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Effects of Reduced Visual Acuity on Extracurricular Activities among Secondary School Students in Southern Nigeria

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Abstract:
Background: Clinical evaluation can help to quantify the extent of vision loss, but relating vision loss to the impact on one's functional ability and quality of life is useful just as our study will show.
Materials and Methods: A descriptive cross sectional study was used that involved the use of Data form, for each of the 2 secondary schools and the administration of 360 self administered structured questionnaires to pupils in these secondary schools. A simple random sampling was employed in choosing the students that were studied.
Results: Of the 350 students studied, 27.09% of students with reduced visual acuity had a bad student participation or quality of life, while 72.9% had fair and above students' participation. Visual acuity had a significant impact on the students quality of life (Reading: X^2 cal < X^2 tab). No significant association between visual acuity and participation in sports. Also, no significant association was found between visual acuity and participation in other recreational activities (X^2 calculated = 1.82, X^2 tabulated =m 3.84, degree of freedom = 1,ض-value =0.05, therefore X^2 tabulated >X^2 calculated).
Conclusion: School screening programmes should be established for prompt referral to specialists, further evaluation, immediate treatment and follow up of refractive errors involving both preschool and school children to avert reading disability and its sequellae as shown in this study series.

Key words: *reduced 'visual acuity', refractive error" school children, visual screening; vision 2020; visual acuity and health status, visual acuity and social wellbeing*

1. Introduction

Visual acuity is the acuteness or clearness of vision which is dependent on the sharpness of the retinal focus within the eye and the sensitivity of the interpretative faculty of the brain. It depends upon how accurately light focused on the retina (mostly the macular region), the integrity of the eyes' neural elements, and the interpretative faculty of the brain.[1]

The visual acuity demands for a given task depending on the minimum size of the detail in the task and the observer distance.[2] the rational of acuity is written as a fraction with normal vision being 6/6. This implies that a person can see details from 6 meters away the same as a person with normal sight would see from 6 meters. [3] Conversely, a 6/60 vision implies that a person can be see details from 6 meters away, a person with normal eyesight will see the same from 60 meters away.

Clinical evaluation can help to quantify the extent of vision loss, but relating vision loss to the impact on one's functional ability and quality of life is useful just as our study will show, which will not only indicate the effect of reduced visual acuity on the health status of the students studied. Assessing the impact of visual impairment beyond clinical evaluation.

Numerous studies in some populations have investigated the impact of bilateral or unilateral visual impairment on health related quality of life.[4,5,6,7,8,9] Visual impairment has been shown to have negative effects on health related quality of life and a significant impact on daily functioning [10,11] including social activities [12,13] and emotional functioning.[14]
Data from industrialized countries suggest that incidence of visual impairment has declined over the last few decades due partly to the organized visual screening programs.
Worldwide data available from population surveys that included children from community base rehabilitation programmes and from registers of suggest that the prevalence of visual impairment in children varies among socio-economic development and Under-5 mortality rate.
In high income countries with low Under-5 mortality rate, the prevalence is around 0.3/1000 children while in low incomes countries with high under-5 mortality rate (which Nigeria is a part), the prevalence may be as high as 1.5/1000 children. From this correction, the number of visually impaired children in the world is estimated to be 1.4m. This means that approximately three quarters of the world's visually impaired children live in the poorest region of Africa and Asia. Also due to the inadequacy of primary eye care and visual screening programmes, the estimate of the number of cases of visual impairment in children markedly underestimate the magnitude of the problem. [15]

2. Materials and Methods

2.1. Study Area

The study was conducted among students of Foundation Comprehensive College in Aluu with a population of 486 students and Community Secondary School Rumuekini in Rumosi with a population of 1200 students (private and public schools respectively) both in Ikwere Local Government Area of Rivers State , which has a total number of thirty five (35) public secondary schools. Both are mixed school comprising Junior Secondary (JSS) and Senior Secondary School (SSS). Therefore, there are six levels in school.

2.2. Study Population

This consisted of students of foundation Comprehensive College and Community Secondary School. The eligibility criteria were as follow:

2.2.1. Inclusion Criteria

- Student of foundation Comprehensive College and Community Secondary school.
- Students within the age of 11-17 years.

2.2.2. Exclusion Criteria

- Students less than 11 years
- Students greater than 17 years of age.

2.3. Study Design

It was a descriptive cross sectional study of students of Foundation Comprehensive College and Community Secondary School.

2.4. Sampling Size Determination

A total number of 360 students were selected from the study population. The sample size was derived thus:
The population of children with reduced visual acuity as shown from other studies is 30.8%, as referred from a work carried out Kasmann-Keller B and Rupercht K.w in Germany.[16]
This was taken as our working population. The precision tolerated was set at 5% at 95% confidence interval using the formula:

$$n = \frac{pq}{\left(\frac{e}{1.96}\right)^2}$$

Where n= sample size
p = working proportion = 30.8%
q= 100-p = 100-30.8 = 69.2%
e = margin of sampling error tolerated (5%), at 95% of degree of confidence.

$$n = \frac{30.8 \times 69.2}{\left(\frac{5}{1.96}\right)^2}$$

$$n = \frac{2131.36}{6.51}$$

$$n = 327$$

Attrition rate was taken as 10%. Therefore, adjusting for 10% attrition

$$= \frac{10 \times 327}{100}$$

$$= 32.1$$

$$= 33$$

Hence, adjusted sample size = 327 +33 = 360
Working sample size = 360 students.
School A = Foundation Comprehensive College, Aluu
School B = Community Secondary School Rumuekini Rumosi
The ratio of school A: School B = 1:3
Working sample size of school A = 90 students
Working sample size of school = 270 students

2.5. Sampling Method
A proportionate stratified Random sampling method was used. Each level represented a stratum i.e. JSS1, JSS2, JSS3, SSS1, SSS2 and SSS3.

Steps

- Sampling frames were obtained from the study areas. Sampling frames:
  486 = for foundation Comprehensive College, Aluu.
  1200 = for Community Secondary School Rumuekini, Rumosi.
- The contribution of each stratum (level) to the study population was noted.
  School A: Foundation Comprehensive College, Aluu.
- 2a. Contribution of each stratum to the study population:
  JSSI = 37, 37/486x100/1 = 7.61%
  JSS2 = 52, 52/486x100/1 = 10.70%
  JSS3 = 75, 75/486x100/1 = 15.43%
  SSS1 = 89, 89/486x100/1 = 18.31%
  SSS2 = 143,143/486x100/1 = 29.42%
  SSS3 = 90, 90/486x100/1 = 18.52%
- 3a. The percentage contribution of each level in school A to the sample size was determined.
  JSS1 = 7, JSS2 = 10, JSS3 = 14
  SSS1 = 16, SSS2 = 26, SSS3 = 17
  Total: 7+10+14+16+26+17=90
- 4a. the subjects were randomly selected using a table of random numbers.
  School B: Community Secondary School Rumuekini, Rumosi
- 2b. Contribution of each stratum to the study population was noted.
  JSSI = 250,250/1200 x100/1 = 20.83%
  JSS2 = 230,230/1200x100/1 = 19.17%
  JSS3 = 203,203/1200x100/1 = 16.92%
  SSS1 = 182,182/1200x100/1 = 15.17%
  SSS2 = 176,176/1200x100/1 = 14.66%
  SSS3 = 159,159/1200x100/1 = 13.25%
- 3b. the percentage contribution of each level in school B to the sample size was determined.
  JSS1 = 56, JSS2 = 52, JSS3 = 46
  SSS1 = 41, SSS2 = 40, SSS3 = 35
  Total: 56+52+46+41+40+35=270
  (Sample size for school B)
- 4b. the subjects were randomly selected using a table of random numbers.

2.6. Study Instruments

2.6.1. Snellen Chart
This is an eye chart used to measure distant visual acuity. The symbols on chart are known as optotypes. The optypes have the appearance of block letters and are intended to be seen and read as letters. Each line of letters is noted from the top to the bottom respectively;

$\frac{6}{60}, \frac{3}{36}, \frac{6}{24}, \frac{6}{18}, \frac{6}{12}, \frac{6}{9}, \frac{6}{6}, \frac{6}{5},$ and $\frac{6}{4}$

For this study, a three metre snellen chart was used. (reverse snellen chart)

2.6.2. Pinhole Occlude
The pinhole occlude is an opaque disc with one or more small holes, which is used to test VA. It is a sampling way of focus light, temporarily removing the effects refractive error.
Hence, it is used to distinguish visual effects by refractive error, which improves when the pinhole occlude is used from other problems which do not.

2.7. Data Form
This is a form which consists of the biodata and the result of the screening in each eye. A copy of the data form, questionnaire and the photograph of the instrument is shown in the appendix.

2.8. Questionnaire
The questionnaire consists of 2 parts.

- The biodata
- Student's participation in extra-curricular activities.

2.8.1. Biodata
This was comprised of, age, sex, class and parent's occupation.

2.8.2. Student's Participation in Extracurricular activities
The extra-curricular activities used were, sports, writing, reading and other recreational activities such as watching television.
The responses gotten were graded using bad/poor, good and fair.

2.9. Study Procedure
The principals for the two schools were contacted and an informed consent was obtained after a detailed explanation of the purpose, content and benefit of the study.
The students were also made to understand the essence of the screening and specific conducted in a hall with normal day light lighting.
A six meter distance we mapped out and the snellen chart was placed at one end. A seat was placed at the other end of the distance with the back of the seat directly on the sis meter line. The right (R) eye was the let (L) eye with an occlude without pressing tightly. The child was not allowed to squint, tilt-head or close occlude eye.
The child was told to read the letters on the chart from top to the button moving across the line from right to left using a pointer. If any student failed to read a line, it was repeated in the reverse order. If the line was failed twice, the visual acuity (VA) is taken as the next higher line read correcting. The procedure was repeated with the right eye occlude. The pinhole was used for children with visual Acuity (VA) less than or equal to 6/9.
For subjects using spectacles, Visual Acuity (VA) with spectacles was tested and recorded.
The visual Acuity (VA) was recorded as a fraction where the numerator (top number) represents the distance from the chart while the denominator (bottom number) represents the lowest line read correctly on the chart.

2.10. Data Analysis
Information obtained from the data from and questionnaire used for the screening exercise were analyzed manually by sorting and tallying. Summary statistics, simple frequency, cross tabulations and chi square test computed. The cut off for normal distant visual acuity was taken to be vision of greater than or equal to (6/6, 6/5 or 6/4) using the Snellen chart.
Visual acuity of less than or equal to 6/9 ($\leq$6/9) was taken as criteria for reduced visual acuity because WHO criterion for 1000 vision (VA$\leq$6/18 in the better eye) is already grossly subnormal for school children. The students with refractive error were defined by those whose reduced vision improved with pinhole.

2.11. Study Limitation

- Some children who were selected declined the test for reason not known.
- Some children may have pretended not to see some of the letters on the chart.
- Some children may have memorized the chart which would affect the outcome.

3. Result Analysis

3.1. Introduction

The visual acuity of three hundred and fifty students of two schools; community secondary school Rumuckini 260 (74.28%) and Foundation secondary school Aluu (90) (27.7%), were tested. Out of the three hundred and fifty students selected (350). Ten students did not participate in the screening exercise (3 were absent 7 declined). Hence, the response rate was 97.22% and the attrition rate 2.78%. 100% response from Foundation Comprehensive College and 96.15% from Community Secondary School, Rumuekini.

The students tested were between the ages of eleven and seventeen years (11-17) Seventy students (20.00%) were within the ages of 11-12yrs, one hundred and fifty three students (43.71%) were within the ages of 13-15yrs and one hundred and twenty seven (36.29%) were within ages of 16-18 yrs.

Class Interval	Class mark[x]	Absolute freq [f]	Relative freq[%]	fx	x-x-3.5	$(x-x)^2$	$F(x-x)^2$
10-12	11	70	20	770	-3.5	12.25	857.5
13-15	14	153	43.71	2142	-0.5	0.25	38.25
16-18	17	127	36.29	2159	2.5	6.25	106.25
total		350		5074			1002

Table 1: A table showing the standard deviation of age distribution

$$\bar{X} = \frac{\sum fx}{\sum f}$$

$$\bar{X} = \frac{5074}{350}$$

$$= 14.50$$

$$SD = \sqrt{\frac{\sum f(x-x)^2}{n-1}} = \sqrt{\frac{1002}{350}} = 1.69$$

Mean ±SD=14.50+1.69

Among the students tested, there were more females than males. The females were 200 (57.14%), with 40 from foundation and 160 from CSS Rumuekini. One hundred and fifty (42.85% were males, 50 from foundation and Hundred from Rumuekini.

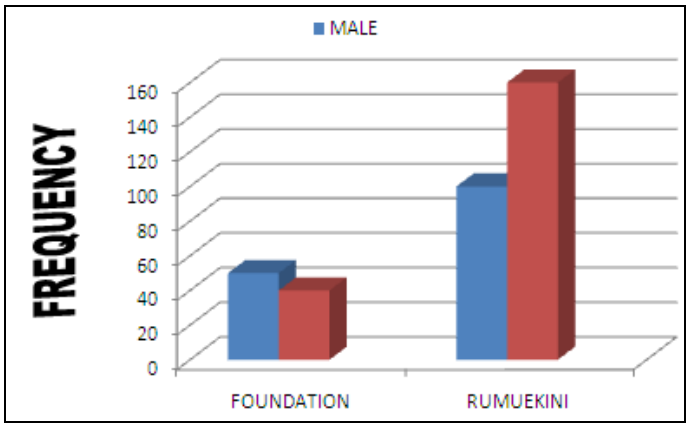

Figure 1: Bar chart showing sex distribution of each school

Of all the students tested, 59 (16.86%) were in JSS1 (foundation 7, Rumuekini 52), 57 (16.29) were in JSS2 (f10, R40), 60(17.14) were in JSS3 (F14, R46), 56(16.28%0 were in SSS1 (F16, R40), 60 (17.14%) were in SSS2 (F26, F34), AND 58 (16.57%) were in SSS3 (F17, R41).

3.2. Proportion with Normal Visual Acuity

Out of the three hundred and fifty students tested, two hundred and fifty one (71.71%) had a visual acuity of 6/6 or 6/5 or 6/4 in either eye of which 45 (17.92%) were between ages 10-12 (F10, R35), 118 (47.20%) were between ages 13-15years (F30, R88) and 88 (35.20%) were between ages 16-18 (F28, R60).

Age	Normal
10-12	45
13-15	118
16-18	88

Table 2: A table between age distribution and normal vision

3.3. Proportion with Reduced Visual Acuity

A total of Ninety nine (28.28%) students have reduced visual acuity that is visual acuity of 6/9 or worse. Of this number, 29 (29.22%) were within ages 10-12 years (F4, R25), 33 (33.33%) were between ages 13-15 (F6, R27) and (37.37%) students were within ages 16-18 years (F12, R25).

Out of the ninety-nine students with reduced visual acuity fifty-five (55.56%) were females (F12, R43) and forty-four were (44.44% were males (F8, R36%).

Out of the ninety-nine students with reduced visual acuity fifty-five (55.55%) were females (F12, R43) and forty-four were males (F8, R36).

Out of the ninety-nine students with reduced visual acuity (79.80%) had refractive error (F15, R64) and 20 (20.20%) had visual acuity problem with the macula (F7, R13).

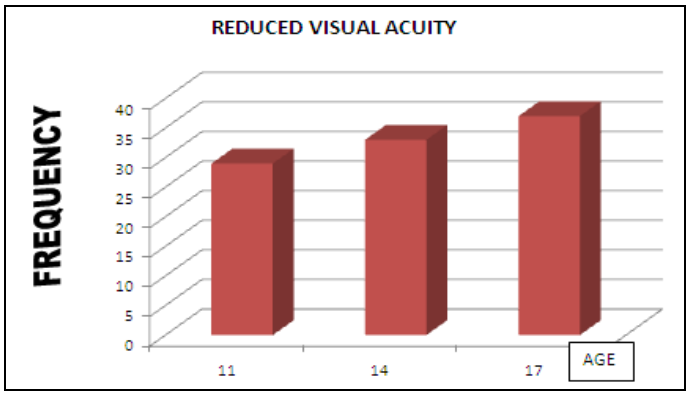

Figure 2: A bar chart showing age distribution and reduced visual acuity

3.4. Student Participation

- Out of the two hundred and fifty one students with normal visual acuity, 207 (82.47%) had good sports participation, 29 (11.55%) fair and 15 (5.98) had poor performance in sports. 207 (82.47%) had good performance in recreational activity, 23 (9.16%) fair and 21 (8.36%) poor, also, 197 (78.48) do not have problems with writing from the board, 38 (15.14%) fair while 16 (6.37%) students had difficulty in writing from the board, and 200 (79.68%) students have good reading from the board, 35 (13.94%) fair while 16 (6.31%) had problems reading from the board.
- Of the ninety-nine students with reduced visual acuity, 67 performed very well in sports, 22 fair and 10 (3.98%) can hardly partake in sports.

  In recreational activity, 71 persons had good performance in recreational activity, 16 fair and 12 (12.12%) students had difficulty in partaking in recreational activities. 69 (69.69%) students with reduced vision can write very well from the board, 20 can write fairly while 10 (10.10%) can hardly write very well from board. In reading 61 (61.61%) with reduced visual acuity can read effectively from the board, 22 (22.22%) fairly while 16 (16.16%) students cannot read from the board.

The association between visual acuity and student's participation

3.4.1. Participation in sport

Visual acuity	Poor	≥fair	Total
Normal	15	236	251
Reduced	10	89	99
Total	25	325	350

Table 3: A two by two chi-square table to compare the association between visual acuity and participation in sports

Assuming the null hypothesis (H_0) = There is no significant association between visual acuity and participation in sports.
H_1 = There is significant association between the visual acuity of respondent and participation in sports. To calculate the expected value (E) = $\frac{R_T \times c_T}{\text{Grand total}}$

R_R = Row total, column total c_T

$X^2_{cal} = \frac{\sum (\text{observed- Expected})^2}{\text{Expected}}$

X^2_{cal} = 0.479+0.037+1.214+0.093
=1.823 = 1.82

Degree of freedom = (r-1) (c-1)
= (2-1) (2-1)
=1x1=1
=0.05 (i.e 5%)
Tabulated = 3.84
X^2 Calculated is less than X^2 tabulated.
This accepts the null hypothesis which means that there is no significant association between visual acuity student's participation in sports.

3.4.2. Participation in other recreational activity

Visual acuity	Poor	≥Fair	Total
Normal	21	230	251
Reduced	12	87	99
Total	33	317	350

Table 4: A two by two chi-square table to compare the association between Visual acuity and participation in other recreational activity

Assuming the null hypothesis (HO) = there's no significant association between visual acuity and students participating in other recreational activities H1 = there's significant association between visual acuity of respondents and participation in other recreational activities.
To calculate the expected (E)
RT x CT Grand Total
RT =row total, CT= column total
X^2 calculated = $\sum$ (observed-expected) ^{2} /Expected.
X^2 calculated = 0.3012+0.0314+0.07640+0.0789 = 1.175 = 1.18
Degree of freedom = (r-1) (C-1)
= (2-1) (2-1)
= 1x1=1
=0.05 (5%)
= 3.84
X^2 tabulated
X^2 calculated is less than X^2 tabulated this accept the null hypothesis which means that there is no significant association between visual acuity and students participation in other recreational activities.

3.4.3. Students ability to write from the board

VA	Poor	≥Fair	Total
Normal	16	235	251
Reduced	10	89	99
Total	26	324	350

Table 5: A two by two chi-square table to compare the association between visual acuity and student's ability to write from the board

Assuming the null hypothesis (HO) = there's no significant association between the visual acuity and students ability to write from the board H1 = there's significant association between visual acuity and students ability to write from the board.
To calculate the expected (E)
= RT x CT / Grand total
RT = row total, CT = column total.
X^2 calculate = $\sum$ (observed-expected) ^{2} / expected
=0.377+0.0302+0.9554+0.0766
X^2 calculated =1.44
Degree of freedom (df) = (R-1) (C-1)
(2-1) (2-1) =1x1=1
= 0.05 (5%)
X^2 calculated = 3.84
Since x^2 tabulated >x^2 calculated, this accepts the null hypothesis which means that there's no significant association between visual acuity and students to write from the board.

	Reading		
VA	Poor/bad	≥Fair	Total
Normal	16	235	251
Reduced	16	83	99
Total	32	318	350

Table 6: A two by two chi-square table to compare the association between visual acuity and reading

Assuming the null hypothesis (HO) = there's no significant association between visual acuity and reading. h1 =there's significant association between visual acuity and reading.
To calculate expected (E) = R_T x C_T / Grand total
= R_T = row total, C_T =Column total
X^2 calculated =$\sum$ (observed-expected) ^{2}/ expected
X^2 calculated =2.105+0.219+5.337+0.537
= 8.198=8.20

Degree of freedom (D_F) = (R-1) (C-1)
= (2-1) (2-1)
= 1x1=1
= 0.05 (i.e. 5%)
X^2 Tabulated = 3.84
Since X^2 Tabulated is < X^2 calculated this rejects the null hypothesis which means that there's significant association between visual acuity and reading.

4. Discussion

Generally speaking, refractive error contributes a significant chunk of school children with visual impairment. Refractive error leading to poor vision can be detrimental to a child's capacity to lean and sometimes it can be very difficult to differentiate this from mental handicap. Poor school performance, lack of interest in schooling and dropping out of school totally can be prevented reasonably from spectacle correction. [15]
Moreover, to mark the world sight day (2006), the world Health Organization (WHO) released new global estimate which for the first time revealed that 153 million people around the world have uncorrected refractive errors, including children. 90% of all people with uncorrected refractive errors live in low and middle income countries like Nigeria. [17, 18, 19]
Hence, this study is very important considering the fact that Visual impairment has been shown to have negative effects on health related quality of life and a significant impact on daily functioning [10,11] including social activities [12,13] and emotional functioning.[14]

The results revealed that, of the 350 students, 57.14% were females and 42.86% were males, 20% of the population studies were between 10-12 years, 43.71% were between 13-15 years and 36.29% were between 16-18 years. 71.71% of the population studied had normal visual acuity while 28.29% had reduced visual acuity.

In our study, student's participation in sports, other recreational activities, writing and reading was the measure to assess quality of life of secondary school students using fair response as the pass mark.

Of the 350 students studied, 27.09% (68) of students with reduced visual acuity had a bad student participation or quality of life. Packwood E.A et al in his work on the relationship between amplyopia agreed that it interfered with schooling work and other domestic activities, and nearly 75% reported that amplyopia affected self image. [20]

Another work done by Rasmeet k.C. et al on the effect of visual impairment on the quality of life children aged 3-16 years using the low vision quality questionnaire in which distance and near visual acuity and age that could be used as predictor of quality of life were assessed. Results showed that children with reduced visual acuity had significantly lower quality of life score ($p<0.001$). Quality of life score in children with visual impairment were correlated with distance and near visual acuity ($p< 0.05$). 38% of the variance can be predicted by these factors and age.[21] these findings do not completely support our work.

There was only a significant association between visual acuity and reading (X^2 calculated = 8.20, X^2 tabulated =3.84, degree of freedom = 1,ض-value = 0.05, X^2 tabulated $<X^2$ calculated) X^2 calculated for sports gave 1.82, X^2 tabulated gave 3.84, degree of freedom = 1,ض-value = 0.05, X^2 calculated. So there is no significant association between visual acuity and participation in sports. For participation in other recreational activity, no significant association was found between visual acuity and participation in other recreational activity (X^2 calculated = 1.82, X^2 tabulated =m 3.84, degree of freedom = 1,ض-value =0.05, therefore X^2 tabulated $>X^2$ calculated).

For the relationship between visual acuity and students ability to write from the board, no significant association was found (X^2 calculated = 1.44, X^2 tabulated = 3.84, degree of freedom =1,ض-value = 0.05, X^2 calculated $< X^2$ tabulated).

Our overall finding is that visual acuity only affected the student's quality of life through its effect on their reading ability.

5. Conclusion

School screening programmes should be established for prompt referral to specialists, further evaluation, immediate treatment and follow up of refractive errors involving both preschool and school children to avert reading disability and its sequellae as shown in this study series.

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