12.9)	23 (7.7)
40 – 49	50 (31.6)	56 (40.3)	106 (35.7)
50 – 59	47 (29.7)	39 (28.1)	86 (29.0)
60 – 69	32 (20.3)	19 (13.7)	51 (17.2)
70 – 79	21 (13.3)	4 (2.9)	25 (8.4)
80 – 89	3 (1.9)	3 (2.2)	6 (2.0)
Total	158 (100.0)	139 (100.0)	297 (100.0)

Table 2
Distribution of amplitude of accommodation by gender

Amplitude of accommodation (D)	Sex		Total n (%)
	Male n (%)	Female n (%)	
0.25 – 1.24	35 (22.2)	17 (12.2)	52 (17.5)
1.25 – 2.24	77 (48.7)	57 (41.0)	134 (45.1)
2.25 – 3.24	18 (11.4)	19 (13.7)	37 (12.5)
3.25 – 4.24	24 (15.2)	36 (25.9)	60 (20.2)
4.25 – 5.24	4 (2.5)	10 (7.2)	14 (4.7)
Total	158 (100.0)	139 (100.0)	297 (100.0)

Table 3
Distribution of amplitude of accommodation by age group

Age group	Mean AA \pm SD (D)	95% confidence interval
30 – 39	4.19 \pm 0.54	3.94 – 4.41
40 – 49	2.90 \pm 0.81	2.75 – 3.06
50 – 59	1.62 \pm 0.39	1.54 – 1.71
60 – 69	1.17 \pm 0.36	1.07 – 1.27
70 – 79	0.42 \pm 0.18	0.35 – 0.50
80 – 89	0.25 \pm 0.00	0.25

Table 4
Distribution of near add power of respondents

Near add power (D)	Sex		Total n (%)
	Male n (%)	Female n (%)	
1.00 – 1.49	16 (10.1)	20 (14.4)	36 (12.1)
1.50 – 1.99	38 (24.1)	44 (31.7)	82 (27.6)
2.00 – 2.49	38 (24.1)	40 (28.8)	78 (26.3)
2.50 – 2.99	46 (29.1)	28 (20.1)	74 (24.9)
3.00 – 3.49	20 (12.7)	7 (5.0)	27 (9.1)
Total	158 (100.0)	139 (100.0)	297 (100.0)

Table 5
Mean near add power for different age group

Age group	Mean ± SD (D)	95% confidence interval	Change in add power (D)
30 – 39	1.34 ± 0.23	1.24 – 1.44	-
40 – 49	1.64 ± 0.31	1.58 – 1.70	0.30
50 – 59	2.22 ± 0.34	2.15 – 2.29	0.58
60 – 69	2.51 ± 0.32	2.42 – 2.60	0.29
70 – 79	2.90 ± 0.42	2.73 – 3.07	0.39
80 – 89	2.83 ± 0.33	2.40 – 3.20	- 0.07

Figure 1:
Relationship between amplitude of accommodation and age

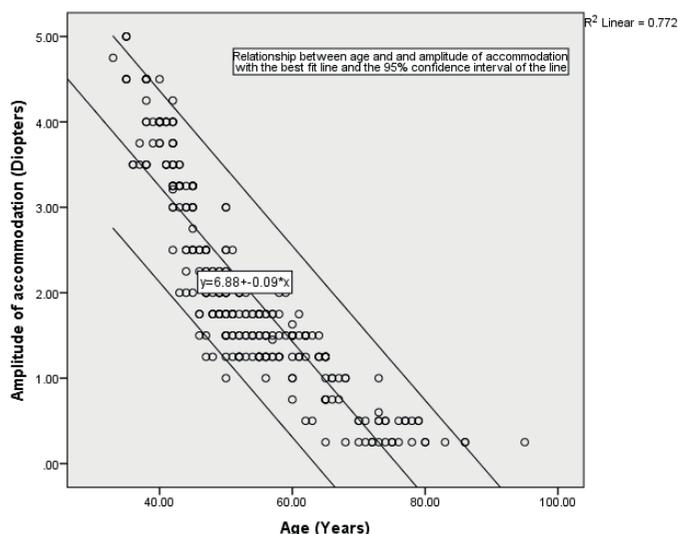
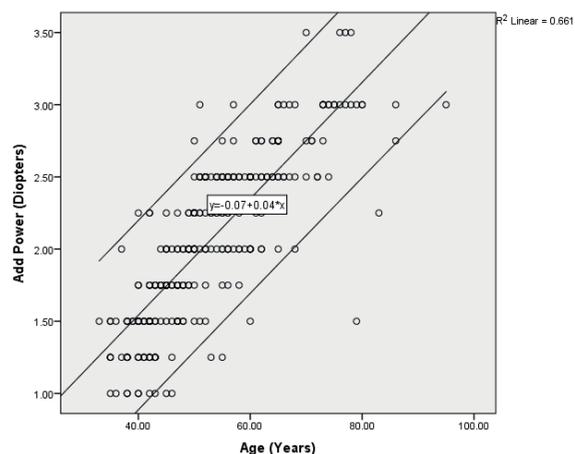


Table 6
Multivariate analysis of association among near addition power, age and amplitude of accommodation

Parameter	Regression coefficient B	Standard error	Standardized coefficient of beta	p-value
Age (years)	0.028	0.003	0.572	< 0.001
Amplitude of accommodation (D)	- 0.131	0.33	- 0.274	< 0.001

Figure 2
Relationship between age and near addition power



Effect of Combined Intake of Garcinia Kola and Ascorbic Acid on Intraocular Pressure of Normotensive Nigerians.

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Abstract

This study was carried out to determine the effect of combined intake of Garcinia kola and Ascorbic acid on Intraocular pressure (IOP) of normotensive Nigerians. A total of one hundred and sixty (n= 160) participants, males, and females within the age range of 18-50 years (Mean age = 29.29± 8.74) were used for this study. The participants were randomly assigned to four groups: A, B, C, D (n=40 in each group). About 500mg of Ascorbic acid only was administered to subjects in Group A; 7.4g of Garcinia kola only was administered to subjects in Group B; combined 7.4g of Garcinia kola and 500mg of Ascorbic acid was administered to subjects in group C, while 100ml of water was administered to Group D to serve as a control. The IOP of each subject was measured with a Tonopen Tonometer pre and post ingestions of the assigned treatment at 30 minutes interval for 120 minutes. The findings showed a statistically significant reduction ($p < 0.05$) in mean IOP from baseline values in groups A, B, and C at 60 minutes and 90 minutes post administration of assigned treatment, with peak reduction at 60 minutes. The percentage change in mean IOP at 60 minutes in Groups A, B, C were 6.76%, 15.07%, 23.04% respectively. This change was statistically significant ($p < 0.05$) in the three groups, with group C recording the highest reduction in mean IOP. There was, however, an increase in mean IOP towards baseline after 60 minutes. Group D recorded no statistically significant change in mean IOP. The reduction in mean IOP recorded in group C was statistically significant at all times of assessment post ingestion. ($P < 0.005$). It was concluded from this study that combined intake of Garcinia kola and Ascorbic acid had a greater effect on IOP than Garcinia kola or Ascorbic acid alone. However, this effect was transient, since the reduction was not sustained after 60 minutes of ingestion. This may form the basis for the development of affordable medicine for lowering IOP.

Keywords: Garcinia kola, Ascorbic acid, intraocular pressure, tonometer.

Introduction

The spaces within the eye are filled with a clear fluid, the aqueous humour and a jelly, the vitreous body. The aqueous humour is contained in the anterior and posterior chambers, while the vitreous body is contained in the large space between the lens and the retina¹. The tissue pressure of the

intraocular contents is called the intraocular pressure (IOP)¹. The intraocular pressure is a function of the rate at which aqueous humour enters the eye (inflow) and the rate at which it leaves the eye (outflow) through the trabecular meshwork.

1. Murgatroyd H, Bembridge J. Continuing education in anesthesia, criticalcare and pain. 2008; 8(3): 100-103

When both inflow and outflow are equal, a steady state exists, and the intraocular pressure remains constant. Any factor which disrupts the relationship between the inflow and outflow of the aqueous humour will invariably affect the intraocular pressure. A disruption in favour of increased aqueous humour production (inflow) or decreased aqueous humour outflow will cause an increase in intraocular pressure, while a disruption in favour of decreased aqueous humour production and increased aqueous outflow will cause a decrease in the intraocular pressure. In the chronic setting, raised intraocular pressure may cause nerve damage at the head of the optic nerve leading to visual field loss – Glaucoma. This may be due to the direct effect of raised pressure upon the nerves, or the effect of chronic under-perfusion of the nerve head.

Glaucoma is a heterogeneous group of eye diseases characterised by damage to the optic nerve usually (but not always) due to excessively high Intraocular pressure (IOP). This increased pressure within the eye, if untreated can lead to optic nerve damage resulting in progressive, permanent vision loss, starting with the unnoticeable blind spots at the edges of the field of vision, progressing to tunnel vision, and then blindness. High Intraocular Pressure without clinical signs of optic nerve damage or visual field loss is called ocular hypertension. High IOP is the highest risk factor of glaucoma². According to Quigley, glaucoma is the second leading cause of vision loss in the world after cataract². At present all resources are directed towards reduction of intraocular pressure, the only known causal and treatable risk factor for glaucoma³. The “prevalence of glaucoma in Nigeria is on the increase from 4% in 1998 to 23% in 2006⁴”. The poor and rural dwellers are not spared of the scourge. Medication and /or surgery are used to lower the intraocular pressure

(IOP) in order to reduce or stop the progression of the disease. In Nigeria, “the most commonly available IOP reducing agents are B-blockers (mainly timolol maleate 0.5% eye drops) and prostaglandins, mainly latanoprost 0.005% which are expensive and out of reach of the poor and rural dwellers with attendant poor compliance with long-term use in Nigerian patients⁵”. With so many adverse effects connected with the use of most of the popularly used intraocular pressure reducing agents in the country, there is certainly a need for the search for a safer and equally effective medication. The challenge, therefore, is to search for an alternative medication that is affordable, available and effective in lowering the IOP amongst the poor populace, especially rural dwellers.

Historically, plants have provided a source of inspiration for novel drug compounds, as plants derived medicines have made large contributions to human health and well-being⁶. Their role is two ways in the development of new drugs⁷. They may become the basis for the development of new medicine i.e. a natural blueprint for the development of new drugs, or a phytomedicine to be used for the treatment of disease.

Garcinia kola (*Heckel Guttiferae*) is “natural vegetation native to Africa and Asian countries. It is an indigenous herb in Nigeria and widely available all year round. It prevails as a multipurpose tree crop in the home gardens of Southern Nigeria. The tree is usually cultivated within villages in Southern Nigeria, grows to a height of about 12-14m and produces reddish, yellowish or orange coloured fruit^{7,8}. The fruits are named bitter kola or male kola, *Orogbo* in Yoruba, *Agbailu* in Igbo, *Adu* in South Mid-West and *Naminjigoro* in Hausa⁵. Each fruit contains 2-4 yellow seed, sour tasting pulp and the seed has only one cotyledon⁷. They have, in chewing a bitter astringent and resinous taste, somewhat resembling that of the raw coffee bean with a

2. Quigley HA. Number of people with glaucoma worldwide. *British Journal of Ophthalmology*.1996; 80:389-393.

3. Parikh RS, Parikh S, Navim S, Arun E, Thomas R. Practical approach to medical management of glaucoma. *Indian Journal Ophthalmology*. 2008; 56(3): 223-230.

4. Nosiri C, Chawat S, Gambo A. Prevalence of glaucoma in Nigeria. *The Internet Journal of Epidemiology*. 2011; 9 (1). Retrieved 16 April, 2012 from www.isub.com/journal/the-internet-journal-of-epidemiology.

5. Adefule-Ositelu AO, Aderibigbe BO, Adefule AK, Aderibigbe OO, Samonla E, Oladigbolu K. Efficacy of garcinia kola 0.5% aqueous eye drops in patients with primary open-angle glaucoma or ocular hypertension. *Middle East African Journal of Ophthalmology*. 2010; 17 (1): 88-93.

6. Omaye K, Eriyeta OG, Uhumwangho SE. Evaluation of hypoglycaemic and antioxidative properties of aqueous extract of garcinia kola seed in wistar rats. *Current Research Journal of Biological Sciences*.2011; 3 (4): 326-329.

7. Okogie A, Ebomoyi M, Ekhaton C, Emeri C, Okosun J, Onyesu G, Uhonrenren O, Atima J. Review of physiological mechanisms underlying the use of garcinia kola in the treatment of asthma. *The Internet Journal of Pulmonary Medicine*.2009;11(1). Retrieved 9 July, 2012.

8. Agada PO, Braide VB. Effects of dietary Garcinia kola seed on selected serum electrolytes and trace metals in male albino rats. *Nigerian Journal of Physiological Sciences*. 2009;24(1-2):53-57.

resident slight sweetness⁹. *Garcinia kola* constituents include crude protein, lipid extracts, ash and crude fiber; flavinoids (bioflavinoids), xanthenes and benzophenones¹⁰. *Garcinia kola* is highly valued because of its medicinal use and the seeds are chewed as an aphrodisiac or used to cure cough, dysentery, chest colds in herbal medicine⁷. The seeds of *Garcinia kola* form a major part of the herbal preparations used in traditional African medicine practice for the treatment of various diseases¹¹. *Garcinia kola* nut crude water extracts was experimented upon with laboratory animals' eyes and the result revealed its intraocular pressure lowering and miotic effect¹². Adefule-Ositelu et al studied the antibacterial effects of *Garcinia kola* nut extracts on ocular bacterial isolates in Lagos and reported that the water extract has strong inhibitory activities on *Escherichia coli*, *Enterococcus faecalis*, *Proteus mirabilis*¹³. The methanol extract only inhibited *Staphylococcus aureus* and *Pseudomonas aeruginosa* better. Both extracts inhibited *Staphylococcus albus* equally. When the effects of 5% of the water extract were compared with that of 0.05% Ciprofloxacin, there was no statistically significant difference. They concluded that these results give evidence of some antibacterial activities in *Garcinia kola* nut extracts.

According to Okojie et al, *Garcinia kola* is used in folklore remedies for the treatment of ailments such as hepatitis, diarrhoea, laryngitis, bronchitis and gonorrhoea⁷. *Garcinia kola* clinically appeared to have a significant analgesic/anti-inflammatory effects in knee osteoarthritis patients and thus a potential osteoarthritis disease modifier¹⁴. *Garcinia kola* is

primarily carried bound to albumin in the blood and only a minor amount is metabolised by hepatic metabolism¹⁴. Unlike other kola nuts, *Garcinia kola* is believed to clean the digestive system without side effects such as abdominal problems, even when a lot of nuts are eaten¹⁵. "The excretion has neither an organ nor behavioural abnormalities. Most of the studies on the pharmacological activity of phytochemical components of *Garcinia kola* seed have been on the bioflavonoid. These phytochemicals have been shown to have a very broad spectrum of pharmacological activity: protective action against chemical induced haemolysis in G6PD deficient human red blood cells; anti-inflammatory antipyretic activity; inhibition of hepatic drug metabolism and anti hepatotoxicity"¹⁶.

Ascorbic acid or vitamin C is a physiologically important compound which is a carbohydrate derivative¹⁷. Ascorbic acid is an enediol-lactone of an acid and water soluble with a configuration similar to that of sugar, L-glucose¹⁸. Ascorbic acid is sensitive to heat and, therefore, lost by cooking and it is destroyed when exposed to sunlight. It cannot be stored in the body and therefore the daily supply of this vitamin is a must¹⁹. Ascorbic acid is widely distributed in both plants and animals (except man, monkey and guinea pig), occurring as both ascorbic acid and dehydroascorbic acid²⁰. Fruits, vegetables, liver and kidney are generally the best sources, only small amounts are found in muscle meat¹⁹. Plants synthesize L- ascorbic acid from carbohydrates. Most seeds do not contain ascorbic acid but start to synthesize it upon sprouting. Some plants are believed to accumulate high levels of ascorbic acid (for example, fresh tea leaf, berries, and guava). For practical reasons, citrus

5. Adefule-Ositelu AO, Aderibigbe BO, Adefule AK, Aderibigbe OO, Samonla E, Oladigbolu K. Efficacy of *Garcinia kola* 0.5% aqueous eye drops in patients with primary open-angle glaucoma or ocular hypertension. Middle East African Journal of Ophthalmology. 2010; 17 (1): 88-93.
7. Okogie A, Ebomoyi M, Ekhaton C, Emeri C, Okosun J, Onyesu G, Uhonrenren O, Atima J. Review of physiological mechanisms underlying the use of *Garcinia kola* in the treatment of asthma. The Internet Journal of Pulmonary Medicine. 2009;11(1). Retrieved 9 July, 2012.
9. Indabawa II, Azai AH. Antibacterial activity of *Garcinia kola* and *Cola nitida* seed extracts. Bayero Journal of Pure and Applied Sciences. 2010; (1):52-55.
10. Eleyinmi AF, Bressler DC, Amoo IA, Oshodi AA. Chemical composition of bitter kola (*Garcinia kola*) seeds and hull. Polish Journal of Food Nutrition Science. 2006; 15/56, (4): 395-400.
11. Ebomoyi M, Iyawe V. Peak expiratory flow rate (PEFR) in young adult Nigerians following ingestion of *Garcinia kola* seeds. Afr. J. Biomed. Res. 2000;3:187-189.
12. Adefule-Ositelu AO, Adefule AK, Giwa MS. Effects of *Garcinia kola* extracts on intra ocular pressures and pupillary diameters in laboratory animals in Lagos University Teaching hospital. Nigeria Journal Hospital Medicine. 1996;3:222-242.
13. Adefule-Ositelu AO, Adefule AK, Dosa BO, Oyene PC. Antibacterial Effects of *Garcinia kola* Extracts on ocular Bacterial Isolates in Lagos. Nigeria Journal Hospital Medicine. 2004;14(1): 107-111.
14. Adegbehingbe OO, Adesanya SA, Idowu TO, Okinni OG, Oyelami OA, Iwalewa EO. Effects of *Garcinia kola* in knee osteoarthritis. Journal of Orthopaedic Surgery and Research. 2008;10 (3): 34-44.
15. Odebunmi EO, Oluwaniyi OO, Awolola GV, Adediji OD. Proximate and nutritional composition of kola nut, *Garcinia kola* and alligator pepper. African Journal of Biotechnology. 2009; 8(2): 308-310.
16. Ahumibe AA, Braide VB. Effects of *Garcinia* treatment with pulverised *Garcinia kola* seeds on erythrocyte membrane integrity and selected haematological indices in male albino wistar rats. Nigerian Journal of Physiological Sciences. 2009; 24 (1): 47-52.
17. Suttie JW. Introduction to biochemistry. 2nd Edition. London: Holt-Saunders: 1977. 806-808.
18. Pandey SN, Sinha BK. Plant physiology. 4th Edition. New Delhi: Vikas Publishing House, PVT Ltd. 2006; 234-245
19. Dutta AC. Botany for Degree Students. 6th Edition. Calcutta: Oxford University Press. 1995; 61-78.
20. Oguntibeju OO. The biological, physiological and therapeutic roles of ascorbic acid. African Journal of Biotechnology. 2008. Vol. 7(25): 4700- 4705.

fruits are good daily sources of ascorbic acid, as they are generally eaten raw and are therefore not subjected to cooking procedures that can destroy ascorbic acid²⁰. The ascorbic acid contents of most foods decrease dramatically during storage due to the aggregate effects of several processes by which the vitamin can be destroyed. The official recommended daily dosage of ascorbic acid is 60mg/day (100mg/day for smokers)²⁰. It is vital to note that the recommended daily administration (RDA) is not based on what is required for optimum health. The RDA is based on the ascorbic acid content of the average diet. Many experts have now realized that the RDA of 60mg/day is rather low to provide optimum health and protection against diseases and degenerative aspects of ageing²⁰.

Ascorbic acid functions in a number of biochemical reactions, mostly involving oxidation. There is clear evidence that ascorbic acid is required for the hydroxylation of lysine and proline in procollagen. Thus, ascorbic acid is obviously important for wound healing, since the connective tissue is usually laid down first²¹. Ascorbic acid is said to enhance the human immune defense system and this it does by enhancing the random migration of human polymorphonuclear leucocytes to the site of infection²². There is increasing epidemiological evidence that increased intake of ascorbic acid may help reduce the risk of diseases associated with increased oxidative stress. With regular intake, the ascorbic acid absorption rate in the body varies between 70 to 95%²³. However, the degree of absorption decreases as intake increases. "At high dietary doses (corresponding to several hundred mg/day in humans) ascorbates is accumulated in the body until the plasma levels reach the renal absorption threshold, which is about 1.5mg/dl in men and 1.3mg/dl in women"²³. Concentrations in the plasma larger than this value (thought to represent body saturation) are rapidly excreted in the urine

with a half-life of about 30minutes. Concentrations less than this threshold amount are actively retained by the kidneys, and the excretion half-life for the remainder of the ascorbic acid store in the body thus increases greatly, with the half-life lengthening as the body stores are depleted. Ascorbic acid can be oxidized (broken down) in the human body by enzyme L-ascorbate oxidase. Ascorbate that is not directly excreted in the urine as a result of body saturation or destroyed in other body metabolism is oxidized by this enzyme and removed²². High dose of Ascorbic acid has been reported to lower intra ocular pressure²⁴. *Garcinia kola* has also been reported to lower Intra ocular pressure²⁵. However, there has not been any investigation on the combined effect of both Ascorbic acid and *Garcinia kola* on intra ocular pressure.

Materials and methods

This was a cross-sectional study to investigate the effect of combined intake of *Garcinia kola* and ascorbic acid on the intraocular pressure of normotensive Nigerians. Participants for this study were volunteers from patients that visited Modupe Eye Centre, Ogbomoso, Oyo state of Nigeria; Ladoke Akintola University of Technology, Ogbomoso; and The Baptist Theological Seminary, Ogbomoso. A total of 160 participants were used for this study (95 Males and 65 Females). The age range was 18 to 50years. Participants gave informed consent and the study was carried out in accordance with the guidelines of the Declaration of Helsinki for the use of human subjects.

Inclusion Criteria

Participants recruited for this study were between the ages of 18 and 50 years. They had baseline intraocular pressure between 13mmHg and 21mmHg and no glaucomatous optic nerve head cupping.

20. Oguntibeju OO. The biological, physiological and therapeutic roles of ascorbic acid. African Journal of Biotechnology. 2008. Vol. 7(25): 4700- 4705.
21. Danford DE, Munro HN. Water soluble vitamins (Vitamin B complex and Ascorbic Acid) In: The pharmacological basis of therapeutics. 6th Edition. New York: Macmillan Publishing Company: 1980; 1576-1580.
22. Levine M. Textbook of biochemistry with clinical correlations. 2nd Edition. Singapore: Wiley Medical Publications. 1986; 102-121.
23. Levine, M. Determination of optimal vitamin C requirements in humans. Am. J. Clin. Nutri. 199; 62:1347-56.
24. Boyd HH. Eye pressure lowering effect of vitamin C. Journal of Orthomolecular Medicine. 1995; 10(3): 165-167.
25. Iyamu E, Ajayi OB. Effect of *Garcinia kola* on the intra ocular pressure of young Nigerian adults. Journal of Health and Visual Sciences. 2006; 8:10-14.

Exclusion Criteria

Participants were excluded if they had any ocular disease, systemic disease, contraindication to *Garcinia kola* (hypotension, palpitation, and dizziness), gastrointestinal ulcer, and Glucose-6-phosphate dehydrogenase (G-6-P) deficiency. Smokers and alcoholics were also excluded.

Preparation of *Garcinia kola*

Dried *Garcinia kola* seeds were purchased from Arada market (a popular local market in Ogbomoso) and identified by a professor of Botany at the Ladoké Akintola University of Technology, Ogbomoso. The dark brown covers were peeled off manually. The yellowish seeds were taken to the Chemistry Department of the Ladoké Akintola University of Technology, for weight measurement by a Technologist using BRAINWEIGH® 5000 OHAUS® balance, and measurement by difference method. Ten randomly selected sizes of *Garcinia kola* seeds were measured and the following weights obtained: (a) 10.7g; (b) 7.8g; (c) 5.5g; (d) 6.1g; (e) 6.2g; (f) 8.8g; (g) 5.8g; (h) 6.2g; (i) 8.3g; (j) 9.0g. The average was calculated to be 7.4g. *Garcinia kola* seed weights of 7.4g were then measured and each packed in a nylon drug envelope and kept in the refrigerator until they were used for this study.

Preparation of Ascorbic Acid

Ascorbic acid tablets (100mg) manufactured by Tuyl pharmaceutical industries was purchased from a reputable pharmaceutical store in Ogbomoso. Five tablets (500mg) were packed in each nylon drug envelope and kept in the refrigerator until they were used for this study.

Screening of Participants

After informed consent, volunteers were invited to Modupe eye clinic where they were screened using the inclusion and exclusion criteria. Each volunteer

was screened by the researcher. Blood pressure was measured using a Digital blood pressure monitor and external ocular examination done with a diffuse illumination after taking the visual acuity.

Funduscopy was performed with a direct ophthalmoscope to assess the integrity of the optic nerve head. The intraocular pressure was then measured with a TonoPen after instillation of a drop of Proparacaine Hydrochloride 0.5% Ophthalmic Solution to anesthetize the cornea. Only volunteers that met the inclusion and exclusion criteria were accepted as subjects for the study. Each participant was randomly assigned to one of the four groups. Appointment for the study was booked at the participants' convenience.

Procedure

Participants were randomly assigned to four different groups (of 40 each) –and treatment administered as follows: Group A: 500mg of Ascorbic acid only was administered to subjects in this group. Group B: 7.4mg of *Garcinia kola* only was administered to subjects in this group. Group C: combined 500 mg Ascorbic acid and 7.4 mg *Garcinia kola* was administered to subjects in this group. While Group D: 100 ml of water was administered to subjects in this group. All treatments were administered orally.

Intraocular Pressure Measurement Procedure

The entire study was carried out in the consulting room of Modupe Eye Clinic, Ogbomoso. Having satisfied the inclusion and exclusion criteria, each subject was made to sit comfortably on the examination chair with eye fixation at the primary position and the 6/60 letter on the Snellen distance chart used as a fixation point. A drop of proparacaine hydrochloride 0.5% ophthalmic solution was instilled into the eyes and the subject instructed to close the eyes gently for about 5 seconds. A sanitized tip cover was placed on the TonoPen and the instrument calibrated for use. IOP measurement was taken for each subject and recorded as Baseline IOP. The specimen (*Garcinia kola*,

Ascorbic acid only or Garcinia kola plus Ascorbic acid) belonging to the participant's group was then administered orally (by chewing) to the subjects. Intraocular pressure measurements were taken at 30 minutes interval up to 120 minutes post ingestion of treatment for each group.

Quality assurance for reliability of data collected for the study

To ensure the exclusion of the effects of as many extraneous factors as possible from the study, the following precautions were taken: All measurements were taken with the subject's eyes in the primary position (straight ahead) of gaze. This is to rule out the effect of direction of gaze on the intraocular pressure. The same examination seat was used to conduct the study to rule out the effect of varying positions on the intraocular pressure. All measurements were taken by the researcher, to ensure uniformity in findings and were taken between 12.00 noon and 4.00pm each day to avoid diurnal variation of IOP. Participants were advised to stay away from alcohol during the time of study as alcohol reduces the intraocular pressure. To stay away from aspirin as it has been shown to increase the rate of ascorbic acid's excretion from the body. Not to drink water, tea or coffee within two hours of intraocular pressure measurement, as they have been shown to raise the intraocular pressure.

Data Analysis

The analysis was done using SPSS (statistical package for social sciences), version 21.0 for Windows. Descriptive statistics using percentage frequency distribution mean and the standard deviation was employed; while t-test (unpaired and paired) and one-way analysis of variance (ANOVA) was used to analyse the data for this study. Post Hoc using Scheffe was done for significance shown by ANOVA. The level of significance was set at $p < 0.05$

Results

A total of one hundred and sixty ($n=160$) subjects with mean age 29.99 ± 8.74 years (range 18 to 50 years), were recruited for this study. After ingestion of Ascorbic acid the difference between IOP at 30 minutes compared with baseline IOP was not statistically significant ($t=1.778$, $p=0.083$) but a change in IOP was statistically significant at 60 minutes and 90 minutes ($t=9.294$, $p=0.000$ and $t=6.296$, $p=0.000$) respectively. The difference in IOP was not statistically significant at 120 minutes ($t=1.955$, $P=0.058$).

The mean change in IOP at all times of assessment after ingestion of Garcinia Kola only was statistically significant as compared with baseline IOP. (At 30 minutes, $t=3.766$, $p=0.001$; at 60 minutes, $t=18.043$, $p=0.000$; at 90 minutes $t=20.158$, $p=0.000$; at 120 minutes $t=3.606$, $p=0.001$). Compared with water, there was statistically significant difference in IOP at all times of assessment.

The change in mean IOP at all times of assessment after ingestion of combined Garcinia Kola and Ascorbic acid was statistically significant (at 30 minutes, $t=8.530$, $p=0.000$; at 60 minutes, $t=29.32$, $p=0.000$; at 90 minutes, $t=25.058$, $p=0.000$; at 120 minutes, $t=15.227$, $p=0.000$). Compared with the control (water), there was a statistically significant difference at all times of assessment.

To find out if there was any statistically significant difference between all treatments at all times of assessment, ANOVA and post Hoc tests analyses were used. At time = 0 minute, the statistical difference in mean IOP between all treatments was not significant ($p=0.062$). Similarly, the difference in mean IOP at 30 minutes between all treatments was not statistically significant ($p=0.100$). At time = 60 minutes, the difference in mean IOP between all treatments was statistically significant ($p=0.000$). Post Hoc tests at 60 minutes showed there was a statistically significant difference between Garcinia Kola + Ascorbic acid and Garcinia Kola only; there was a statistically significant difference between Garcinia Kola + Ascorbic acid and Ascorbic acid only; there was a statistically significant difference between Garcinia Kola only and Ascorbic only.

and Ascorbic only. There was also a statistically significant difference between the three treatments and control (water).

Similarly, there was a statistically significant difference in mean IOP reduction between all treatments at 90 minutes ($p=0.000$). At Time = 120 minutes, the difference in IOP between all treatments was statistically significant ($P=0.006$). However, Post Hoc test at 120 minutes showed statistically significant difference only between combined Garcinia Kola + Ascorbic acid and water. No statistically significant difference between all other treatments at 120 minutes.

Discussion

Intraocular pressure is the only known causal and treatable risk factor for glaucoma. In this study, oral administration of Ascorbic acid was found to induce 0.5% (0.08mmHg) reduction in IOP after 30 minutes of ingestion; 6.76% (1.03mmHg) reduction of IOP after 60 minutes; 4.12% (0.63mmHg) reduction in IOP after 90 minutes; and 0.81% (0.13mmHg) reduction after 120 minutes of ingestion. This supports a study by Linner which showed a marked fall in Intra ocular pressure following oral administration of 0.1 to 0.5g per Kilogram weight of Ascorbic acid²⁶.

Virno, as cited by Danford and Munro, obtained an average IOP reduction of 3.5mmHg from the administration of 0.5g/kg body weight of ascorbic acid²¹. He believed the mechanism to be due to the blood acidosis produced by the high dose of ascorbic acid, which according to him alters the blood-aqueous barrier to hinder aqueous formation. Linner also explained that the fall in pressure in ocular hypertension (after oral intake of ascorbic acid) was due to a reduction in the rate of aqueous flow and possibly by "bulk drainage by way of posterior uveo-scleral

routes"²⁶. Timothy and Okeke²⁷ observed that ascorbic acid has been established to support the osmotic influx of water following osmolarity elevation of blood artificially, leading to the fall of intraocular pressure.

This study also showed that oral administration of Garcinia kola induced 2.49% (0.40mmHg) reduction in mean IOP after 30 minutes of ingestion; 15.07% (2.40mmHg) mean IOP reduction after 60 minutes; 12.38% (1.98mmHg) reduction in mean IOP after 90 minutes; and 1.50% (0.25mmHg) reduction in mean IOP after 120 minutes of ingestion (Table 4). This is consistency with the work of Iyamu and Ajayi who reported a reduction in mean IOP at 30 minutes (0.50mmHg); 60 minutes (0.90mmHg) and 90 minutes (0.90mmHg)²⁵. The difference in the mean IOP reduction between this study and theirs may be due to the difference in the source of materials used. This is in line with the work of Eleyimi et al, who reported a difference in the proximate and elemental composition of Garcinia kola from the works of others (Dosunmu and Johnson [1995] and Arogba [2000] respectively), due to the difference in the source of material used¹⁰. Iyamu and Ajayi attributed the IOP decrease to amines which are vasoconstrictors and nitroso-N-methyl urea, a systemic hyperosmotic agent and that these constituents of Garcinia kola implicated in intra ocular pressure reduction actually caused a decrease in the volume of aqueous humour²⁵. Adefule-Ositelu et al concluded that Garcinia kola nut extracts surely can be useful in the management of glaucoma through its combined effects of reduction of aqueous humour formation, improving drainage of aqueous humour by its miotic effects and improvement of ocular blood flow through vasodilation²⁸.

Reduction of IOP with combined intake of Garcinia kola and Ascorbic acid in this study followed the trend observed in intake of Ascorbic acid only and Garcinia kola only, but caused a higher percentage of reduction in mean IOP. In this study, combined intake of Garcinia

10. Eleyinmi AF, Bressler DC, Amoo IA, Oshodi AA. Chemical composition of bitter kola (*Garcinia kola*) seeds and hull. *Polish Journal of Food Nutrition Science*. 2006; 15/56, (4): 395-400.
21. Danford DE, Munro HN. Water soluble vitamins (Vitamin B complex and Ascorbic Acid) In: *The pharmacological basis of therapeutics*. 6th Edition. New York: Macmillan Publishing Company: 1980; 1576-1580.
25. Iyamu E, Ajayi OB. Effect of Garcinia kola on the intra ocular pressure of young Nigerian adults. *Journal of Health and Visual Sciences*. 2006;8:10-14.
26. Linner E. The pressure lowering effect of ascorbic acid in ocular hypertension. *ACTA Ophthalmologica*. 1969; 47: 685-689.
27. Timothy CO, Okere CO. Effect of dennetiatripetel (MMIMM) seed intake on the IOP of normotensive emmetropic Nigerian Igbo. *Journal of the Nigerian Optometric Association*. 2008; 14: 14-17.
28. Adefule-Ositelu AO, Onakoya AO, Adefule AK, Dosa BOS. Comparative chromatographic analysis and pharmacodynamic activities of garcinia kola nut extracts. *Nigeria Journal Hospital Medicine*. 2005;15(1): 30-33.

kola and Ascorbic acid caused a reduction of mean IOP by 6.30% (1.08mmHg) after 30 minutes of ingestion; 23.04% (3.90mmHg) after 60 minutes; 21.51% (3.65mmHg) after 90 minutes; and 12.60% (2.15mmHg) reduction after 120 minutes of ingestion. Like in the reduction of mean IOP by Ascorbic acid only and Garcinia kola only respectively, this study showed a consistent reduction of mean IOP by combined intake of Garcinia kola and Ascorbic acid which peaked at 60 minutes (23.04% or 3.90mmHg). This decrease in IOP was however not sustained after 60 minutes post-consumption. The IOP reversed towards baseline afterward. The decrease in IOP was, however, higher with combined intake of Garcinia kola and Ascorbic acid at all times of assessment than with other treatments (Ascorbic acid only and Garcinia kola only respectively).

The IOP reduction by Ascorbic acid was statistically significant at 60 minutes and 90 minutes ($p < 0.05$) but was not statistically significant at 30 minutes and 120 minutes ($p > 0.05$). On the other hand, there was a statistically significant reduction in IOP at all times of assessment by Garcinia kola only and combined intake of Garcinia kola and Ascorbic acid respectively ($p < 0.05$). These confirmed the already established fact that Ascorbic acid and Garcinia kola reduces IOP. According to Trygre, 1.50% of the anterior chamber contents are renewed each minute and

the half life of anterior chamber aqueous is some 45 minutes corresponding to a daily production of about 2.80ml²⁹. Therefore, when Garcinia kola and Ascorbic acid are ingested and its constituents absorbed into the system, they reach the eye and lower the IOP probably through different mechanisms.

According to Timothy and Okeke, Ascorbic acid has been established to support the osmotic influx of water following osmolarity elevation of blood artificially leading to the fall in intra ocular pressure²⁷. In inhibiting adenosine, the Garcinia kola extract is inhibiting the active process of aqueous secretion mediated through selective transport of ions across the basolateral membrane of nonpigment ciliary epithelium²⁸. The reversal of IOP reduction at 90 minutes and 120 minutes of assessment was probably due to an insufficient amount of Garcinia kola and Ascorbic acid in the anterior chamber to continue the reduction of IOP.

In this study, we believe that the greater reduction in mean IOP by combined intake of Garcinia kola and Ascorbic acid than other treatments may be due to the combined effects of reduction of aqueous humour formation, improving drainage of aqueous humour by its miotic effects and improvement of ocular blood flow through vasodilation (by Garcinia kola), and the osmotic influx of water following osmolarity elevation of blood artificially (by Ascorbic acid), leading to the fall in intra ocular pressure.

Conclusions

From the findings in this study, the following conclusions were made: Garcinia kola caused a reduction in intraocular pressure, Ascorbic acid caused a reduction in intraocular pressure, while the combined intake of Garcinia kola and Ascorbic acid caused a higher reduction in intraocular pressure than Garcinia kola only and Ascorbic acid only.

The reduction of IOP by combined intake of Garcinia kola and Ascorbic acid was transient. Glaucoma is the second leading cause of vision loss in the world and at present, all resources are directed towards reduction of intraocular pressure, the only known causal and treatable risk factor for glaucoma. In view of this fact, we hereby recommend that further studies be carried out using different sources of Garcinia kola, since it has been observed that proximate and elemental composition may vary, depending on the source of materials used for the study. We recommend a further study using ocular hypertensives and glaucoma patients as subjects.

27. Timothy CO, Okere CO. Effect of dennetiatripetel (MMIMM) seed intake on the IOP of normotensive emmetropic Nigerian Igbos. *Journal of the Nigerian Optometric Association*. 2008; 14: 14-17.
28. Adefule-Ositelu AO, Onakoya AO, Adefule AK, Dosa BOS. Comparative chromatographic analysis and pharmacodynamic activities of garcinia kola nut extracts. *Nigeria Journal Hospital Medicine*. 2005;15(1): 30-33.
29. Trygre S. *Ocular Anatomy and Physiology*. Black Science Ltd, 2003; 41-43.

Table 1
Distribution of participants by groups in the total population

Group	N	Mean Age (Years)	Std. Deviation
An (Ascorbic acid only)	40	28.03	8.28
B (Garcinia Kola only)	40	29.65	9.80
C (Garcinia Kola + Ascorbic acid)	40	27.98	8.17
D (Water)	40	31.53	8.47

Table 2
Mean IOP at all times of assessment after ingestion of water only

Time of assessment (min)	Mean (mmHg)	SEM
Baseline 0'	16.18	0.77
30'	16.01	0.01
60'	16.01	0.00
90'	16.01	0.01
120'	16.01	0.01

Table 3
Mean IOP before and after treatment in all groups

Time of Assessment (In Minutes)	Mean IOP (mmhg \pm SEM)							
	Ascorbic Acid Only		Garcinia Kola Only		Combined Garcinia Kola & Ascorbic		Water	
	OD	OS	OD	OS	OD	OS	OD	OS
0	15.40 \pm 0.22	15.30 \pm 0.22	15.98 \pm 0.24	15.78 \pm 0.21	17.10 \pm 0.32	16.83 \pm 0.32	16.18 \pm 0.77	15.65 \pm 0.18
30	15.32 \pm 0.23	15.15 \pm 0.22	15.58 \pm 0.25	15.15 \pm 0.19	16.03 \pm 0.32	15.65 \pm 0.34	16.01 \pm 0.01	16.01 \pm 0.00
60	14.38 \pm 0.26	14.23 \pm 0.23	13.58 \pm 0.25	13.28 \pm 2.00	13.20 \pm 0.33	13.08 \pm 0.36	16.01 \pm 0.00	16.01 \pm 0.00
90	14.78 \pm 0.25	14.72 \pm 0.23	14.00 \pm 0.23	14.00 \pm 0.23	13.45 \pm 0.33	13.43 \pm 0.32	16.01 \pm 0.01	16.01 \pm 0.00
120	15.28 \pm 0.23	15.13 \pm 0.22	15.73 \pm 0.22	15.63 \pm 0.20	14.95 \pm 0.32	14.40 \pm 0.33	16.01 \pm 0.01	16.00 \pm 0.00

Table 4:
Mean change in IOP at different times of assessment after ingestion of Ascorbic acid only.

Time of assessment (min)	Mean IOP (mm Hg)	SEM	Mean change in IOP (mmHg)	% change in mean IOP (%)
0 (Baseline)	15.40			
30	15.33	0.23	- 0.08	0.50
60	14.38	0.26	- 1.03	6.76
90	14.78	0.25	- 0.63	4.12
120	15.28	0.23	- 0.13	0.81

Table 6
Mean change in IOP at different times of assessment after ingestion of combined Garcinia kola and Ascorbic acid.

Time of assessment (min)	Mean IOP (mm Hg)	SEM	Mean change in IOP (mmHg)	% change in mean IOP (%)
0 (Baseline)	17.10			
30	16.03	0.32	- 1.08	6.30
60	13.20	0.33	- 3.90	23.04
90	13.45	0.33	- 3.65	21.51
120	14.95	0.32	- 2.15	12.60

Table 5
Mean change in IOP at different times of assessment after ingestion of Garcinia kola only.

Time of assessment (min)	Mean IOP (mm Hg)	SEM	Mean change in IOP (mmHg)	% change in mean IOP (%)
0 (Baseline)	15.98			
30	15.58	0.25	- 0.40	2.49
60	13.58	0.25	- 2.40	15.07
90	14.00	0.23	- 1.98	12.38
120	15.73	0.22	- 0.25	1.50

Barriers to Accessing Good Eye Care Services in Nigeria: A Focus on Anambra State.

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Abstract

Certain forms of blindness can be prevented if the right steps and treatments are applied at the right times, but this is not always possible due to the challenges patients face in accessing eye care services. The aim of this study was to explore and identify the barriers in accessing good eye care services in Anambra State Nigeria, and suggest how the three major stakeholders could work in harmony to minimise these barriers and facilitate easier access. Three main stakeholders in eye health comprising of 28 key informants (the target population), 8 service providers (the eye doctors) and 3 policy makers were identified and recruited for this study through purposive sampling method. Data was collected from all consenting participants through semi-structured interviews. The resulting transcripts were analysed using interpretative phenomenological analysis framework. Poverty and inability to pay for eye care services has been the most prominent barrier among this population. Other barriers include: distance of eye care service centres from the rural dwellers, fear of financial exploitation from the service providers, fear of treatment outcome and the availability of other cheaper treatment options. Also other barriers identified were: the ability to cope with eye disease, seriousness of the symptoms and lack of awareness of eye diseases and the related risk factors. Poverty remains a major determinant of health in Nigeria. Therefore to reduce the barriers to accessing eye care services in Nigeria, the three stakeholders must work in harmony.

Keywords: eye care services, barriers, challenges, Anambra State, accessing services.

Introduction

For the war against increasing global blindness to be won, there must be an increased commitment in effort of various stakeholders in eye health. These three major stakeholders comprising of the target population (the key informants), the service providers (the eye doctors) and the policy makers must work in harmony to produce positive results. Eye health has been a neglected area of health in both developed and developing world.¹⁻³ In fact most countries treat eye health with less attention when compared to other areas of health.⁴ In Nigeria evidence from different studies^{2,5} suggest that eye health has not been given priority attention. In many states of Nigeria, patients find it difficult to access eye care services. Therefore, effort must be stepped up if the aims of Vision 2020^{6,7} must be achieved in the country; hence there is a need

1. Cross V, Shah P, Bativala R, Spurgeon P. Glaucoma awareness and perceptions of risk among African-Caribbeans in Birmingham, UK. *Diversity in Health and Social Care* 2005; 2:81-90.
2. Nwosu S, Obidiorozor JU. Incidence and risk factors for traditional eye medicine use among patients at a tertiary eye hospital in Nigeria. *Niger J Clin Pract* 2011; 14(4):405-7
3. International Agency for Prevention of avoidable Blindness. Time to end the eye health 'neglect' in Europe. [internet]. 2014 [Accessed 2017 February 23]. Available from: <http://www.iapb.org/news/time-end-eye-health-neglect-europe>
4. National Population Commission Nigeria. Anambra State. [internet]. 2017 [Accessed 2017 March 23]. Available from: <http://www.population.gov.ng/index.php/anambra-state>
5. Leamon S, Hayden C, Lee H, Trudinger D, Appelbee E, Hurrell DL, et al. Improving access to optometry services for people at risk of preventable sight loss: a qualitative study in five UK locations. *Journal of Public Health*. 2014; 36(4):667-673.
6. Toit R, Faal HB, Etya'ale D, Boateng W, Mason I, Graham R, et al. Evidence for integrating eye health into primary health care in Africa: a health systems strengthening approach. *BMC Health Serv Res*. [internet]. 2013 [Accessed 2017 Jan 15]; 13:102. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3616885/>
7. Cook C. Glaucoma in Africa: size of the problem and possible solutions. *J Glaucoma* 2009; 18(2): 124-8.

for the three main stakeholders in eye health to pool resources together in order to win the war against rising challenges of global blindness. In Europe, there is renewed effort in the fight against blindness; also there has been clarion calls to end the neglect of eye health and to include it in the political agenda.³ The aim of this study was to explore and identify the barriers in accessing good eye care services in Anambra State, and suggest how the three major stakeholders could work in harmony to minimise these barriers and facilitate easier access. Anambra State is one of the 36 states that make up Nigeria. It was created as a state in 1976 out of former East Central State. In 1991 the state was further split into two to form Enugu State and the present Anambra State. The state derived its name from the Anambra River. The 2006 population and housing census shows that the state has a total land area of 4,416 sq. Km and a population of 4,182,032.⁴

Patients from different places face different types of challenges that prevent them from easily accessing eye health services.^{5,9,10} The type of problem patients face depends on who they are, where they are and the cause of the eye problem.^{1,11-13} Visual impairment and blindness are caused by problems that are often treatable or preventable such as cataract, glaucoma, refractive errors, harmful traditional practices, trachoma and childhood blindness.^{9,12,14} A study by Fletcher et al.,¹⁵ in a rural community in India found that cost for eye care was among the prominent barriers people face when accessing eye care services; others include: reduced ability due

to age, pressing family responsibilities and attitude of being able to cope with low vision and blindness. Later study by Kovai et al.,¹⁶ in rural South India cite personal reasons, social and economic challenges as barriers; Odds Ratio for seeking treatment was higher for educated people compared to the uneducated. Cost for eye care services was equally cited as the reason for low up-take of eye care services in Ethiopia.¹⁷ In Fiji,¹⁸ the barriers people face in accessing eye care are: economic problems, being able to manage with the eye problem, lack of awareness of available services especially in the rural areas, and the thought that nothing can be done to remedy the problem. The barriers are almost similar in most places. Inability to pay for eye care services offered by qualified optometrists and ophthalmic doctors has forced some people into using alternative options like traditional eye medicine¹⁹ [TEM]. In a report of recent studies done around United Kingdom, Leamon et al.,⁵ pointed out the following as the existing barriers: racial differences, language problems, deprivation, financial problems, social status, and limited awareness and understanding of eye health; also most people that go for eye care services do not do this as preventative measure rather attendance is driven predominantly by distressing disease symptoms. In Nigeria some of these challenges are also faced by patients Ajibode et al.¹⁰ However, simply identifying these problems without providing ways of solving them might not be very helpful; hence this study advocates that the major stakeholders in eye care must work in harmony to provide easy access to the entire population.

1. Cross V, Shah P, Bativala R, Spurgeon P. Glaucoma awareness and perceptions of risk among African-Caribbeans in Birmingham, UK. *Diversity in Health and Social Care* 2005; 2:81-90.
3. International Agency for Prevention of avoidable Blindness. Time to end the eye health 'neglect' in Europe. [internet]. 2014 [Accessed 2017 February 23]. Available from: <http://www.iapb.org/news/time-end-eye-health-neglect-europe>
4. National Population Commission Nigeria. Anambra State. [internet]. 2017 [Accessed 2017 March 23]. Available from: <http://www.population.gov.ng/index.php/anambra-state>
5. Leamon S, Hayden C, Lee H, Trudinger D, Appelbee E, Hurrell DL, et al. Improving access to optometry services for people at risk of preventable sight loss: a qualitative study in five UK locations. *Journal of Public Health*. 2014; 36(4):667-673.
9. Jadoon MZ, Dineen B, Bourne RR, Shah SP, Khan MA, Johnson GJ, Gilbert CE, Khan MD. Prevalence of blindness and visual impairment in Pakistan: the Pakistan National Blindness and Visual Impairment Survey. *Invest Ophthalmol Vis Sci*. 2006; 47(11):4749-55.
10. Ajibode HA, Jagun OOA, Bodunde OT, Fakolujo VO. Assessment of barriers to surgical ophthalmic care in south-western Nigeria. *J West Afr Coll Surg*. 2012; 2(4): 68-78.
11. Adekoya BJ, Akinsola FB, Balogun BG, Balogun MM, Ibadapo OO. Patient refusal of glaucoma surgery and associated factors in Lagos, Nigeria. *Middle East Afr J Ophthalmol*. 2013; 20(2):168-73.
12. Isawumi MA, Kolawole OU, Hassan MB. Couching techniques for cataract treatment in Osogbo, South West Nigeria. *Ghana Med. Journal* 2013; 47(2): 64-69.
13. Abdul M. Glaucoma and the patients, what are the challenges? *Comm Eye Health* [internet]. 2012 [Accessed 2017 January 10] 25(79 & 80):44-45. Available from: <http://www.cehjournal.org/article/patients-and-glaucoma-what-are-the-challenges/>
14. World Health Organisation. Global initiative for elimination of avoidable blindness action plan 2006-2011. [internet]. 2007 [Accessed 2017 March 16] Available from: <http://www.iapb.org/sites/iapb.org/files/VISION%202020%20Action%20Plan%202006-2011.pdf>
15. Fletcher AE, Donoghue M, Devavaram J, Thulasiraj RD, Scott S, Abdalla M, et al Low uptake of eye services in rural India: a challenge for programs of blindness prevention. *Arch Ophthalmol*. 1999; 117(10):1393-9.
16. Kovai V, Krishnajiah S, Shamanna BR, Thomas R, Rao GN. Barriers to accessing eye care services among visually impaired populations in rural Andhra Pradesh, South India. *Indian J Ophthalmol*. 2007; 55(5):365-71.
17. Melese M, Alemayehu W, Friedlander E, Courtright P. Indirect costs associated with accessing eye care services as a barrier to service use in Ethiopia. *Tropical Medicine and International Health*. 2004; 9(3):426-431.
18. Brian G, Maher L, Ramke J, Palagyi A. Eye care in Fiji: a population-based study of use and barriers. *Ophthalmic Epidemiol*. 2012; 19(2):43-51.
19. Eze BI, Chuka-Okosa CM, Uche JN. Traditional eye medicine use by newly presenting ophthalmic patients to teaching hospital in south-eastern Nigeria: socio-demographic and clinical correlates. *BMC Complementary and Alternative Medicine*. 2009; 9(40).

Materials and Methods

This study was conducted between July and August 2014 in Anambra State, Nigeria. Ethical approval was given by the Health and Social Care Ethics Committee of School of Health and Education, Middlesex University London, and by the Anambra State Ministry of Health Awka, Nigeria. The study adhered to the revised Helsinki declaration 2000. The purpose of the study, the details of the processes, the risks involved and the benefits of the study to participants were all clearly explained in the participants information sheets which were given to all the participants prior to the interviews. Participants were also informed that they have the choice to quit before the end of the study if anyone so wished. All participants read and signed the informed consent form.

Three sets of participants:- The key informants (28), the service providers (8 eye doctors) and the policy makers (3) were recruited for this study using purposive sampling method. Age and place of residence were the inclusion and exclusion criteria used in the recruitment. Participants aged 21-80 living in Anambra State were included for the study; while those outside this age range were all excluded including also those living outside the state.

Semi-structured interview was used to collect data from the total sample of 39 consenting participants. Originally, 20-40 key informants were targeted but 28 were eventually used when the interviews started returning similar responses. The interviews were all audio-recorded with the consent of each participant. All the interviews were transcribed and anonymized. Each of the participants was given pseudo-name for the purpose of the analysis. The transcripts were uploaded in the Nvivo 10 software for analysis; the key informants interviews were first analysed, followed by the service providers' interviews and lastly by the policy makers interviews. The interpretative phenomenological analysis [IPA] framework was adopted for the analysis of the transcripts.

Results

Out of the 28 (100%) key informants, (53.6%) live in urban areas and (46.4%) live in the rural areas [Table 1]. Eight service providers [eye doctors] were interviewed;

of the eight eye doctors, none of them lives or practices in the rural areas. Two of the policy makers live in urban area; while one lives in the rural area. All the participants identified different barriers faced by the people while accessing eye care services in the state. Coding of the transcripts helped in identifying the following themes that are relevant to the purpose of the study:

- ▶ Poverty, cost and inability to pay for treatment
- ▶ Distance of hospitals from the rural dwellers
- ▶ Fear of exploitation from the doctors
- ▶ Fear of outcome of treatment
- ▶ Lack of awareness of eye diseases and the related risk factors
- ▶ Seriousness of the problem
- ▶ Ability to cope with eye disease
- ▶ Availability of other options

These themes are presented below and discussed with extracts from the interviews; which were annotated with pseudo-names and line numbers from the particular manuscript from where it was excerpted. All extracts were italicised, and where needed we used words in brackets to further clarify the quoted statement. For the three policy makers, the titles of their offices were used to replace their names. Thus the Health Commissioner [HC], the Local government chairman [LC] and the King by [HRH].

Emerging themes

Poverty, cost and inability to pay for treatment

Poverty and inability to pay for the cost of eye care services were among the main barriers this population face. Many people that need one form of eye care or the other cannot afford to pay for such services principally due to poverty.

"That's very true, because we do not have much money, many people are poor. So what people find easy to do is to use herbs or go to patent medicine shops to buy some medications that they could afford for the treatment of their problems" (Fatima:102-104).

"Why we are doing it is that sometimes we think that going to the hospital is more expensive and we go to the cheaper and quick one" (Ogonna:22-23).

Fatima, one of the key informants was pointing to the fact that they resort to the use of herbs, and also that they find it cheaper to purchase medications from patent medicine vendors due to the fact that they do not have enough money to spend consulting the professionals. Ogonna in the same vein pointed cost as the main determinant of how to act when one has a health issue. However, the use of herbs or even medications not prescribed by a professional has been identified as one of the major blindness risk factors. Sometimes this approach to treatment fails the people.

"...we have some challenges; people needed to access some professionals but because of the poverty level in the state they would resort to 'local doctors', [patent medicine vendors] if they didn't find remedy they will now move up to the professionals in the state" (Dr Sam: 4-6).

"Poverty is number one, that is, patients do not have enough money. When you tell them to come in two weeks' time [for follow up treatment], they end up not coming or come after a month, and or you tell them to come in a week's time they don't come at all, because in most cases they don't have enough money, so the patient may end up coming after a month in worse situation." (Dr Yugos:105-108).

Nigeria is a country where the level of poverty is very high, with about 70.2% living in poverty; with poverty as a challenge,²⁰ to access treatment for certain eye diseases is always overwhelming to many people as pointed by Adio and Onua.²¹ Poverty is therefore a major contributor to health inequality in Anambra State. The service providers should be aware of this and make efforts to devise a way of assisting those that need their services; a person that wears a shoe knows where it pinches most. Naturally, most people would like to have their ailment treated if they can afford to do that without any issues.

Distance of hospitals from the rural dwellers

The distance of the hospitals and eye care service outlets are sometimes one of the challenges this population face. Most of the services are located in

the cities; quite a reasonable distance from the rural dwellers. Most often, those in need of eye care services find it difficult to travel such distances due to transport costs and other logistics. This implies that proper arrangements regarding transport both for the sick persons and their escorts must be made prior to the travel date. Both the HC and some of the doctors acknowledged this challenge.

"Yea people that have problems in the eyes especially in the rural areas, they don't have good access to eye care" (Dr Okafor:4-5).

"...most of the doctors here tend to be domicile in the cities and that's where people will even come and to check their sight...(HC:102-103).

Fear of exploitation from the doctors

Some people do not believe that the doctors are genuinely providing their services the way it should be; some believe that the main intention of the doctors is to exploit them financially each time they pay a visit. This exploitation might be in the form of making sure that the person was diagnosed with one illness or the other. This opinion was expressed by one of the key informants.

"You know that we the Africans or we the local people use to feel that if you carry yourself to a doctor that doctor must find a fault, that's why we are afraid of going to a doctor" (Zenda:27-29).

The claims of exploitation by the doctors cannot be dismissed completely. Some studies have investigated the reasons for mistrust of doctors by their patients, and found that cost of care, conflict of interest and imposition of decision have been some of the major triggers.^{22, 23} The challenge to meet up with running costs may force some service providers to charge more for their services, which may result to conflict of interest between the doctor and the patient. In some cases, some of the service providers are not really sensitive to the plights of the services users and the difficulties they face. The comments of one of the service providers presented below gives some insight. Dr Owelle considers payments made by the patients as "token"

"no no no they do pay a token; you know all these equipment, and they involve money to procure them...." (Dr Owelle: 80).

Fear of outcome of treatment

This is an important theme that is influenced by a number of factors. Some forms of eye diseases are chronic; thereby need long term treatment and management. One of the key informants while speaking about glaucoma pointed that glaucoma is not treatable in any way at all. He was of the opinion that whosoever has glaucoma must surely end up with blindness.

"I learnt that it is very bad and in most cases incurable [that is glaucoma]. You don't operate it because if you do it worsens it and the few people that I know that had it gradually became blind with their eye wide open but they have lost the whole sight" (Ezenwata:39-42)

With this mind-set, whoever has glaucoma may not see any reason in going for treatment, as the person is already convinced that blindness is eminent; what is the point in wasting money and one's precious time?

Lack of awareness of eye diseases and the related risk factors

Lack of awareness is an important factor in blindness prevention. People are not aware of what could predispose them to blindness; as a result, they lack the motivation to seek eye care services except when the situation becomes severe and probably too bad to remedy. This explains the reason for late presentations of certain eye diseases to the hospitals.

"Hey! I want them to organise seminars, workshops, bring medicine, create awareness, tell people about likely things that can cause blindness. Educate people because people don't know. Ignorance is very big disease. Even some of us that are educated don't even give special attention to our eyes. So, it is very necessary they wake up from slumber and do something very very important patterning our eyes because if you don't have your eyes, you can't do anything" (Carol:91-95).

Seriousness of the problem

How serious a health issue is, determines the reaction or the effort made to treat the problem. Some problems are considered too insignificant to be bothered about.

"There is a type of sickness it will be and I will just take them to hospital if I have the money but if there is no money, I will just take them to a chemist [patent medicine vendor]. The truth is that I am not familiar with any medications so any one they give me I will just take believing that they have given the right medication" (Johnson:4-7)

Johnson, one of the key informants was describing how he approaches his children's health issues. Naturally, not many like to waste time and money on any sickness that is not significantly serious. Inasmuch as this is reasonable, there are some diseases that might appear to be mild by the patients' assessment but which could be seen as otherwise by a professional. Furthermore, some forms of eye diseases could come with little or no symptoms at all until at the advanced stage.

Ability to cope with eye disease

Sometimes people are able to cope with certain eye conditions. This encourages some to over-stretch ability of the eye to adjust to such conditions; thereby exposing them to higher risk of blindness. The eye has certain mechanisms that could enable it to keep on functioning in spite of certain obvious problems but sometimes, this ability to adjust paves a way for neglect which may result to serious complications in the future. One of the key informants when asked why he has not consulted an eye doctor retorted: *"why should I be looking for problem where none is around?"*

Availability of other options

Some people are not patient enough to wait for standard treatment from the hospitals; they prefer a quick service from the patent medicine vendors. Hilda cited this as one of the barriers to accessing health care services in the state.

"...Is still money and protocols -that is, 'the issue of come today come tomorrow" (Hilda:97).

A patient might be asked by the doctor to return for further assessment as a result of findings from the previous tests; this is always a normal conventional method in medical practice but the issue is that some people may want everything to be done instantly. The result is that they will feel that they are wasting too much time. Hilda branded this “come today, come tomorrow”. Some patients may feel that way probably due to the fact that they may have other options. Availability of alternative treatment options makes it possible for some to try these cheaper options before consulting the professionals. Some try some home remedies like urine, breast milk, herbs, gasoline, sugar and many different things; some also consult the patent medicine vendors. Inasmuch as these options might be cheap, they prevent people from going promptly for the right treatment in most cases.

“...with regards to eye health, I think especially people from the remote areas, initially they like doing self-medication. Most times you see somebody using breast milk, dropping breast milk into their eye, sometimes you see them making concoction out of roots and herbs and sometimes you even see them dropping early morning urine into their eyes...” (Dr Rita:4-8). “I have used that myself [that is herbs]. People told us that if you are having itching eyes, that you should look for one particular herb, squeeze it to extract the water, and applied the water as eye drops. This will take care of the problem” (Ogonna:72-74).

Discussion

Our findings revealed that the barriers to up-take of good eye care services in the state are varied and many, but poverty and inability to pay for treatments are the most prominent challenges. This directly influences the health seeking behaviour of this population. Having the capacity to pay for health care

services determines who they consult when they have health issues. People’s poor health seeking behaviour can be changed if they have the capacity to pay for better options.²⁴ Akande and Owoyemi²⁵ in their study found that one of the major reasons for delay in seeking treatment for an illness among some Nigerians is financial constraints; thus, good lectures and various health seminars cannot solve this problem if the government do not come to assist the poor masses. From the tone of most of the participants, affording the cost of the treatment has always been an unsurmountable feat. Subsidising the cost for medications and treatment would go a long way in minimising this barrier.

Location of most treatment centres away from the rural populace tends to be additional burden to the existing financial challenge. This finding is consistent with previous studies done in Ethiopia, Fiji and South-western Nigeria.^{10,17,18} Thinking of the risk, the costs for transportation as well as the cost for the eye care services simply force many to remain without any treatment, culminating eventually to blindness. Bringing the services closer to the people would at least remove the cost for transportation and even the time wasted in travelling to the cities for treatment.

Fear of exploitation by the service providers probably arose due to financial stress; people are worried and very concerned with how they spend the limited cash they have. This type of belief and attitude may cause some friction on doctor-patient relationship with its attendant consequences. Previous studies^{22,23} revealed that some service providers do not use patient-centred approach in their dealings with the service users. Patient-centred approach is useful in understanding the feelings of the patient in order to provide the best of the services; the service providers should adopt this. Mere giving instructions and directives may sometimes cause the patient to feel being forced to accept the doctor’s decision. Conversely; in a situation where the doctor

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10. Ajibode HA, Jagun OOA, Bodunde OT, Fakolujo VO. Assessment of barriers to surgical ophthalmic care in south-western Nigeria. *J West Afr Coll Surg.* 2012; 2(4): 68–78.
 17. Melese M, Alemayehu W, Friedlander E, Courtright P. Indirect costs associated with accessing eye care services as a barrier to service use in Ethiopia. *Tropical Medicine and International Health.* 2004; 9(3):426-431.
 18. Brian G, Maher L, Ramke J, Palagyi A. Eye care in Fiji: a population-based study of use and barriers. *Ophthalmic Epidemiol.* 2012; 19(2):43-51.
 22. Tucker JD, Cheng Y, Wong B, Gong N, Nie J, Zhu, W, et al. Patient–physician mistrust and violence against physicians in Guangdong Province, China: a qualitative study. *BMJ Open* 2015; 5(10).
 23. Kaba R, Sooriakumaran P, The evolution of the doctor-patient relationship. *International Journal of Surgery* 2007; 5(1): 57–65.
 24. Rosenstock IM, Strecher VJ, Becker MH. The social learning theory and health belief model. *Health Education Quarterly* 1988; 15(2):175-183).
 25. Akande TM, Owoyemi JO. Healthcare-seeking behaviour in Anyigba, North-central, Nigeria. *Medwell Journals* 2009; 3(2): 47-51.

aims at providing the best services for the patient, and the patient refuses to acknowledge this due to suspicion, relationship is often affected. Good understanding and smooth relationship between the patients and the doctors is very important to achieving better eye care programme in the state.

Some people are not impressed by the treatment outcome of some eye conditions, especially in case of some eye diseases that are chronic, and as such can only be managed throughout one's life time. In such cases, for instance glaucoma, people tend to believe that the prolonged treatment must have been due to the in-experience of the doctor. This sometimes results to loss of confidence in the doctor. Previous research has shown that patients' confidence in the doctor would be seriously affected as a result of poor treatment outcome.²⁶ However, while some poor outcome could be result of poor management, it is equally important that the population should have adequate awareness of some common eye diseases so as to be able to understand differences between the disease natural course and poor management. Therefore, creation of awareness of eye diseases and its associated risk factors is very important in this population, and would go a long way in removing some barriers to accessing eye services promptly.

Seriousness of the condition and the ability to cope with it tends to be another influential barrier.^{15,18} Some tend to interpret the seriousness of a condition

based on subjective symptomatic assessment and their ability to endure the discomfort; however, this could be most misleading. Furthermore, some eye diseases might not present obvious symptoms until when the condition has become very bad.^{7,27} The solution still lies on creating effective awareness among the entire population. Most importantly, there is a great need to reassess other optional treatment choices available to the population to ensure that those choices are safe to use; the policy makers should take note of this.

The service providers as a matter of urgency must be ready to provide regular eye health education to the population to promote awareness of eye diseases and the associated risk factors. This would go a long way in increasing the awareness and knowledge of eye diseases and dousing some misconceptions about certain eye conditions. The service users must be empowered in order to become partners with their service providers. They need to know they have the right to information and the right to make decisions based on their discussion with the doctor. Trusting a doctor is most important but trust is earned through mutual respect and the knowledge and skills of the doctor. The policy makers should be able to make services available and affordable to the population by setting up more eye care services within the reach of the entire population. There is a great need for all the stakeholders to cooperate for the achievement of better eye care services in the state. This has been the main goal of International Agency for the Prevention of Avoidable Blindness⁷- vision for Africa Phase 1.

Conclusion

This study has been able to identify the various barriers that prevent people from easily accessing eye care services in Anambra State, and has made some suggestions on how to reduce them. Evidence from this study shows that all the stakeholders in eye health have a role to play in reducing the barriers to accessing good eye care services in the state. Everyone has to play their part to make this work.

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7. Cook C. Glaucoma in Africa: size of the problem and possible solutions. *J Glaucoma* 2009; 18(2): 124-8.
 15. Fletcher AE, Donoghue M, Devavaram J, Thulasiraj RD, Scott S, Abdalla M. et al Low uptake of eye services in rural India: a challenge for programs of blindness prevention. *Arch Ophthalmol*. 1999; 117(10):1393-9.
 18. Brian G, Maher L, Ramke J, Palagyi A. Eye care in Fiji: a population-based study of use and barriers. *Ophthalmic Epidemiol*. 2012; 19(2):43-51.
 26. Egbert PR. Glaucoma in West Africa: a neglected problem. *Br J Ophthalmol*. 2002; 86(2): 131-132.
 27. Kanski JJ. *Clinical Ophthalmology: A Systematic Approach*, 6th ed. London: Butterworth Heinemann; 2007.

TABLE 1
Socio-demographic characteristic of respondents

Characteristics	Frequency	Percentage (%)
Key informants (populace n=28)		
Sex		
Male	11	39.3
Female	17	60.7
Age (in years)		
21 - 30	5	17.9
31 - 40	6	21.4
41 - 50	6	21.4
51 - 60	7	25.0
61 - 70	3	10.7
71 - 80	1	3.6
Occupation		
Driver	1	3.6
Technician	2	7.1
Farmer	1	3.6
Retired	2	7.1
Trader	6	21.4
Student	3	10.7
Civil servant	13	46.4
Residence		
Rural	13	46.4
Urban	15	53.6
Eye care Service providers (n = 8)		
Sex		
Male	7	87.5
Female	1	12.5
Occupation/Profession		
Optometrist	8	100
Policy makers (n = 3)		
Sex		
Male	3	100
Female	0	
Occupation		
Public servant	2	66.7
King	1	33.3

Prevalence of Concomitant Onchocerciasis-Malaria Infection in Ahani-Achi Community, Enugu State, Nigeria.

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Abstract

The preponderance of onchocerciasis and malaria infections in similar ecological settings is incidental to co-infection. Therefore, investigations into the mixed-infection pattern of these parasitic diseases are apt in order to maximize interventions and facilitate epidemiological mapping. A population-based cross-sectional study was conducted in Ahani-Achi community, a rain forest mosaic area of Enugu State, Nigeria from March 2012 to April 2014 to ascertain the prevalence of onchocerciasis-malaria co-infection. Four hundred and forty seven (447) persons aged 10 - ≥60 years were recruited into the study through a convenience sampling technique and examined using standard skin snip biopsy and smear microscopy techniques. Three hundred and nine (309) persons tested positive to concurrent *O. volvulus* and malaria parasitemia, representing a co-infection rate of 69.13%. In both males (53.62%) and females (70.83%), the ≥60 years age group was most infected and the infection rate was significantly ($p < 0.05$) affected by age. On the overall, more females (77.50%) were infected than males (59.45%), although the difference was not statistically significant ($p > 0.05$) while fishermen were significantly ($p < 0.05$) more infected (81.08%) than other occupation groups. Although the burden of co-infection reported is worrisome, the study strongly posits that if periodic surveillance and integrated approach to control strategies are adopted and sustained, the morbidity, mortality and economic loss associated with these infections will be forestalled.

Keywords: Prevalence, Concomitant, Onchocerciasis, Malaria, Infection.

Introduction

Human onchocerciasis, commonly called river blindness is a chronic parasitic disease caused by *Onchocerca volvulus*-- a nematode that belongs to the family of Filaridae and the only *Onchocerca* with a human host, although an infected Spider-Monkey and Gorilla have been recorded¹. In Nigeria and other West African Countries, the microfilaria are predominantly found in the lymphatic channels of the skin around the pelvis and upper arm and have caused blindness, visual impairments, general decrepitude and grave socio-economic problems². Onchocerciasis is the second leading cause of blindness in the world³ and it is estimated that between 18-37million people are infected, with up to 1-2 million people who are visually impaired and 270,000 people who are rendered completely blind⁴.

1. Engelkirk PG, Williams JF, Schmidt GM, Leid RW. Zoonotic Onchocerciasis. Handbook Series in Zoonoses. 1982; (2): 225-250.

2. Nwoke BEB. Worms and Human Diseases (First Edition). Owerri. Alphabet Nigerian Publishers. 2009.

3. Deut AE, Kazura JW. Other Tissue Nematodes. Nelson Textbook of Pediatrics. 2011; 1225-1227.

4. Diemert DJ. Tissue Nematode Infections. Goldman's Cecil Medicine. 2011; 193-200.

Out of the 37 endemic countries, 30 are in Africa and 6 are in Latin America⁵, however, more than 90 million people are estimated to be at risk in Africa, with Nigeria and Zaire being the most affected countries⁶.

O. volvulus invades all ocular tissues from the eyelid through the conjunctiva to the deeper tissues of the eye. Predominantly, the ocular complications of onchocerciasis include conjunctivitis, keratitis, corneal opacity, angle closure glaucoma, chorioretinitis, Iridocyclitis, cataract and optic neuritis. Typically, dermatologic manifestations are the initial presenting features with ophthalmic signs often presenting several years later. The severity of these ocular complications depends on the duration of infection, the microfilarial load and the strain of microfilaria⁷.

Malaria is a parasitic disease caused by *Plasmodium* parasites which are spread through the bites of infected female *Anopheles* mosquitoes. In Africa, the female *Anopheles gambiae* complex has been shown to be responsible for most transmission of the disease⁸. Among the different species, *Plasmodium falciparum* and *vivax* are the most common, while *Plasmodium falciparum* is the most deadly⁹. Recently, *Plasmodium knowlesi* has been identified as the fifth species and has been prejudged to cause malaria among Monkeys and humans and occurs in certain forest areas of South-East Asia¹⁰.

The prevalence, morbidity, mortality and associated economic loss due to malaria have been variously reported, for example, a worldwide prevalence of over 200 million cases and over 600 thousand

deaths have been recorded by the World Malaria Report¹¹. According to a report from the Federal Ministry of Health¹², malaria accounts for about 110 million diagnosed cases per year and an estimated 300,000 children die of malaria yearly. A study¹³ had shown that 11% of maternal related mortality is associated with malaria in pregnancy. It has been implicated in 25% of infant mortality and 30% of childhood mortality while it's economic burden in Nigeria is estimated at about 132 billion Naira¹⁴.

Malarial retinopathy stands out as a first line diagnostic feature in adults with severe malaria and children with cerebral malaria in endemic areas where parasitemia does not usually account for clinical malaria. It has been reported¹⁵ that the visualization of malarial retinopathy is more reliable than clinical or laboratory features in distinguishing malarial from non-malarial coma.

Malarial retinopathy consists of four main components namely: retinal (macular) whitening, vessel changes, retinal haemorrhage and papilloedema. While retinal (macular) whitening and vessel changes are specific to malaria, retinal haemorrhage and papilloedema are incidental to other ocular or systemic conditions¹⁵.

It is estimated that over a third of the world's population, mainly those individuals living in the tropics and sub-tropics, are infected with parasitic helminths (worms) and one or more of the species of *Plasmodium*^{16,17}. Another study¹⁸ had shown that school-age children are at the highest risk of co-infection of hookworm and malaria parasites.

5. McLeod SD. Parasitic Keratitis. Yanoff and Duker: Ophthalmology. 2008; 274-278.
6. WHO Expert Committee on Onchocerciasis and Its Control (Geneva, 1995).
7. Keiser PB. Bacterial Endosymbiont of *Onchocerca volvulus* In the Pathogenesis of Post-treatment Reactions. *Journal of Infectious Diseases*. 2002; 185: 805-811.
8. White GB. *Anopheles gambiae* Complex and Disease Transmission in Africa. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. 1974; 63(4), 278-301.
9. WHO Malaria Fact sheet. World Malaria Report. 2014.
10. Kantele A, Jokiranta TS. Preview of Cases With the Emerging Fifth Human Malaria Parasite, *Plasmodium knowlesi*. *Clinical Infectious Diseases*. 2011; 52(11)1356-1362.
11. World Health Organization. World Malaria Report. 2012; http://www.who.int/entity/malaria/world_report_2010/en-40k (retrieved 18/04/2017)
12. Federal Ministry of Health. National malaria and vector control programme: Policy for the implementation of indoor residual spraying for malaria vector control in Nigeria. Prime Wonder Ltd Kaduna/Abuja. 2010; 13pp.
13. Aribodor DN, Nwaorgu OC, Eneanya CI, Okoli I, Pukkila-Worley R, Etaga HO. Association of low birth weight and placental malaria infection in Nigeria. *Journal of Infectious Diseases in Developing Countries (USA)*. 2009; 3(8): 620-623.
14. FMOH & NMCP. Advocacy, Communication and Social Mobilization Strategic Framework and Implementation Plan. National Malaria Control Programme, Federal Ministry of Health, Abuja. 2010; 80pp.
15. Beare NAV, Taylor TE, Harding SP, Lewallen S, Molyneux ME. Malaria Retinopathy: A newly established diagnostic sign in severe malaria. *American Journal of Tropical Medicine and Hygiene*. 2006; 75(5): 790-797.
16. De Silva NR, Brooker S, Hotez PJ, Montresor A, Engels D, Savioli L. Soil Transmitted Helminth Infections: Updating the Global Picture. *Trends in Parasitology*. 2003; 19: 547-551.
17. Snow RW, Guerra CA, Noor AM, Myint HV, Hay SI. The Global Distribution of Clinical Episodes of *Plasmodium falciparum* Malaria. *Nature*. 2005; 434, 214-217.
18. Brooker S, Akhwale W, Pullan R, Estambale B, Clarke SE, Snow RW, Hotez PJ. Epidemiology of *Plasmodium*-Helminth Co-infection in Africa: Population at Risk, Potential Impact on Anemia, and Prospects for Combining Control. *American Journal of Tropical Medicine and Hygiene*. 2007; 77(6): 230-238.

While a recent study¹⁹ reported a prevalence of 3.6% for concomitant malaria and lymphatic filariasis infection in Georgetown, Guyana, a previous one²⁰ recorded a prevalence rate of 8.4% for *O. volvulus* and Plasmodiasis co-infection in Garaha-Dutse community of Adamawa State, Nigeria.

Furthermore, studies^{21,22} have also shown that helminth infections may alter susceptibility to clinical malaria and this has necessitated further investigations into the distributions and consequences of co-infection²³, for example, a study²⁴ suggested that infection with intestinal nematode, *Ascaris lumbricoides* was associated with the suppression of malaria symptoms and that anthelmintic treatment led to a recrudescence of malaria. Maizels et al.²⁵ postulated that the mechanism underlying this finding, and those of more recent studies are based on the assumption that helminth infections induce a potent and highly polarized immune response which has been proposed to modify the acquisition of immunity to malaria. In animal models, this evidence is suggestive of both synergism and antagonism in *Plasmodia* and helminth co-infections²⁶. In mixed infections, the burden of one or both of the infectious agents may be increased, one or both may be suppressed or one may be increased and the other suppressed²⁷. For example, in a case where onchocerciasis and malaria were co-infected, it was shown that the Th2 associated cytokines in microfilariae negative mice kept microfilariae at bay by impairing²⁶ or delaying²⁸ the control of malaria whereas Th1 cytokines (IFN- γ) in microfilariae positive mice promoted the clearance of malaria²⁹.

Many studies have assessed the distribution of separate infections of onchocerciasis and malaria, yet little has been done to appraise the burden of their concurrent infection irrespective of their similarity in ecological distribution which accounts for co-infection³⁰, likely heightened debility, ocular complications and immunological interactions in co-infected persons³¹. The study therefore evaluated the prevalence of mixed infection of onchocerciasis and malaria in Ahani-Achi, a co-endemic community in Enugu State, Nigeria.

Materials and methods:

Study-area:

Ahani-Achi is an autonomous community located in Oji River Local Government Area of Enugu State, Nigeria. It has a geographical coordinate of 6° 8' North, 7° 22' East. The climate of the area is marked with typical rain forest mosaic vegetation characterized by mainly rainy seasons.

The community is traversed by many streams and fast flowing rivers such as Iyibenze, Nwoka, Ogba, Iyi Owerri, Iyi Agwo and Ngene iyi agu drained by a principal tributary known as Oji River. These enhance the breeding of both *Simulium damnosum* and Anopheles mosquitoes, the insect vectors of onchocerciasis and malaria respectively.

There are two different climatic seasons in the area, the rainy season from March to October and dry season from November to February. Year round, rainfall of approximately 2,900-3,400 mm occurs, with maximum precipitation occurring from June to August.

19. Chadee DD, Rawlins SC, Tiwari TSB. Short Communication: Concomitant Malaria and Filariasis Infections in Georgetown, Guyana: Tropical Medicine and International Health. 2003; 8(2):140-143.
20. Rebecca SN, Akinboye DO, Abdulazeez AA. Onchocerciasis and Plasmodiasis: Concurrent Infection in Garaha-Dutse Community, Adamawa State, Nigeria. Biomedical Research. 2008; 19(2): 5-8.
21. Nacher M, Singhasivanon P, Silachomroon U, Treeprasertsuk S, Vannaphan S, Troare B, Gay F, Looareesuwan S. Helminth Infections are Associated with Protection From Malaria-related Acute Renal Failure and Jaundice in Thailand. American Journal of Tropical Medicine and Hygiene. 2001; 65: 834-836.
22. Druilhe P, Tall A. Worms Can Worsen Malaria: Towards a New Means to Roll Back Malaria?. Trends in Parasitology. 2005; 21: 359-362.
23. Nacher M, Gay F, Singhasivanon P, Krudsood S, Teeprasertsuk S, Mazier D, Vouloukis I, Looareesuwan S. *Ascaris lumbricoides* Infection is Associated with Protection from Cerebral Malaria. Parasite Immunology. 2000; 22: 107-113.
24. Murray MJ, Murray AB, Murray MB, Murray CJ. Parotid Enlargement, Forehead Edema and Suppression of Malaria as Nutritional Consequences of Ascariasis. American Journal of Clinical Nutrition. 1977; 30: 2117-2121.
25. Maizels RM, Balic A, Gormez-Escobar N, Nair M, Taylor MD, Allen JE. Helminth Parasites- Masters of Regulation. Immunology Reviews. 2004; 201: 89-116.
26. Helmbly H, Kullberg M, Troye-Blomberg M. Altered Immune Response in Mice with Concomitant *Schistosoma mansoni* and *Plasmodium chabaudi* infections. Infection and Immunity. 1998; 66: 5167-5174.
27. Cox, FE. Concomitancy infections, parameters and immune responses. Parasitology. 2001; 122: 23-38.
28. Von der Weid T, Koff M, Kohler G, Langhorne J. The Immune Response to *Plasmodium chabaudi* Malaria in IL-4 Deficient Mice. European Journal of Immunology. 1994; 1(24): 2285-2293.
29. Su Z, Stevenson MM. Central Role of Endogenous Gamma Interferon in Protective Immunity Against Blood-stage *Plasmodium chabaudi* Infection. Infect Immun. 2000; 68: 4399-4406.
30. Petney TN, Andrews RH. Multiparasite communities in animals and humans: Frequency, Structure and Pathogenetic Significance. Inter Journ of Parasitol. 1998; 28: 377-393.
31. Mwangi TW, Bethony J, Brooker S. Malaria and Helminth Interactions in Humans: An Epidemiological Viewpoint. Ann of Trop Med and Parasitol. 2006; 100(7): 554-570.

The main occupations of the people are farming and trading. The community is made up of 4 villages namely, Okpuno, Umuelebe, Mgbaragu and Oruchi. It is surrounded by some other towns such as, Isuochi (in Abia State), Inyi (also part of Oji-River LGA of Enugu State), Ugbo, and Obeagu (Awgu LGA of Enugu State) and some parts of Udi local government area of Enugu State.

Study population and sample size:

The population of the community was estimated at about 26,970 people based on the 2006 census exercise. A sample size of 447 persons aged 10 - ≥60 years was drawn using the convenience sampling technique; all subjects who satisfied the inclusion criteria were recruited into the study in no particular order.

The sample size was calculated using the Taro Yamane's formula for minimum sample size determination and reasonable allowance was made for attrition factors.

Ethical clearance:

The study complied with established protocols of the Helsinki declaration on human experiments. Appropriate ethical clearance from Enugu State Ministry of Health was obtained for the study, a written permission to conduct the study was obtained from the traditional ruler of the community and his cabinet, written informed consents of adult participants were procured and surrogate consents were given for participants below the age of 18 years.

Specimen collection and analysis:

The participants were examined for concomitant onchocerciasis-malaria parasitemia using the skin snip biopsy and smear microscopy techniques.

Skin snip biopsy:

The posterior iliac crest region was cleaned with a spirit swab and allowed to dry. One (1) mg of skin snip was extirpated using a sclero-corneal punch and the bloodless snip was incubated in a laboratory tube containing 0.2 ml of normal saline for 24 hours. The contents of the tube were transferred to a slide and examined microscopically using the gold standard technique³² of 10x microscopy. Parasite quantification was done in all fields of the microscope.

Smear microscopy:

To obtain a thick (capillary) blood smear, the tip of the third finger was sterilized with a spirit swab and allowed to dry. The finger was pricked using a sterile and disposable lancet to obtain a drop of blood placed on a microscopic slide. The drop of blood was turned in a circular pattern 3-4 times with a glass rod to obtain a thick blood smear. The blood smear was air-dried and stained with field's stain A for 2 minutes. After 2 minutes, the stain was washed off with water sprayed from a wash bottle and a drop of field's stain B was placed on the smear for 3 minutes and washed off. The blood film was air-dried and a drop of oil immersion placed on the film and viewed under 100x objective microscope³².

Statistical analysis:

Data were analysed using Chi-square (X²) to evaluate the associations between age, gender, occupation and disease frequency at 95% confidence level.

Results:

Four hundred and forty seven (447) participants comprising of 207 (46.31%) males and 240 (53.69%) females were examined for concomitant onchocerciasis-malaria parasitemia based on demographic predilections. In both genders, the ≥60 years age group had the highest number of participants (males n=177, females n=211). The predominance of this age group among the sample population may likely be predictive of retirement and attendant relocation to the villages at the age of 60 years. The least number of

32. Cheesbrough M. District Laboratory Practise in Tropical Countries, Part i. Cambridge University. 1998; 455pp.

male participants (n=20) was found within the 10-19 years and 30-39 years age groups while the least number of female participants was recorded in the 30-39 years age group (Table 1).

Table 1: Age and sex distribution of sample population in Ahani-Achi community.

Age (Years)	Sex		Total (%)
	Male	Female	
10-19	2 (0.97)	4 (1.67)	6 (1.34)
20-29	4 (1.93)	6 (2.50)	10 (2.24)
30-39	2 (0.97)	3 (1.25)	5 (1.12)
40-49	10 (4.83)	9 (3.75)	19 (4.25)
50-59	12 (5.80)	7 (2.92)	19 (4.25)
≥ 60	177 (85.5)	211 (87.92)	388 (86.80)
Total	207 (46.31)	240 (53.69)	447

On the overall, 309 (69.13%) participants tested positive to mixed onchocerciasis-malaria parasitemia and more females (77.50%) were infected than males (59.42%).

The ≥60 years age category was most infected in both males (53.62%) and females (70.83). There was no case of mixed onchocerciasis-malaria found among males and females within the age group of 10-19 as highlighted in Table 2. The association between age and infection rate was statistically significant ($p < 0.05$) while infection rate did not vary significantly with gender ($p > 0.05$).

Table 2: Age and sex distribution of concomitant onchocerciasis-malaria parasitemia.

Age (Years)	Male		Female	
	No.	No. infected (%)	No.	No. infected (%)
10-19	2	0 (0)	4	0 (0)
20-29	4	2 (0.97)	6	3 (1.25)
30-39	2	0 (0)	3	3 (1.25)
40-49	10	4 (1.93)	9	4 (1.67)
50-59	12	6 (2.90)	7	6 (2.50)
≥ 60	177	111(53.62)	211	170(70.83)
Total	207	123(59.42)	240	186(77.50)

Test statistics used: Chi-square (χ^2)

P-value (age) = 0.000122

P-value (gender) = 0.068195

The study identified seven occupation groups namely students, civil servants, fishermen, others, farmers, traders and the unemployed. Among these, the fishermen were most infected (81.08%) followed by farmers (77.50%) while the unemployed group was least infected (30%) as shown in Table 3. The relationship between occupation and prevalence of infection was statistically significant ($p < 0.05$).

Table 3: Occupation-related distribution of concomitant onchocerciasis-malaria parasitemia in Ahani-Achi.

Occupation	No. Examined	No. Infected	% infected
Students	30	16	53.33
Civil service	40	29	72.50
Fishing	37	30	81.08
Others	30	15	50
Farming	200	155	77.50
Trading	70	52	74.29
Unemployed	40	12	30
Total	447	309	447

Test statistics used: Chi-square (χ^2)

P-value = 0.00001

Discussion:

The overall prevalence rate of 69.13% recorded by the study is burdensome, especially when compared with the findings of Rebecca et al.²⁰ where a prevalence rate of 8.4% was reported for onchocerciasis and plasmodiasis co-infection. Although the wide discrepancy could be as a result of extensive ecological variation between the study-settings which most likely affected the ferocity of causal vectors in both locations, it could also represent the level of success of intervention programmes in both areas. The gap in prevalence rate of both localities is huge and underscores the exigency for inter-agency partnership and exchange of resources between the advanced and upcoming intervention agencies and programmes.

Furthermore, the result of the present study does not compare with another one¹⁹ observed in Georgetown, Guyana where a prevalence of 3.6% was reported for malaria and lymphatic filariasis co-infection. The

gap between the results may be as a result of differences in parasite biology of lymphatic filariasis and onchocerciasis.

The 60 years age category was most infected in both males (53.62%) and females (70.83) followed by the 50-59 years age group with a prevalence of 2.90% and 2.50% for males and females respectively with a significant correlation ($p < 0.05$) between age groups and infection rate. The infection burden among the 60 years age category is logical in view of the dense population of the age group in the area and their propensity for farming and fishing a leisurely activity, which makes them vulnerable to the bites of causal vectors of onchocerciasis and malaria. Moreover, most persons within these age strata may have substantially inhabited in the area with attendant proneness to vector contacts.

In males (0%) and females (0%), the infection rate of the 10-19 years age group was the least and may be accounted for by the low population of this age group within the sample population, the lengthy time spent at school, parental care and non-involvement in predisposing activities such as farming and fishing. This result differs from that of another study¹⁸ where school age children were observed to have the highest risk of co-infection, although for hookworm and malaria. The discrepancy may most likely be associated with variation in the general biology, life cycles, ecological preferences and vectoral ferocity of hookworm and onchocerciasis parasites.

On the overall, a higher co-infection burden was recorded among the females (77.50%) than the males (59.42%), although the difference was not statistically significant ($p > 0.05$). The result is unprecedented irrespective of the greater number of females among the sample population and could

therefore be inferred that more women were engaged in farming and riverside activities such as laundering, washing of farming tools, washing of harvested crops and bathing a leisurely agricultural activities than men. These activities are predisposing factors to the bites of *Simulium damnosum* and female Anopheles mosquitoes, which are insect vectors of onchocerciasis and malaria respectively.

Among the occupation groups, the fishermen (81.08%) were most infected followed by farmers (77.50%) while the unemployed (30%) had the least infection burden, more so, the association between occupation groups and infection rate was statistically significant ($p < 0.05$). On the contrary, Rebecca et al.²⁰ had shown that the prevalence of onchocerciasis was highest among the farmers (28.8%), malaria infection was highest among the fishermen (47.7%), while the highest concomitant infection rate (18.2%) was observed among the farmers. The occupation predilection of both studies could not have been a product of chance but a likely indication of the ecological diversity of the study-areas. The rain forest vegetation of the present study-area promotes fishing activities while the savannah vegetation of the previous study-area²⁰ does not, thereby accounting for less fishing enterprise.

The prevalence pattern among occupation groups in the present study is understandable for two reasons: first, the major occupations of the inhabitants are farming and fishing; second, the physical exertion associated with fishing and farming usually prompts the workers to go top-bare for better aeration thereby increasing the exposure rate, vector contact time and subsequent biting rates.

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18. Brooker S, Akhwale W, Pullan R, Estambale B, Clarke SE, Snow RW, Hotez PJ. Epidemiology of Plasmodium-Helminth Co-infection in Africa: Population at Risk, Potential Impact on Anemia, and Prospects for Combining Control. *American Journal of Tropical Medicine and Hygiene*; 2007; 77(6): 230-238.
 19. Chadee DD, Rawlins SC, Tiwari TSB. Short Communication: Concomitant Malaria and Filariasis Infections in Georgetown, Guyana: *Tropical Medicine and International Health*. 2003; 8(2):140-143.
 20. Rebecca SN, Akinboye DO, Abdulazeez AA. Onchocerciasis and Plasmodiasis: Concurrent Infection in Garaha-Dutse Community, Adamawa State, Nigeria. *Biomedical Research*. 2008; 19(2): 5-8.

Conclusion

Despite the decades of Ivermectin distribution, nodulectomy, environmental modifications, indoor residual spraying and free insecticide treated net distribution (ITN) programmes by various agencies aimed at mitigating the infections, the hyperendemicity of concomitant onchocerciasis-malaria infection in the study-area has remained unabated. The study emphasized the need for all stakeholders including relevant intervention agencies and inhabitants of the area to collaborate with the government of Enugu State, Nigeria in designing more radical approaches to the control of these diseases. If timely recession of the infections is not rapidly actualized, the general well-being, quality of life and economic prospects of the people may likely degenerate further.

Since significant success has not been recorded in curbing the rate of co- infection, the advocacy strategies, implementation approaches adopted by control agencies and individual compliance to recommended control techniques should be re-appraised to ascertain associated inconsistencies in the entire implementation process.

Furthermore, to forestall further morbidity, mortality and associated economic loss, more efforts should be channelled into health education, environmental sanitation, self-protective measures and periodic programme evaluation to ensure the attainment of set goals.

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Competing Interests:

The authors declare that there were no personal or financial interests which may have inappropriately affected the conduct or the results of the study.

Rehabilitation for Independent Living: Challenges and Priorities of Visually Impaired Older People in Urban Nigeria

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Abstract

The specific objectives of this study is to determine aspects of self-reliance in daily life activities that are most challenging for adults with vision impairment and to determine what areas of rehabilitation should be the keystone of low vision care and/or rehabilitation for this group. Participants were recruited from Lagos and Delta state, Nigeria. A total of 128 visually impaired older adults aged 60 years and over took part in the study. A survey method; using questionnaires was employed in order to get data from respondents. Participants Visual Acuities were measured and using the Lawton Instrumental Activities of Daily Living (IADL) scale, participants responded to questions on daily living tasks they considered as challenging. The relation between self-reliance in daily tasks and years of vision impairment proved the presence of relationship in some activities such as being able to use the telephone ($\chi^2=0.66$, $p=0.7196$), being able to plan, prepare and serve meals without help ($\chi^2=4.13$, $p<0.1271$), and doing laundry without help ($\chi^2=2.31$, $p=0.3155$). Other activities did not show such correlation. The results revealed that, with increasing years of visual impairment, participants were more likely to report that indoor tasks (such as doing laundry, doing household chores, and using the telephone) were easier than outdoor tasks (such as shopping, spending money independently, and travelling independently). The study concludes that rehabilitation for outdoor activities should be keystone of low vision care. Implications of this study for social inclusion of this group and for successful adjustment to difficulties posed by vision impairment are discussed.

Keywords: independence, vision, daily-living, impairment, rehabilitation

Introduction

The World Health Organisation (WHO) defines vision impairment as visual acuity of less than 6/18 and/or corresponding vision field loss to less than 10 degrees in the better eye with glasses or after medical or surgical treatment.¹ Of the current total world population of over 6.8 billion people, there are more than 800 million people aged 60 years and over.² Among this population group, approximately 1 in 12 persons is visually impaired and predictions

indicate that this number will increase by 20% over the next 10 years especially in less developed countries.^{2,3} This is mainly because people are living longer and ageing is associated with an increased risk of vision impairment.

Research suggests that visual impairment limits the capacity to perform one or more essential activities of daily life.⁴ Visual impairment in elderly persons decreases

1. Resnikoff S, Pascolini D, Mariotti SP, Pokharel GP. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. *Bulletin of the World Health Organization*. 2008;86(1):63-70.
2. Bongaarts J. United Nations Department of Economic and Social Affairs, Population Division World Mortality Report 2005. *Population and Development Review*. 2006; 32(3):594-6.
3. World Health Organisation. What is Vision2020? Prevention of blindness and vision impairment. [Online]. 2017. Available from: <http://www.who.int/blindness/partnerships/vision2020/en/index.html>
4. Wahl HW. The psychological challenge of late-life vision impairment: concepts, findings, and practical implications. *Journal of ophthalmology*. 2013; 17(1).

independence and functional abilities.^{5,6} Apart from vision impairment, ageing is often characterised by losses such as bereavement, retirement, children leaving home, which can adversely affect the social networks of older adults or their ability to maintain their independence. In line with these issues, interventions that can enhance the ability of older adults to maintain independence particularly with carrying out daily living tasks is becoming an on-going public health concern in today's ageing societies.^{7,8}

In Nigeria as well as many developing countries, older visually impaired people often have fewer opportunities to make necessary adjustments required for independent living after the diagnosis of vision impairment due to inadequate facilities, resources, and access to rehabilitation systems.^{9,10} There is paucity of data on rehabilitation priorities of visually impaired elderly in developing countries. The focus of this study, however, is to identify aspects of daily living tasks that are most challenging among older people with visual impairment. There is a need to clarify and deepen the understanding of the most common difficult activities of daily living as such knowledge could in turn inform understanding of issues of prime concern such as most important considerations for rehabilitation and training programs among this group.

Independent living, or the ability to take care of one's self, centres on the idea that the elderly and those with disabilities can have the ability to take care of themselves with very little, if any, need for help from others. In the face of adversity resulting

from functional loss, older people maintain their health and well-being via psychosocial adjustments which define their resilience.¹¹ Difficulties with making adjustments to functional limitations caused by visual impairment can result in feelings of frustration at having to be overly reliant on support from others.¹² A visually impaired person who is unable to make necessary adjustments by adapting or compensating for such losses may go through psychological symptoms such as: anxiety, stress, and major depression which may ultimately affect their self-esteem.¹³ With the right selection of training for independent living, older people with vision disabilities can perform everyday tasks and be self-reliant.

Many studies conducted in developed countries,¹⁴⁻¹⁶ suggest that difficulty with reading (i.e. access to print materials) is the most commonly reported problem among people with low vision, regardless of the underlying cause of their vision loss. A low vision rehabilitation study of 819 patients seeking low vision services at 28 clinical centres in the United States between 2008 and 2011 showed that women were more likely to report difficulty with in-home activities, facial recognition and social interactions, whereas men were more likely to report mobility difficulties.¹⁵ The study authors concluded that since difficulty with reading was the most common complaint, reading rehabilitation should be a cornerstone of low vision care. Other functional difficulties reported by participants in the United States study¹⁵ included driving (27.8%), using magnifiers and other vision aids (17.5%), mobility (16.3%), performing normal in-home activities (15.1%), problems

5. West SK, Munoz B, Rubin GS, Schein OD, Bandeen-Roche K, Zeger S, German S, Fried LP. Function and visual impairment in a population-based study of older adults. The SEE project. *Salisbury Eye Evaluation. Investigative ophthalmology & visual science*, 1997; 38(1): 72-82.
6. Brown RL, Barrett AE. Visual impairment and quality of life among older adults: an examination of explanations for the relationship. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*. 2011; 66B (3): 364-373.
7. Dickenson AP, Richards SH., Greaves CJ, Campbell JL. Interventions targeting social isolation in older people: a systematic review'. *BMC Public Health*, 2011; 15(11): 647-660.
8. Cattan M. *Later Life*. In: L., Knifton N, Quinn (eds.). 2013. *Public Mental Health; Global Perspectives*. Maidenhead: Open University Press.
9. Tunde-Ayinmode MF, Akande TM, Ademola-Popoola DS. Psychologica and social adjustment to blindness: Understanding from two groups of blind people in Ilorin, Nigeria. *Annals of African medicine*. 2011;10(2).
10. Ademola-Popoola DS, Tunde-Ayinmode MF, Akande TM. Psychosocial characteristics of totally blind people in a Nigerian city. *Middle East African journal of ophthalmology*. 2010;17(4):335.
11. Zautra AJ, Hall JS, Murray KE. A new definition of health for people and communities. *Handbook of adult resilience*. 2010; 4:1.
12. Percival J, Hanson J. 'I'm like a tree a million miles from the water's edge': Social care and inclusion of older people with visual impairment. *British Journal of Social Work*. 2005;35(2):189-205.
13. Houde SC. *Vision loss in older adults: Nursing assessment and care management*. Springer Publishing Company; 2006;18(1).
14. Ayoubi, L. Human Rights Perspectives on Access of the Blind, Visually Impaired and Other Reading Disabled Persons to Copyrighted Materials. [Online] Available from: <https://lup.lub.lu.se/student-papers/search/publication/2063363>
15. Brown JC, Goldstein JE, Chan TL, Massof R, Ramulu P, Low Vision Research Network Study Group. Characterizing functional complaints in patients seeking outpatient low-vision services in the United States. *Ophthalmology*. 2014;121(8):1655-62.
16. Riazi A, Riazi F, Yoosfi R, Bahmeci F. Outdoor difficulties experienced by a group of visually impaired Iranian people. *Journal of Current Ophthalmology*. 2016;28(2):85-90.

associated with lighting and glare (11.7%), and trouble recognizing faces and engaging socially (10.3%). Many studies on how vision impairment affects activities of daily living suggest that visually impaired older people do not only have challenges with carrying out their daily activities, but they are also faced with significant challenges in outdoor mobility.¹⁷⁻²⁰ Mobility restrictions associated with vision impairment were identified in an earlier study as a hindrance to participation in social activities and social engagements.¹⁸ Some studies contend that the prevalence of loneliness and social isolation among visually impaired older adults is much higher than their sighted peers due to reduced mobility.¹⁸⁻²⁰

There is paucity of information on rehabilitation needs of visually impaired older people living in developing countries despite increasing populations of older people with visual impairment – which is even growing faster than available funding and the availability of qualified rehabilitation personnel.^{21,22} Funding for low vision rehabilitation services in developing countries is inadequate for specialized agencies and professionals to develop and deliver services to the geographically and culturally diverse population of older people with visual impairments. With limited resources, there is a need for the identification of specific rehabilitation services of priority or utmost importance, and informed decision about the rehabilitation therapy that should be targeted in specific vision impairments. This may reduce costs associated with providing unnecessary services. It is also possible to change stereotypes about vision impairment by promoting interventions that could enhance independent living among people

with vision impairment. Negative attitudes based on stereotypes about disabilities not only leads to restrictions on people with disabilities, but might further exclude them.^{23,24} Ignorance about the skills and capacity of disabled people to live independently have been argued to be the greatest obstacle in preventing them from accessing opportunities available from within mainstream society and enjoying other aspects of social inclusion.^{25, 26}

The goals of this study include adding to the body of knowledge that can be used by eye care rehabilitation professionals to promote independent living, and economic and social self-sufficiency among older people with vision impairment. This study could assist visually impaired persons to make informed choices, especially where resources for vision rehabilitation are limited, as there might be a need for prioritized choices in the type of training for independent living. The specific objectives of the study is to determine aspects of self-reliance in daily life activities that are most challenging for adults with vision impairment and to determine what areas of rehabilitation should be the keystone of low vision care and/or rehabilitation for this group.

Materials and Methods

The study design employed for this study was survey method using questionnaires. A purposive sampling technique was used to select participants (visually impaired older adults) eligible to participate in the study. As the exact population size of visually impaired older adults in Lagos and Delta states were unknown, the authors employed a 'non-finite approach'²⁷ for the determination of sample size; given as: $n = Z^2 \sigma^2 / E^2$.

17. Brouwer DM, Sadlo G, Winding K, Hanneman MI. Limitations in mobility: Experiences of visually impaired older people. *British Journal of Occupational Therapy*. 2008;17(10):414-21.
18. Lamoureux EL, Hassell JB, Keeffe JE. The determinants of participation in activities of daily living in people with impaired vision. *American journal of ophthalmology*. 2004 Feb 29;137(2):265-70.
19. Swatski AL. The Elderly's Perception of the Impact on Mood, Socialization, and Mobility as a Result of Late Onset Visual Impairment: Implications for Dance/movement Therapy (Doctoral dissertation, Drexel University).
20. Gusi N, Prieto J, Forte D, Gomez I, Gonzalez-Guerrero JL. Needs, interests, and limitations for the promotion of health and exercise by a web site for sighted and blind elderly people: a qualitative exploratory study. *Educational Gerontology*. 2008;34(6):449-61.
21. Chiang PP, Marella M, Ormsby G, Keeffe J. Critical issues in implementing low vision care in the Asia-Pacific region. *Indian journal of ophthalmology*. 2012;60(5):456.
22. Ryan B. Models of low vision care: past, present and future. *Clinical and Experimental Optometry*. 2014;97(3):209-13.
23. Shinohara K, Wobbrock JO. In the shadow of misperception: assistive technology use and social interactions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems 2011 May 7 (pp. 705-714)*. ACM.
24. Neves BB, Amaro F. Too old for technology? How the elderly of Lisbon use and perceive ICT. *The Journal of Community Informatics*. 2012;8(1).
25. Brouillette DC, Hotchkiss R, Saleh L. Overcoming obstacles to the integration of disabled people. Available from: <http://betadaa.org.uk/uploads/pdf/Overcoming%20Obstacles.pdf>
26. Powers T. Recognizing ability: the skills and productivity of persons with disabilities: literature review. *International Labour Organization*; 2008.
27. Louangrath, P.I. Sample size determination for Non-finite population. *Southeast-Asian Journal of Sciences*, 2014; 3(2): 141-152.

Where Z = standard score at a specified confidence interval, i.e. 1.65 for 0.95 Confidence Interval (CI); σ = estimated population standard deviation; and $E = \sigma / \sqrt{n}$. Under this non-finite sample size calculation, the minimum sample size is $n=30$.²⁷

A total of 128 visually impaired older people recruited from 14 private eye clinics in Delta-state and Lagos state, Nigeria were recruited for the study. The private clinics were randomly selected from 5 local government areas in Delta state and 9 local governments in Lagos state. The criteria for inclusion in the sample include visually impaired adults aged 60 years and over, fluency in English, binocular corrected visual acuity $< 6/18$ (LogMAR < 0.5), and not less than 1 year since the diagnosis or onset of vision impairment. Medical exclusions included presence of a serious medical illness, a recent head injury or stroke (less than 6 months prior to testing), hearing loss, dementia, Parkinson's disease, psychiatric diagnosis, or ongoing dependence on alcohol or other drugs that could impair daily functioning. Participants were briefed about the study and their verbal consent audio recorded before participation. Visual acuity (VA) of participants was measured using a Snellen chart. Best corrected monocular visual acuity was also recorded. The severity of visual impairment was determined by measuring binocular visual acuity and recording the equivalent LogMAR ratio of Snellen values using the International Council of Ophthalmology conversion chart (mild vision impairment ≤ 0.5 , moderate = 0.6 – 1.0, severe vision impairment = 1.5 – 1.9, blindness ≥ 1.9).²⁸ Binocular VA was used because the evaluation of visual function for activities of daily living that are strongly associated with use of both eyes, is best conducted via binocular acuity testing.²⁹ Consecutive consenting respondents visiting the registered private clinics in the two states were recruited for the study. A structured interview questionnaire to ascertain socio-demographic details of participants was read out to participants and their responses

recorded. Interview questionnaire consisted questions on age, gender, educational level (low, medium, or high), and household composition (single or living with others). We categorized individuals with Secondary School Certificates, General certificate of Education (GCE), or Ordinary National Diplomas (OND) as Low levels of education, and participants with Higher National Diploma (HND) or a University Bachelor's Degree as Medium level education. Respondents with a Master's degree or a Doctorate degree were classified as High education levels. These classifications were based on the International Standard Classification of Education (ISCED-97) that provided guidance to countries within Organisation for Economic Cooperation and Development (OECD) on how to implement ISCED-97 framework in international data collection.³⁰ Enquiries were also made concerning the number of years that each participant has lived with vision impairment, and existing medical conditions. The Lawton scale (IADL) was used to evaluate self-reliance and ability to conduct activities of daily living independently. Each thematic question on the Lawton IADL scale was addressed as one question. Participants were required to answer yes (score =1) or no (score=0) to each question. The activities assessed include: use of telephone, shopping, food preparation, house-keeping, self-care, mobility/independent travelling, and handling finances. Analysis (Chi-square test, Mann - Whitney test, and Kruskal - Wallis test) was conducted using IBM SPSS (2015) and significance level was accepted at the value $p<0.05$. T-test was employed to examine Lawton IADL score differences between genders.

RESULTS

A total of 76 females (59.38%) and 52 males (40.62%) participated in the study (Table 1). Respondents were aged between 60 and 89 years (Mean = 71.60 years, 95% Confidence Interval of the mean= 70.25 – 72.94; SD = 7.68 years). A majority of the respondents had either low or medium level education (61 (47.66%) and 39 (30.46%) respectively). Only 28 participants

27. Louangrath, P.I. Sample size determination for Non-finite population. Southeast-Asian Journal of Sciences, 2014; 3(2): 141-152.

28. Colenbrander A. Visual standards: aspects and ranges of vision loss with emphasis on population surveys. Report for the International Council of Ophthalmology. 2002; 2:1-33.

29. Wu G, Wang L, Li B, Zai C, Zhao S, Cao H. Effects of Binocular Acuity in Visual Impairment Assessment. International Journal of Sciences, 2015; 4(10): 17-21.

30. Organisation for Economic Co-operation and Development. Classifying educational programmes: Manual for ISCED-97 implementation in OECD countries. Paris: OECD; 1999. Retrieved from: <http://www.oecd.org/edu/1841854.pdf>

(21.88%) had high level of education. Many of the respondents (n= 113; 88.28%) lived with their families and admitted having access to family care and support. The mean LogMAR visual acuity was 1.06 (SD=0.51, 95% CI: 0.06-2.06). Visual acuity (VA) result indicated that 39 participants (30.47%) were blind (LogMAR VA: ≥ 1.9), 26 respondents (20.31%) were severely vision impaired (LogMAR VA: 1.1 - 1.4), 29 of them (22.65%) had moderate vision impairment (LogMAR VA: 0.6 – 1.0), and 34 respondents (26.57%) had mild vision impairment (LogMAR VA: 0.5 – 0.59). The average number of years of onset of vision impairment was 5.56 years (SD= 4.41, 95% CI= -3.08 – 14.21). Participants, however, reported suffering from other diseases, namely; hypertension (n= 37; 28.90%), diabetes (n=28, 21.88%), osteoarthritis (n=14; 10.94%), and prostate enlargement (n=10; 7.81%). Only 2 participants (1.56%) used wheelchairs and 13 participants (10.16%) used a walking stick.

The result of the Lawton scale (IADL) ranged between 3 and 17 points (Mean [M] = 8.23; SD= 3.32). None of the respondents was totally independent in all assessed activities of daily living. As shown in Table 2, a majority of participants reported difficulties with shopping without help: 53 (41.41%), preparing and serving meals without help: 61 (47.66%), doing house chores: 54 (42.19%), and doing laundry without help: 53 (41.41%). Similarly, other activities more frequently mentioned as impossible to perform independently included dispensing medications independently: 77 (60.16%), managing finances: 68 (53.13%), travelling independently on public transport: 77 (60.16%), and using the telephone: 67 (52.34%). The results on the Lawton scale did not reveal any significant statistical differences between genders (t= -0.3226, p=0.3737, not significant at p<0.05) when considering independence in activities of daily living explored. The relationship between education levels and scores on Lawton scale revealed a positive correlation between level of education and scores (r = +2.1036, p \leq 0.0000) – the

more educated respondents had higher scores. An inversely proportional correlation was also observed between severity of vision impairment and self-reliance in activities of daily living (r= -0.5945, p = 0.0000). A stronger independence was reported among participants with less severity of vision impairment ($\chi^2 = 58.61$; p = 0.0000) (Table 3). Analysis of the relationship between self-reliance in daily tasks and years of visual impairment showed the presence of relationship with some activities such as being able to use the telephone ($\chi^2 = 0.66$, p = 0.7196), being able to plan, prepare and serve meals without help ($\chi^2 = 4.13$, p = 0.1271), and doing laundry without help ($\chi^2 = 2.31$, p = 0.3155). Other activities did not show such correlation (Table 4).

Discussion

This study set out to investigate the most common difficult activities of daily living among visually impaired people in order to provide an understanding of the aspects that the generic rehabilitation training programs for independent living among this group should prioritise. Many elderly persons value their sense of independence, self-reliance and self-sufficiency.^{6,19} While vision impairment is associated with challenges of maintaining independence, particularly with daily tasks, findings from this study suggests that the most difficult daily-living-tasks for the participants included shopping without help, travelling independently, managing financial matters without help, and dispensing medications without the support of other people. These findings point out areas deserving attention as they highlight aspects that should be addressed not only for interventions to promote independent living but also for social inclusion for visually impaired persons in society. Firstly, given that traditional design retail shopping environments in many parts of the country focus primarily on mainstream market, with little attention to the needs of the visually impaired customers, retail shopping demands significant effort at every step of the shopping process for people with vision impairment, including getting

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6. Brown RL, Barrett AE. Visual impairment and quality of life among older adults: an examination of explanations for the relationship. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*. 2011; 66B (3): 364-373.
19. Swatski AL. The Elderly's Perception of the Impact on Mood, Socialization, and Mobility as a Result of Late Onset Visual Impairment: Implications for Dance/movement Therapy (Doctoral dissertation, Drexel University).

into the store; distinguishing colours, judging product quality; reading labels, receipts or store signage with tiny prints; negotiating store layout and dealing with store lighting; and interacting with sales associates.

Secondly, findings echo conclusions from previous studies that mobility is fundamental to independence^{31,32}. Participants reported limited capacity to travelling independently, and such reports emphasize the importance for mobility training among this group. Mobility restrictions associated with vision impairment were identified in earlier studies^{17,18} as a hindrance to social inclusion due to lack of confidence, fear of falls, fear of getting lost, fear of hidden dangers or obstacles, and feelings of vulnerability.^{20,33} It is possible that, for this group, the big fear of travelling independently could be compounded by mobility challenges and transport safety associated with people living with disabilities in Nigeria. Such challenges include, but are not limited to, lack of accessible transport infrastructure that do not meet the needs of the blind, poorly illuminated walkways ridden with potholes, elevated floor vehicles, and lack of disability awareness training for public transport staff.³⁴

Findings from this study also show that managing financial matters and making cash payments is a significant issue for this group. As computer automated systems are now in use for financial services that were previously delivered in person, there are evidences indicating that people living with vision impairment are more likely to experience economic and social disadvantage and are more at risk of poverty than those without disability.^{35,36} In Nigeria, common recognisable barriers which

complicate difficulties experienced by people with vision impairment to manage money and get equal access to technology-enhanced banking include a lack of user friendly online interface that are inaccessible with a screen reader, widespread use of Automatic Teller Machines (ATMs) that cannot be operated using speech, ATMs without head phone jacks to listen to audio instructions, unavailability of braille embossed debit cards, lack of audio enhanced security dongles for online transactions, ATM screen with poor contrast and fonts, etc. With the dearth of assistive technologies that can help identify currency notes and other inclusive infrastructure, adults with vision impairment are more likely to depend on family, friends or third parties to access and manage their finances and are arguably less likely to register for online or mobile telephone banking due to the difficulties associated with the computer mediated user interfaces.

The study also showed that dispensing medications without help still remains challenging for many visually impaired older persons. This is consistent with previous findings that most visually impaired adults face difficulties in handling their medication³⁷ and more specifically, reading medication labels, recognising expired medications, administering eye drops, and measuring liquid doses are difficult tasks for this group.^{38,39}

In Nigeria as well as many developing countries, pharmaceutical companies rarely include medication name in Braille on the drug package. A previous study identified difficulty with handling medication as one of the major reasons for drug non-compliance among many visually impaired persons in Nigeria.⁴⁰

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17. Brouwer DM, Sadlo G, Winding K, Hanneman MI. Limitations in mobility: Experiences of visually impaired older people. *British Journal of Occupational Therapy*. 2008;17(10):414-21.
 18. Lamoureux EL, Hassell JB, Keeffe JE. The determinants of participation in activities of daily living in people with impaired vision. *American journal of ophthalmology*. 2004 Feb 29;137(2):265-70.
 20. Gusi N, Prieto J, Forte D, Gomez I, Gonzalez-Guerrero JL. Needs, interests, and limitations for the promotion of health and exercise by a web site for sighted and blind elderly people: a qualitative exploratory study. *Educational Gerontology*. 2008;34(6):449-61.
 31. Pavey S, Douglas G, McCall S, McLinden M, Arter C. Steps to independence: the mobility and independence needs of children with a visual impairment. Recommendations and summary report, London: RNIB on behalf of RNIB, Guide Dogs, Opsis, DfES and VICTAR. 2002 Sep.
 32. Zijlstra GR, Balleman J, Kempen GI. Orientation and mobility training for adults with low vision: a new standardized approach. *Clinical rehabilitation*. 2013;27(1):3-18.
 33. Tolman J, Hill RD, Kleinschmidt JJ, Gregg CH. Psychosocial adaptation to visual impairment and its relationship to depressive affect in older adults with age-related macular degeneration. *The Gerontologist*. 2005;45(6):747-53.
 34. Ipingbemi O. Mobility challenges and transport safety of people with disabilities (PWD) in Ibadan, Nigeria. *African journal for the psychological studies of social issues*. 2015;18(3):15-27.
 35. Gallagher BA, Murphy E, Fennell A. Ageing, Vision Impairment and Digital Inclusion in Ireland. *The Journal of Community Informatics*. 2012;8(1).
 36. Pokempner J, Roberts DE. Poverty, welfare reform, and the meaning of disability. *Ohio St. LJ*. 2001;62:425.
 37. Zhi-Han L, Hui-Yin Y, Makmor-Bakry M. Medication-handling challenges among visually impaired population. *Archives of Pharmacy Practice*. 2017;8(1):8.
 38. Kentab BY, Al-Rowiali KZ, Al-Harbi RA, Al-Shammari NH, Balhareth et al. Exploring medications use by blind patients in Saudi-Arabia. *Saudi Pharmaceutical Journal*, 2015; 23(1):102-106
 39. Riewpaiboon A. How the blind cope with problems of medicine utilization: a study in Bangkok, Thailand. *Pharmacoepidemiology and drug safety*. 2009;18(8):708-12.
 40. Onakoya AO, Mbadugha CA. Self-reported adherence rates in glaucoma patients in Southwest Nigeria. *Journal of Clinical Sciences*. 2016;13(2):51.

A cursory look at the findings from this study suggests that, apart from dispensing medications, the visually impaired participants were more likely to cope with indoor daily living tasks (i.e. using the telephone, preparing and serving meals, doing household chores, and doing laundry) than outdoor tasks (i.e. shopping, travelling independently, and spending money). It is possible that, with increasing years of living with sight loss, visually impaired persons are more likely to have learnt to develop coping mechanisms for home-based activities of their daily lives and lead independent lives.⁴¹ While home-based tasks and indoor environment can be organised or modified to enable a visually impaired person make adjustments, adapt, and cope with challenges of daily living, the outdoor environment is, to a large extent, beyond the modification capacity of any individual. It is therefore imperative for government to make public places and facilities

accessible for people with vision impairment as this will not only promote their inclusion into society but also enhance their successful adaptation to daily-life challenges posed by vision impairment.

The study findings should be taken with caution due to the small sample size. While, environmental and societal factors play a crucial role in the adjustment process and impact on self-reliance abilities, personal factors also play an important part in the adjustment process. This study did not investigate the scope of personal factors that could have influenced participants' responses on daily tasks they regarded as difficult or easy. In addition, the list of possible challenges with activities of daily living culled from Lawton scale is not exhaustive of the spectrum of difficulties with daily tasks. Again, a majority of the participants were old (60 years and over) and may not reflect problems faced by younger patients.

Conclusion

All aspects of rehabilitation and intervention to support self-reliance among older people with vision impairment are important. Adjustment to and coping with vision impairment is a vital element of well-being because adjusting to one's environment, which it entails, can foster self-reliance, and the development of healthy self-esteem.⁴² As shown in the findings of this study, there is a need for improved access to public places and facilities for this group as a majority of the daily living tasks that they found most-challenging were associated with participation in public domains. Cost effective interventions to promote successful adaptation to vision impairment and self-reliance may therefore focus on more inclusive facilities for shopping, banking or managing money, travelling, as well as handling medications. This will be cost effective because government's single investment in vision-disability-inclusive facilities will enable the large numbers of people living with vision disabilities to participate actively in society and adapt positively to challenges of vision impairment. This kind of approach is a one-size-fits-all sustainable approach and not an individualistic approach which could be more expensive. The government, commercial institutions, travel and transport companies, and pharmaceutical companies must work in collaboration to address the special needs of the visually impaired. Rehabilitation professionals for independent living should focus more on the identified aspects and also champion advocacy for an inclusive society – as a potential avenue for independent living among this group.

41. Orr KS, Leven T. Community care and mental health services for adults with sensory impairment in Scotland. Scottish Executive Social Research; Scottish Executive Publishers. 464. 2006.

42. Tuttle DW, Tuttle NR. Self-esteem and adjusting with blindness: The process of responding to life's demands. Charles C Thomas Publisher; 2004.

Table 1.
Demographic characteristics of participants

	N	%
Gender		
Male	52	40.62
Female	76	59.38
Age		
60- 70	54	42.19
71 - 80	60	46.89
80+	14	10.92
Education Level		
High	28	21.88
Medium	39	30.46
Low	61	47.66
Vision impairment (Based on LogMAR Vision Acuity)		
Mild (LogMAR VA: 0.5-0.59)	34	26.57
Moderate (LogMAR VA: 0.6-1.0)	29	22.65
Severe (LogMAR VA: 1.1 – 1.4)	26	20.31
Blind (LogMAR VA \geq 1.5)	39	30.47
Household composition		
Single	15	11.72
Living with others	113	88.28

Table 2.
Participants' responses to activities of daily life

No	Content of Questionnaire	Responses (n, %)	
		Yes	No
1	Are you able to use the telephone independently?	61(47.66)	67(52.34)
2	Can you do your shopping without help?	75(58.59)	53(41.41)
3	Are you able to plan, prepare, and serve your meals without help?	67(52.34)	61(47.66)
4	Can you do your house chores without assistance?	74(57.81)	54(42.19)
5	Can you do your laundry without help?	75(58.59)	53(41.41)
6	Can you travel independently on public transportation?	51(39.84)	77(60.16)
7	Can you manage your financial matters and make cash payments without help?	60(46.87)	68(53.13)
8	Are you able to dispense your medications independently?	51(39.84)	77(60.16)

Table 3.
Severity of vision impairment in connection with Self-reliance among participants

No	Content of Questionnaire	Severity of Vision impairment	Self-reliance		χ^2 p<0.05
			Yes	No	
1	Are you able to use the telephone independently?	Mild (n= 34) Moderate (n=29) Severe (n=26) Blind (n= 39)	31 19 9 2	3 10 17 37	59.57 < .0001
2	Can you do your shopping without help?	Mild (n= 34) Moderate (n=29) Severe (n=26) Blind (n= 39)	34 26 10 5	0 3 16 34	73.58 < 0.0001
3	Are you able to plan, prepare, and serve your meals without help?	Mild (n= 34) Moderate (n=29) Severe (n=26) Blind (n= 39)	29 20 9 9	5 9 17 30	34.67 < 0.0001
4	Can you do your house chores without assistance?	Mild (n= 34) Moderate (n=29) Severe (n=26) Blind (n= 39)	30 20 16 8	4 9 10 31	36.78 < 0.0001
5	Can you do your laundry without help?	Mild (n= 34) Moderate (n=29) Severe (n=26) Blind (n= 39)	34 26 10 5	0 3 16 34	73.58 < 0.0001
6	Can you travel independently on public transportation?	Mild (n= 34) Moderate (n=29) Severe (n=26) Blind (n= 39)	24 16 8 3	10 13 18 36	33.96 < 0.0001
7	Can you manage your financial matters and make cash payments without help?	Mild (n= 34) Moderate (n=29) Severe (n=26) Blind (n= 39)	32 19 8 1	2 10 18 38	67.98 < 0.0001
8	Are you able to dispense your medications independently?	Mild (n= 34) Moderate (n=29) Severe (n=26) Blind (n= 39)	29 16 6 0	5 13 20 39	61.03 < 0.0001

Table 4. Years of vision impairment in correlation with self-reliance of respondents

No	Content of Questionnaire	Years of Vision Impairment	Self-reliance		χ^2 P (P<0.05)
			Yes	No	
1	Are you able to use the telephone independently?	1-5 (n=62)	36	26	0.66 0.7196
		5-10 (n=42)	21	21	
		10+ (n=24)	12	10	
2	Can you do your shopping without help?	1-5 (n=62)	48	14	10.48 0.0005
		5-10 (n=42)	25	17	
		10+ (n=24)	10	14	
3	Are you able to plan, prepare, and serve your meals without help?	1-5 (n=62)	40	22	4.13 0.1271
		5-10 (n=42)	19	23	
		10+ (n=24)	12	12	
4	Can you do your house chores without assistance?	1-5 (n=62)	40	22	10.10 0.0060
		5-10 (n=42)	14	28	
		10+ (n=24)	14	10	
5	Can you do your laundry without help?	1-5 (n=62)	36	30	2.31 0.3155
		5-10 (n=42)	23	19	
		10+ (n=24)	9	15	
6	Can you travel independently on public transportation?	1-5 (n=62)	49	13	11.40 0.0335
		5-10 (n=42)	26	16	
		10+ (n=24)	10	14	
7	Can you manage your financial matters and make cash payments without help?	1-5 (n=62)	41	21	22.28 < 0.0001
		5-10 (n=42)	13	29	
		10+ (n=24)	4	20	
8	Are you able to dispense your medications independently?	1-5 (n=62)	39	23	7.62 0.0221
		5-10 (n=42)	18	24	
		10+ (n=24)	8	16	

Ophthalmic Skills Assessment of Primary Health Care Workers at Primary Health Care Facilities in Rural Communities in Cross River State, Nigeria

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Abstract

Primary eye care is at the frontline in the elimination of the avoidable causes of blindness. Proficiency in the basic ophthalmic skills is a critical factor in the effective delivery of eye care services at the primary level of care. The aim of the study was to assess the ability of the primary health care workers to provide basic ophthalmic services at primary health care facilities. A semi-structured questionnaire was administered to 146 health providers in twelve primary health care facilities in Cross River State. Multi-stage random sampling technique was used in the selection of respondents for this study. The ability of the health providers to carry out visual acuity test and correctly identify cataract and conjunctivitis using pictures of eye conditions and patients complaints was also assessed and scored. Ethical approval was obtained from the ethics committee, Ministry of Health, Cross River State. Data were analysed using SPSS version 20.0.1. Majority of the participants could not perform the visual acuity test 126(86%). Their ability to correctly identify cataract and conjunctivitis were 78(53%) and 45(31%) respectively. Majority of those who showed the ability to perform some of the tests had previous training in primary eye care. The workers attributed the high failure rate/low score to lack of follow-up and inadequate duration of training on eye care, which was just for one day. The ophthalmic skills and knowledge of the primary health care providers were generally poor. This calls for a review of the strategy for the integration of primary eye care services into the existing primary health care system.

Key words: primary, skills, eye care, assessment, ophthalmic

Introduction

Globally, about 285million people are either blind or visually impaired. Of this number, 90% is said to be in developing countries¹. In Nigeria, a national survey in 2008 revealed that about 4.2 million people are either blind or visually impaired². Also, the prevalence of blindness in Cross River State is 0.8% across all age group³. An important similarity amongst these studies was that 80% of all causes of blindness were *preventable*. Prevention of diseases

is the hallmark or goal of primary health care (PHC). Primary health care has been identified by the World Health Organization (WHO) as the frontline of defense in tackling health care problems and many countries including Nigeria have adopted this.

Primary eye care (PEC) as an integral part of primary health care (PHC) is a key strategy that was adopted by the national health programs on the recommendation

1. Pascolini D, Mariotti SP. Global estimate of visual impairment. *British Journal of Ophthalmology*. 2010; 96(11):614-618.
2. Kyrai F, Murthy GV, Sivasubramaniam S, Gilbert C, Abdull M, Entekume G, Foster A, the Nigerian National blindness and visual impairment study group. Prevalence of blindness and visual impairment in Nigeria. *The Nigerian blindness and visual impairment survey. Investigative Ophthalmology & Visual Science*. 2009; 50: 2033-2039.
3. Nkanga DG, Asana U, Duke R, Ekpenyong BN, Etim BN. Refractive error; an important cause of blindness in Cross River State. Poster Abstract; World Congress on refractive error, Durban SA. 2007.

of the WHO. It includes promotion of eye health and provision of basic preventive and/or curative treatment for common eye disorders⁴. Primary eye care involves eye health promotion, treatment of simple eye diseases, identification of persons needing specialist eye care followed by prompt referral^{5,6}.

The content of PEC delivery is country specific, depending on the available resources and facilities. Although the content and human resource for PEC is yet to be prescribed both at the national and state levels in Nigeria, the primary goal of PEC which is the elimination of avoidable blindness requires the development of human resources and infrastructure at all levels⁷. Findings from East Africa showed that the percentage of PHC workers who received training in eye care was 34% in Tanzania, 97% in Kenya and 48% in Malawi.

To effectively deliver primary eye care services, primary health care providers must possess the necessary ophthalmic skills which should include the ability to perform visual acuity (a very important indicator of eye health), identify common ophthalmic conditions such as cataract and conjunctivitis. This study is an assessment of the ophthalmic skills of health providers in the primary health care centers in Cross River State, Nigeria.

Methodology

Cross River State (CRS) is one of the 36 states in Nigeria. The state is located in the south-south geopolitical zone. The state has an estimated population of 3.1million persons (2006 census figure). CRS is made-up of 18 local governments (LGA) areas each with its separate administrative council. Politically, the 18 LGAs in the state are grouped into three senatorial zones namely southern, central and northern zones. Each senatorial zone is made up of six LGAs. There are 567 PHC centres/facilities in CRS with at least one PHC centres in each community/ward in the LGA (CRS Ministry of Health,

Department of health statistics, June 2010).

The study was a descriptive cross-sectional study. A total of 146 staff from 12 PHC facilities, 4 PHC facilities from each senatorial zone participated in the study. A multi-stage random sampling method was used in the study to select PHC facilities in communities in CRS. First stage sampling was the selection of one LGA randomly from a list of LGAs in each of the three senatorial zones. In stage two sampling, since there is at least one PHC in a ward, four wards were selected per LGA using the simple random technique. In the third stage selection, one PHC was randomly selected, from each of the selected wards. In all, a total of 12 PHC centers (4 per zone) were sampled.

A pretested semi-structured questionnaire was administered to all health providers at the PHC facilities. The questionnaire had two sections. Section A – for the demographic details of the health care provider with six questions. Section B – focused on primary eye care skills assessment including the ability to recognize and manage cataract and conjunctivitis using a scoring system, the ability to perform visual acuity using a scoring system was done. Knowledge of the use of an ophthalmoscope, retinoscope, and tonometer was assessed using a Scoring system (Table 1).

Points were awarded for demonstrating how to perform visual acuity using a Snellen chart, identifying the correct distance for text, measuring each eye separately, recording and interpreting the results. Testing ability to recognize and manage two eye conditions (cataract and conjunctivitis) was done using pictures with a brief history of condition presented by the examiner.

Statistical package for social sciences (SPSS) version 20.0.1 was used for the data analysis. Data were presented in frequency tables. Ethical approval was given by the CRS health research ethics committee before the commencement of the research. Consent from health care providers was obtained verbally.

4. Khandekar R, Mohammed AJ. Health facilities for primary eye care in Sultanate of Oman, Primary eye care study. Sultan Qaboos University Medical Journal. 2000; 6(1): 21-26.

5. Gilbert C. The importance of primary eye care. Community Eye Health Journal. 1998; 11(26): 16-17.

6. Khan MA, Soni M, Khan MD. Development of primary eye care as an integrated part of comprehensive health care. Community Eye Health Journal. 1998; 11(25): 24-26.

7. Eze IB, Chuka-Okosa CM, Ezepue UF. Material resources for eye-care delivery in urban South eastern Nigeria. OJM. 2004; 16: 13-18.

Table 1: Score and Grade system for assessment of ophthalmic skills of PHC provider.

Score system for cataract and conjunctivitis identification test		Score(points)
Cannot describe the condition		0
Can describe the condition		2
Can name the condition		6
Can describe treatment		2
Score system for visual acuity Test		Score(points)
Identify correct distance		2
Tested one eye at a time		2
Correct recording of result		2
Correct interpretation of result		4
Score system for equipment identification and use test		Score(points)
Cannot name equipment		0
Can name equipment		2
Can describe use of equipment		2
Can use equipment		5
Overall Grade system for the PHC providers		
Points/score	Grade	
0 – 1	Poor	
2 – 3	Fair	
4 – 6	Good	
7 - 10	Very good	

Results

A total of one hundred and forty-six health care providers were interviewed using the questionnaire. The result shows that 136 (93.2%) were females, 27 (18.5%) were 20 – 29 years, 53 (36.3%) were 30 – 39 years, 56 (38.4%) were 40 – 49 years and 10 (6.8%) were 50 – 59 years. Most, 85 (58.2%) were community health extension workers (Junior and Senior), 19 (13%) were nurses, 14 (9.6%) were Community Health Officers, and 8 (5.5%) were Medical Laboratory Technicians. There were 3(2.1%) General practitioners, 2 (1.4%) were Pharmacy Technicians others included a social worker (0.7%), ward orderly? 12 (8.2%), volunteer 1 (0.7%) and medical recorder 1 (0.7%). The general practitioners (GP) were not stationed in one health facility. Each GP covered six LGA, moving from one centre to another as the need arose. The Pharmacy Technicians were seen in only two out of

the 12 health centres visited. Also, there was no ophthalmic nurse nor any trained eye care worker in all the centres visited. The proportion of workers who have been working in the center for less than one year were 16 (11%), 1- 3 years were 49 (33.5%), 4 – 6 years 41 (28.1%) and 7 years and above were 40 (27.4%). The number of staff who had training on primary eye care were 8 (5.5%), while those who provide basic eye care services were 14 (9.6%) (Table 2).

Of the 146 health workers assessed, 126 (86%) could not perform visual acuity test. Only 2(1.4%) of the participants had knowledge of the use of an ophthalmoscope, while none had a fair knowledge of the use of the retinoscope and tonometer. Seventy eight (54%) of the health workers passed the cataract knowledge score test, while 45 (31%) could identify conjunctivitis. Two out of the three General Practitioners were not available for assessment, due to itinerant nature of their engagement (Table 3).

Table 2: Demographic characteristics and description of primary health care workers/providers.

Characteristics	Frequency (n = 146)	Percentage (%)
Sex		
Male	10	6.8
Female	136	93.2
AGE (in years)		
20 – 29	27	18.5
30 – 39	53	36.3
40 – 49	56	38.4
50 – 59	10	6.8
OCCUPATION/PROFESSION		
General Practitioner	3	2.1
Nurse	19	13.0
Community Health Extension Worker	85	58.2
Community Health Officer	14	9.6
Pharmacy Technician	2	1.4
Medical Laboratory Technician	8	5.5
Social Worker	1	0.7
Ward Orderly	12	8.2
Volunteer	1	0.7
Medical Recorder	1	0.7
NUMBER OF YEARS OF SERVICE		
<1 years	16	11.0
1 – 3 years	49	33.5
4 – 6 years	41	28.1
7 years and above	40	27.4

PROVIDE EYE CARE SERVICES		
Yes	14	9.6
No	132	90.4
HAD TRAINING IN EYE CARE		
Yes	8	5.5
No	138	94.5

Table 3 : Basic Ophthalmic Skill Assessment of Primary Health Care workers

Variable	Skill assessment	Frequency N = 146	Percentage (%)
Visual Acuity test	Poor	126	86.3
	Fair	11	7.5
	Good	4	2.7
	Very Good	3	2.1
	Not indicated*	2	1.4
Ophthalmoscopy	Poor	142	97.2
	Fair	2	1.4
	Not indicated*	2	1.4
Refraction	Poor	144	98.6
	Not indicated*	2	1.4
Tonometry	Poor	144	98.6
	Not indicated*	2	1.4
Cataract	Poor	66	45.2
	Good	78	53.4
	Not indicated*	2	1.4
Conjunctivitis	Poor	99	67.8
	Good	45	30.8
	Not indicated*	2	1.4

*Two participants were absent

Discussion

A total of one hundred and forty six primary health care services providers participated in the study. Majority of the workers in the PHC were community health extension workers. This finding was similar to the study by Eze and Maduka-Okafor⁸ in

south-eastern Nigeria, where they reported that majority of the health care work force in PHC facilities were community health extension workers. It is important to note that there was no optometrist, ophthalmic nurse or any other especially trained eye care professional in any of the sampled health facilities. Females dominated the PHC work force, representing at least 80% of the work force. This perhaps reflects the gender sentiment associated with nursing and nursing related professions.

The number of workers who reported receiving training on eye care was low (9.6%). This is in contrast to the finding of Kalua et al⁹ who reported much higher numbers of trained health workers in the East African countries of Tanzania (34%), Kenya (97%) and Malawi (48). This low level of training may also explain why there was a correspondingly low number of staff who reported providing basic eye care services at the PHC facilities. This finding also implies that an "overstepping" of competence which was a source of concern in the East African countries was not reflected here as the number who reported providing eye care were lower than those who had received training. Onakpoya et al¹⁰ in a study in south-western Nigeria found that none of the PHC workers had received any in-service training on primary eye care.

In this study, the ability of the health care providers to carry out visual acuity was found to be very low. This is of critical importance as visual acuity is a critical indicator of health status of an eye and ought to be part of the routine procedure for every patient visiting the PHC facilities. Low scores were also recorded in Tanzania, Kenya, and Malawi⁹. Only two health providers had knowledge of the use of an ophthalmoscope, while none had any knowledge of the use of tonometer and retinoscope. Cataract is a major cause of blindness in Nigeria, yet about half of the workers at the primary health could not identify it. Also less than half of the workers could identify conjunctivitis which is the most common cause of red-eye.

8. Eze BI, Maduka-Okafor. An assessment of the eye care work force in Enugu state, South-eastern Nigeria. *Human resources for health*. 2009; 7(38): 1478-4491.

9. Kalua K, Gichangi M, Barassa E, Elijah E, Lewallen S, Courtright P. Skills of general health workers in primary eye care in Kenya, Malawi and Tanzania. *Human Resources for Health*. 2014; 12(1): S2.

10. Onakpoya OH, Adeoye AO, Adegbehinde BO, Akintola FB. Assessment of human and material resources available for primary eye care delivery in communities of Southwestern Nigeria. *West Indian Medical Journal*. 2009; 58(5): 472-477.

Those who had training on PEC but failed the test complained about the short length of training (one day), as inadequate and lack of follow up on those trained. This clearly indicates the need for review and update of primary health workers curriculum. The one day in-service training of primary health care workers on PEC in Cross River State, Nigeria, is low when compared with that of some other countries. In Pakistan, for instance, the primary eye care training is a course of an initial one week and then 2-3 days refresher courses every 6 – 12 months. While in Malawi, training ophthalmic medical assistant involves a one year course offered to medical assistants, clinical officers, and nurses at the Lilongwe school for health sciences⁹.

The findings from the study show a weakness in the

provision of primary eye care services at the primary health care facilities in Cross River State. This weakness in primary eye care services provision, which is also witnessed in East African countries, is perhaps one of the reasons why the burden of avoidable blindness keeps increasing in Sub-Saharan African. The ineffectiveness in providing primary eye care services can also explain the inappropriate presentation of primary eye care cases in many tertiary eye care facilities in Nigeria¹¹. Training of frontline health workers (Nurses, Junior Community Health Extension workers, Senior Community Health Extension workers, Midwives) at the primary health care facilities on basic eye care is in line with the Federal government of Nigeria Task shifting and Task sharing policy. This would improve accessibility, quality, and availability of primary eye care services to the underserved communities.

Conclusion

The elimination of avoidable blindness requires the development of both human resources and infrastructure. However, in a country that is not technologically advanced, coupled with the challenges of scarce resources, it may be wiser to focus more on human resource development as it will allow for the maximum use of already available technology. This is necessary if we must meet up with the global eye care action plan of reduction of visual impairment by 25% in 2019.

Acknowledgement:

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9. Kalua K, Gichangi M, Barassa E, Elijah E, Lewallen S, Courtright P. Skills of general health workers in primary eye care in Kenya, Malawi and Tanzania. *Human Resources for Health*. 2014; 12(1): S2.
 11. Mahmoud AO, Kuranga SA, Ayanniyi AA, Babata AL, Adido J, Uyanne IA. Appropriateness of ophthalmic cases presenting to a Nigerian tertiary health facility: implications for service delivery in a developing country. *Nigeria J. Clin. Pract.* 2010; 13(3): 280-3.

Case Study: Contact Lens Fitting in the Presence of Corneal Ectasia Post Penetrating Keratoplasty and Cataract Surgery

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Abstract

Keratoglobus (KG) is a bilateral corneal ectasia characterised by overall protrusion of the cornea associated with diffuse thinning from limbus to limbus. Differential diagnosis includes pellucid marginal degeneration (PMD) and keratoconus (KC). KG is rare in comparison to the prevalence of KC and PMD. Refractive error management in patients with corneal ectasia post penetrating keratoplasty should aim to achieve a best corrected visual acuity better than 6/12. Spectacles, soft lenses, hard lenses and scleral lenses are all viable options for refractive error management in the presence of corneal ectasia. A smooth regular refractive surface is important for one to obtain good VA. The use of intraocular lens implants to correct the ametropia allows for more options in post-surgery management of patients with corneal irregularities as less complex prescriptions are more affordable and available in more options compared to high toric prescriptions. It is important for practitioners to continue to try new methods of managing the non-standard patient for best visual outcomes. It will be beneficial for additional research to be carried out in the management of patients with corneal ectasias post cataract surgery to document what methods give best visual outcomes and high patient satisfaction.

Keywords: Hard lenses; Rose K2 IC; Keratoglobus, Corneal ectasia

Introduction

A 54 year old female patient attended our optometry practice for an eye exam having been referred by her Ophthalmologist (Oph) for refractive error management post right eye (RE) cataract extraction. She is complaining of poor near vision and discomfort out of her left eye (LE). She is a married mother of three and works in the judicial system. Her working life does not leave much time for hobbies but she does enjoy spending time with her family and does a lot of reading.

Case history

- Documented history of Keratoglobus diagnosed in her mid-20's.

- Recurrent ocular allergies and anterior uveitis flare-ups which have been managed with topical and subconjunctival steroids.
- Successful bilateral penetrating keratoplasty; RE in 2004 and LE in 2005.
- Uneventful cataract extractions; RE 2016 LE 2005
- Patient has had YAG laser treatments in both eyes post cataract removal
- Currently using a rigid gas permeable lens in the LE
- Patient is otherwise in good health and not taking any other medications.

Refraction

	RE	LE
Unaided VA	0.05	CF
Subjective Rx	+2.00/-6.00 X 15	-0.75/-5.25 X 60
Aided VA	0.2 ⁺²	0.4 ⁺²

*Best corrected binocular VA is 0.4⁺¹

*Reads N6 with a +2.50ADD at 25cm

*No improvement with pinhole OU

*VA measured using an LCD decimal chart

Slit-lamp examination

	RE	LE
HVID	12mm	12mm
IPAH	10mm	10mm
Pupil diameter	5mm photopic; 7mm mesopic	5mm photopic; 7mm mesopic
Conjunctiva	G2 hyperaemia	Mild Giant papillary conjunctivitis
Tear assessment	2 sec TBUT; 0.2mm TMH	3 sec TBUT; 0.2mm TMH
Cornea	KP's, graft scars visible, G2 Fluorescein staining	KP's, graft scars visible, G1 Fluorescein staining
Keratometry (Automated Huvitz HRK 7000A)	7.88/42.75 along 18 6.85/49.25 along 108 Distorted mires	6.05/55.75 along 19 7.21/46.75 along 109 Distorted mires
Average K's	7.37/46.00	6.63/51.25
IOL	Pseudophakic	Pseudophakic
I-CARE Tonometry at 13:26	11mmHg	15mmHg

*Patient topography maps and measurements have been stable for the last six years showing no progression of the condition.

Management Differential

1. **Spectacles:** the aided visual acuity achieved of 0.4⁺¹ is unsatisfactory for her daily needs

and falls short of the minimum driving standard of 0.5 best corrected visual acuity (BCVA). In addition, the use of separate pairs was not an option and the patient was also not keen on working through the adaptive learning period required for the use of progressive lenses.

2. **Soft contact lenses:** the noted dry eyes, history of recurrent infections and susceptibility to ocular allergies makes them an unsuitable candidate for soft lens use. The steep Keratometry readings and high cylindrical requirement in the prescription also rule out the use of readily available soft contact lenses. Although conventional specialised soft lenses made for steep corneas such as the Soflex Soft-K are available on the market, the higher cost and the relative increased risk of infection associated with soft lenses¹ leaves them unsuitable for this patient.
3. **Hard lenses:** the availability of many different types ranging from regular rigid gas permeable lenses to specialised toric lenses makes hard lenses the most viable option. The fact that the patient is familiar with the use of hard lenses is an added advantage as it reduces the adaptation time required compared to first time wearers.
4. **Scleral lenses:** scleral lenses are available in many different parameters and offer added comfort and protection to the ocular surface making them another viable option for this patient. However scleral lenses are considered high maintenance due to the need of daily saline vials in addition to the cleaning system.

Contact Lens Fitting

Specialised hard lenses made for corneal irregularities were considered first due to availability. The Rose K2 IC fitting set was used as the large diameter and larger optical zone was expected to give the best visual performance in a patient with Keratoglobus. The large total diameter would also serve best to vault the host/donor junction.

1. Dart JKG, Stapleton F, Minassian D, Dart JKG. Contact lenses and other risk factors in microbial keratitis. The Lancet. 1991 Sep 14;338(8768):650-3.

- RE first lens choice was 0.2mm steeper than avg. K at base curve 7.20
- LE first lens choice was equal to avg. K at Base curve 6.60

The first lens choice was made per Rose K fitting guidelines. An optimum fit was achieved in both eyes with the following parameters;

	RE	LE
Power	+0.50DS	-9.00DS
Base curve	7.10	7.0
Total diameter	11.4	10.8
Edge lift	Standard reduced	Standard reduced
BCVA	0.8 ⁺¹	1.2 ⁻¹

The above mentioned Rose K2 IC lenses were dispensed. The patient was able to read N5 print at 40cm with +2.00DS reading glasses.

Discussion

Keratoglobus (KG) is a bilateral corneal ectasia characterised by overall protrusion of the cornea associated with diffuse thinning from limbus to limbus. Differential diagnosis includes pellucid marginal degeneration (PMD) and keratoconus (KC). KG is rare in comparison to the prevalence of KC and PMD. It is present from birth whilst KC tends to present in the early teens and PMD presents much later. To accurately differentiate KG from KC a slit lamp exam, full corneal thickness map, anterior curvature map and anterior tomography elevation map is required^{2,3}. Histopathologic findings are similar in KC and KG both being characterised by higher levels of degradative enzymes and reduced levels of protease inhibitors^{2,4}. KG often has disruption of

the Bowman's layer; it may even be absent, and maximal thinning at the periphery⁴. KC is characterised by para-central corneal thinning.

A previous publication on fitting corneas post-keratoplasty stated that scleral lenses, small diameter RGP's and reverse geometry hydrogel lenses were the only contact lens options suitable for corneas exhibiting extreme protrusion⁵. The good visual outcome achieved with the use of specialised hard lenses such as the Rose K2 IC used above suggests that there are now more options available to manage patients with corneal ectasias post-surgery. The large diameter resulted in good lens centration on the cornea and good comfort.

Although this patient could have been dispensed a pair of glasses as her BCVA was significantly better than her unaided VA, it was important that we tried to achieve a better VA not only to meet the driving standards but to help the patient maintain a higher quality of life (QoL). A previous study which related measured BCVA to QoL found that the participants that measured the lowest in QoL also had the lowest BCVA and it was particularly significant when the BCVA was less than 6/126. It was therefore important for us to achieve a BCVA better than 0.5.

It was interesting to note that the RE VA significantly improved with the introduction of the contact lens despite it having very little corrective power. This further highlights the importance of a smooth regular refractive surface for one to obtain good VA. The use of intraocular lens implants to correct the ametropia allows for more options in post-surgery management of patients with corneal irregularities as less complex prescriptions are more affordable and available in more options compared to high toric prescriptions.

2. Krachmer JH, Feder RS, Belin MW. Keratoconus and related noninflammatory corneal thinning disorders. *Survey of Ophthalmology*. 1984 Jan 1;28(4):293–322.

3. Gomes JAP, Tan D, Rapuano CJ, Belin MW, Ambrósio R, Guell JL, et al. Global consensus on keratoconus and ectatic diseases. *Cornea*. 2015;34(4):359–69.

4. Meghpara B, Nakamura H, Vemuganti GK, Murthy SI, Sugar J, Yue BYJT, et al. Histopathologic and Immunohistochemical Studies of Keratoglobus. *Arch Ophthalmol*. 2009 Aug 1;127(8):1029–35.

5. Katsoulos C, Nick V, Lefteris K, Theodore M. Fitting the post-keratoplasty cornea with hydrogel lenses. *Contact Lens and Anterior Eye*. 2009; 1;32(1):22–6.

6. S AK, A A, T G, S A, T S. Vision related quality of life in patients with keratoconus., Vision Related Quality of Life in Patients with Keratoconus. *J Ophthalmol*. 2014;694542–694542.

Conclusion

It is important for practitioners to continue to try new methods of managing the non-standard patient cases for best visual outcomes. It will be beneficial for additional research to be carried out in the management of patients with corneal ectasias post cataract surgery to document what methods give best visual outcomes and high patient satisfaction.

Disclosure

The authors have no proprietary or commercial interest in any materials discussed in this article.

Barriers to Accessing Eye Care Services in the Federal Capital Territory, Abuja, Nigeria

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Abstract

This study was carried out to determine the barriers to accessing eye care services in the Federal Capital Territory (FCT), Abuja. Using 25 item semi-structured questionnaire, a descriptive cross sectional survey was carried out. The study population comprised 400 respondents. Data generated from the survey was analysed using SPSS 20 and was presented in tables, figures and percentages. The result from the study showed that 74.5% of the respondents were aware of the need for regular eye examination, yet they did not seek care. More males 85(55.9%) accessed eye care services than the females 67(44.1%), especially those in older age grade. Out of the 400 respondents, only 152 (38%) respondents utilized eye care services while the rest resorted to traditional methods of treatment. Utilisation significantly increased with age ($p < 0.05$), while utilisation by gender showed no statistically significant difference ($p > 0.05$). The barriers affecting the access of eye care services as reported by respondents included; no felt need, this accounted for 153(61.7%), others were high cost of services, lack of money, non-availability of eye care services, long waiting time and reluctance to go for eye care services. Although many respondents were aware of the need for regular eye check, the utilization was low. There should be concerted effort by the Federal Government, Non-Governmental Organisations (NGOs) and eye care practitioners to sensitize the community on the need for regular eye checks and also establish eye clinics/centres that are affordable and accessible to the people.

Key words: Barriers, access, eye care, utilisation, FCT

Introduction

Visual impairment and blindness due to ocular diseases is a significant public health problem in many parts of the world. According to World Health Organization Report in 2010, about 285 million people are visually impaired worldwide and out of these numbers, 39 million (14%) are blind while 246 million (86%) have low vision or severe visual impairment and 90% of them live in developing countries with poor economy¹. There have been several global initiatives to alleviate the increasing burden of eye diseases and some of the strategies include developing and establishing eye care services. In spite of these measures, evidence showed poor uptake and utilisation of these services. The efforts may be hampered by poor uptake of service. Barrier studies are being conducted in many settings to understand community poor response to service uptake with a view to influence positive behaviour change. Nigeria with an estimated

1. Mariotti SP, Pascolini D. Global estimates of visual impairment. Br J Ophthalmol.2012; (5):614-618.

population of about 181 million people (National Bureau of Statistics, 2012; United Nations, 2017) is the most populated country in Africa^{2,3}. The results of the National blindness and low vision survey conducted from 2005 – 2007 reported the prevalence of blindness and visual impairment at 0.78% for all ages and 4.2% for people aged 40 years and above⁴. If eye care services are made accessible to the people, prevalence of avoidable causes of blindness will be reduced⁵.

The Federal Capital Territory (FCT), Abuja according to the 2006 census has a population of 1,405,201. According to the national visual impairment and blindness survey in Nigeria, the North West geopolitical zone has the highest number of blind people (28.6%)^{4,5}. Both urban and rural dwellers in the Federal Capital Territory exhibit similarity in the prevalence of eye diseases yet there is a significant difference in their utilization of eye care services.

There are three major broad factors that affect the utilization of eye care services namely: availability, affordability and accessibility. Studies within and outside Nigeria have implicated gender, cost, ignorance, attitude, lack of education and urban residence as common reasons that contribute to the utilisation of eye care services^{6,7,8,9,10}.

In Nigeria and the Federal Capital Territory (FCT), eye care services are provided by ophthalmologists, optometrists, ophthalmic nurses and dispensing opticians. The available services range from routine eye examinations to invasive surgical procedures. Majority of the eye facilities are located in the cities and operational hours are usually from 8.00a.m to

6.00p.m on week days and only a few operate on weekends. The consequence is mal-distribution of skilled personnel and facilities. Evidence suggest that improved access to adequate health care leads to enhanced health outcomes. If eye care services are accessible, people who need the services will use them¹¹. The prevalence of blindness and visual impairment are high in Nigeria, determining the barriers to access of eye care services is essential for developing strategies to prevent blindness. This research was therefore carried out to determine the barriers affecting utilization of eye care services in the Federal Capital Territory Abuja, Nigeria.

Methodology

The study was a cross-sectional descriptive survey using knowledge, attitude, and perception (KAP) methodology in gathering data using both quantitative and qualitative methods. Questionnaire based interviews was used to collect quantitative data. Open ended questions were utilized to gather qualitative responses.

The instrument for data collection was the semi structured questionnaire. The questionnaire was pre-tested outside the study area on 20 respondents to determine its validity and reliability. The desired sample was calculated using the formula¹² $n = Z^2 Pq/d^2$ (Lawanga and Lemeshow, 1990¹²) and considering expected prevalence of 50% and allowing for an error of 5% at 95% confidence interval the sample size was calculated to be 400.

The FCT is located in the North central of Nigeria with a population of 1,405,201(2006 census) and made up of six area councils namely; Gwagwalada, Kuje, Bwari, Kwali, Abaji and the Abuja Municipal. Simple random

2. Nigerian National Bureau of Statistics, 2012
3. United nation, World population prospects, 2017 revision.pop/DB/wpp/Rev.2017/pop/F15-1
4. Kyari F, Gudlavalleti MVS, Sivsubramaniam S, Clare GE, Abdul MM, Entekume G, Foster A, the Nigeria National Blindness and Visual Impairment Study. Prevalence of blindness and visual impairment in Nigeria: The national blindness and visual impairment survey. Invest. Ophthalmol. Vis. Sci.2009 ;(5):2033-2039
5. Abdull MMS, Murthy GV, Gilbert C, Abubaka T, Ezelum C, Rabi MM. Nigerian National blindness and visual impairment Study group. Invest. Ophthalmol. Vis. Sci.2009;50(9):4114 -20
6. Nirmalan PK, Katz J, Robin AL, et al. Utilisation of eye care services in rural south India: the Aravind Comprehensive Eye Survey. The British Journal of Ophthalmology. 2004;88(10):1237-1241. doi:10.1136/bjo.2004.042606.
7. Ekpenyong BN, Ikpe BM. Uptake of Eye care Services in University of Calabar Teaching Hospital, Cross River State, Nigeria. Nigeria Journal of the Nigerian Optometric Association. JNOA.2009;15(1)24-27
8. Ocansay S, Kumi-Kyereme A, Awusambo-Asare K, Ileechie AA, Boadi-Kusi S, Abraham CH. utilization of eye care services among Ghanaian Elderly Population: Evidence from a peri-urban community. Ophthalmology Research: An international Journal. 2013; 1(2):89-101.
9. Ebeigbe J, Ovenseri-Ogbomo G. Barriers to utilization of eye care services in rural communities in Edo State, Nigeria. Borno Medical Journal.2014;11(2):98 -104
10. Ndep AO, Ekpenyong BN, Okareh O, Peter A, Ezenwankwo A, Ayuk FN. Eye care seeking behaviour of Patients in rural Cross River State, Nigeria. Research on Humanities and Social Sciences. 2017;7(2);11-15
11. Ekpenyong, B.N, Kovin Naidoo, Kelechukwu Ahaiwe, Onyebuchi Ndukwue, Ogar Emmanuel, Onyeka Ezenwankwo, Ekanem Ekanem. (2017). Visual Status and P revalence of Eye Disorders among School-age Children in Southern Nigeria. African Vision and Eye Health Journal 76:1
12. Lwanga, S. k, & Lemeshow, S. (1991). Sample size determination in health studies: A practical manual. World Health Organization Bulletin, 1 – 80.

sampling technique was used to select Bwari area council out of the six area councils. Bwari area council is made up of 10 wards. A random selection of clusters of population based household was used to enumerate the study sample. Clusters of approximately equal population size were defined geographically by using the census data, to create clusters of reasonably uniform size. The cluster was defined such that they contain 40 study participants per ward. The study participants comprised of adults 18 years and above.

Results

Results show that nearly half of the respondents 196 (49.0%) were within the age group of 18-35 years. Those in the age group of 36-53 years were 139 (34.75%), and 54 years and above were 65 (16.25%) of the study population. The sex distribution showed that 208 (52%) were male and 192 (48%) were female. Majority of the respondents were traders 135 (33.75) followed by civil servants 121 (30.25%) Table 1.

Respondents with secondary education had the highest number with 191 (47.75%), those with tertiary education were 115 (28.75%), respondents with primary education were 58 (14.5%) and those with no formal education were 36 (9.0%) (Table 2). Majority of the respondents were married 259 (64.75%), seven (1.75%) were widows, six (1.5%) were widowers and four (1.0%) were divorced (Table 1).

Out of 400 respondents, 299 (74.75%) were aware of the need for regular eye check. Majority of the respondents were not aware of any eye care services available in their locality (Table 2). Utilization of eye care services in this study significantly increased with increasing age, $p < 0.001$. Among the age group 18-35 years, 48 (24.5%) utilized eye care services, 61 (43.9%) of those within the age group 36 – 53 years utilized eye care services and majority 43 (66.2%) of adults 54 years and above utilized eye care services.

Result also revealed that 85 (40.9%) of the males utilised eye care services while 67(34%) of the females utilized eye care services. This difference however was not statistically significant ($p = 0.10$) (Table 3).

The barriers to accessing eye care services by gender is shown in Table 4. Majority of the respondents 153(38.3%) do not access eye care services because they perceived no felt need to seek help and majority of them were females. Other identified barriers were perceived high cost of services, non-availability of eye care services, lack of money and long waiting time (Table 4; Table 5)

Discussion

Majority of the respondents were female, younger adults, traders and civil servants, with secondary and tertiary education and married. Eye care services were not available to 52% of the respondents while about 25% were not aware of the need for regular eye checks.

In the utilization of eye care services, more males accessed eye care services than their female counterparts especially those in the age group of 54 years and above. Further, our findings established significant relationship between utilisation of eye care services and increasing age. This finding supports a similar study by Olusanya et al¹³, in 2016 who found increasing age and male gender influenced the utilization of eye care services. A study carried out by Ebeigbe and Oveneri-Ogbomo⁹ in Edo State, Nigeria also found that utilisation of eye care services increased with increasing age. The possible explanation for this result is that the prevalence of eye disorder increases with age and as such they elderly are more likely to have reason to visit eye care facility for treatment.

In this study, only 38% of respondents utilized eye care services while majority of those who did not, resorted to other means of care like traditional method of treatment. This result when compared to a study carried out in

9. Ebeigbe J, Oveneri-Ogbomo G. Barriers to utilization of eye care services in rural communities in Edo State, Nigeria. *Borno Medical Journal*.2014;11(2):98 -104
13. Olusanya BA., Ashaye AO, Owoaje ET, Baiyeroju AM, Ajayi BG. Determinants of Utilization of Eye Care Services in a Rural Adult Population of a Developing Country. *Middle East African Journal of Ophthalmology*.2016; 23(1):96–103. <http://doi.org/10.4103/0974-9233.164621>

the south western Nigeria¹² is higher, it is also higher than the result of the Cross River State Study¹⁰. This underscores the need to create more awareness in the Northern part of the country. It is however in agreement with some similar studies within and outside the country^{8,9,14}.

Barriers to accessing eye care services were expounded, among the reason given for not going for eye check was individuals' belief that 'there was no need for it'. This counts strongest and accounts for more than 25% across all the dimensions of sex, age group, education and occupation. Next was respondent feeling that eye care services will be expensive, which accounts for at least 10% in all the dimensions. Although 'none availability' also lent its weight amongst the reasons, others including no money to do so and reluctant about it account close to nothing. This result is in agreement with findings from other similar studies^{6,7,8,15,16}.

A closer look at 'feel it will be expensive', shows an interesting trend between age group and education. The feeling of eye care services being expensive increased by age group, the situation is reversed when considering the educational background of individuals. Respondents with higher educational background complained least of eye care being expensive while those with little or no education complained most of eye care services being expensive. It was observed that a greater percentage of individuals seek other sources of eye care rather than available standard eye clinics because they reported the services were cheaper. Studies^{6,16,17,18} within and outside the country agree with the findings of this study.

Conclusion

Although more respondents were aware of the need for regular eye check, the utilization was low. The study has identified no felt need as the major reason why people in Bwari area council do not access eye care services. Cost was also a factor. The other reason why individuals were not accessing eye care services was the non-availability of eye clinics/centres.

More effort needs to be made to get more people utilizing the eye clinic/centres. These include awareness and health education campaign on the need for regular eye check-up. Development of strategies for accessible and affordable eye care services.

6. Nirmalan PK, Katz J, Robin AL, et al. Utilisation of eye care services in rural south India: the Aravind Comprehensive Eye Survey. *The British Journal of Ophthalmology*. 2004;88(10):1237-1241. doi:10.1136/bjo.2004.042606.
7. Ekpenyong BN, Ikpeme BM. Uptake of Eye care Services in University of Calabar Teaching Hospital, Cross River State, Nigeria. *Nigeria Journal of the Nigerian Optometric Association*. JNOA.2009;15(1)24-27
8. Ocansay S, Kumi-Kyereme A, Awusambo-Asare K, Iiechie AA, Boadi-Kusi S, Abraham CH. utilization of eye care services among Ghanaian Elderly Population: Evidence from a peri-urban community. *Ophthalmology Research: An international Journal*. 2013; 1(2):89-101.
9. Ebeigbe J, Oveneri-Ogbomo G. Barriers to utilization of eye care services in rural communities in Edo State, Nigeria. *Borno Medical Journal*.2014;11(2):98 -104
10. Ndep AO, Ekpenyong BN, Okareh O, Peter A, Ezenwankwo A, Ayuk FN. Eye care seeking behaviour of Patients in rural Cross River State, Nigeria. *Research on Humanities and Social Sciences*. 2017;7(2):11-15
12. Lwanga, S. k, & Lemeshow, S. (1991). Sample size determination in health studies: A practical manual. *World Health Organization Bulletin*, 1 – 80.
14. Kovai V, Sannapaneni K, Ramaswany SB, Ravi T, Roa GN. Barriers to accessing eye care services among visually impaired population in rural Andhra Pradesh, South India. *India J. Ophthalmol*. 2007; (5): 365-371.
15. Ntsoane MD, Octunten OA. A review of Factors influencing the utilization of eye care services, *avehjournal*.2010;69(4):182 -192
16. Kimani K, Karimurio J, Gichuhis SM, Nyaga G, Wachira j, Ijako D. Barriers to utilisation of eye care services in Kibera and Dagoreti Kenya. *Journal of Ophthalmology of Eastern, Central and Southern Africa*.2008;14(2):55 -6
17. Ndegwa LK, Karinurio J, Okelo RO, Adala HS. Barriers to utilization of eye care services in Kibera slums of Nairobi; *East African medical Journal*.2005;82(10):506-8
18. Patel D, Baker H, Murdoch I. Barriers to uptake of eye care services by the Indian population living in Ealing, West London. *Health Education Journal*.2006;65(3):267-276

Table 1
Socio-demographic characteristic of respondents

Characteristics	Frequency (n = 400)	Percentage (%)
Sex		
Male	208	52.0
Female	192	48.0
Age (in years)		
18 – 35	196	49.0
36 – 53	139	34.75
54+	65	16.25
Occupation		
Trading	135	33.75
Civil Service	121	30.25
Farming	51	12.75
Artisans	28	7.00
Teacher	22	5.50
Student	19	4.75
Housewife	12	3.00
Unemployed	7	1.75
Lawyer	2	0.50
Retired	1	0.25
Highest Education		
No formal Education	36	9.00
Primary	58	14.50
Secondary	191	47.75
Tertiary	115	28.75
Marital Status		
Married		
Single	259	64.75
Widow	124	31.00
Widower	7	1.75
Divorced/Separated	6	1.50
	4	1.00

Table 2
Awareness of the need for regular eye check and availability of eye care services

Characteristics	Frequency (n = 400)	Percentage (%)
Awareness of need for regular eye check		
Aware of the need	299	74.75
Not aware of the need	101	25.25
Availability of eye care services		
No Presence of eye Clinics	208	52.0
Yes there are eye clinics	187	46.75
No Idea	5	1.25

Table 3
Utilization of eye care services by age and sex

Variables	Use n (%)	Non Use n (%)	Total n=400 (%)	Chi-square Value	df	p-value
Age						
18 - 35	48 (24.5)	148 (75.5)	196 (100)	39.1	2	<0.001
36 – 53	61 (43.9)	78 (56.1)	139 (100)			
54+	43 (66.2)	22 (33.8)	65 (100)			
Total	152 (38.0)	248 (62.0)	400 (100)			
Sex						
Male	85 (40.9)	123 (59.1)	208 (100)	1.52	1	0.10
Female	67 (34.9)	125 (65.1)	192 (100)			
Total	152 (38.0)	248 (62.0)	400 (100)			

Analysis based on Chi – square

Table 4
Barriers to accessing eye care services by gender

Barriers	Male (%)	Female (%)	Total (%)
No need for it	74 (35.6)	79 (41.1)	153 (38.3)
Feel it will be expensive	20 (9.6)	22 (11.6)	42 (10.5)
No eye clinic available	16 (7.7)	17 (8.8)	33 (8.3)
No money to do so	0 (0.0)	1 (0.5)	1 (0.3)
Reluctant about it	1 (0.5)	0 (0.0)	1 (0.3)
Waiting time too long	0 (0.0)	1 (0.5)	1 (0.3)
Not indicated	97 (46.6)	72 (37.5)	169 (42.3)
Total	208 (100.0)	192 (100.0)	400 (100.0)

Table 5
Percentage distribution of barriers to accessing eye care services in Bwari area council of the FCT by sex, age group, education and occupation

REASONS FOR NOT ACCESSING EYE CLINICS		FEEL IT WILL BE EXPENSIVE	NO MONEY TO DO SO	NO NEED FOR IT	NONE AVAILABLE	WAITING TIME TOO LONG	ALL %
Sex	Male	23.4	0	64.8	11.8	0	100
	Female	16.3	6	65.5	12.2	0.5	100
AGE GROUP	18-35	14.6	0	72.4	12.4	0.6	100
	36-53	23.5	1.5	58.8	16.2	0	100
	54+	52.6	0	36.9	10.5	0	100
EDUCATION	None	39.1	0	52.2	8.7	0	100
	Primary	26.4	2.6	60.5	10.5	0	100
	Secondary	19.5	0	69.7	10.8	0	100
	Tertiary	11.6	0	69.2	19.2	0	100
OCCUPATION	Artisan	33.3	0	58.3	8.4	0	100
	Civil servant	0	0	78.9	21.1	0	100
	Driving	100	0	0	0	0	100
	Farming	36.4	0	60.6	3.0	0	100
	Housewife	0	12.5	50	37.5	0	100
	Retired	0	100	0	0	0	100
	Student	5.9	0	76.5	17.6	0	100
	Teaching	18.2	0	54.5	27.3	0	100
	Trading	18.1	0	68.7	13.3	0	100
	Unemployed	100	0	0	0	0	100

Prevalence of Ocular Trauma among Paediatrics and Geriatrics: A Hospital based Study in Abia State Nigeria

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Abstract

Ocular trauma, one of the leading causes of monocular loss of vision especially in children and the elderly, poses a significant public health challenge. This study found the epidemiological characteristics of patients hospitalized in a private eye clinic and a tertiary eye centre in Umuahia, Abia State through a hospital based survey. The study reviewed over 172 injured eyes from 172 patients over a period of 5 years from January 2010 to December 2015. Of the 172 cases of trauma reviewed, 77 (44.8%) closed globe, 39 (19.8%) open globe, 50 (29.1%) lacerations, 5 (2.9%) chemical injuries, 6 (3.5%) thermal injuries were seen. The mean ages of the paediatric and geriatric patients were 9 ± 4.15 and 72 ± 4.27 respectively. The most frequent types of injuries were school-related in paediatrics and domestic-related in geriatrics. The majority (55 cases) of injuries in males and females occurred in the age group of 6-12 in paediatrics and (23 cases) 71-75 in geriatrics respectively. The relationship between final visual acuity (VA) and initial VA was tested using Chi-square test at 5% level of significance ($\alpha = 0.05$), and there was no significant difference in the initial VA and final visual outcome after trauma since ($\chi^2_{cal} = 137.96$) is greater than ($\chi^2_{tab} = 28.85$). The study reveals the need for adopting proper prevention measures especially for the age group that is mostly affected by ocular trauma. Also more studies are needed to further investigate the effectiveness of the current ocular trauma preventive or management strategies.

Keywords : Paediatrics, Geriatrics, Trauma, injuries

Introduction

Ocular trauma refers to any injury to the eye. The injury could be due to mechanical trauma (blunt or penetrating), chemical agents, or radiation (ultraviolet or ionizing) (see figure 1)¹ Ocular trauma is the leading cause of preventable vision loss in children and adults.² Ocular trauma is a common cause of visual impairment and accounts for a reasonable percentage of all patients presenting as ophthalmic accident and

emergency cases to the hospital.¹ It constitutes a major cause of visual morbidity worldwide, with significant socioeconomic impact. Every year, approximately 2 million eye injuries occur in the United States, of which, more than 40 thousand results in permanent visual impairment³. Eighteen million people worldwide have monocular blindness from traumatic injury.⁴ Injuries occur disproportionately commonly in childhood.

1. The British Medical Association. Illustrated Medical Dictionary. London: Dorling Kindersley Limited. UK. 2011; P.430
2. Firat PG, Doganay S, Cumurcu T, Demirel S, Kutukde D. Anterior Segment Complications in Ocular Contusion. Trauma & Treatment. 2011; 1:101
3. McGwin G, Xie A, Owsley C. Rate of eye injury in the United States. Archives of Ophthalmology. 2005; 123(7): 970-976).
4. Abbott J, Shah P. The epidemiology and etiology of pediatric ocular trauma. survey of ophthalmology .2013; 58(5): 476-485.

Every year a quarter of a million children present with serious ocular trauma. For the vast majority the injury is preventable⁴. In same vein, Négrel & Thylefors, 1998 opined that open globe ocular injuries constitute a major cause of visual morbidity worldwide with significant socioeconomic impact⁵. Eye injuries are a significant health problem leading to morbidity and blindness, especially in children³. Thirty-five percent of all the cases of ocular trauma occur in children under the age of 17 years in United States⁶. The frequency of hospitalization due to ocular trauma differs between developed and under developed countries; for example, it is 8 per 100,000 people in Scotland and 33 per 100,000 people in Guiana.⁶ In children, ocular trauma is the most common cause of decreased vision in one eye or non-congenital blindness⁷. An earlier study conducted by Desai et al, (1996), suggested that in children under the age of 3 years, the most common cause of enucleation is ocular trauma.⁸ Ocular trauma in children is different from that in adults⁹. Children with ocular trauma usually have no visual complaints and gradually develop amblyopia⁹.

Epidemiologic studies have shown that ocular trauma is a major cause of monocular blindness and potential disability in children worldwide¹⁰. The mechanisms of injury are quite different and often found under mundane circumstances. Orbital fractures in children are more likely to cause entrapment of orbital contents due to the structure of orbital bones at a developmental age and earlier surgical repair is usually beneficial¹⁰. Endophthalmitis after ocular trauma has a very poor prognosis, which may be reduced by early referral and intervention¹⁰.

Childhood ocular injuries present as frequent emergencies that require urgent attention¹¹. Several activities result to these ocular injuries, ranging from play, fight, and during administration of corporal punishment¹¹.

The elderly represents a unique, yet neglected ocular trauma population. The pattern of ophthalmic injury and outcome differs greatly between the geriatric and non-geriatric populations¹². A better understanding of these injuries is necessary to improve prevention and treatment strategies for potentially devastating open globe injuries in this susceptible population¹². Trauma is a serious and escalating problem for the elderly, and increasing age is a significant risk factor for patient mortality¹³.

From the findings of their studies, Levent et al, (2011) asserted that 'the prognosis of open globe injuries is very poor in geriatric patients'.¹⁴ Age-related structural changes and previous history of surgeries contribute to easy development of a rupture. During the treatment process, limited recovery capacity, ocular pathology in patients and low functional capacity in this age group exert negative effects on the prognosis¹⁴. With aging, the quality of vision worsens due to reasons independent of aging eye diseases. There are many changes significant in the non-diseased eye but the most important changes seem to be reduction in pupil size and loss of accommodation. These changes are associated with falls^{15,16}.

About one-third of people over age 65 fall each year, and the frequency of falls increases markedly with advancing age¹⁵. About 10% of falls result in serious injuries such as fractures, soft tissue injuries, and traumatic brain injuries. Complications from falls are the leading

3. McGwin G, Xie A, Owsley C. Rate of eye injury in the United States. *Archives of Ophthalmology*. 2005; 123(7): 970-976.
4. Abbott J, Shah P. The epidemiology and etiology of pediatric ocular trauma. *Survey of ophthalmology*. 2013; 58(5): 476-485.
5. Négrel AD, Thylefors B. The global impact of eye injuries. *Ophthalmic Epidemiology*. 1998; Vol. 5, Iss. 3.
6. Brophy M, Sinclair SA, Hostetler SG, Xiang H. Pediatric eye injury-related hospitalizations in the United States. *Pediatrics*. 2006; 117(6), e1263-e1271.
7. Aghadoost D, Zare M, Fazel MR, Dalirian AB. Epidemiology of Severe Ocular Injuries in Kashan. *Fez*. 2008; 11(5):47-50
8. Desai P, MacEwen CJ, Baines P, Minassian DC. Incidence of cases of ocular trauma admitted to hospital and incidence of blinding outcome. *Br J Ophthalmol*. 1996; 80(7):592-6.
9. Shoja MR, Miratashi AM. Pediatric ocular trauma. *Aeta Medica Iranica* 2006; 44(2):125-30
10. Salvin, JH. Systematic approach to pediatric ocular trauma. *Current opinion in ophthalmology*. 2007; 18(5), 366-372.
11. Okeigbemen VW, Kayoma DH. Pattern of Eye Injuries in Children in Benin City, Nigeria. *Orient Journal of Medicine*. 2013; Vol 25 [1-2]
12. Andreoli MT, Andreoli CM. Geriatric traumatic open globe injuries. *Ophthalmology*. 2011; 118(1), 156-159.
13. Hannan EL, Waller CH, Farrell LS, Rosati C. Elderly trauma inpatients in New York State: 1994-1998. *Journal of Trauma and Acute Care Surgery*. 2004; 56(6), 1297-1304.
14. Levent TÖK, TÖK ÖY, Özkaya D, Eraslan E, Sönmez Y, Örnek F, Bardak Y. Characteristics of open globe injuries in geriatric patients. *Ulus travmaacilcerrahiderg*. 2011; 17(5), 413-418.
15. Bonne S, Schuerer DJ. Trauma in the older adult: epidemiology and evolving geriatric trauma principles. *Clinics in geriatric medicine*. 2013; 29(1), 137-150.
16. Papadakis MA, McPhee SJ, Rabow MW. (Eds.). *Current medical diagnosis & treatment* 2015. New York: McGraw-Hill Medical. 54th Edition. 2015; P. 63

cause of death from injury in persons over age 65. Hip fractures are common precursors to functional impairment, nursing home placement, and death.¹⁶ Apart from just musculoskeletal problems, reduction in peripheral vision, decrease in transparency of ocular media in geriatrics, age related sclerosis of the lens, constriction of pupil in geriatrics, weakness of extra ocular muscles (resulting in sluggish eye movement), etc. are situations which predisposes the elderly to accidental falls. Falls is very significant as a cause of ocular trauma in geriatrics¹⁶.

There is a notable socioeconomic impact of ocular trauma which includes economic impact, cost of rehabilitation, and cost of loss due to impairment^{17,18}. The impact of ocular trauma in terms of need for medical care, loss of income and cost of rehabilitation services clearly points towards enormous economic burden on society as it affects mainly younger age group. Hence public awareness regarding use of protective measures and potential risk factors causing injury should be done on priority basis^{17,18}. This study will provide reliable information on the prevalence and pattern of ocular trauma among paediatrics and geriatrics in Umuahia. This study will identify the age group that is most affected and the possible post-traumatic visual outcome. Also, it will reveal the role of sex and age in the incidence of ocular trauma and the effectiveness of current trauma intervention methods and management strategies in Umuahia.

Materials and Methods

The research is a retrospective study based on data from clinic files of ocular trauma patients admitted from 1st January, 2005 to 31st December, 2015 (10 years). All medical records were anonymous and no patient information could be extracted except for research purposes. The procedure was approved by the Ethics Committee of the Federal Medical Centre, Umuahia and Abia State Specialist Hospital Umuahia.

This research was carried out in two tertiary eye care institutions in Umuahia the capital of Abia State, located in the south east region of Nigeria. The research was based on data collected from clinic records of the eye departments in the hospitals.

The data collected from the patient's clinic records were tabulated according to age, sex, occupation, VA, nature of injury, causes of injury, clinical diagnosis, primary treatment, secondary treatment and classification based on where the eye injury occurred. Completed records from patients were classified by the standardized international classification of ocular trauma according to Birmingham Eye Trauma Terminologies, BETT¹⁹. The Ocular Trauma Score (OTS), was used to evaluate the final visual outcome¹⁹. Data generated from the records of patients was represented in tables and charts. The mean, standard deviations based on OTS was calculated. Percentages were used. Spearman's correlation coefficient was used for inferential statistical analysis.

Results

The following results were obtained on the hospital based survey of ocular trauma in both paediatrics and geriatrics of 172 clinic records of patients, comprising of 104 males and 68 females. The age range of the paediatric patients were between 0-17years while that of the geriatrics were between 65 – 80 years with individual mean ages of 9 ± 4.20 and 72 ± 4.27 years respectively. The distribution of ocular trauma incidence in both paediatrics and geriatrics show that age group 6-11 years had the highest incidence of ocular trauma 55 (31.9)% and age group 76-80 years had the lowest incidence of ocular trauma 17 (9.9)%. Closed globe injury was the highest ocular trauma incidence 77 (44.8) % and chemical injury had the lowest incidence 5 (2.9) %. (See table 4).

But statistically tested using ANOVA at 0.05 significance level, concluded that there was no significant difference

16. Papadakis MA, McPhee SJ, Rabow MW. (Eds.). Current medical diagnosis & treatment 2015. New York: McGraw-Hill Medical. 54th Edition. 2015; P. 63

17. Cao H, Li L, Zhang M, Li H. Epidemiology of Pediatric Ocular Trauma in the Chaoshan Region, China, 2001–2010. PLoS ONE. 2013; 8(4), e60844. <http://doi.org/10.1371/journal.pone.0060844>.

18. Khandelwal RR, Shah K, Gautam A, Bisen R. Clinical profile and etiology of ocular trauma in a rural based hospital. Panacea Journal of Medical Sciences. 2014; 15-18.

19. Whitcher JP, Srinivasan M, Upadhyay MP. Corneal blindness: a global perspective. Bulletin of the world health organization. 2001; 79(3), 214-221).

in the occurrence of ocular injuries among geriatrics and paediatrics ($p>0.05$).

Table 4 shows the distribution of ocular trauma in geriatrics and paediatrics by gender. Male and Female subjects within the age group 6-11 years had the highest incidence. Male subjects had the highest incidence of Trauma 105 (60.47%) more than female subjects 67 (38.95%). Close globe injury occurred both in male subjects 48 (27.91%) and female subjects 29 (16.86%). Conclusions from the ANOVA test at 0.05 level of significance stated that there was no significant relationship between ocular trauma in paediatrics and geriatrics by gender ($p>0.05$).

The predisposing factors to ocular injury among paediatrics and geriatrics is shown in table 3. Age group 6-11 years still had the highest incidence of these predisposing factors. Domestic related factors had the highest occurrence 68 (34.9%) while violence/road related as a predisposing factor had the lowest occurrence 20 (11.6%). Statistical analysis using ANOVA at 0.05 significant level shows that significant relationship exists between occurrence of ocular trauma and the predisposing factors to ocular trauma ($p<0.05$).

The result of the comparison of final visual acuity of subjects at presentation and during the last follow up visit shows that NLP had the highest frequency both at presentation 56 (32.56%), VA¹⁹/100 - ⁵/200 had the lowest at presentation and VA ⁴/200 - LP had the lowest at last follow up visit with frequencies 21 (12.21%) and 19 (11.05%) respectively. Similarly, VA_{≥ 20}/40 had the highest frequency 57 (33.14%) at last follow up. (See Table 4). Statistical conclusions drawn based on the results of Chi-square (χ^2) test at 0.05 significance level show that there was significant difference in the final visual outcome ($p<0.05$).

Discussion

The distribution of ocular trauma is relatively dependent on the source of data. Data from hospitals provides a very relevant source of such information¹⁷. The results from this study show that the high incidence of hospitalized ocular trauma cases in Umuahia was closed globe injuries 77 (44.8%) followed by open globe injuries 34 (19.8%). This finding is in agreement with the results reported by other studies conducted within and outside Nigeria^{17,20,21}. However, the findings of the study differ from the results reported by Cao *et al*, in China, who reported a higher incidence of open globe injuries. This discrepancy could likely be attributed to a higher proportion of occupational injuries from sharp penetrating injuries and involvement of young persons in many plastic industries in China.¹⁷

The findings of this study show a relationship with age and susceptibility to ocular trauma. However, the mean age for ocular injuries among paediatrics in this study was 8.84 + 4.15 years, which corresponds to the study by Uysal *et al*. This is likely due to the school related injuries which contributed to the largest portion of injuries²². The mean age group for geriatrics in this study was 72.95 + 4.27 years which is also similar to the mean age reported by Andreoli & Andreoli, who reported 79.8 years²³. The large population of paediatric ocular trauma in this study may be due to their greater exposure in school, vocational activities and domestic activities. However, there was no significant difference ($p>0.05$) in the occurrence of ocular trauma among paediatrics and geriatrics. This finding is also in agreement with a similar study carried out by Andreoli & Andreoli²³.

The findings of this study show that there was a higher incidence of ocular trauma in males than in females with a ratio of occurrence of (1.7:1) for paediatrics and (1.23:1) for geriatrics. This is in accordance with the study by Al Wadei *et al*²⁴ in Egypt who reported that

17. Cao H, Li L, Zhang M, Li H. Epidemiology of Pediatric Ocular Trauma in the Chaoshan Region, China, 2001–2010. PLoS ONE. 2013; 8(4), e60844. <http://doi.org/10.1371/journal.pone.0060844>.
20. Ojabo CO, Adeniyi OS, Ogidi SA. Farm-related trauma in Makurdi, Nigeria. J Med. 2011; 20:114-119 [PubMed]
21. Pandita A, Merriman M. Ocular Trauma Epidemiology: 10 years' retrospective study. N.Z. Med.J. 2012; 125:61-69 [PubMed]
22. Uysal Y, Mutlu FM, Sobac G. Ocular Trauma Score in childhood open-globe injuries. Journal of Trauma and Acute Care Surgery. 2008; 65(6), 1284-1286.
23. Andreoli MT, Andreoli CM. Geriatric traumatic open globe injuries. Ophthalmology. 2011; 118(1) 156-159
24. Al Wadei EAY, Osman AA, Macky TA, Soliman MM. Epidemiological Features of Pediatric Ocular Trauma in Egypt. Journal of Ophthalmology. 2016;

children at a higher risk of trauma are males. This is also in agreement with other similar studies^{25,26}. This could be as a result of the more active nature of boys than girls and also because of the aggressive and adventurous nature of boys to girls^{26,27}. Several factors accounts for the incidence of ocular trauma.

Most of the factors are subject to environmental predispositions, age tendencies and frequent activities of patients²⁶. The findings of this study reveals that the paediatrics ocular trauma cases occur most frequent from school related activities, followed by domestic related injuries. These injuries resulted from corporal punishment.²² In the same manner, the findings of this study revealed that domestic accidents, especially as a result of accidental fall is the most prevalent cause of ocular trauma in geriatrics. This is in accordance with the findings of Andreoli & Andreoli, who reported fall as the most common mechanism of injury in geriatrics²³. Also an earlier study of Hannan *et al*, found that the majority of eye trauma cases of patients of 75years and old resulted from low fall¹³. Furthermore, the findings of this work showed that geriatric patients older than 75 years had more incidence of ocular trauma resulting from

falls. This could be associated with aging changes that affect balance. This is in agreement with the assertion made by Papadakis *et al*, who mentioned that balancing mechanisms are compromised with age resulting to postural sway²⁷

Results from this study show that most patients who presented with visual acuity of less than 4/200 – LP and NLP showed worse prognosis after treatment. The majority of patients that presented with visual acuity of $\geq 20/40$ and $20/50 - 20/100$ showed better prognosis after treatment. The category of patients with visual acuity of less than 4/200 are in the category of patients with open globe injury which showed poor prognosis after treatment. These findings are consistent with other studies^{28,29,30}. This study analyzed the ocular trauma score (OTS) distribution in the two types of globe injuries. The findings showed that those who had open globe injuries had lower Ocular Trauma Score (OTS) level when compared with those that had closed globe injuries. Higher OTS scores tend to indicate a better prognosis. The finding was also in line with the similar studies.study^{13,22}.

Conclusion

Ocular trauma is a significant cause of visual impairment in paediatrics and geriatrics. The incidence of ocular trauma in paediatrics is relatively higher than the incidence of ocular trauma in geriatrics, this difference however was not statistically significant. The age group 6-11 years and those 75 years and above presented with greater risk of ocular trauma. There is significant difference between ocular trauma and sex in paediatrics and geriatrics. Nature of ocular injury was found to be a strong determining factor of post traumatic visual outcome. The predictive visual prognosis of ocular trauma score is similar to the pattern of final visual acuity in this study. Hence ocular trauma score is a useful tool in predicting prognosis of ocular trauma and counseling patients.

13. Hannan EL, Waller CH, Farrell LS, Rosati C. Elderly trauma inpatients in New York State: 1994–1998. *Journal of Trauma and Acute Care Surgery*. 2004; 56(6), 1297-1304.
22. Uysal Y, Mutlu FM, Sobac G. Ocular Trauma Score in childhood open-globe injuries. *Journal of Trauma and Acute Care Surgery*. 2008; 65(6), 1284-1286.
23. Andreoli MT, Andreoli CM. Geriatric traumatic open globe injuries. *Ophthalmology*. 2011; 118(1) 156-159
25. Kyari F, Alhassan MB, Abiose A. Pattern and outcome of paediatric ocular trauma—A 3-year review at National Eye Centre, Kaduna. *Nigerian Journal of Ophthalmology*. 2000; 8(1), 11-16.
26. Strahlman E, Elman M, Daub E, Baker S. Causes of pediatric eye injuries: a population-based study. *Archives of Ophthalmology*. 1990; 108(4), 603-606.
27. Papadakis MA, McPhee SJ, Rabow MW. (Eds.). *Current Medical Diagnosis & Treatment 2015*. New York: McGraw-Hill Medical. 54th Edition. 2015; P.63.
28. Hossani, MM, Mohiuddin AA, Akhanda AH, Hossain MI, Islam MF. Pattern of ocular trauma. *Mymensingh Med J*. 2011; 20:377-380.
29. Kanoff JM, Turalba AV, Andreoli MT, Andreoli CM. Characteristics and outcomes of work-related open globe injuries. *Am. J Ophthalmol*. 2010; 150:265-269
30. Mansouri M, Faghihi H, Hajizadeh F, Rasoulinejad SA, Rajabi MT. Epidemiology of open-globe injuries in Iran: analysis of 2,340 cases in 5 years (report no.1). 2009; *Retina* 29: 114-119[PubMed].

Table 1
Distribution of ocular trauma incidence in both paediatrics (0-17yrs) and geriatrics (65 – 80 yrs)

Age (Yrs)	Close Globe Injury	Open Globe Injury	Laceration	Chemical Injury	Thermal Injury	Total
0-5	13 (7.6)	3 (1.7)	5 (2.9)	0	1 (0.6)	22 (12.8)
6-11	31 (18.0)	10 (5.8)	12 (7.0)	1 (0.6)	1 (0.6)	55 (31.9)
12-17	10 (5.8)	4 (2.3)	10 (5.8)	4 (2.3)	0	28 (16.3)
65-70	9 (5.2)	4 (2.3)	11 (6.4)	0	3 (1.7)	27 (15.7)
71-75	8 (4.7)	7 (4.1)	7 (4.1)	0	1 (0.6)	23 (13.4)
76- 80	6 (3.5)	6 (3.5)	5 (2.9)	0	0	17 (9.9)
TOTAL	77 (44.8)	34 (19.8)	50 (29.1)	5 (2.9)	6 (3.5)	172 (100)

One-way ANOVA Statistics was used for analysis:

F-calculated value = 12.2, F-tabulated value = 33.5. F-tab_(0.05,5,59) = 2.83

Since F-calculated value = 12.2 is not greater than the F-tabulated value = 3.35, we accept (H_0) and conclude that there is no significant predisposing factors to Ocular Trauma among the Age Factors. ($p > 0.05$).

Table 2
Distribution of Ocular Trauma Incidence in both Paediatrics and Geriatrics.

Age (Yrs)	Closed Globe Injuries		Open Globe Injury		Laceration		Chemical Injury		Thermal Injury		Total
	M(%)	F(%)	M(%)	F(%)	M(%)	F(%)	M(%)	F(%)	M(%)	F(%)	
0-5	8 (4.7)	5 (2.91)	2 (1.2)	1 (0.6)	3 (1.7)	2 (1.2)	0	0	1 (0.6)	0	22 (12.8)
6-11	20 (11.6)	10 (5.8)	6 (3.5)	4 (2.3)	7 (4.1)	6 (3.5)	1 (0.6)	0	0	1 (0.6)	55 (31.9)
12-17	7 (4.1)	3 (1.7)	3 (1.7)	1 (0.6)	6 (3.5)	4 (2.3)	3 (1.7)	1 (0.6)	0	0	28 (16.3)
65-70	6 (3.5)	4 (2.3)	3 (1.7)	1 (0.6)	8 (4.7)	4 (2.3)	0	0	0	1 (0.6)	27 (15.7)
71-75	4 (2.3)	4 (2.3)	4 (2.3)	3 (1.7)	4 (2.3)	4 (2.3)	0	0	0	0	23 (13.4)
76- 80	3 (1.7)	3 (1.7)	2 (1.2)	4 (2.3)	3 (1.7)	2 (1.2)	0	0	0	0	17 (9.9)
TOTAL	48 (27.9)	29 (16.8)	20 (11.6)	14 (8.1)	31 (18.0)	22 (12.8)	4 (2.3)	1 (0.6)	1 (0.6)	2 (1.2)	172 (100)

F-calculated value = 13.7, F-tabulated value = 2.83. F-tab_(0.05,5,59) = 2.83

Since F-calculated value = 13.7 is greater than the F-tabulated value = 2.83, we reject (H_0) and conclude that there is significant relationship between Ocular Trauma among sex in Paediatrics and Geriatrics.

Table 3
Predisposing Factors to Ocular Injury among Paediatrics and Geriatrics.

Age (Yrs)	School Related Injury	Domestic Related Injury	Vocational Related Injury	Violence/ Road Traffic Injury	Total
0 – 5	5 (8.3)	12 (6.98)	1 (0.67)	4 (2.3)	22 (12.8)
6 – 11	30 (17.4)	9 (5.2)	11 (6.4)	5 (8.3)	55 (31.9)
12 – 17	10 (5.8)	5 (8.3)	10 (5.8)	3 (1.7)	28 (16.3)
65 – 70	7 (4.1)	15 (8.7)	2 (1.2)	3 (1.7)	27 (15.7)
71 – 75	6 (3.5)	13 (7.6)	-	4 (2.3)	23 (13.4)
76 – 80	2 (1.2)	14 (8.1)	-	1 (0.6)	17 (9.9)
Total	60 (34.9)	68(39.5)	24(14.0)	20(11.6)	172(100)

One-way ANOVA Statistics was used for analysis:

F-calculated value = 12.2, F-tabulated value = 33.5. $F_{(0.05,5,59)} = 2.83$

Since F-calculated value = 12.2 is not greater than the F-tabulated value = 3.35, we accept (H_0) and conclude that there is no significant predisposing factors to Ocular Trauma among the Age Factors ($p > 0.05$).

Table 4
Comparison of Final Visual Acuity after treatment with Presenting Visual Acuity.

Visual Acuity	At Presentation		At Last Follow Up	
	Frequency	(%)	Frequency	(%)
NLP	56	32.56	34	19.77
$\frac{4}{200}$ - LP	30	17.44	19	11.05
$\frac{19}{100}$ - $\frac{5}{200}$	21	12.21	22	12.79
$\frac{20}{50}$ - $\frac{20}{100}$	37	21.57	40	23.26
$\geq \frac{20}{40}$	28	16.27	57	33.14
TOTAL	172	100	172	100

Review of folders from 2005 – 2015 (10 years)

The above research hypothesis was analyzed using Chi-square test of significance at 0.05 degree of freedom. Level of significance = 0.05. Degree of freedom = 16. χ^2 Calculated=137.96

χ^2 tabulated=28.85. If χ^2 -calculated value is greater than the χ^2 -tabulated value. Otherwise, Accept(H_0).

Since χ^2 -calculated value = 137.96 is greater than the χ^2 -tabulated value = 28.85, we reject (H_0) and conclude that there is significant difference in the Final Visual Outcome.

Relationship between Central Corneal Thickness, Vitreous Chamber Depth and Axial Length of Adults in a Nigerian Population.

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Abstract

The central corneal thickness (CCT), Vitreous chamber depth (VCD) and axial length (AL) are important ocular parameters used in the assessment of ocular health in relation to some ocular morbidities. Determining the differences in these parameters in relation to each other is fundamental to understanding the general eye health and also aid in developing strategies to help early diagnoses and management of some ocular conditions. Sixty-six (66) participants consisting of thirty-one (31) males and thirty-five (35) females between 18 to 68 years participated in this study. CCT and other ocular biometry was measured with Ultrasound pachymetry and ultrasonography. VCD was obtained by subtracting the sum of anterior chamber depth and lens thickness, from AL. All data were analyzed with Statgraphics plus version 5.1 and SPSS version 22.0. The mean age, CCT, VCD and AL were 37.2 ± 11.6 years, 536.71 ± 23.89 μm , 16.30 ± 0.80 mm and 23.60 ± 0.80 mm respectively. Statistically significant positive correlation was found between VCD and AL ($r = 0.83$, $r^2 = 69.3\%$, $p < 0.0001$). The difference in mean VCD (0.49mm) between males (16.63 ± 0.89 mm) and females (16.14 ± 0.66 mm) was statistically significant ($p = 0.015$). Similarly, the difference in mean AL (0.54mm) between males (23.89 ± 0.78 mm) and females (23.35 ± 0.74 mm) was statistically significant ($p = 0.005$). The linear association between CCT, VCD and AL was not significant. AL and VCD were not significantly affected by age but a significant negative linear relationship was found between CCT and age. The result of this study will aid in early diagnoses of some ocular morbidity by identifying risk factors associated with these parameters.

Keywords: Central corneal thickness, Vitreous chamber depth, Axial length

Introduction

The cornea is the most powerful refracting surface of the optical system of the eye¹. It accounts for two-thirds of the eye's focusing power. The transparency of the cornea with its appropriate refractive power determines the production of a sharp image at the retinal receptors. The refractive power of the cornea is in turn determined by its curvature and the difference in refractive indices² between it and air on one hand and aqueous on the other. Corneal thickness as measured by pachymetry is a sensitive indication of the cornea health status. Its measurement is useful for the diagnosis of disease, determining the effectiveness of medical and surgical treatment and the evaluation of contact lens wear³.

Central Corneal thickness (CCT) is an important indicator

1. Navarro R. The Optical Design of the Human Eye: a Critical Review J Optom. 2009; 2(1): 3–18.
2. David B, Fabrice M, Arthur H, Noel Z, Alexandre M. R, Rakhi J, Adriana A, Esdras A, Robert CA, Jean-Marie P. Optical power of the isolated human crystalline lens. Invest Ophthalmol Vis Sci. 2008; 49(6): 2541–2548.
3. Bovellet R, Kaufman SC, Thompson HW, Harmano H. Corneal thickness measurement with topical SP-2000P specula microscope and an ultrasound pachymeter. Arch Ophthalmol. 1999; 117: 868-870.

of cornea status and affects intraocular pressure (IOP) measurements.⁴ However, there is no general consensus with respect to how CCT varies with refractive error, corneal curvature, vitreous chamber depth (VCD), anterior chamber depth (ACD) and axial length (AL). The axial length is the distance between the anterior and posterior poles of the eye.⁵ In vivo, it is measured either by ultrasonography or by partial coherence interferometry (PCI). These measurements represent the distance between the anterior pole and Bruch's membrane. The axial length of the eye at birth is approximately 17 mm and reaches approximately 24 mm in adulthood. It is typically longer than 24 mm in myopes and shorter than 24 mm in hyperopes. Each millimetre of change in axial length of the eye corresponds to approximately 2.5 D.⁶ It has been found that myopes have longer axial length than hyperopes³ and also they are known to have the thinnest corneas ($449.65\mu\text{m}\pm 39.36\mu\text{m}$) followed by emmetropes ($542.66\mu\text{m}\pm 46.35\mu\text{m}$) and hyperopes ($557.67\mu\text{m}\pm 41.83\mu\text{m}$)⁷.

There are four ocular structures contributing to the refractive status of a given human eye, including the cornea, aqueous humour, lens and the vitreous humour. Myopia and other refractive-error disorders are consequences of uncoordinated contributions of ocular components to overall eye structures. In other words, the cornea and lens fail to compensate for axial length (AL) elongation (myopia) or shortening (hyperopia). Thus, parameters closely linked to measurements of these parts such as corneal curvature, anterior chamber depth (ACD), lens thickness (LT), vitreous chamber depth (VCD) and AL are widely

evaluated in the study of eye diseases. In general, AL increases rapidly in the early stages of life then slowly increases until adulthood,⁸ then decreases in old age and AL also reflects the sum of the thickness of the lens, ACD and the length of the vitreous chamber.

The VCD and the AL are considered to be the most representative indicators for the growth of the posterior segment, as well as the main factors in the progression of myopia⁹. The VCD occupies posterior 4/5ths of the eyeball. This chamber consists of the space between the lens and the retina, and is filled with a transparent gel called the vitreous humour. However, the vitreous has a viscosity two to four times that of pure water giving it a gelatinous consistency¹⁰. It also has a refractive index of 1.336. Recent research has highlighted the importance of central corneal thickness (CCT) in relation to several ocular conditions. Despite having an extensive knowledge of the structure and function of the cornea, little is known about the pathways that determine CCT. There are data to suggest however that CCT has a strong genetic component. There is no general consensus with respect to how CCT relates with axial length of the eyes and or anthropometric parameters¹¹⁻¹³.

A fundamental understanding of central corneal thickness (CCT), Vitreous chamber depth (VCD) and Axial Length (AL) is required due to the fact that these parameters play an important role in early diagnosis of some ocular conditions such as glaucoma and helps to understand the refractive status of a patient. This study therefore aims to determine the relationship between central corneal thickness (CCT), vitreous chamber depth (VCD) and Axial Length (AL) of adults in a Nigerian population.

3. Bovel R, Kaufman SC, Thompson HW, Harmano H. Corneal thickness measurement with topical SP-2000P specula microscope and an ultrasound pachymeter. *Arch Ophthalmol*. 1999; 117: 868-870.
4. Dueker DK, Singh K, Lin SC, Fechtner RD, Minckler DS, Samples JR, Schuman JS. Corneal Thickness Measurement in the Management of Primary Open-angle Glaucoma: A Report by the American Academy of Ophthalmology. *Ophthalmology* 2007; 114(9): 1779-1787
5. Abdul M, Madhusudhan U, Shankarappa C, Bhanuprakash G. "A Comparative Study in Axial Length of Eye between Myopes and Emmetropes in Indian Population". *Journal of Evidence based Medicine and Healthcare*; 2015; 2(26): 3870-3874.
6. Chae JB, Park HR, Yoon YH. Axial length measurement in silicone oil-filled eyes using laser Doppler interferometry. *Retina*. 2004; 24: 655-657.
7. Lin LL, Shih YF, Tsai CB. Epidemiological study of ocular refraction among school children in Taiwan. *Optom Vis Sci*. 1999; 76: 275-281.
8. Meng W, Butterworth J, Malecaze F, Calvas P. Axial Length of Myopia: A Review of Current Research. *Ophthalmologica* 2011;39(225):127-134
9. Yebra-pimentel E, González-méjome JM, García-resúa C, Giraldez-fernández MJ. The relationships between ocular optical Components and implications in the process of Emmetropization. *Arch Soc Esp Oftalmol* 2008; 83: 307-316
10. Dartt DA, Besharse J, Dana R, Battelle BA, Beebe D, Bex P, Bishop P, Bok D, D'Amore P, Edelhauser H, Mcloon L, Niederkorn J, Reh TA, Tamm ER. *Encyclopedia of the Eye*: Academic Press 2010; 1: 2344 pages
11. Chen MJ, Liu YT, Tsai CC, Chen YC, Chou CK, Lee SM. Relationship between central corneal thickness, refractive error, corneal curvature, anterior chamber depth and axial length. *J Chin Med Assoc* 2009; 72: 133-137.
12. Wong TY, Su DH, Foster PJ, Tay WT, Saw SM, Aung T. Central corneal thickness and its associations with ocular and systemic factors: The Singapore Malay Eye Study. *Am J Ophthalmol* 2009; 147: 709-716.
13. Shufelt C, Fraser-Bell S, Ying-Lai M, Torres M, Varma R. Refractive error, ocular biometry, and lens opalescence in an adult population: The Los Angeles Latino Eye Study. *Invest Ophthalmol Vis Sci*. 2005; 46: 4450-4460.

MATERIALS AND METHODS

This was an observational, prospective, cross sectional study to determine the relationship between central corneal thickness, axial length and vitreous chamber depth carried out at Rachel eye centre, Area 11, Garki, Abuja. The participants were recruited after detailed optometric examination that included best corrected visual acuity, refraction, slit-lamp examination, applanation tonometry and fundus examination. Only participants who had no ocular disease, no previous ocular surgery, normal IOP, normal blood pressure, refractive error less than or equal to $\pm 0.50D$ and participants without comorbidities affecting CCT such as diabetes mellitus were recruited. Exclusion criteria were previous ocular surgery (any type of eye surgery), glaucoma, trauma history, external eye disease, extensive pterygium, corneal edema or dystrophy, aphakia, amblyopia and lack of cooperation.

The study was approved by the Ethics and Research Committee of the Department of Optometry, Faculty of Life Sciences, University of Benin, Benin City, Edo State, Nigeria, in accordance with the tenets of Helsinki declaration for human participants.

Procedure

Measurements were taken on the right and left eye of each subject throughout this research after sterilization of the probe. The subject was comfortably seated with the head upright and eyes in the primary position of gaze. The probe was sterilized with 70% alcohol and allowed to air-dry. A drop of topical anaesthetic (Tetracaine HCl 0.1%) was instilled in subject's eye. The probe was carefully aligned perpendicularly to and lightly applanating the cornea.

CCT

The central corneal thickness was measured by ultrasound pachymetry using SW-1000P ultrasound Pachymeter (Tianjian Suowei Electronics Technology Co., LTD, China). Sterilized Ultrasound pachymeter probe (Speed: 1640ms^{-1} , Frequency: 20 MHz). The probe will be carefully aligned perpendicularly to and lightly applanating the anaesthetized cornea. Five readings were continually taken and the average

calculated by the instrument as measured CCT.

AL, VCD, LT and ACD

A-Scan ultrasonography using I-2100 A Scan Biometer (Cima Technology Inc., USA). Sterilized A-Scan Ultrasound biometer probe (Speed: 1548ms^{-1} , Frequency: 10 MHz). The probe will be carefully aligned perpendicularly to and lightly applanating the anaesthetized cornea. Five readings were continually taken and the average calculated by the instrument as measured AL, VCD, LT and ACD.

The subject was comfortably seated with the head upright and eyes in the primary position of gaze. The probe was sterilized with 70% alcohol and allowed to air-dry. A drop of topical anaesthetic (Tetracaine HCl 0.1%) was instilled in subject's eye. The probe was carefully aligned perpendicularly to and lightly applanating the cornea. At least ten readings are continually taken and the average calculated as the measured central corneal thickness (expressed in microns).

For the axial length measurement, subject's and instrument preparations are same as in pachymetry. The axial length was displayed on liquid crystal display (LCD) screen through output interface. Three measurements were taken for each subject and the average calculated as the measured variable. All measurements were taken between 10.00 am and 12.00 noon. All measurements were taken by the same observer to avoid inter-observer bias.

Statistical Package

All data obtained were analyzed with Statgraphics plus ver. 5.1 (Statistical graphics corp., USA) and SPSS ver. 22.0 (SPSS Inc, Chicago IL, USA). Measures of spread including standardized kurtosis and standardized skewness were derived. The measured variables (CCT, spherical equivalent refractive error, axial length, vitreous chamber depth) was tested for normality with the Kolmogorov Smirnov Z - test (normal distribution when the lower p-value is greater than 0.05). Analysis of variance (ANOVA) was used to compare variables across age groups and post hoc test for pair wise comparison within the groups. Gender-related differences in measured variables were tested with student's t-test (unpaired). The correlation or association between variables was tested using regression analysis. Statistically significant

will be declared when p-value is < 0.05.

Results

A total of 66 (n=66) participants (132 eyes) aged between 18 to 68 years with mean age of 37.2 ± 11.6 years, consisting of 31 males and 35 females participated in this study (Table 2). The difference in mean age between males (38.8 ± 12.0 years) and females (35.7 ± 11.1 years) was not statistically significant (unpaired t-test: $t = 1.09$, $df = 64$, $p = 0.28$). The difference in mean CCT between males ($536.7 \pm 38.38 \mu\text{m}$) and females ($536.7 \pm 19.50 \mu\text{m}$) was not statistically significant ($p > 0.05$) (Table 4). However, the difference in mean VCD (0.49mm) between males (16.63 ± 0.89 mm) and females (16.14 ± 0.66 mm) was statistically significant (unpaired t-test: $t = 2.571$, $df = 64$, $p = 0.015$). Men had deeper VCD than their female counterparts (Table 4). Similarly, the difference in mean AL (0.54mm) between males (23.89 ± 0.78 mm) and females (23.35 ± 0.74 mm) was statistically significant ($t = 2.90$, $df = 64$, $p = 0.005$). By this men have longer axial length than women.

The mean CCT was $536.7 \pm 23.89 \mu\text{m}$ (Table 4). The correlation between CCT and age showed a negative trend, though not statistically significant ($r = -0.20$, $r^2 = 3.8\%$, $p = 0.12$). The linear regression model is represented by: $\text{CCT} = 551.7 - 0.404 \text{ AGE}$ (Figure 1). The model as fitted explains 3.8% of the variability in CCT. From the regression model, a prediction of approximately $4.0 \mu\text{m}$ decreases in CCT per decade can be made. The mean VCD was 16.37 ± 0.81 mm (Table 4). Regression analysis performed on VCD and age showed no statistically significant correlation ($r^2 = -0.07$, $p = 0.58$). The linear regression

model is represented by: $\text{VCD} = 16.55 - 0.05 \text{ AGE}$. The mean AL was 23.60 ± 0.80 mm (Table 4). There was no statistically significant correlation between AL and age ($r = 0.078$, $p = 0.53$). The linear regression model is represented by: $\text{AL} = 23.40 + 0.05 \text{ AGE}$.

There was no statistically significant linear relation between CCT and VCD ($r = 0.014$, $p = 0.91$). The linear regression model is represented by: $\text{CCT} = 543.57 - 0.419 \text{ VCD}$. In the same vein, the correlation between CCT and AL (Table 4) was not statistically significant ($r = 0.032$, $P = 0.80$). The linear regression model is represented by: $\text{CCT} = 559.45 - 0.963 \text{ AL}$. Statistically significant positive correlation was found between VCD and AL ($r = 0.83$, $r^2 = 69.3\%$, $p < 0.0001$). The model as fitted explains 69.3% of the variability in VCD (Figure 2).

Discussion

When making decisions in clinical practice, parameters that are quantifiable are very important to aid accurate diagnosis of a clinical condition and cannot be over emphasized. Quantifiable parameter such as CCT has proven to be of great usefulness in the diagnosis of ocular conditions such as Glaucoma and also an indicator of corneal health status. In this study, the mean CCT was higher than the mean CCT reported by some other researchers¹⁴⁻¹⁸ but was closely in line with Doughty and Zaman¹⁹ and Atchison et al.,²⁰ they reported a mean CCT of $536 \pm 31 \mu\text{m}$ and of $534 \pm 0.047 \mu\text{m}$ respectively. A non-statistically significant negative correlation between CCT and age was found in this study, some studies showed a similar finding although statistically significant²¹⁻²³.

14. Eballe AO, Koki G, Ellong A, Owono D, Epee E, Bella LA. Central corneal thickness and Intraocular pressure in the Cameroonian non glaucomatous population. Clin Ophthalmol. 2010; 4:717-724.
15. Gelaw Y, Kollmann M, Irungu NM, Ilako DR. The influence of central cornea thickness on intraocular pressure measured by Goldmann applanation tonometry among selected Ethiopian Communities. J Glaucoma. 2010; 19(8): 514-518.
16. Iyamu E, Ituah I. The relationship between central corneal thickness and intraocular pressure: A comparative study of normals and glaucoma subjects. Afr J Med Sci. 2008; 37(4): 345 - 353.
17. Leksukul M, Aimpun P, Nawapattarakul B, Bumrungsawat S, Trakulmunkijjarn T, Charoenvanichvisit J. The correlations between central corneal thickness and age, gender, intraocular pressure and refractive error of aged 12-60 years old in rural Thai community. J Med Assoc Thai. 2005; 88: 175-179.
18. Mohamed H, Jorge LA, Pascual C, Walid HA, Juan JP. Relationship between Anterior Chamber Depth, Refractive State, Corneal Diameter, and Axial Length. J Refract Surg. 2009; 16: 336-340.
19. Doughty MJ, Zaman ML. Human corneal thickness and its impact on intraocular pressure measures: A review and meta-analysis approach. Surv Ophthalmol. 2000; 44, 368-408.
20. Atchison D, Jones C, Pritchard N, Pope J, Schmid K, Strugnell W. Eye shape in emmetropia and myopia. Invest Ophthalmol Vis Sci. 2004; 45: 3380-3386.
21. Iyamu E, Kio F, Idu FK, Osedeme B. The relationship between central corneal thickness and intraocular pressure in adult Nigerians without glaucoma. Sierra Leone. J Biomed Res. 2010; 2(2): 95 - 102.
22. Wong AC, Wong CC, Yuen NS, Hui, SP. Correlational study of central corneal thickness measurements on Hong Kong Chinese using optical coherence tomography, orbscan and ultrasound pachymetry. Eye. 2002; 16: 715-721.
23. Galgauskas S, Juodkaite G, Tutkuvienė J. Age-related changes in central corneal thickness in normal eyes among the adult Lithuanian population. Clinical Interventions in Aging. 2014; 9: 1145-1151.

Iyamu and Ituah¹⁶ and Mohamed *et al*²⁴ reported that there was no significant association between CCT and age. Doughty and Zaman¹⁹, found that age did not appear to influence CCT across the studies of Caucasian groups, but age-related decrease were reported in non-Caucasian groups although some recent studies have reported age effects on CCT^{17, 25-30}, while other studies have not found any age effect on CCT.³¹⁻³⁴ From the regression equation $CCT = 551.7 - 0.404 AGE$, a decrease of approximately 4.0 μm in CCT for every decade was predicted in this study. Eballe *et al.*¹⁴ also reported a similar finding that CCT decreases by 4.2 μm for each 10 years of life. Iyamu *et al.*²¹ also reported a statistically significant negative correlation between CCT and age ($r = -0.25$, $p = 0.021$) that was represented by $CCT = 571.93 - 0.513AGE$. From the equation given in their study, a decrease of approximately 5.0 μm in CCT for every 10-year increase in age was predicted, and this was similar to that obtained in this study. This relationship between CCT and age that is the change in CCT with age can be attributable to changes in the structural biomechanical properties of the cornea that occur as a person ages³⁵. Kamiya *et al*³⁶, also reported that biomechanical data for the cornea change during the course a lifetime, but could not identify significant changes in age-related CCT. Thinning of the cornea at a rate of 3–7 μm per decade has been observed in older age in

some ethnic groups²³. Referring to theory based on histologic studies, the corneas of older people are thinner because of a reduction in keratocyte density and possible destruction of collagen fibers, and senior individuals are exposed to environmental factors for a longer period of time, which might influence corneal structure³⁷.

The difference in mean CCT between males (536.7 \pm 38.38 μm) and females (536.7 \pm 19.50 μm) was not statistically significant ($p > 0.05$). This was similar to the report of Hawker *et al.*,³⁸ they found out that there was no significant difference in CCT between men and women (mean CCT 546.1 μm and 542.7 μm respectively, $p = 0.15$). Other studies^{11, 29, 30, 39} also suggest a gender difference in ocular biometrics with women having a significantly thinner cornea. Also it was observed in Iyamu *et al.*²¹ that the mean CCT of males was higher (552.8 μm) than females (543.8 μm) however the difference in mean CCT between males and females was not statistically significant ($P = 0.41$) in line with this study and also favours some studies^{16, 18, & 40}, they reported that gender-related differences in CCT was not significant ($p > 0.05$). Doughty and Zaman,¹⁹ found no apparent gender influence across Caucasian group studies. Some studies,^{20, 27} have reported males having slightly thicker corneas than females, but others have not found gender-related differences.^{17, 25, 28, 31 & 32}

11. Chen MJ, Liu YT, Tsai CC, Chen YC, Chou CK, Lee SM. Relationship between central corneal thickness, refractive error, corneal curvature, anterior chamber depth and axial length. *J Chin Med Assoc* 2009; 72: 133–137.
14. Eballe AO, Koki G, Ellong A, Owono D, Epee E, Bella LA. Central corneal thickness and Intraocular pressure in the Cameroonian non glaucomatous population. *Clin Ophthalmol*. 2010; 4:717–724.
16. Iyamu E, Ituah I. The relationship between central corneal thickness and intraocular pressure: A comparative study of normals and glaucoma subjects. *Afr J Med Sci*. 2008; 37(4): 345 – 353.
17. Lekskul M, Aimpun P, Nawanoopparatskul B, Bumrungsawat S, Trakulmungskijarn T, Charoenvanichvisit J. The correlations between central corneal thickness and age, gender, intraocular pressure and refractive error of aged 12–60 years old in rural Thai community. *J Med Assoc Thai*. 2005; 88: 175–179.
18. Mohamed H, Jorge LA, Pascual C, Walid HA, Juan JP. Relationship between Anterior Chamber Depth, Refractive State, Corneal Diameter, and Axial Length. *J Refract Surg*. 2009; 16: 336–340.
19. Doughty MJ, Zaman ML. Human corneal thickness and its impact on intraocular pressure measures: A review and meta-analysis approach. *Surv Ophthalmol*. 2000; 44, 368–408.
21. Iyamu E, Kio F, Idu FK, Osedeme B. The relationship between central corneal thickness and intraocular pressure in adult Nigerians without glaucoma. *Sierra Leone. J Biomed Res*. 2010; 2(2): 95 – 102.
23. Galgauskas S, Juodkaite G, Tutkuviene J. Age-related changes in central corneal thickness in normal eyes among the adult Lithuanian population. *Clinical Interventions in Aging*. 2014; 9: 1145–1151.
24. Mohamed H, Jorge LA, Pascual C, Walid HA, Juan JP. Relationship between Anterior Chamber Depth, Refractive State, Corneal Diameter, and Axial Length. *J Refract Surg*. 2009; 16: 336–340.
25. Cosar C, Banu MD, Sener A, and Bozkurt MD. Orbscan Corneal Topography System in Evaluating the Anterior Structures of the Human Eye. *Cornea*. 2003; 22: 118–121
26. Landers JA, Billing KR, Mills RA, Henderson TR, Craig JE. Central corneal thickness of indigenous Australians within Central Australia. *Amer J Ophthalmol*. 2007; 143: 360–362.
27. Nomura H, Ando F, Niino N, Shimokata H, Miyake Y. The relationship between age and intraocular pressure in a Japanese population: The influence of central corneal thickness. *Curr Eye Res*. 2002; 24: 81–85.
28. Rüfer F, Schroder A, Bader C, Erb C. Age-related changes in central and peripheral corneal thickness: Determination of normal values with the Orbscan II topography system. *Cornea*. 2007; 26: 1–5.
29. Shimmyo M, Ross AJ, Moy A, Mostafavi R. Intraocular pressure, Goldmann applanation tension, corneal thickness, and corneal curvature in Caucasians, Asians, Hispanics, and African Americans. *Amer J Ophthalmol*. 2003; 136: 603–613.
30. Suzuki S, Suzuki Y, Iwase A, Araie M. Corneal thickness in an ophthalmologically normal Japanese population. *Ophthalmol*. 2005; 112: 1327–1336.
31. Altinok A, Sen E, Yazici A, Aksakal FN, Oncul H, Koklu G. Factors influencing central corneal thickness in a Turkish population. *Curr Eye Res*. 2007; 32: 413–419.
32. Eysteinsson T, Jonasson F, Sasaki H, Arnarsson A, Sverrisson T, Sasaki K. Central corneal thickness, radius of the corneal curvature and intraocular pressure in normal subjects using non-contact techniques: Reykjavik Eye Study. *Acta Ophthalmologica Scandinavica*. 2002; 8: 11–15.
33. Khoramnia R, Rabsilber TM, Auffarth GU. Central and peripheral pachymetry measurements according to age using the Pentacam rotating Scheimpflug camera. *J Cataract Refract Surg*. 2007; 33: 830–836.
34. Sanchis-Gimeno JA, Lleo-Perez A, Alonso L, Rahhal MS. Caucasian emmetropic aged subjects have reduced corneal thickness values: Emmetropia, CCT and age. *Inter Ophthalmol*. 2004; 25: 243–246.
35. Iyamu E, Iyamu JE, Amadasun G. Central corneal thickness and axial length in an adult Nigerian population. *Journal of Optometry*. 2013; 6 (3):154–160.
36. Kamiya K, Shimizu K, Ohmoto F. Effect of aging on corneal biomechanical parameters using the ocular response analyzer. *J Refract Surg*. 2009; 25 (10):888–893.
37. Patel HY, Patel DV, McGhee CN. Identifying relationships between tomography-derived corneal thickness, curvature, and diameter and in vivo confocal microscopic assessment of the endothelium in healthy corneas of young adults. *Eye* 2009; 23(2):270–277
38. Hawker MJ, Naoakira N, Fujiko A, Hiroshi S, Yozo M. Relationship between age and central corneal thickness in a Japanese population. *Jpn J Clin Ophthalmol*. 2009; 55(3):300–302
39. Hahn S, Azen S, Mei YL, Varma R. Los Angeles Latino Eye study group. Central corneal thickness in Latinos. *Invest Ophthalmol*. 2003; 44(4): 1508–1512.
40. Foster PJ, Alsbirk PH, Baasahu J, Munkhbayar D, Uranchimeg D, Johnson GJ. (1997). Anterior chamber depth in Mongolians: Variation with age, sex and method of measurement. *Amir J Ophthalmol*. 1997; 124, 53–60.

The failure in this study to detect a relationship between CCT and AL was in line with some studies^{29,41 & 42}. Chang *et al.*⁴³ demonstrated significantly thinner CCTs in eye balls with greater axial length ($r = -0.502$, $p < 0.001$). They proposed that as the surface area of the cornea is increased, the stromal became thinner and reduced CCT could be expected as the eyeball elongated axially. Although their sub-population may be too small to give a true relationship between AL and CCT in the general population.

The mean VCD gotten from this study is in keeping with the VCD reported in adult population in some studies which ranged between 14.42 to 16.60mm⁴⁴⁻⁴⁷. In this study no statistically significant correlation was found between VCD and Age ($r = -0.07$, $p = 0.58$), although there was a negative trend which might suggest a decrease in VCD with age but not statistically significant. This was in line with Atchison *et al.*²⁰ and Norton *et al.*,⁴⁸ although they reported that VCD increased rapidly until 15 days of visual exposure, and then decreased because the lens thickness increased more rapidly than axial length. The Linear regression model in this study might have also suggested a decrease of 0.5mm. It must also be noted that our data come from a cross-sectional study, therefore no judgment can be made about the trend of VCD changes with age and longitudinal studies are needed for a definite answer.

The difference in mean VCD (0.49mm) between

males ($16.63 \pm 0.89\text{mm}$) and females ($16.14 \pm 0.66\text{mm}$) was statistically significant (unpaired t-test: $t = 2.51$, $df = 64$, $p = 0.015$). Men had deeper VCD than their female counterparts. This result agrees with the finding of Shufelt *et al.*¹³ and Atchison *et al.*²⁰ which showed that males had longer VCD than females. The older women had significantly shallower VCD when compared with the younger women ($P = 0.005$). These gender-related differences in VCD were statistically significant after adjusting for height ($P = 0.03$). Wong *et al.*⁴⁹ also reported shorter and shallower VCDs for women. Based on these findings, inter-gender differences in refractive errors are expected⁴⁵.

A statistically significant positive correlation was found between VCD and AL ($r = 0.83$, $r^2 = 69.3\%$, $p < 0.0001$). This was in line with the finding of Weihua *et al.*⁵⁰, who reported that AL increase was due to lengthening of the vitreous chamber. However, Osuobeni *et al.*⁵¹, reported that there was no relationship between VCD and AL. The mean AL in this study was very similar to previous studies^{44 & 45, 52 & 53}. AL varies between 22.6 mm to 24.09 mm in majority of studies, and the mean AL in our study falls in the midrange. Regression analysis performed on AL and the effect of age did not agree with Atchison *et al.*²⁰, who reported significant age changes between AL and age, and that axial length increased 0.011 mm/year and it most likely reflects the refractive correction pattern with change in age rather than ongoing growth of the eye itself. Also Biino *et al.*⁵⁴, found that AL increases rapidly in the early stage of life, then slowly increases

13. Shufelt C, Fraser-Bell S, Ying-Lai M, Torres M, Varma R. Refractive error, ocular biometry, and lens opalescence in an adult population: The Los Angeles Latino Eye Study. *Invest Ophthalmol Vis Sci.* 2005; 46: 4450-4460.
20. Atchison D, Jones C, Pritchard N, Pope J, Schmid K, Strugnell W. Eye shape in emmetropia and myopia. *Invest Ophthalmol Vis Sci.* 2004; 45: 3380-3386.
29. Shimmyo M, Ross AJ, Moy A, Mostafavi R. Intraocular pressure, Goldmann applanation tension, corneal thickness, and corneal curvature in Caucasians, Asians, Hispanics, and African Americans. *Amer J Ophthalmol.* 2003; 136: 603-613.
41. Oliveira C, Tello C, Liebmann JM, Ritch R. Central corneal thickness is not related to anterior scleral thickness or axial length. *J Glaucoma.* 2006; 15(3): 190-194.
42. Nangia V, Jonas J, Sinha A, Matin A, Kulkarni M. Central corneal thickness and its association with ocular and general parameters in Indians: The central India Eye and Medical Study. *Ophthalmol.* 2010; 117(4):705-710.
43. Chang AC, Fan D, Tamg E, Lam DS. Effect of corneal curvature and corneal thickness on the assessment of intraocular pressure. *Cornea.* 2006; 25(1): 26-28.
44. Roy A, Kar M, Mandal D, Ray RS, Kar C. Variation of Axial Ocular Dimensions with Age, Sex, Height, BMI-and Their Relation to Refractive Status. *JCDR.* 2015; 9(1):AC01-AC04.
45. Hashemi H, Khabazkhoob M, Miraftab M, Emamian MH, Shariati M, Abdolahinia T, Fotouhi A. The distribution of axial length, anterior chamber depth, lens thickness, and vitreous chamber depth in an adult population of Shahrud, Iran. *BMC ophthalmology.* 2012; 12:50
46. Yekta A, Fotouhi A, Hashemi H, Moghaddam HO, Heravian J, Heydari S, Yekta R, Derakhshan A, Rezvan F, Behnia M, Aliakbari S, Khabazkhoob M. Relationship between Refractive Errors and Ocular Biometry Components. *Iranian Journal of Ophthalmology* 2010; 22(2):45-54
47. Tuncer I, Karahan E, Zengin MO. The Assessment of Anterior Chamber Depth, Lens Thickness, Vitreous Length and Axial Length in an Adult Population. *Glokom-Katarakt* 2014; 9(3): 185-188
48. Norton TT, McBrien NA. Normal development of refractive state and ocular component dimensions. *Neuroimage.* 2003; 19(3):482-95
49. Wong TY, Foster PJ, Johnson GJ, Klein BEK, Seah, SKL. The relationship between ocular dimensions and refraction with adult stature: The Tanjong Paper survey. *Invest Ophthalmol Vis Sci.* 2001; 42:1237-1242.
51. Osuobeni EP, Okpala I, Williamson TH, Thomas P. Height, weight, body mass index and ocular biometry in patients with sickle cell disease *Ophthal Physiol opt.* 2009; 29(2): 189-198.
52. Eysteinnsson T, Jonasson F, Amarsson Á, Sasaki H, Sasaki K. (2005), Relationships between ocular dimensions and adult stature among participants in the Reykjavik Eye Study. *Acta Ophthalmologica Scandinavica*, 83: 734-738
53. Fotedar R, Wang JJ, Burlutsky G, Morgan IG, Rose K, Wong TY, Mitchell P. Distribution of axial length 7 gtvtyghand ocular biometry measured using partial coherence laser interferometry (IOL Master) in an older white population. *Ophthalmol.* 2010; 117:417-423.
54. Biino G, Palmas MA, Corona C, Prodi D, Fanciulli M, Sulis R, Serra A, Fossarello M, Pirastu M. Ocular refraction: heritability and genome-wide search for eye morphometry traits in an isolated Sardinian population. *Hum Genet.* 2005; 116:152-159.

until adulthood, then decreases in old age, showing a quadratic relationship between AL and age. However, this study was in line with some studies^{13,39} which observed no age-related differences in axial length ($p>0.05$). An explanation for this is that once the eye has attained its adult size, little change occurs in the axial length during adulthood and with aging.

In this study the difference in mean AL between males ($23.89\pm 0.78\text{mm}$) and females ($23.35 \pm 0.74\text{mm}$) was statistically significant ($t= 2.90$, $df=64$, $p= 0.005$). By this men had longer AL than women. This was consistent with the study of Atchison *et al* (2008) who reported that males had longer axial lengths (0.62 mm) than females. Some previous studies estimated differences in AL between males

and females between a range of 0.47 mm and 0.65 mm.³⁶⁻³⁸ Also, Shufelt *et al*¹³, also asserted that AL varies with gender, the difference between the males and females being significant, both overall and at each age group ($p<0.0001$). This difference remained significant even after adjusting for height ($p<0.0001$). Weihua *et al*⁵⁵ agreed that women tend to have a shorter AL, partly explained by stature, this was in line with the findings in this study. This finding could be attributed to males being taller with the influence of anatomical differences, which have been reported in other studies⁵⁶. According to a report drawn by a previous study, eyes that are larger were found between taller people and even adjustment for height can thus explain or attribute to the different findings between male and female⁴⁴.

Conclusion

The ocular parameters evaluated are important in the assessment of corneal health status therefore the differences in the measured variables, their relationship with one and another and also relationship with gender and age will be fundamental to understanding general eye health and the development of strategies that would aid in prevention, early diagnosis, treatment and management of some ocular conditions. This study has shown that there was a statistically significant positive correlation between VCD and AL. The difference in mean VCD and AL between males and females was also statistically significant. The measurement of CCT which cannot be over emphasized should be inculcated into routine examination especially on a regular basis as this is important determinant in many ocular disorders such as glaucoma. AL measurement should be carried out more often in the primary eye care management as this could give an insight to other ocular defects. Seeing that CCT decreases significantly with age, elderly individuals in the population should be screened regularly.

Global advances in primary eye care has brought about the necessity for ocular parameters in different clinical and diagnostic fields. Another important ophthalmic parameter is the axial length (AL) which is commonly needed for intraocular lens power calculation before cataract and refractive surgery and also aids eye care providers in the diagnosis of several eye conditions.

13. Shufelt C, Fraser-Bell S, Ying-Lai M, Torres M, Varma R. Refractive error, ocular biometry, and lens opalescence in an adult population: The Los Angeles Latino Eye Study. *Invest Ophthalmol Vis Sci.* 2005; 46: 4450–4460.
44. Roy A, Kar M, Mandal D, Ray RS, Kar C. Variation of Axial Ocular Dimensions with Age, Sex, Height, BMI-and Their Relation to Refractive Status. *JCDR.* 2015; 9(1):AC01-AC04.
36. Kamiya K, Shimizu K, Ohmoto F. Effect of aging on corneal biomechanical parameters using the ocular response analyzer. *J Refract Surg.* 2009; 25 (10):888–893.
37. Patel HY, Patel DV, McGhee CN. Identifying relationships between tomography-derived corneal thickness, curvature, and diameter and in vivo confocal microscopic assessment of the endothelium in healthy corneas of young adults. *Eye* 2009; 23(2):270–27
38. Hawker MJ, Naoakira N, Fujiko A, Hiroshi S, Yozo M. Relationship between age and central corneal thickness in a Japanese population. *Jpn J Clin Ophthalmol.* 2009; 55(3):300-302
39. Hahn S, Azen S, Mei YL, Varma R. Los Angeles Latino Eye study group. Central corneal thickness in Latinos. *Invest Ophthalmol.* 2003; 44(4): 1508-1512.
44. Roy A, Kar M, Mandal D, Ray RS, Kar C. Variation of Axial Ocular Dimensions with Age, Sex, Height, BMI-and Their Relation to Refractive Status. *JCDR.* 2015; 9(1):AC01-AC04.
55. Weihua M, Jacqueline B, François M, Patrick C. Axial Length of Myopia: A Review of Current Research. *Ophthalmologica.* 2010; 225:127-134.
56. Nangia V, Jonas J, Sinha A, Matin A, Kulkarni M. Central corneal thickness and its association with ocular and general parameters in Indians: The central India Eye and Medical Study. *Ophthalmol.* 2010; 117(4):705-710.

Table 1
Comparing Findings with other studies

STUDY	AGE (years)	CCT (μm)	VCD (mm)	AL (mm)
Yebra-Pimentel et al. ⁹	15 – 35	–	16.16 \pm 0.60	23.34 \pm 0.65
Chen et al. ¹¹	40 – 80	554.0 \pm 29	–	23.3 \pm 1.2
Eballe et al. ¹⁴	5 – 75	528.74 \pm 35.89	–	–
Galgauskas et al. ²³	18 – 89	544.6	–	–
Iyamu et al. ³⁵	20 – 69	547.0 \pm 29.5	–	23.50 \pm 0.70
Roy et al. ⁴⁴	8 – 70	–	15.42 \pm 0.36	23.35 \pm 0.87
Hashemi et al. ⁴⁵	40 – 64	–	15.72	23.14
Sanchis-Gimeno et al. ⁵⁸	40 – 70	558.0 \pm 0.30	16.75 \pm 1.75	24.58 \pm 1.73
Fahmy ⁵⁹	18 – 27	555.54 \pm 31.71	–	23.75 \pm 1.01
Mercieca et al. ⁶⁰	17 – 68	535.0 \pm 38	–	–
Ntim-Amponsah et al. ⁶¹	21 – 90	530.53 \pm 35.64	–	–
This study	18 – 68	536.71 \pm 23.89	16.30 \pm 0.80	23.60 \pm 0.80

Table 2
Descriptive statistics of the measured variable of respondents

VARIABLES	AGE (years)	CCT (μm)	VCD (mm)	AL (mm)
Mean \pm SD	37.17 \pm 11.60	536.71 \pm 23.89	16.30 \pm 0.80	23.60 \pm 0.80
Range	18.0-68.0	490.0-649.0	14.79-18.85	22.04-26.19
SEM	1.42	2.94	0.099	0.99
Std Skew	0.66	1.42	0.75	0.77
Std Kurt	0.22	6.41	1.11	1.43
K S	1.02	0.92	0.71	1.04
P-Value	0.25	0.36	0.70	0.23
95% CI	35.75-38.59	533.77-539.65	16.27-16.50	22.6-24.6
Total	66	66	66	66

CCT = Central Corneal Thickness; VCD = Vitreous chamber depth; AL= Axial Length; SD= Standard deviation; SEM = Standard Error of Mean; Std Skew= Standard Skewness; Std Kurt= Standardized kurtosis; K – S= Kolmogorov – Smirnov Z Score; CI = Confidence Interval.

9. Yebra-pimentel E, González-méijome JM, García-resúa C, Giráldez-fernández MJ. The relationships between ocular optical Components and implications in the process of Emmetropization. Arch Soc Esp Ophthalmol 2008; 83: 307-316
11. Chen MJ, Liu YT, Tsai CC, Chen YC, Chou CK, Lee SM. Relationship between central corneal thickness, refractive error, corneal curvature, anterior chamber depth and axial length. J Chin Med Assoc 2009; 72: 133–137.
14. Eballe AO, Koki G, Ellong A, Owono D, Epee E, Bella LA. Central corneal thickness and Intraocular pressure in the Cameroonian non glaucomatous population. Clin Ophthalmol. 2010; 4:717–724.
23. Galgauskas S, Juodkaite G, Tutkuvienė J. Age-related changes in central corneal thickness in normal eyes among the adult Lithuanian population. Clinical Interventions in Aging. 2014; 9: 1145-1151.
35. Iyamu E, Iyamu JE, Amadasun G. Central corneal thickness and axial length in an adult Nigerian population. Journal of Optometry. 2013; 6 (3):154-160.
44. Roy A, Kar M, Mandal D, Ray RS, Kar C. Variation of Axial Ocular Dimensions with Age, Sex, Height, BMI-and Their Relation to Refractive Status. JCDR. 2015; 9(1):AC01-AC04.
45. Hashemi H, Khabazkhoob M, MirafTAB M, Emamian MH, Shariati M, Abdolahinia T, Fotouhi A. The distribution of axial length, anterior chamber depth, lens thickness, and vitreous chamber depth in an adult population of Shahroud, Iran. BMC ophthalmology. 2012; 12:50
58. Fahmy RM. Correlation between Anthropomorphic Measurements and Ocular Parameters among Adult Saudi Females. Austin J Clin Ophthalmol. 2016; 3(2): 1070.
59. Mercieca K, Odugu V, Feibai B, Arowolo O, Chukwuka F. Comparing central corneal thickness in a sub-Saharan cohort to African Americans and Afro-Caribbeans. Cornea. 2007; 26:557–560.
60. Ntim-Amponsah CT, Seidu AY, Essuman VA, et al. A study of central corneal thickness in glaucoma and nonglaucoma patients in a West African population. Cornea. 2012; 31:1093–1096.

Table 3
Descriptive statistics of measured variables by Gender

Variables	CCT (µm)	VCD (mm)	AL (mm)
Male (n=31); Mean±SD	536.71±28.38	16.63±0.89	23.89±0.78
Female (n=35); Mean±SD	536.71±19.50	16.14±0.66	23.35±0.74
Unpaired t-test	0.001	2.571	2.90
P Value	>0.05	0.015	0.005
M-W	515.0	356.0	310.0
P value	0.72	0.017	0.003
K-Z (2-sample)	0.47	1.34	1.38
P Value	0.98	0.055	0.044
Df	64	64	64

CCT= Central Corneal Thickness; VCD= Vitreous chamber depth; AL= Axial Length; SD= Standard deviation; M-W= Mann-Whitney U; K-S= Kolmogorov-Smirnov; Df= Degree of freedom

Table 4
Pearson's Correlation Coefficient between Measured Variables

Variables	CCT (µm)	VCD (mm)	AL (mm)
Age	-0.20 (0.12)	-0.07 (0.58)	0.078 (0.53)
CCT		0.14 (0.91)	0.032 (0.80)
VCD			0.83 (<0.0001)

CCT= Central Corneal Thickness; VCD= Vitreous chamber depth; AL= Axial Length

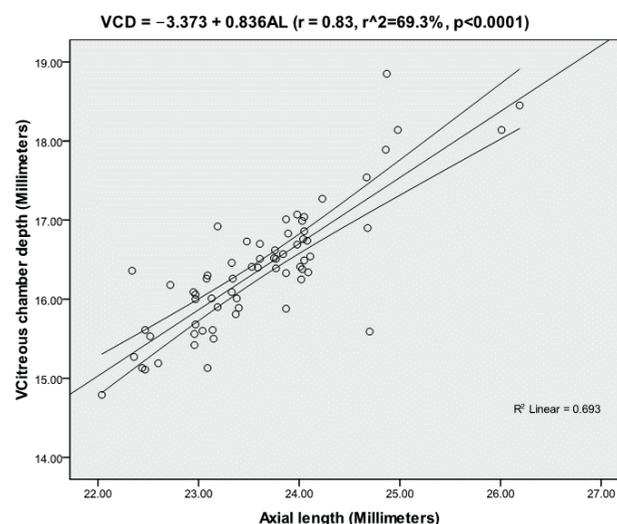


Fig. 2: Correlation of vitreous chamber depth and axial length with the linear regression line with 95% confidence interval of the regression line.

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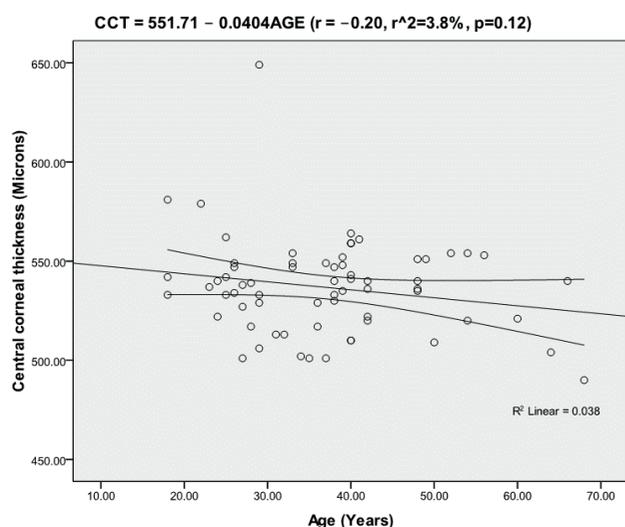


Fig. 1: Correlation of central corneal thickness and age with the linear regression line with 95% confidence interval of the regression line.

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