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Assessment of Morbidity in Malaria and Urinary Schistosomiasis using Some Specific Indicators

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Abstract
The severity of infections with malaria and urinary schistosomiasis was assessed in a rural endemic community using morbidity indicators such as anaemia, haematuria, proteinuria, leukocyturia and low anthropometry. Parasitological examinations of urine and blood specimens were carried out for *Schistosoma haematobium* and *Plasmodium* sp in addition to measurements for height and weight of the candidates. One thousand and sixty persons (1060) including 535 males and 525 females between 6 months and 83 years were examined. The overall estimated prevalence of malaria was 62.3%, that of urinary schistosomiasis was 80.7% and co-infection was 55.1%. Age related peak prevalence of the infections occurred in children of ages 5-9 years for malaria, 10-14 years for urinary schistosomiasis and 5-9 years for co-infection. Heavy intensity (1001-2000 eggs/10ml urine) was predominant in those under 20 years while light intensity (≤100 eggs/10ml urine) occurred more in older individuals. Prevalence of the morbidity parameters exceeded 70% with haematuria being the highest. Individuals with moderate to high concentration of the parameters and those with co-infection of malaria and *S. haematobium* infections were found with relatively low haemoglobin concentration. The later correlated more closely with urinary schistosomiasis (r=0.99) than with malaria (r=0-17). Reduction in weight and height occurred more in children of ages 0-4 who had co-infection.
Keywords: Malaria, urinary schistosomiasis, morbidity parameters, severe infection.

1. INTRODUCTION

Malaria and schistosomiasis are major parasitic diseases of public health importance the world over. In areas where they are endemic, great health hazard and socio-economic problems occur. Prevalence record, of both infections indicate that they could rise as high as 90% in most communities (Chen & Mott 1989; Agi & Okafor 2005). The infections are water related and most importantly occur in areas where environmental conditions favour their transmission.

Malaria causing parasites are noted to invade the liver and red blood cells where they feed, multiply and rupture causing them to become sticky. Consequently blood vessels in organs such as spleen, liver, brain, kidney may be blocked. Prolonged infection especially with *P. falciparum* can be fatal to the humans (Edington & Gilles 1976).

On the other hand, the infection with *S. haematobium* results in immuno-pathologic sequel caused by the parasite oviposition in the vessical plexuses of the urinary bladder. Studies revealed that patients of urinary schistosomiasis suffer from urinary blood loss (haematuria and leukocyturia), urinary protein loss (proteinuria), inflammation in the genito-urinary organs, fibrosis, bladder cirrhosis (hardening of the bladder) tumous and kidney dysfunction (Chuling *et al* 2012).

Both malaria and urinary schistosomiasis are associated with significant loss of red blood cells (leading to anaemia), poor growth, nutritional disturbances and health degeneration especially in chronic conditions (NMFS, 2011; Rafiluddin *et a*l 2001). They affect the welfare and productivity of the affected individuals, and the community.

2. MATERIALS AND METHODS

2.1 Study Site:

This study was concluded in a rural community in Rivers State, Nigeria. Odau is located on latitude $4^0$56'N and longitude 6^O7'E. The temperature ranges from 29^0C during the rainy season to 32^0C during the drier months. Dry season occurs from late December to February while the period of rainfall lasts from March to the middle of December. The average rainfall is 2,200mm annually (Kinako *et al* 1989).

Odau is among the lowest areas of the flood plains of the Niger Delta. The average altitude is 2.3m above sea level (Agi 1995) and the vegetation is fresh water swamp forest. The indigenous people are predominately peasant farmers and fishes folks and depend sufficiently on ponds and rain water for most of their occupational and domestic activities.

The ponds and surrounding vegetations have be found to contain fresh water snails including *Bulinus* sp which is the intermediary host of the blood fluke *Schistosoma haematobium,* the organism that causes urinary schistosomiasis (Agi & Okafor 2005). Other disease vectors identified in the community include most importantly *Anopheles* sp. which transmit malaria parasites (Okafor 2005).

2.2 Blood and urine sample collection and analysis:

The specimens were collected from the selected individuals who totaled 1060 in the age range of 6months to 83 years. Universal sterile dry plastic containers with a capacity of 50ml were used to collect the urine between 10am and 2pm of the sample days and analysed both parasitologically and biochemically.

The parasitological analysis of the urine specimen involved filtering, staining of the filtrate and observing drops of the urine placed on the microscope slide under the objective lens (5x -20x) of a binocular microscope. The terminally spine schistosome eggs, if present were counted.

The percentage of the people who were infected was recorded as prevalence of the infection or infection rate. While the average number of eggs obtained from 10ml of the urine was reported as intensity (egg/10ml urine) of the infection.

2.2.1 Biochemical Urine Assessment:

Freshly voided urine collected from the individuals were used to semi-quantitatively determine the concentrations of protein, red and white blood cells using, Combi Screen 10SL (ANALYTICON$^{(R)}$ GMBH D-35 104,LITCHENFEL GERMANY) test stripes. The minimum, medium and maximum sensitivity of the stripes for the morbidity indicators were: protein(30mg/dl; 50mg/dl; 500mg/dl), leucocytes(25leukos/ul,75leukos/ul and 500leukos/ul),red blood cells(5-10Ery/ul;100Ery/ul and 300Ery/ul)

2.2.2 Analysis of blood for Malaria Parasites:

Blood was collected from all the participants with sterile blood lancet(AUTOCLIX LANCET). The thick blood film method was used and the smeared slides were examined under 40x and 100x objective lenses of a binocular microscope for malarial parasite.

2.2.3 Measurement of haemoglobin concentration of the individuals:

Haemoglobin concentrations of the study population was measured using the method described by Okafor & Elenwo (2007).

2.3 Anthropometric measurement:

The weight(kg) and height(m) of the examined individuals were measured using a portable VINLING SCALE with a capacity of 120kg for weight and calibrated meter rule fixed on the wall for height.

2.4 Statistical Analysis:

The density of malaria parasites or degree of parasiteamia was determined using the formula

Mean parasite count per HPF x 500

= Parasite count per microliter of blood

Arithmetic mean/Geometric mean for *S. haematobium* determines the intensity of the infection.

Product moment correction coefficient was used to measure linear relationship between the variables.

Simple T- test was used to compare levels significance.

3. Results

3.1 Prevalence of the infections.

The individuals who participated in the study included 535 males and 525 female (total=1060) of which 65.8% of them were under 20 years of age. The overall prevalence of urinary schistosomisis was 80.7%. Compared to that of malaria (62.3%), the difference was statistically significant ($P < 0.05$) table 1.

Prevalence record for individual age groups considered was higher than 50% for urinary schistosomiasis and more than 30% for malaria infection. The peak prevalence (93.4%) by age occurred in the 10 – 14 years age group for schistosomiasis, and 5-9 years age group (84.5%) for malaria. Co-infection of malaria and urinary schistosomiasis occurred in 584 (61.1%) of the idnividiual with a peak(82.0%) found in the 5-9 years old.

3.2 Intensity of malaria and urinary schistosomiasis.

The overall mean eggs of *S. haematobium* excreted was 123,617 eggs/10ml urine (geometric mean = 742.49 egg/10ml urine).

The geometric mean egg count ranged from 56. 2 eggs/10ml urine in the small children aged 0-4 years to 200 eggs /10ml urine in the 10-14 years old, who led the highest average urinary egg count. Adults from 20 years and above excreted less volume of schistosome eggs compared to the younger ones. A negative correlation (r=-0.69) was found between *S. haematobium* infection and age.

The mean egg output was grouped into different degrees (low, medium and high), according to the quantity excreted. The rate of occurrence of low intensity (≤100eggs/10ml urine) was 58.0%; medium (101-500 eggs/10ml urine) was 32.7% and high intensity (501≥ 2000 eggs/10ml urine) was 9.4%. High degree intensity was found in children under 16 years and a greater percentage of the adults had low degree intensity.

The highest malaria parasite load (15,400 per mm^3) was obtained from children in the 0-4 years age category. This gradually declined as the years progressed, table 2.

3.3 Intensity of haematuria, proteinuria and leucocyturia.

The amount of haematuria, proteinuria and leukocyturia excreted in all age groups were considered significant. Blood excretion in urine increased progressively from 15.96 Ery/um (0-4 years) to a peak of 83.98 Ery/um in the 10-14 years. A minimum amount of haematuria (10.59Ery/um) occurred in adults of 50 years plus. Also the quantity of protein in the urine was highest in the 10-14 years old and the lowest detectable amount was found in the adults, table III. Leukocyturia also reduced as the years increased and was highest children under 15years. The difference in the amount of the urine parameters between the children and the adults was statistically significant (P= 0.05). High concentrations of haematuria, proteinuria and leukocyturia occurred in the urine with high egg counts. A consistent fall in the amount of the urine parameters was observed with declining egg counts. There was a positive linear relationship (r= 1.0) between the intensity of *S. haematobium* infection and the other indicators of urinary schistosomiasis.

3.4 Haemoglobin status of the infected individuals.

The haemoglobin concentration of all the candidate were evaluated. Individuals with either malaria, schistosomiasis or both have slightly lower haemoglobin values compared to the uninfected table iv.An average Hb concentration of 12.0g/dl was obtained from the uninfected candidates. Malaria infected individuals had slightly higher mean Hb concentration than those with urinary schistosoimiasis. The different was more pronounced in those below 20 years of age (P=0.05). Children who had more severe *S. haematobium* infection had an average Haemoglobin value of 11/.0g/dl while their uninfected counterparts had 13.3 g/dl.

3.5 Average height and weight.

Variations were observed in the mean height and weight of the children under 20 years examined. Children infected with malaria had less weight compared to their counterpart with urinary schistosomiasis. The mean height measurement followed a similar pattern as the weight except for the children within 5-9 years age category with less mean height compared to their counterparts with malaria.

Expectedly, uninfected children had higher mean heights and weight than the infected (P=0.05). On the other hand, children with co-infected had relatively lower mean height and weight than the others, table v.

DISCUSSION

Specific parameters that indicate the presence of malaria and/or urinary schistosomiasis were assessed in connection with the morbidity of both infections in a community that is highly endemic to both infections (Okafor 2005). The endemicity / presence of malaria and urinary schistosomiasis in the study community was associated with the ecological factors in the area as well as to socio economic condition of the people (Agi & Okafor 2005). High infection rates of these diseases indicate that they are wide spread and a large population of the people may be at very high risk if transmission remains stable. Peak prevalence rates of malaria as well as urinary schistosomiasis and co-infection observed in young growing children under 15 years could be associated with factors such as regular contact with the infection sites, under development of immunity towards the infection or other genetic problems (WHO 2000; Gallup & Sachs 2001).

The combined effect of malaria and urinary schistosomiasis on the affected persons could be devastating since there was little or no access to good health services. Previous studies in the community revealed that it is rich in vegetation, fresh water, adequate rainfall and warm humid climate (Okafor 2005). The occupational practices such as fishing and farming, in addition to clustered arrangement of mud houses, lack of drainages and indiscriminate littering of human wastes around living places and water bodies, create enabling environment for the infections (Agi & Okafor 2005) Agyepong *et al* (1995) noted that the density of mosquito largely determines malaria transmission and is dependent on the longevity of the adult mosquito and availability of suitable breading places.

The high intensity of *S. haematobium* infection and the other morbidity indices in malaria and urinary schistosomiasis indicates the severity of internal damage associated with the infections and pathological manifestations which could lead to serious health decay (McGregor 1984; Poggenssee 1991).

The occurrence the haematuria (excretion of red blood cells in urine), proteinuria (excretion of protein in urine) and leukocyturia (excretion of white blood cells in urine) in various significant amount in by *S. haematobium* infected individuals was due to the involvement of the genital and urinary organs which resulted to some level of damage to the urinary bladder, ureter, kidneys and the genital organs (Ezzat *et al* 1974; Eltoum *et al* 1989; Brouwer *et al* 1999).

Peak positive urinalysis tests and their concentration in children may have resulted from the bodies' high sensitivity to the egg antigens in addition to non acquisition of adequate immunity to the infection.

Low haemoglobin values found in those with co infection of malaria and *S. haematobium* infection were associated with high blood losses which commonly occur in both infections. Malaria and urinary

schistosomiasis are associated with some level of alteration in blood constituents of the humans leading to some types of anemia (Nakajina 1995; WHO 1999; Rafiluddin 2001).

S. haematobuim infection is accompanied with heavy haematuria and loss of red blood cells from 1.3ml to 12ml, and iron loss of about 0.6mg to 32.3mg daily. Similarly in malaria infection, *Plasmodium falciparum* is noted to destroy red blood cells at any age causing massive loss and reduction in haemoglobin level of the infected individuals (Farid *et al* 1968; Kilama 2001).

In addition to anaemia, growth impairments especially in infected children have been reported to occur in areas endemic to parasitic infections (Breman 1972). Childhood is a period of active physical growth (increase in height and weight) which is a readily available standard for assessing nutritional status (Breman 1972; ACC/SCN 1979). Severe loss of protein and blood in the body may result in nutritional imbalances due to the interference with their functions. Consequently, individuals especially children with this deficiency could suffer from growth suppression or retardation and depressed immune functions. (Bergquist 2004; Hamady *et al* 2002; McGregor 1984).

CONCLUSION

This study has shown that certain morbidity induces can be used to effectively assess malaria and *S. haematobium* infections in areas endemic to both parasitic infections. These indicators as outlined here are haematuria, which means the presence of red blood cells in the urine of people with schistosomiasis especially in the last few drops of the urine, proteinuria which means the presence of significant amount or quantity of protein in the urine and leukocyturia, the presence high level of white blood cells The simultaneous presence of haematuria and proteinuria in an individual in a schistosomiasis endemic area is highly indicative of urinary schistosomiasis (Ezzat et al 1978). Diagnostic indices for both malaria and urinary schistosomiasis such as anaemia and reduced height and weight for especially the young and growing population were also considered. Individuals with co-infections of malaria and urinary schistosomiasis are prone to anemia, growth impairment (in the case of growing children) and genito-urinary infections (Gallup & Sachs 2001). Environmental conditions that favor parasites responsible malaria and urinary schistosomiasis include, warm and humid climate; fresh water and swampy areas, presence of ponds and vegetation in swampy regions and dirty surroundings. In addition, poor socio economic status of the people which encourages poor nutrition and other life styles and lack of adequate medical attention complicate the infections.

The infection status of the community under study calls for an immediate intervention by way of drug treatment of infected individuals or by supplying social amenities such as good sources of drinking water, good roads, schools and health centers. This no doubt will go a long way towards alleviating the huge sufferings of the affected population and the other members of the community.

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World Health Organization (2005). World Malaria Report 2005, *WHO Geneva.* within 5-9 years age category with less mean height compared to their counterparts with malaria.

Table I**.** Prevalence of malaria and urinary schistosomiasis in the infected individuals**.**

Age groups	No. examined.	No. with schist. (%)	No. with malaria (%)	No. with co-infection (%)
0-4	124	114 (91.9)	92 (74.2)	89 (71.8)
5-9	200	185 (92.5)	169 (84.5)	164 (82.0)
10-14	257	240 (93.4)	172 (66.9)	169 (65.8)
15-19	116	97 (83.6)	61 (52.6)	55 (47.4)
20-24	76	43 (56.6)	43 (56.6)	28 (36.8)
25-29	77	49 (63.6)	35 (45.5)	26 (33.8)
30-34	65	43 (66.1)	30 (46.1)	20 (30.8)
35-39	28	15 (53.6)	12 (42.8)	5 (17.9)
40-44	17	9 (52.9)	8 (47.1)	3 (17.6)
45-49	55	33 (60.0)	22 (40.0)	12(21.8)
50+	45	27 (60.0)	16 (35.6)	13 (28.9)
Total	1060	855 (80.7	660 (62.3)	584 (55.1)

Note: No. = number; schist. = schistosomiasis; mal. = malaria.

Table 2. The intensity of malaria and urinary schistosomaisis (eggs/10ml urine and malaria parasites count/mm^3)

Age (yrs)	Mean schist. eggs excreted: arithmetic mean	mean no of mal. parasites per high field	mean mal. parasite /ul blood
0-4	7320	30.8	15,400
5-9	24,639	21.5	10,750
10-4	69,068	17.2	8, 600
15-19	7,950	14.0	7,400
20-24	1,820	17.2	8,750
25-29	1,010	14.5	7,250
30-34	560	11.6	5,800
35-39	540	13.8	6,900
40-44	400	11.3	5,650
45-49	260	10.6	5,300
50+	50	11.2	5,600
Mean total	11,237. 91	15.9	7,950

Yrs = years
Schist = schistosomiasis
Mal = malaria

Table 3. The haemoglobin concentration(mg/dl) of the study population

Age (yrs)	Malaria infected	Schist. Infected	Individuals with mal & schist.	Uninfected
0-4	10.87	10.13	10.09	11.25
5-9	10.79	10.59	10.30	-
10-14	11.50	10.95	10.40	13.25
15-19	11.25	11.09	11.0	12.0
20-24	11.70	11.62	11.14	13.0
25-29	11.32	11.41	11.37	11.86
30-34	11.73	11.58	11.35	12.30
35-39	11.55	11.56	11.46	12-50
40-44	-	11.65	11-34	12-50
45-49	11.89	11.76	11.78	12-05
50+	12.2	12.20	11.80	12.65

Yrs = years
Schist = schistosomiasis
Mal = malaria

Table 4. Mean values of the indicators of urinary schistosomiasis according to age.

Age (yrs)	Eggs in 10 ml urine	Haematuria (Ery/ul)	Proteinuria (mg/dl)	Leukocyturia (g/dl)
0-4	56.2	15.9	31.1	38.8
5-9	117.8	51.4	38.3	41.3
10-14	200.6	83.9	53.1	61.8
15-19	89.4	40.4	40.7	43.8
20-24	63.7	29.9	27.7	36.7
25-29	46.1	26.4	32.5	43.8
30-34	17.3	14.2	31.0	24.1
35-39	38.1	11.4	30.0	23.8
40-44	63.2	13.3	30.0	14.1
45.49	36.1	15.0	30.0	25.0
50+	14.1	10.6	30.0	25.0

Ery/ul = erythrocytes per microliter
mg/dl = milligrams per deciliter
g/dl = grams per deciliter

Table 5. Average height and weight of the examined individuals under 20 years

Age (yrs)	Infected with schist.		Uninfected with schist.		Infected with mal.		Uninfected with mal.		Infected with mal. & schist.		Uninfected	
	Wt	HT	WT	HT	WT	HT	WT	HT	WT	HT	WT	HT
0-4	10.94	0.78	11.22	0.80	11.22	0.76	11.29	0.79	10.81	0.72	13.47	0.83
5-9	20.23	1.11	20.40	1.14	20.66	1.12	20.60	1.12	20.0	1.08	21.44	1.16
10-14	30.42	1.33	31.64	1.36	30.12	1.31	30.50	1.33	26.46	1.27	31.81	1.38
15-19	48.94	1.49	51.34	1.55	49.33	1.51	50.49	1.53	47.63	1.46	52.58	1.56

Note: Wt= weight, Ht = height