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Gender and environmental influences on visual acuity in Owerri, Nigeria

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Summary: This study assessed the gender and environmental influences on visual function among adults in Owerri, Nigeria. Visual acuity (V.A.) is a measure of visual function in health and disease. Visual disability together with other disabling conditions is a barrier to development, yet there is little known about the visual acuity and determinants of visual function in Owerri, Imo State, Nigeria. Results of a cross-sectional analytical study conducted between September 2007 and November 2009 using 3451 adults living in Owerri, Nigeria consisting of 2606 persons (test) and 845 persons(control), randomly selected are presented. Data were obtained using interviewer administered structured - questionnaires and standard procedures were used to determine gender and environmental influences on visual acuity. There were more females with poor vision than males in both study and control groups. The majority of the subjects were aged 40-49. At 6 metres, 20.9% and 39.1% of study and control groups in the right eye; 31.8% and 41.2% of study control groups respectively in the left eye had unaided V.A. ≥ 6/6. Similarly at 6m, 18.0% and 4.3% of study and control groups in the right eye; 15.2% and 5.0% of study and control groups respectively in the left eye had unaided V.A. < 6/18. Twenty-nine per cent and 25.0% of study and control groups respectively had unaided V.A. at near of N_5. Over 70.0% had ≤ N_6 at near and V.A. improvement with pin-hole device. Emmetropia was found in 20.5% (study) and 23.2% (control). The percentage prevalence of reduced VA was higher among ametropics and rural dwellers. The contributory factors were poor nutrition & irrational and uncontrolled use of chloroquine as first line drug for malaria treatment. Health education on diet, drug use and safe environmental health practices especially for persons living in rural areas in developing countries are recommended.

Keywords*:* Visual acuity, Vision, Gender, Age, Environment

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INTRODUCTION

Vision is a vital physiologic parameter of ocular health. Traditionally, visual function is tested as visual acuity (capacity to discriminate fine details of objects and visual field (proportion of space in which objects are visible at the same moment during steady fixation of gaze in one direction). Colour vision, flicker sensitivity, contrast sensitivity, pupillary responses and motion testing are some of the other methods of quantitating vision (Attebo, 1996; Emerole et al, 2011; Johnson and Keller, 1983).Visual acuity test is a measure of central vision; a measure of sharpness of vision; and an assessment of total visual system from cornea to the occipital cortex. Visual acuity (V.A..) can be tested for both distant (far) and near vision. It is the most commonly used clinical measure for determining visual impairment (Borish, 1975). Visual acuity appears to reach its maximum at the age of 10, varies only slightly from the age of 15 to 20 onward until it begins to decline at the age of 45, as observed by most clinicians. However, more precise measures indicate that there is a gradual loss from that age onward, although the amount is not readily observed until an older age is reached, at which time morphological changes again influence it markedly, as they do in early years of life. In addition to changes in acuity, variations in retinal sensitivity with age also occur.Higher thresholds appear at the age of 40 and become even more pronounced by the age of 50 (Borish, 1975). Normal Vision (6/6) relies on the following: both eyes in alignment (extra-ocular muscles functioning); clear cornea; clear crystalline lens of the eye; clear ocular media (aqueous and vitreous); & intact retina, optic nerve and visual pathway. Saccadic eye movements are one of the factors that affect V.A.. (Borish, 1975; Emerole et al, 2011).Vision can be as low as counting fingers (CF); hand movement (HM); perception of light (PL) or even non-perception of light (NPL) (Borish, 1975; Emerole et al, 2013b).

Visual impairment is a result of abnormalities in the physiology of the eye or the visual pathway

(Guyton and Hall, 2003). This impairment can manifest in three predominant ways: a decrease in V.A.., a constriction of peripheral visual field, or an alteration in contrast sensitivity (Johnson and Keller, 1983). A visual acuity test is done as a diagnostic tool; to provide baseline data; as a measure of progression of disease; to evaluate treatment; as an employment and school admission requirements; in acquisition of license for motor driving and use of ammunition; for research purposes; and as a legal requirement (Emerole et al, 2013b; Emerole and Nneli, 2013). Amblyopia is defined as "reduced visual acuity not correctable by refractive means and not attributable to obvious structural or pathological ocular anomalies". Amblyopia can be primary (congenital), acquired (functional) and secondary (e.g toxic amblyopia). In persons malingering, there is a general inconsistency evident in the testing. The malingerer is generally uncooperative and ocular error does not correspond to the V.A. unlike in hysterical amblyopia (Borish, 1975). Factors such as age, refractive error, alcohol use, tobacco consumption, drugs, environmental factors (e.g dust, irritants, radiations, season), disease (systemic and ocular infections, allergies and disorders), illumination and nutritional deficiency may impair or affect vision (Anker, 1997, 1998; Borish, 1975; Carter et al, 2005; Emerole et al, 2011, Guyton and Hall, 2003; Lade, 2004; McClean et al, 1987; Miranda, 2011; World Bank, 2003).

Eye problems have been associated with self-reported visual function impairment and impairment in other activities of daily living. The first global estimate on the magnitude and causes of visual impairment was based on the 1990 world population data (38 million blind), indicating a two-fold increase in the magnitude of visual impairment in the world by 2020. This provided the basis for the 1999 launch of vision 2020, the global initiative for the elimination of avoidable blindness (World Health Organization, 1999). Visual disability, together with other disabling conditions, is a barrier to development (Bekibele et al, 2007; Fagbohungbe and Akinbode, 2012; Kirkwoood et al 1983; Nigeria Optometric Association Report, 2007; Nwosu and Alozie, 2006; The Eye Diseases Prevalence Group, 2004; World Health Organization, 1999; World Health Organization, 2000). Elimination of avoidable blindness is a moral imperative and priority under the disease control component of the Global Initiative – VISION2020: The Right to Sight among the poorest of the poor (World Health Organisation – News Report, 2000). This study was undertaken to provide epidemiologic information on gender and environmental influences on visual acuity among adults in Owerri, Imo state, Nigeria as a basis for cost effective intervention.

MATERIALS AND METHODS

Ethical approval for the study was obtained from Ethical committee of College of Medicine and Health Sciences, Abia State University, Uturu; and informed consent was obtained from the subjects. A total of 3451 subjects made up of 2606 persons of both sexes (test group) who met the inclusive criteria were recruited between September 2007 and November 2009 from a population of persons living in old Owerri province, Imo State, Nigeria. 845 persons both sexes (controls) were selected from a population of persons living in Ihiagwa autonomous community in Owerri–West local government area using a multistage random sampling. The controls were made up of individuals who did not present any eye defects on examination protocol. Only those above 18 years (aged 20–69 years) were selected for the study. Interviewer administered structured – questionnaires were used to determine demographic characteristics, dietary habits, alcohol consumption, tobacco use; and history of past ocular and systemic problems of subjects were also obtained. Those with conditions interfering with accurate ocular refraction such as corneal opacity; visually impairing opaque media; diabetes mellitus; hypertension; pseudophakic and aphakics were excluded from analysis.

All the subjects underwent a complete ophthalmic examination which included measurement of distant and near V.A.& pin-hole visual acuity in subjects with V.A. less than 6/6 (With Snellen's chart, near reading chart and tumbling ''E'' chart for illiterate subjects).Visual acuity at distant or far is reported as Snellen fraction (ratio between the distance at which the test is made or done in metres or feet [numerator] to the distance at which the smallest letter read subtends an angle of 50^0 [denominator] or with its decimal equivalent (e.g 6/12, 20/40, or 0.5). The Snellen fraction in meters is known as the metric snellen fraction and in feet as imperial fraction Vision in an eye were defined as above normal, >6/6; normal, 6/6; subnormal, <6/6 to 6/12; and visually impaired, ≤6/18.Reading fifty per cent or more of the letters on a line correctly was regarded as the subject getting the V.A. level correct. Improvement in visual acuity by two or more lines on the Snellen's chart when looking through the pin-hole was regarded as an indication of refractive error or uncorrected error when the the patient was already wearing spectacles);tonometry (tonometric values of 9mmHg – 24mmHg were taken as normal while tonometric values >24mmHg were considered clinically significant); ophthalmoscopy (internal eye examination was done with the direct ophthalmoscope); retinoscopy (refractive status was determined objectively with the streak retinoscope); subjective refraction; and perimetry to investigate other possible causes of impairment or reduction in

vision. Refractive errors (ametropia) in an eye were defined. Emmetropia was defined as a spherical dioptric power between -0.50DS and +0.50DS. Refraction data are based on subjective refraction.

Statistical analysis:
The data obtained were reported as percentages and statistical analysis was done using EPI Info version 3.5, 2008.

RESULTS

There were more females than males in both study and control groups. The majority of subjects were aged 40-49. There was no statistically significant difference between the control and the study group as shown in table 1.

In the present study, 61.2% and 61.3% of study and control groups respectively were domiciled in the rural areas. Forty-one per cent and 30.8% of study and control groups respectively had tertiary education. In the study group, students (22.9%) were in the majority while skilled persons (21.5%) were in the majority in the control group. About 57.4% of the subjects in the study group were unmarried while 49.7% of subjects in the control group were married (Emerole et al, 2011).

Twenty-one per cent and 39.1% of the subjects in the study and control groups respectively had unaided visual acuity at 6m ≥6/6 in the right eye (18.0% and 4.3% of study and control groups had unaided visual acuity of <6/18 in the right eye). There was no statistically significant difference in the unaided vision of the right and left eye visual acuity at 6m in the two groups as shown in table 2.

Table 1: Subjects by gender and age

Age (yrs)	MALE				FEMALE			
	A (n=1079)		B (n=357)		A (n = 1527)		B (n = 488)	
	No.	%	No.	%	No.	%	No.	%
20 – 29	194	18.0	32	9.0	340	22.3	89	18.2
30 – 39	183	17.0	50	14.0	260	17.0	122	25.0
40 – 49	279	25.8	170	47.6	441	28.9	189	38.7
50 – 59	244	22.6	65	18.2	296	19.4	47	9.6
60 - 69	179	16.6	40	11.2	190	12.4	41	8.4

A=Study group, B=Control group

Table 2: Unaided visual acuity at far (6m) of subjects

V.A. at 6m	**Oculus Dexter** (O.D/**Right eye**)				**Oculus Sinister** (O.S/**Left eye**)			
	A (n=2606)		B (n=845)		A (n=2606)		B (n=845)	
	No.	%	No.	%	No.	%	No.	%
>6/18	467	18.0	36	4.3	397	15.2	43	5.0
6/18	454	17.4	56	6.6	384	14.7	49	5.8
6/12	725	27.8	197	23.3	652	25.0	164	19.4
6/9	414	15.9	226	26.7	344	13.2	242	28.6
6/6	290	11.1	183	21.7	482	18.5	176	21.0
6/5	256	9.8	147	17.4	347	13.3	171	20.2

A=Study group, B=Control group, V.A.= Visual Acuity

Majority (70.9% and 75.0% of study and control groups respectively) had unaided near visual acuity less than N_5. The differences between the study and control groups were not statistically significant as shown in table 3. The unaided vision in 79.5% and 76.5% of study and control groups was improved with pin-hole. The differences between the study and control groups were not statistically significant as shown in table 4. The difference in gender and age between the study and control groups with respect to emmetropia was not statistically significant. Only 20.5% and 23.2% of the study and control groups respectively were emmetropic. The prevalence of emmetropia decreased with age as shown in table 5.

Ametropia and risk factors affecting visual acuity

Majority of the subjects (79.5% and 76.6% of the study and control groups respectively) had ametropia In the present study, 67.6% and 49.2% of ametropics in the test and control groups respectively used quinines as first-line drug for malaria while 62.2% and 31.0% of study and control groups respectively were in the habit of consuming food items of low nutritional value. About 33.6% and 27.4% ametropics in the study and control groups respectively consumed alcohol while 19.9% and 15.1% of ametropics in the study and control groups respectively had past history of ocular trauma (Emerole et al, 2011).

Table 3: Unaided visual acuity at near (40cm) – oculus uniter/ou/both eyes of subjects

V.A. at 40cm	A (n = 2606)		**B** (n = 845)	
	No.	%	No.	%
N_5	758	29.1	211	25.0
N_6 - N_{18}	1227	47.1	441	52.2
<N_{18}	621	23.8	193	22.8

A=Study group, B=Control group, V.A.= Visual Acuity

Table 4: Pin-hole visual acuity (visual improvement with pin-hole in the unaided eye of subjects)

Pin-hole V.A. Improvement	**A** (n = 2606)		**B** (n = 845)	
	No.	%	No.	%
YES	2072	79.5	649	76.8
NO	534	20.5	196	23.2

A=Study group, B=Control group, V.A.= Visual Acuity

Table 5: Emmetropia By Gender And Age

Age (yrs)	**MALE**				**FEMALE**			
	A (n=252)		B (n= 91)		A (n = 282)		B (n = 105)	
	No.	%	No.	%	No.	%	No.	%
20 – 29	46	18.3	8	8.8	55	19.5	17	16.2
30 – 39	42	16.6	12	13.2	51	18.1	29	27.6
40 – 49	62	24.6	43	47.2	71	25.2	36	34.3
50 – 59	56	22.2	15	16.5	65	23.0	13	12.4
60 - 69	46	18.3	13	14.3	40	14.2	10	9.4

A=Study group, B=Control group

DISCUSSION

The socially constructed nature of gender and culturally based expectations of the roles and behaviours of women and men mediates health inequalities, and the old adage "women get sicker but men die quicker" (Anker, 1997, 1998). Many tasks associated with rural living are divided along gender lines. Gender roles unlike the biology of sex are dynamic-(can change over time and vary widely within and across a culture). Some aspects of these roles originated in the biological differences between the sexes (Anker, 1997, 1998; Miranda, 2011; World Bank, 2003). There were more females than males in this study (58.6% and 57.8% of the study and control groups respectively). This agrees with Nworah and Ezepue, (1992); Nwosu and Alozie, (2006); & Patel and West, (2007). The complaint of reduced vision was more among the females and rural dwellers in this study. Gender differences and environmental influences were observed in the prevalence of ametropia and visual development (Borish, 1975; Emerole et al, 2011). In the rural settings, women may be more exposed to ocular hazard and pollution of the environment from use of firewood for cooking, bush burning practices, cow's skin and hides, long exposure to ultra-violet rays from sunlight during farming, use of lantern or candle to read and dusty environment especially during harmattan and dry season (Emerole et al, 2011). The apparent higher visual demand on women from gender roles may explain why more females in this study sought intervention.

Age is a physiologic parameter and of medical significance in diagnosis and in determining treatment. In this study, the majority of the subjects were aged 40-49 years. In a young person, the crystalline lens is flexible allowing the eye to focus on objects at far and increases its focusing power (accommodation) if objects are brought close. There is a gradual decline in the flexibility of the crystalline lens and accommodation after the age of 35. This presents with varying degrees of difficulty in clear, effortless and comfortable vision at far and near (Borish, 1975). In the present study, the most dorminant ametropia was hyperopia (35.2% and 34.7% in the study and control group with no significant difference between the two groups, $p = 1.00$). The decline in vision at near from presbyopia and hyperopia as the lens becomes rigid (making seeing at close range more difficult) may explain why majority of those who presented for visual care due to reduced vision were in this age group. Ageing also modifies a pre-existing error making it more symptomatic (Borish, 1975; Emerole et al, 2011; Nworah and Ezepue, 1992).

Visual function is affected by gender; age; ocular refraction; alcohol and tobacco consumption; drugs; systemic and ocular diseases, disorders and allergy; environmental factors (such as illumination, dust, irritants and radiation); and nutritional deficiencies (Borish, 1975; Carter et al, 2005; Emerole et al, 2011). In the present study, 20.9% and 39.1% of study and control groups respectively had unaided V.A. at 6m of $\geq$ 6/6 in the right eye while 31.8% and 41.2% of study and control groups respectively had unaided V.A. at 6m of $\geq$ 6/6 in the left eye. Similarly, 18.0% and 4.3% of study and control groups respectively had unaided V.A. at 6m of <6/18 in the right eye while 15.2% and 5.0% of study and control groups respectively had unaided V.A. at 6m of <6/18 in the left eye. In the study on prevalence of blindness and visual impairment in Atakunmosa local government area of south western Nigeria; South Sudan, and school children in Tanzania 6.30%, 7.70% and 9.50% respectively had presenting vision <6/18 in their better eye/eye with better vision or V.A. (Kingo and Ndawi, 2009; Ngondi et al, 2006; Onakpoya et al, 2007). Majority of the subjects (over 70.0% of the study and control groups) had V.A. improvement with pin-hole device/aid in the unaided eye. This is indicative of presence of uncorrected refractive error (Borish, 1975).The magnitude of pin-hole visual acuity improvement is consistent with the prevalence of ametropia in this study.Twenty-nine per-cent and 25.0% of study and control groups respectively had unaided V.A. at near of N_5 (over seventy per cent of subjects in the study and control groups had unaided V.A. of $\leq N_6$ at near). This is consistent with the magnitude of presbyopia in the study and control groups. The observations in this study are consistent with earlier studies on prevalence and impact of presbyopia in low and middle income countries (Emerole et al, 2011; Kingo and Ndawi, 2009; Ngondi et al, 2006; Onakpoya et al, 2007). The findings suggest that more than half of adults over the age of 30 have presbyopia; women have both a higher prevalence of, and more severe presbyopia; hotter climates are associated with the earlier onset of presbyopia and the majority of those with presbyopia (an aspect of refractive error that impacts on older persons economic independence) do not have corrective spectacles. This observation corroborates the findings of Bekibele et al, (2007) & Patel and West, (2007).

The matter of the dominant eye is usually of importance from a diagnostic consideration. While opinion varies from those who believe that ocular and hand dominancy is of little significance to those who ascribe to it, most of the defects of personality and asthenopia. Many investigators seem to indicate that the dominant eye has a definite place in the determination of proper refractive correction. It is believed that opposite handedness and eye dominancy is less efficient than coincident dominancy (Rengstorff, 1967). Fagbohungbe and Akinbode (2012) recommend that

those who engage in any visual acuity search task that requires monocular viewing should always identify and use their dominant eye for effective performance. In a study on dominance, Rengstorff (1967) found 91.5% right-handed, 7.7% left-handed, 1.1% ambidextrous, 66.0% right-eyed and 34.0% left-eyed. Also in a separate study of mentally retarded children, Rengstorff reported that 51.0% of subjects indicated mixed hand and eye relationship (Borish, 1975; Rengstorff, 1967).From above observations, majority of individuals are right handed, thus right handedness associated with left eyedness as a result of uncorrected refractive error and reduced vision implies alteration of the dominancy of an eye from the natural one to the other. This will result in difficulties of personality and comfort and may explain why subjects in the study group sought intervention. There were also more subjects in the study group with unaided V.A. at 6m of <6/18 than in the control group.

In the present study, majority of the (79.5% and 76.8% of study and control groups respectively) had ametropia/refractive error. A refractive error is an error in the focusing of light by the eye and a frequent reason for reduced visual acuity; and a major cause of visual impairment and blindness. Of the 2606 subjects in the study group and 845 subjects in the control group in this study, 35.2% and 34.7% of study and control groups had hyperopia; 23.4% and 19.6% of study and control groups were myopic; 20.9% and 22.5% of study and control groups had astigmatism. Ocular refractive status is considered normal ("emmetropia"), if parallel light rays from distant objects are in sharp focus on the retina when the ciliary muscle is completely relaxed. Emmetropia was found in 20.5% and 23.2% of the study and control groups respectively. Although there were more emmetropic subjects in the control group than study group, it was not statistically significant and decreased with age. Emmetropia of 50.6% was found in the Chennai glaucoma study in India. Prevalence of emmetropia was higher in studies in the United States of America and Asia (Emerole et al, 2011; Raju et al, 2004; The Eye Disease Prevalence Research Group, 2004; World Health Organization, 1999; World Health Organization, 2000).Studies conducted in the United States of America, Western Europe and Australia showed prevalence of ametropia of 35.1%, 37.7% and 22.2% respectively. This appears paradoxical as demographic studies have shown that Asia and America harbour more aged population and thus are expected to have a higher prevalence of ametropia since increase in age is a physiologic determinant of ametropia. This observation shows that the environment may be a factor in this high prevalence of ametropia and visual acuity pattern (Raju et al, 2004; The Eye Diseases Prevalence Research Group, 2004).

The use of chloroquine as anti-malarial as well as poor dietary habits among the subjects with reduced vision in the study and control groups, were statistically significant. The eyes need adequate nutrition to function as other parts of the body (Emerole et al, 2011; Emerole et al, 2013a; Lade, 2004). Drugs are casually referred to as 'useful poisons'. About sixty-seven per cent and forty-nine per cent of ametropics and subjects that had reduced vision in the study and control groups respectively used chloroquine as their regular anti-malarial. Malaria is endemic in Nigeria and Chloroquine is used as first line drug especially in the rural areas. Abuse of chloroquine can damage the macula and affects components of refraction especially in the absence of adequate nutrition (Borish, 1975). Many of the ametropics (62.2% in the study group and 31.6% in the control group) were in the habit of consuming food items of low nutritional values. From this study, poor dietary habit and abuse of chloroquine may be implicated as risk factors for reduced V.A. (Emerole et al, 2011).

This study has provided information on gender and environmental influences on vision among adults in Owerri, Imo state, Nigeria. The V.A. pattern is consistent with the magnitude of ametropia and presbyopia in the study and control groups. The differences in visual acuity when compared with high and medium resource countries may be due to the high prevalence of ametropia, identified poor level of nutrition, frequent use of chloroquine derivatives for treatment of malaria as well as being domicile in the rural areas. Regular vision screening and health education on diet, drug use and safe environmental health practices are recommended. In conclusion ametropia was highly endemic in the population owing to poor nutrition, regular use of chloroquine and environmental factors; and that more females than males presented with higher rate and more severe eye defects like presbyopia.

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