VISUAL ACUITY, MICROFILARIAL LOAD, NODULES AND NUTRITIONAL STATUS AMONG ADULTS WITH ONCHOCERCIASIS INFECTIONS IN SOUTH EAST NIGERIA.

Abstract.

The association between onchocerca infection, visual acuity, nodules and nutritional status was determined for 6153 adults, 15 years and above (59 % females and 40 % males) in 3 local government areas (LGAs) in Enugu State, South Eastern Nigeria. As determined by skin snip, 29 % of the population was infected (mean 5.1 microfilariae ± 7.6 SD) and 55.6 % had nodules. Both the prevalence and intensity of infection were higher among men than women (p= .002). There was a significant declined in the intensity of infection with increasing age for females (p = .03) but the intensity did not change significantly for males. The community microfilarial load was 1.7.

Both the prevalence of blindness (0.6 %) and visual impairment increased with age (p =.001). Adults 50 years and above were 13 times more likely to be blind than younger adults. Visual impairment was associated with nodules but not intensity of infection.

BMI (weight/height^2) was used as an index of nutritional status. There was a significant decrease in BMI with both visual impairment and presence of nodules in both males and females. Logistic regression analysis showed that adults with visual impairment have a 50 % chance of having a low BMI, and adults with nodules had a 70 % chance of being visually impaired . There was, however, no difference in BMI among individuals with negative, low, or high microfilarial loads.

INTRODUCTION:

Onchocerciasis is one of the 4 main causes of blindness in the world. It is endemic in 34 developing countries, where 35,000 people are reported blind from the disease (WHO, 1987). Wherever there is onchocerciasis, there are eye lesions and a few blind persons as a result; but it is in the sub-Saharan Sudano- Guinea savanna belt, stretching across Africa from Senegal in the west to Sudan in the east, that blindness rates have become so high as to have severe socio-economic implications (Duke, 1990).

Various studies in the West African savanna regions showed that the severity of ocular onchocerciasis is related to the intensity of infection (Anderson et al., 1976; Thylefors et al., 1977; Kirkwood et al., 1983)). The life expectancy in the blind is greatly reduced (Prost et al., 1981; Kirkwood et al., 1983). Mortality in the blind adults is, on the average, three to four times greater than of people of the same age who can see (Prost et al., 1981).

There is now emerging evidence that mortality rates may be increased in undernourished adults with low BMI (Shetty and James, 1994). Results of a study relating mortality and BMI status shows that mortality steadily increased from 12 per 1000 population with 'normal' BMI class with BMI > 18.5 to 33 per 1000 in groups with BMI < 16.5 (NIN Report, 1989-90). Kirkwood et al (1983) reported a significant decrease in nutritional status of the blind in onchocerciasis endemic areas and suggested that this may be a factor contributing directly to their increased mortality.

In Nigeria at least 7 million people are infected with O. volvulus, 40 million are at risk of infection, about 11,400 are blind (WHO, 1987), and thousands have other disabling complications of the disease. The infection is widely distributed in both the forest and savanna habitats, with varying levels of endemicity. The savanna strain of onchocerca has been shown to be more pathogenic and invasive than the rain-forest strain (Duke et al, 1966, 1970; Duke et al., 1967; Anderson et al, 1974; Rolland, 1974).

In this paper, the association between microfilarial load, nodules, visual acuity, and nutritional status in adults was studied in an area of Nigeria where there is an interface between forest and savanna,

using pre-ivermectin survey data.

MATERIAL AND METHODS

Study Area and Population.

The study area consisted of three contiguous local government areas (LGAs) (fig. 1) randomly selected by the Federal Ministry of Health, namely: Ezeagu (population 204,214.), Oji-River (population 114,160), and Uzo-Uwani (population 218,452). They lie in the rainforest zone and vegetation is Guinea- wooded savanna, with luxuriant vegetation during the rainy season (Oct.-March).

After explaining the purpose of the survey to the population, a house-to-house census was conducted. Subsequently persons, who volunteered to participate in the study underwent physical and parasitological examinations.

Parasitological study

Skin snips were taken using a 2 mm corneo-scleral punch from the right and left iliac crests, the area believed to give the highest yield in West Africa (WHO, 1976). Snips were stored in coded 0.3 ml wells of a 96 well microtitre plates containing normal saline and kept at room temperature to allow the microfilariae to emerge. Plates was examined with a stereo-dissecting microscope. The estimates of the microfilarial density in the skin sites were derived from the number of the larvae emerging from the biopsies taken from both sites. Individuals were categorized into three groups depending on the average microfilarial count per skin snips: (I) uninfected, no microfilariae seen: (ii) average count of between 0.5 and 9.5 microfilariae per skin snip; and (iii) average count of 10.0 microfilariae per skin snip or above. Prevalence and intensity of infection are reported respectively, as percentage of persons found infected and as the arithmetic mean of the microfilarial count among the infected.

Physical Examination

After individuals were undressed, the location and number of palpable nodules characteristic of onchocercomata were determined. The skin was examined for the presence of various skin changes,

hanging groins, and other related changes associated with onchocerciasis.

Visual acuity was measured with the Snellens illiterate E chart at 6 m, one eye at a time. Those with vision <6/60 were then asked to count fingers at 3 m. This standard has been shown by Budden (1956) to be a reasonable measure of ‘economic’ blindness in Northern Nigeria. Visual acuity was thereafter classified as ‘normal’, corresponding to >6/18; or ‘impaired’ corresponding to >3/60 or <= 6/18 or inability to count fingers at 3m; or blind corresponding to <= 3/60 or inability to count fingers at 1.0 m (WHO, 1973). The result from the best of the two eyes was used to determine visual acuity in individuals.

Height was measured on a vertical calibrated board with movable headpiece, while weight was taken with minimal clothing on Detecto bathroom scales.

Body mass index (BMI: kg/m^2),was chosen as the most suitable objective anthropometric index for diagnosing undernutrition in adults. Unlike others nutritional indices, BMI is consistently and highly correlated with body weight and is relatively independent of the stature or height of an adult (Khosla and Lowe, 1967).

Data Analysis

Frequency distributions were calculated for all variables using SAS statistical package and later for collapsed categories. Two-by-two tables were used to determine associations between various groups. The mean BMI in infected and uninfected persons was compared using analysis of variance and analysis of covariance. Simple logistic regression analysis was used to assess the relative influence of sex, age, LGA, vision, presence of nodules, and microfilarial load on nutritional status .

Result

Demographic Characteristics:

A total of 6153 adults, 15 years and above who voluntarily enlisted in the pre-ivermectin prevalence survey in the 3 LGAs were examined (see previous manuscript Nwaorgu et al, 1994). There were 2505 (40.7%) males and 3648 (59.3%) females, giving a male to female sex ratio of 1: 1.2. Their distribution by sex and age-groups is shown beneath the x-axis of table 6.

Prevalence and Intensity of Onchocerciasis.

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The overall crude prevalence for the study population was 29.0% .This was significantly greater for males (30.9%) than for females (27.8%) (p=.008) and was highest among individuals 20-60 years old (fig. 1 and table 1) Mean intensity among those infected was 5.0 (ranging from 0.5 - 297), and was higher among males (mean 5.8 ± 9.4) than women (4.5, ± 6.7 p = .002). Among women under the age of 60, the mean intensity declined with increasing age (test for trend p =.01) but remained relatively constant for males (see fig. 1). The Community Microfilarial Load (CMFL), which is the geometric mean number of microfilariae per skin snip (mfs) in adults aged > 20 years (including those with negative counts), in the community (Remme, et al. 1986) was 1.7.

Visual Acuity

Visual acuity of <=6/18 (impaired vision) was recorded in 1020 (16.8%) of 6063 individuals examined in the population and blindness in 0.6% (39). Males had greater rates of blindness than females (p = 0.03), while females had higher rates of impaired vision. There was a significant increase in visual impairment with increasing age (p = .001). Logistic regression showed that adults 50 years and above were 13 times more likely to have impaired vision than 15-49 years olds. Males were marginally (1.1 times) more likely to be blind than females of same age (p = .2).

Nodules

The prevalence of nodules in males was 55.5% and in females, 55.7%. In persons over

50 years the prevalence was 72.5% in females and 66.5% in males. The prevalence of nodules in all anatomical sites increased with age except for head nodules which remained constant. The highest number of nodules was detected in the iliac region of the body for all ages, and the next highest was in the ribcage. The likelihood of having visual impairment when nodules were present was 2.3 (1.4 after adjustment for other factors by logistic regression).

Table 1. Characteristic of 6153 Individuals infected with Onchocerciasis

	Number	Percentage
Microfilariae positive	1787	29.0
Intensity (mean ± SD)	5.0 ±7.6	
Nodules	3421	55.6
Nodules + Microfilariae	1138	33.3
Body Mass Index < 18.5	1405 (6089)	23.1

Relationship between Nutritional status and Visual Acuity:

Analysis of variance showed that BMI decreased significantly with increasing visual damage (p = . 0001). Females and males with normal vision were 2.1 kg/m^2 and 1.2 kg/m^2 heavier than their blind and vision impaired counterparts (p = .0001). Blind and vision impaired males were 1.1 kg/m^2 and 0.4 kg/m^2 lighter than males with normal eye sight (p = .007) (see tables 2 & 3). The association between BMI and visual acuity varied between the age-groups (p = .0001). Logistic regression showed that adults with low vision had 50% chance of having low BMI after adjusting for age, microfilarial intensity, sex, LGA and nodules (see table 6).

Relationship between nutritional status and microfilarial load:

There was no significant difference in the BMI for individuals with high (10 mf / snip and above), or low (between 0.5 and 9.5 mf / snip) microfilarial load, or those with no microfilaria in their skin snips. Adjusting for vision , age, and LGA, analysis of variance and analysis of covariance did not show any association between microfilarial load and nutritional status in either sex even though nutritional status

was strongly associated with age, sex, vision, LGA and nodules. Logistic regression did not show any association between vision and microfilarial load (table 6). Both visual acuity and microfilarial load seem to be independently related to nutritional status in adults.

Relationship between nutritional status and nodules.

Analysis of variance and analysis of covariance showed a significant difference between nutritional status of females and males who had nodules and those who did not ($p = 0.0001$). Males and females with nodules weighed 0.5 kg/m^2 less than those with no nodules. By adjusting for microfilarial load, vision, LGA and age, both analysis of variance and analysis of covariance showed a statistically significant difference in nutritional status between males and females who had nodules and those who did not ($p = 0.003$; for males and $p = .0001$ for females).

Logistic regression showed that adults with nodules had a 70% chance of having low BMI (see tables 6

Table 2. Showing the relationship between nutritional parameters (BMI) and Onchocerca infection, presence of nodules and visual acuity in adults 15 years and above.

		Body mass index (BMI)	P	Adjusting for other factor	P
1.Microfilarial Load					
Negative		20.5 ± 3.	0.8	20.5	0.8
Low	Analysis of variance	20.6± 3.0		20.6	
High		20.6± 2.5		20.7	
Neg.	Analysis of covariance	20.5	0.8	20.5	0.8
Low		20.6		20.6	
High		20.0		20.7	
2. Visual acuity					
Normal	Analysis of variance	20.7± 3.0	0.0001	20.7	0.0001
Low		19.8± 2.9*		19.8*	
Blind		19.1± 2.6		19.1	
Normal	Analysis of covariance	20.7*		20.6*	
Low		19.8	0.0001	20.1	0.0001
Blind		19.1	0.001	19.5	0.02
3. Nodules					
Absence	Analysis of variance	20.6± 3.0	0.0003	20.6	0.0003
Presence		20.2± 3.0		20.2	
Absence	Analysis of covariance	20.6	0.0003	20.6	0.2
Presence		20.2		20.4	

N.B. * Normal is different from low and blind
Mean ± one standard deviations are displayed.

D. INTERACTIONS.

1. **Association between Microfilarial Intensity and Visual acuity.**

There was no association between microfilarial load and visual acuity in males subjects (p =0.9), while in females there was a weak association (p= .08). There was no association between microfilarial load and vision in the two age-groups. Logistic regression showed no association between microfilarial intensity and vision (see table. 6).

2. **Association between Nodules and Infection Status**

There was a significant (p =.001) association between vision and nodules in both males and females (table 3a & b). Logistic regression showed that, after adjusting for age, sex, microfilarial intensity and LGAs, nodule was still highly significant (p = .0001) with an odd ratio of .702. The likelihood of having visual impairment when nodules were present was 2.3 and 1.4 when other factors were adjusted for. This effect is more among younger adults 15-49 years old with an odd ratio of 2.40 at 95% confidence Interval (1.819,3.167) and p = .001 (see table 3). The only female who was blind in this group was correctly detected by the presence of nodules. In the elderly 50 years and above, the odd ratio was 1,237 at 95% confidence interval (1.007,1.52) with p = .o4. Eighty three percent of females who were blind were detected by the nodules.

Table 3a. Showing association between Nodules and Infection Status by Age-groups in Females

	VISION = NORMAL				VISION = LOW				VISION = BLIND				p value
Age	No Infect	%	Infected	%	No Infect.	%	Infected	%	No Infec.	%	Infected	%	
15-49	1318	51.4	1247	48.6	44	28.8	109	71.3	0		1	100	.001
50+	118	27.0	319	73.0	109	25.4	321	74.7	3	20.0	12	80.0	.7
Total	1436	47.8	1566	52.2	153	26.2	430	73.8	3	18.8	13	81.3	0.001

Table 3b showing association between Nodules and Infection Status by Age-groups in Males

	VISION = NORMAL				VISION = LOW				VISION = BLIND				p
Age	No Infect	%	Infected	%	No Infect.	%	Infected	%	No Infect.	%	Infected	%	
15-49	773	52.0	713	48.0	32	34.4	61	65.6	0		0		
50+	186	36.1	330	64.0	103	29.9	241	70.1	8	34.8	15	65.2	.1
Total	959	47.9	1043	52.1	135	30.9	302	69.1	8	43.8	15	65.2	0.001

DISCUSSION:

The overall prevalence of O. volvulus in adults in the study area was 29% and was similar in many respects to that in other endemic areas (Budden, 1963; Moyou Somo, et al. 1993).There was increase of infection, nodules, visual impairment and blindness(p=.001) with age. Intensity of infection however, did not vary significantly with age among males while it decreased among women. Men had a higher prevalence and mean intensity of infection (p=.008) and were more likely to have nodules than females. The prevalence of blindness were not significantly different for men and women although impaired vision was more among females (p =.03).

The degree of visual damage was not related to microfilarial load. Although other possible causes of blindness (Rodger 1959; Kershaw et al, 1956) could not be eliminated totally since a thorough ophthalmologic examination was not performed, a CMFL above 0.5 mf/s and a prevalence of above 20% does suggest onchocercal blindness (Dadzie et al., 1991). Moreover, strong (p =.001) association between the presence of nodules and visual impairment in the present study suggests that most of the visual problems are onchocercal related.

Visual impairment and nodules, but not microfilarial load were associated with nutritional status. The finding that persons with positive skin snips weighed less than those with negative skin snips confirms the earlier observations of Kirkwood et al. (1983) and Burnham (1991). Reduction in weigh among adults infected with onchocerciasis may be due to a mechanism similar to those of other parasitic infections, such as diversion of vitamins or other nutrients from the host to the parasite. Raper and Ladkin (1950) reported a condition called cachectic infantilism among the Banakalanga‘pigmy Negro’s in Mabira forest. These people have heavy infections with Onchocerciasis volvulus and stunted physical growth and retarded sexual development accompanied by, muscular wasting, poor appetite, general weakness and apathy.

Although the impact of onchocerciasis in the rain forest areas in terms of visual impairment has often been underestimated, results from the present study suggest it is of considerable importance .Apart from revealing for the first time the presence of visual impairment due to onchocerciasis in the south-

eastern part of Nigeria, the association of visual impairment and nodules with low BMI in infected individuals was also established.

In this area, 23.1 % of the adults had BMIs less than 18.6, the level that is considered poor for nutritional status, and they can be expected to have low work productivity and low birth infants. These therefore underscores the importance of onchocerciasis control in endemic areas.

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