Serum Trace elements Profile in the Nigerian with Onchocerca volvulus Infection

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ABSTRACT: The serum trace element namely copper, selenium and zinc among Nigerians with microfiladermia and 4 clinical manifestations of onchocerciasis were investigated. The prevalence of the clinical presentations were onchocercal dermatitis 48 (48.9%), leopard skin 40 (40.8%), onchocercal nodules 40 (40.8%) and hanging groin 9 (9.2%). The relationship between prevalence of onchocercal dermatitis, onchocercal nodules and hanging groin and microfilarial load were positively correlated (r= 0.81, r = 0.12 and r = 0.51) respectively. Leopard skin had negative correlation with the microfilarial load (r= -0.64). The mean serum trace elements of the infected volunteers were copper 670.3±28.6 ng/ml, selenium 59.0±5.9 ng/ml and zinc 400.3±12.4 ng/ml. The differences between the mean concentration of copper of infected volunteers and their control was statistically significant (χ^2 = 20.3, p>0.05). The differences between mean concentration of selenium and zinc of the control and infected volunteers were statistically not significant (χ^2 =1.61, p<0.05) (χ^2=0.64, p<0.05) respectively. The relationship between the serum copper, selenium and zinc and the microfilarial load were negatively correlated (r =-0.93, r =-0.94 and r =-0.84) respectively. The depleted mean serum trace elements in the infected volunteers than their control subjects implicated the deficiency of copper, selenuim and zinc in the pathogenesis of onchocerciasis and the need to incorporated dietary trace element supplements in management of onchocerciasis. [Nature and Science. 2007;5(4):14-17].

INTRODUCTION

The pathogenesis of onchocerciasis is mainly due to the effects of microfilariae which manifests by different clinical presentations mainly in chronic phase. The chronicity of this infection includes lichenification such as leopard skin and other skin pathology (Nmorsi *et al*., 2007).

Nutrition plays a major role in maintaining health and micronutrients are known to influence the disease progression in man (Hussey and Clement 1996). Zinc which is one of the essential trace elements and indeed a member of one of the major subgroups of micronutrient has attained prominence in human nutrition and health (Hambridge, 2000). Zinc deficiency depresses the ability of the body to respond to infection, affecting both cell-mediated immune and humoral responses (Shankar and Prasad 1998; Ibs and Rink, 2003). The established role of selenium in human is its antioxidant activity. Low plasma selenium is found in varied clinical disorders and excessive chronic selenium intake causes skin pathology (Lockitch, 1989). Several bacteria known to be human pathogens die when placed in copper alloy surfaces. Copper continues to play a vital role as we age by keeping our hair and skin in good condition while repairing and maintaining connective tissues in our organs (Michels *et al*., 2005). Deficiencies of some trace elements such as copper and zinc have been associated with higher worm burden. The possibility is emerging that there may be optimum trace element in the diet above which or below which a parasite is advantaged. Moreover, there is some specific data to suggest that specific trace elements may be directly toxic to parasites (Koski and Scott, 2003).

There is paucity or no information on the relationship between trace elements and parasites especially *O. volvlulus* in this part of globe despite the demonstrable relevance of trace elements in pathogenesis of parasitic infections. We therefore investigated the serum trace elements profile in Nigerians with *O. volvulus* infection.

MATERIALS AND METHODS

Egoro-Eguare, a rural community located in Esan West Local Government Area of Edo State, Nigeria is our study area. It lies approximately lat 6^{o}N, 5^{o}E and longitude 6^{o}N, 8^{o}E. It is located about 7km away from Ekpoma, the headquarter of Esan West Local Government Area. Egoro-Eguare has a population of about 900 inhabitants who are predominantly farmers while some females are involved in pretty trading. Here there is absence of a school and market. There is a stream that is shaded with luxuriant green vegetation as the community lies within the rainforest belt of the state. This stream serves as the source of

recreational and domestic activities to the villagers. It constitutes breeding site of *Simulum* found within the community. The inhabitants had been subjected to ivermectin therapy by the State Ministry of Health Onchocerciasis Control Programme, Benin City, Nigeria. Ethical permission was obtained from the State Ministry of Health, Benin City, Nigeria. We carried out community mobilization campaign where the aims, scope and nature of our research were explained to the inhabitants in our study area for their consent. The consenting participants were assembled in the palace of the village head for further study. Here a pre-designed questionnaire on their names, age, weight and occupation were administered. They were subjected to physical examination individually in a room in search for the clinical presentation of the disease.

Two skin-snips were taken from the iliac crest bilaterally and transported to our Tropical Diseases Research Laboratory for further procession and examination microscopically as reported earlier (Nmorsi *et al*., 2002). The 98 volunteers with microfiladermia and different clinical features of Onchocerciasis and 35 control participants were recruited for further study. The presence of other obvious disease conditions namely HIV, malaria, intestinal parasitic infections were ruled out in these participants using standard kits and procedures.

The serum copper, selenium and zinc concentrations from the participants were determined using Atomic Absorption Spectrophotometer.

The data obtained from this study were subjected to statistical analysis using the chi – square test and correlation using the Micro Soft Excel Package.

RESULTS

Table 1 presents the clinical presentations of 98 volunteers with microfiladermia according to their age groups in years. In all, 4 clinical manifestations namely 48(48.9%) onchocercal dermatitis, 40(40.8%) leopard skin, 40(40.8%) and 9(9.2%) hanging groin were encountered. Leopard skin, onchocercal nodules and hanging groin were not reported among the *O. volvulus* infected inhabitants within the first decade of life. The highest prevalence of clinical manifestation of 11(100%) occurred among the individuals above 60 years old. The prevalence of the onchocercal dermatitis, onchocercal nodules, hanging groin and microfilarial load were positively correlated ($r = 0.81$, $r = 0.12$ and $r = 0.51$) respectively. The relationship between the onchocercal nodules and microfilarial load was negatively correlated ($r = -0.64$).

The serum trace elements, microfilarial load according to the age groups in years of the 98 *O. volvulus* infected volunteers are presented in Table 2. The highest microfilarial load of 20 mff/mg was reported among the infested volunteers within the 11-20 age groups in years, while the least occurred among the volunteers above 60 years old. The mean serum trace elements were copper 670.3±28.6 ng/ml, selenium 59.0±5.9 ng/ml and zinc 400.3±12.4 ng/ml. The mean concentration of copper was statistically different from their control subject (925±25.0ng/ml) at ($\chi^2 = 20.03$, $p>0.05$). The difference between the mean concentration of selenium and zinc of the infected and control volunteers were statistically not significant at ($\chi^2 = 1.61$, $p<0.05$), ($\chi^2 = 0.64$, $p<0.05$) respectively. The relationship between the microfilarial load and serum trace elements namely copper, selenium and zinc were negatively correlated at ($r = -0.93$, $r = -0.94$ and $r = -0.84$) respectively.

Table 1. The clinical presentations according to the age groups of 98 Volunteers with Microfiladermia

Age groups in years	No infected with microfilariae	Clinical Presentation			
		Onchocercal dermatitis no (%)	Leopard skin no (%)	Onchocercal nodules no (%)	Hanging groin no (%)
1 – 10	10	9(90)	0(0)	0(0)	0(0)
11 – 20	18	13(72.2)	2(11.1)	4(22.2)	1(5.6)
21 – 30	16	10(62.5)	3(18.8)	9(56.3)	3(18.8)
31 – 40	17	6(35.2)	5(29.4)	10(58.8)	2(11.8)
41 – 50	13	3(28.1)	9(69.2)	6(46.2)	2(15.4)
51 – 60	13	3(23.1)	10(76.9)	5(38.5)	1(7.7)
>60	11	4(36.4)	6(54.5)	6(54.5)	0(0)
Total	98	48(48.9)	40(40.8)	40(40.8)	9(9.2)

Table 2. The Serum trace elements and microfilarial load according to the age groups in years

Age group in years	**Microfilarial Load (mff/mg)**	**Copper ng/ml**	**Selenium ng/ml**	**Zinc ng/ml**
1 -10	10.5±4.1	664.5±50.5	62.5±3.5	419.0±13.2
11 – 20	20.0±3.1	631.8±45.3	46.8±7.0	384.4±44.3
21 - 30	16.5±4.2	641.0±46.7	57.2±2.5	386.4±38.4
31 – 40	12.0±1.1	669.2±25.3	58.3±2.8	393.6±41.2
41 – 50	12.5±3.5	671.3±52.1	60.3±2.8	399.0±10.2
51 - 60	8.3±4.1	689.0±24.0	63.0±3.5	404.5±10.5
>60	6.5±1.1	725.0±45.3	65.0±4.0	415.3±11.8
Mean	12.33±4.7	670.3±28.6	59.0±5.9	400.3±12.4
Control	-	925.0±25.0	78.5±15.2	433.0±8.0

DISCUSSION

Our data showed the prevalence of four clinical manifestations of ochocerciasis namely onchocercal dermatitis, leopard skin, onchocercal nodules and hamging groin. We observed a preponderance of infection towards the adult than the children. This denotes long standing and chronic presentation of this parasitic infection. These observations had been reported earlier (Nmorsi and kio 1994, Edungbola *et al*., 1987).

An important observation reported in our study is a plateau (fairly stable) type presentation of microfilarial load between 20 – 50 years while the children and the volunteers above 50 years of age had lower microfilarial load. This has economic repercussion considering the fact the inhabitants are predominantly farmers and the 20 – 50 years are the active productive age. This observation accords the reports of (Anderson and May 1991, Hudson and Dobson 1995, Nmorsi and Obiamwe 1992) where they reported a stabilizing (plateau) pattern of onchocerciasis with reduced infection in children and old age groups. This pattern of infection can be attributed to reduced exposure and enhanced immunity.

Our data which revealed lower concentration of trace elements than their control subjects reflects the impact of *O. volvulus* on these micronutrients. This assertion is further proved valid by the relationship between the serum concentration of the trace elements namely copper, selenium and zinc with the microfiladermia which were negatively correlated. Furthermore, this deduction is true considering the role of these micronutrients in human health. For instance, copper is involved in keeping our hairs and skin in good condition while repairing and maintaining connective tissues in our organs (Michels *et al*., 2005).

Another significant observation is the depressed zinc status among the Nigerians with onchocerciasis. This state of zinc deficiency reported in our investigation had been documented earlier in other disease conditions (Shankar and \Prasad 1988, Falutz *et al*., 1989). This observation is expected considering the central role of Zinc in human immune system as zinc deficient persons experience susceptibility to a variety of pathogens (Shankar and Prasad, 1989) thereby depresses immune function and leads to morbidity of diseases (Sandstead, 1991). Also Ibs and Rink (2003) documented that zinc deficiency depresses the ability of the body to respond to infection affecting both cell-mediated immune and humoral responses. Therefore this depressed zinc concentration profile will no doubt contribute greatly to the maintenance of the chronicity and long standing onchocerciasis in Egoro-Eguare despite the intervening ivermectin therapy.

The depressed selenium status in our *O. volvulus* infected participants reflects the depletion of this trace element which is known to possess antioxidant activities (Flohe, 1988) Selenium with its selenoenzymes, stutathione peroxidase and indeed zinc are cateforised as antioxidants. In the face of low serum selenium concentration, oxidative stress abound which can contribute to cell injury and oxidation of biomolecules (Fang *et al*., 2002). We believe that this will therefore contribute to the skin pathology and other clinical manifestations in onchocerciasis in Egoro-Eguare, Nigeria.

From our data, we found the interrelationship between serum trace elements and onchocerciasis which is chronic and long standing in Egoro-Eguare, Nigeria. Since administration of trace elements such as Zinc supplementation can improve the immune system in human diseases (Shankar and Prasad, 1998) and dietary antioxidants play an important role in preventing many human diseases (Fang *et al*., 2002), we

recommend the incorporation of dietary trace elements especially zinc, copper and selenium supplementations with current ivermectin in management of onchocerciasis.

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