Impact Of Urinary Schistosomiasis On Nutritional Status Of School Children In South-Eastern Nigeria

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Abstract

Urinary schistosomiasis caused by Schistosoma haematobium constitutes a major public health problem in Nigeria particularly among school age children. This study evaluated the impact of S. haematobium infection on the nutritional status of school children by considering the anthropometric parameters of the children in relation to the infection using standard techniques. Of the total of 403 school children who participated in the study, 320(79.4%) were infected with S. haematobium and the prevalence of infection was significantly higher among the male children compared to the female children (χ^2 =4.67, P<0.05). The prevalence of infection significantly increased with decrease in age of the children (χ^2 =10.70, P<0.05). Children with lower body weight, lower height and lower arm circumference were significantly more infected with S. haematobium than their mates with higher anthropometric parameters (P<0.05). Findings from this study suggest that S. haematobium infection may affect the growth and the nutritional status of children adversely.

INTRODUCTION

Urinary schistosomiasis caused by Schistosoma haematobium constitutes a major public health problem in many tropical and sub-tropical countries [1]. S. haematobium is reportedly endemic in 53 counties in the Middle East and most of the African continent [2]. Two hundred million people worldwide are estimated to be infected with S. haematobium of which 70% live in sub-Saharan Africa [3]. Although infection with schistosomes does not always result in clinical disease, and many infections are asymptomatic, S. haematobium infection however could cause haematuria, dysuria, nutritional deficiencies, lesion of the bladder, kidney failure, an elevated risk of bladder cancer and-in children- growth retardation [4]. Accordingly the estimates for morbidity and mortality in affected populations are high with school age children usually presenting with the highest prevalence and intensity of infection [5].

Urinary schistosomiasis affect 66 million children throughout 76 countries and in some villages in Africa, over 90% of the children are infected by the diseases [5]. Nigeria is one of the countries known to be highly endemic for urinary schistosomiasis with estimated 101.28 million persons at risk and 25.83 million people infected [2]. Studies in Nigeria among school aged children in various parts of the country and in both rural and urban environments have shown that S. haematobium is clearly a problem of this age group. Prevalence among school aged children ranges from 20–40% in typical communities [6789], but can be as high as 50–70% in areas where environmental changes occur due to constructions such as human-made dams and quarries [1011].

The negative influence of infection on child growth in developing countries has been extensively documented [1213]. While under-nutrition has been cited as the common cause for such growth patterns, the influence of infections including urinary schistosomiasis are also considerable [14]. Infection with hookworm and S. haematobium can also result in poorer growth rates [1516] and this may also be a route by which infection leads to impaired performance because undernutrition affects cognitive development and educational achievement [1718]. Although the relationships between various types of infection and nutritional status and physical growth in populations have been evaluated, the impact of S. haematobium infection in the nutritional status and growth of school age children has been little considered.

The purpose of this study therefore is to assess the impact of S. haematobium infection on the nutritional status of school children by considering the anthropometric parameters of the children in relation to the infection. This is with the view to providing scientific information that would be required to monitor socio-economic impact, treatment programs and

assess re-infection after treatment in rural communities, in order to develop most effective and sustainable strategies that would have relevance for future control efforts of urinary schistosomiasis in resource constrained endemic settings.

MATERIALS AND METHODS

STUDY AREA AND POPULATION

This study was conducted from April 2007 to February 2008 in Ezza-North local government area (LGA) of Ebonyi State, south-eastern Nigeria. The climate is tropical and the vegetation characteristic is predominantly the rain forest with an average annual rainfall of about 1600mm and average atmospheric temperature of 30°C. There are two distinct seasons, the wet and the dry season. The former takes place between April and October, while the latter occurs from November to March. The study took place in selected primary schools in the rural communities of the LGA. The schools were Community Primary School CPS Ugalaba, and Community Primary School CPS Achiagu. The major sources of water supply in these communities are rivers, streams and ponds. Systematic schistosomicidal treatment had never been applied in the LGA. Primary school pupil were selected for this study because: (i) schools are accessible without much difficulties, (ii) the peak of prevalence of schistosomiasis is to be found in this group [19] and (iii) experience shows that there is general good compliance from children and parents [20].

ETHICAL CONSIDERATION

This study protocol was approved by the Department of Medical Microbiology/Parasitology, Faculty of Clinical Medicine Ebonyi State University. The study was also approved by the Ezza-North Local Government Council Authorities, the Local Government Health Departments and the Parent-Teachers Association (PTA) of each of the schools used for the studied. Informed consent was obtained from each of the pupils before inclusion in the study. All work was performed according to the international guidelines for human experimentation in biomedical research [21].

SAMPLING TECHNIQUE

About 20ml of clean-catch, midstream urine samples were collected in 50ml capacity autoclaved wide mouthed, leak, proof universal containers by subjects themselves, who were previously carefully instructed with illustration aids. Samples were obtained between 10:00hrs and 14:00hrs [22]. Samples with visible haematuria were noted. The specimens were appropriately labeled with identification numbers and placed in a cold box with ice packs, immediately after collection. They were processed 1-2hrs of collection. In situations where delay in transportation of specimens to laboratory was inevitable, ordinary household bleach was added to the urine samples (ratio; 1ml bleach: 50ml urine) to preserve any schistosome ova present [2223].

Assessment of nutritional status via anthropometric parameters

Anthropometric measurements were conducted for body weight, height and mid-upper arm circumferences. Body weight was measured with minimum clothing to the nearest 100g with minimum clothing (only T-shirts and shorts) and using battery-operated digital scales (SECA, manufactured for UNICEF). For height, the child stood erect against a stadiometer affixed to a wall for measurement to the nearest 0.1 cm. Mid-upper arm circumference (MUAC) was measured with a flexible tape and recorded to 0.1 cm.

LABORATORY ANALYSIS

The urine sedimentation technique described previously [2223] was used to detect the presence of S. haematobium ova in the urine samples and to determine the intensity of the infection in each case. Intensity was reported as the number of ova/10ml of urine and was categorized as light (≤ 50 ova/10ml of urine) and heavy (≥50 ova/10ml of urine). A few drops of saponin solution were added to samples with visible haematuria to enhance clarity in microscopy [23].

STATISTICAL ANALYSIS

Differences in proportion were evaluated using the Chi-square test. Statistical significance was achieved it $P < 0.05$.

RESULTS

Of the total of 403 school children who participated in the study, 320(79.4%) were infected with S. haematobium. The prevalence of infection was higher among the male children (82.9%) compared to the female children (74.1%) and the difference was statistically significant (χ^2 =4.67, df=1, P<0.05) (Table 1). The prevalence of infection increased with decrease in age of the children with those aged six years old and below having the highest prevalence of infection. Statistical analysis indicate a significant difference in the trend (χ^2 =10.70, df=2, P<0.05) (Table 2).

Figure 1

Table 1:Prevalence of infection in relation to sex of children in Ezza-North LGA of Ebonyi State Nigeria

Sex	No. examined	No.(%) infected
Male	241	200 (82.9)
Female	162	120 (74.1)
Total	403	320 (79.4)

Figure 2

Table 2: Prevalence of infection in relation to age of children in Ezza-North LGA of Ebonyi State Nigeria

Age	No. examined	No.(%) infected
≤6	86	75(87.2)
7-10	238	192(80.7)
11-14	79	53(67.1)
Total	403	320(79.4)

The result of the association between S. haematobium infection and the assessment of the nutritional status of the children using the anthropometric parameters is shown in Table 3. Children with lower body weight were the most infected category with the highest prevalence recorded among those who weighed 19.0-22.0k g (88.8%) while the least prevalence was recorded among those who weighed above 31.0kg. Chi-square test indicated that there was a significant difference in the trend (χ^2 =43.8, df=4, P<0.05). There was a significant association between height of the children and S. haematobium infection. Children of lower height (4.0-5.9m) were significantly more infected with S. haematobium (χ^2 =86.92, df=1, P<0.05). Similarly, children with lower arm circumference (6.0-7.0cm) recorded significantly more prevalence of S. haematobium infection than those with higher arm circumference (7.1-8.0cm) (χ^2 =33.82, df=1, P<0.05) (Table 3).

Figure 3

Table 3: Prevalence of infection in relation to anthropometric parameters of children in Ezza-North LGA of Ebonyi State Nigeria

Anthropometric parameters	No. examined	No.(%) infected
Weight (Kg)		
19.0–22.0	135	120(88.8)
23.0–26.0	162	130(80.2)
27.0–30.0	65	44(72.3)
31.0–34.0	42	20(47.6)
> 34.0	19	11(57.8)
Total	403	320(79.4)
Height (m)		
4.0–5.9	344	300(87.2)
6.0–7.9	59	20(33.8)
Total	403	320(79.4)
Arm Circumference (cm)		
6.0 – 7.0	328	284(86.6)
7.1 – 8.0	75	36(48.0)
Total	403	320(79.4)

DISCUSSION

The findings of this study indicate that the prevalence of S. haematobium infection is very high (79.4%) among children in the study locality and this satisfies the WHO classification as endemic [5]. Similar earlier studies have indicated that S. haematobium is endemic in many parts of Nigeria particularly among school children [242526]. This finding supports reports that of the world's serious parasitic diseases, schistosomiasis still ranks second only to malaria in the number of people infected and the extent of areas where the disease is endemic including Nigeria [2].

The public health significant of this cannot be over stated as it is has been established that the chronic character and steady increase in morbidity in infected individuals in such endemic areas result in diminished working capacity and prolonged suffering, hence disability looms if treatment with anti-schistosomal drug, such as praziquantel, cannot be provided and more so early on when the pathology is still reversible [27]. Extreme poverty, the unawareness of the risks, the inadequacy or total lack of public health facilities plus the unsanitary conditions in which millions of people lead their daily lives especially in the rural areas of developing tropical countries are all factors contributing to the risk of infection [1]. These are perhaps the major reasons why urinary schistosomiasis remains endemic and a matter of public health concern in many parts of developing tropical

countries including Nigeria [26].

The male children were significantly more infected with S. haematobium than the female children. This is similar to our findings from earlier studies conducted in the same south-eastern Nigeria State of Ebonyi [2628]. The reason for the higher prevalence among the male children is presumably due to higher water contact activities by male pupils particularly in fishing as well as swimming and bathing in cercariae-infested rivers [28]. In addition, females are generally restricted from swimming and bathing in the rivers on religious and socio-cultural grounds [26]. Similar observations were made in studies in Tanzania [29], Cote d'Ivoire [30] and in south-western Nigeria [8].

In this study a clear relationship was established between S. haematobium infection and the nutritional status of the children as expressed by the anthropometric parameters. It has been estimated that more than 230 million (43%) of all preschool children in the developing world are stunted in their growth because of malnutrition caused by lack of food and by disease including urinary schistosomiasis [143132]. Anthropometric parameters were used in this study to assess the nutritional status of the children in relation to urinary schistosomiasis because anthropometric measurements assess body size and composition, and reflect inadequate food intake and disease. Furthermore anthropometry has been described as the single most universally applicable, inexpensive, and non-invasive method available to assess the size, proportions, and composition of the human body [31]. In the nutrition field, low height and/or weight relative to reference data have been used as classic indicators of undernutrition for individuals and groups; and recent research has expanded the applications of anthropometry to include predicting who will benefit from interventions, identifying social and economic inequity, and evaluating responses to interventions [31].

In this study, despite the occurrence of a very high prevalence rate of S. haematobium infection among the subjects, children with lower body weight, lower height and lower arm circumference were significantly more infected with S. haematobium than their mates with higher anthropometric parameters ($P<0.05$). Reports have indicated that because parasitic infections such as schistosomiasis and soil transmitted helminth infections cause anorexia and poor absorption of nutrients and promote the deviation of nutrients to the organism's defense mechanisms, they contribute to the onset or exacerbation of weight and height deficits, as well as to specific nutritional deficiencies [33]. A number of earlier studies have shown that in the acute phase, these helminth infections induce an immune response and the production of cytokines [3435], which can directly affect the process of bone formation and remodeling required for the growth of long bones [36].

Although the role of other factors in the development of the poor nutritional status in the affected children in this study may not be completely overruled, it is however obvious that S. haematobium which is endemic in the study area is playing a significant role in the growth retardation of majority of the infected children. A previous study in Kenya provided evidence that relatively heavy infections of S. haematobium can cause urinary iron loss which, if it persists, is great enough to produce iron deficiency anemia and can also reduce physical fitness of children [14]. On the contrary no significant impact of urinary schistosomiasis could be demonstrated regarding anthropometric parameters among the infected children compared with the controls in an earlier study in Nigeria, although this was attributed to low intensity of the infection among the children investigated [37]. Findings from this study therefore suggest that in an area of high endemicity of schistosomiasis the disease may affect the growth and the nutritional status of children adversely. The different species of Schistosoma have been shown to be associated with linear growth retardation in children in many developing countries [383940]. The implication of this is that there is need to target school children for intervention.

Regular school-based deworming programmes and health education can cost-effectively reverse and prevent much of the morbidity associated with urinary schistosomiasis in children. Furthermore, schools offer a readily available, extensive, and sustained infrastructure with a skilled workforce that is in close contact with the community. With support from the local health system, teachers can deliver the drugs safely and teachers need only a few hours of training to understand the rationale for deworming and to learn how to give out the pills and keep a record of their distribution [4142]. The importance of information and education for children and the role of school and teachers in disease prevention is easily demonstrated by diverse examples of successful strategies that reflect the progressive drop in prevalence and incidence of certain health problems, verified through longitudinal analyses.

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