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The Effect of Urinary Schistosomiasis on the Health of Children in Selected Rural Communities of Osun State, Nigeria

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Abstract

The effect of *Schistosoma haematobium* infection on the nutritional status of pupils in selected rural communities of Osun State was investigated. The rural communities were Iloko-Ijesa and Aye-Oba. In total 349 male and 345 female students aged 4-20 years at selected schools in the communities were screened. Urine samples from each subject were collected in a clean bottle between 10:00 AM and 2:00 PM. Samples were later analyzed for presence and intensity of infection with *S. haematobium*. Nutritional anthropometric parameters of weight, height and age of each subject were taken to determine the nutritional status using the Z-score values.

Among the 694 screened students, the prevalences of infection in Iloko-Ijesa and Aye-Oba were 0% and 29.6%, respectively. Among the 115 positive cases, the prevalence of infection was higher among females (31%) than males (28.1%). Although infection was common among the 6-15 years old, the prevalence declined with increasing age. A significant difference ($\chi^2 = 20.49$, $p < 0.05$) in the prevalence of infection among the different age groups was seen. Heavy and light infections were seen in 40.9% and 59.1% respectively.

In Iloko-Ijesa, 7.2% of students were underweight, 3.3% had wasting and 16.4% had stunting. In Aye-Oba, 17.7% were underweight, 1.3% had wasting and 19.8% had stunting. Nutritional status was not significantly different between sexes ($t = 0.348$, $p > 0.05$) but was significantly different among the age groups ($\chi^2 = 34.95$, $p < 0.05$). There was no correlation between *S. haematobium* infection and anthropometric/nutritional status. Findings are compared with other parts of the world.

Keywords: urinary schistosomiasis, health, children, rural communities, Nigeria

Introduction

Schistosomiasis is a major parasitic diseases in tropical developing countries. The urinary form of the disease, caused by *Schistosoma haematobium,* has the widest geographical distribution, with an estimated 200-300 million people suffering from the disease world-wide [1] while more than 750 million people are at risk [2]. The disease is endemic in Nigeria [3-5] although for several reasons there has

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been no systematic assessment of baseline data regarding endemicity in the community [6]. Adult *Schistosoma* species are intravascular flukes. Wormburden in any infected individual is difficult to estimate. Since nutrients are derived from the host, the nutritional status of an infected individual may be compromised. Chronic infectious diseases, repeated episodes of acute infections, conditions of poverty and inadequate dietary intake are all associated with compromised growth and development of children in developing countries [7]. Studies of urinary schistosomiasis in other parts of the world have found children [8,9] and adults [10] show evidence of poor nutritional status associated with *S. haematobium* infection. Comparable studies of this infection in Nigeria are lacking. Studies of *S. mansoni* infection in Tanzanian school children report lower heights and weights in infected as opposed to uninfected children. Albeit studies in various other parts of the world claimed no relationship between *S. mansoni* infection and nutritional status [11-13]. This study was undertaken to determine if the experience in Nigeria supports or contradicts the association between infecton and nutrition.

Materials and methods

Study locations

This investigation was carried out between May 2007 and June 2008 in Iloko-Ijesa in the Oriade Local Government Area of Osun State and Aye-Oba in the Ife-South Local Government Area in Osun State. Iloko-Ijesa lies at latitude 7°39'N and longitude 7°33'E and Aye-Oba lies at latitude 6°1'N and Longitude 5°33'E. There was a dam construction project going on at the time of this study in Iloko-Ijesa. The village has a stream which the inhabitants use principally for their source of water supply and recreational activities. Clean water is also available via a bore-hole centrally located in the community. Aye-Oba inhabitants get their water supply from a dam. They use this for cooking, washing, bathing, recreational activities and fishing. This dam provides ideal conditions for breeding of schistosomiasis-transmitting snail intermediate hosts. The villagers in both communities are mainly farmers and hunters while a few of them, especially women, are petty traders. More than 90% of the inhabitants of the two communities are Yorubas. While Iloko-Ijesa has amenities, such as health care and sanitation facilities and a clean water supply, Aye-Oba lacks most of these amenities. The reservoir is their major source of domestic water supply as many of the inhabitants do not use pipe-borne water exclusively for all purposes.

Climate, soil and vegetation

The climate is tropical sub-equatorial and the vegetation is predominantly rainforest with an average annual rainfall of 1,250-2,000 mm and an average temperature of 27°C. Rainfall is characterized by two peak periods of particularly heavy rainfall in July and September.

The soil structure is ferralitic/forest soil which is deeply weathered with few or no stones. The soil is heavily leached by the heavy rainfall, leading to a low nutrient level. The soil is used to grow cocoa, rubber and kolanuts; hence agriculture (cash crops) and subsistence farming are the mainstays of the economy.

Study population

The study population was comprised of 694 students aged 4-20 years, of both sexes and drawn from eight schools; these were Aderemi Memorial College, Catch Them Young Nursery/Primary School, Best Legacy Nursery/Primary School, Divine Foundation Nursery/Primary School, Oye's International Nursery/Priary School and United Anglican Primary School, all in the Aye-Oba study area and Local Authority Primary School and Anglican Primary School in Iloko-Ijesa. Consent of each pupil was obtained through the Parent Teachers Association (PTA). A PTA meeting held with the researchers and the PTA members unanimously agreed to permit their wards to participate in the study. All consenting individuals at each school were included in the study because of the low population of each school.

Design of study and data collection

A cross-sectional study design was used in this investigation. Information about each individual, including name, age, sex, weight and height, history of hematuria, knowledge of the mode of transmission (based on interpretation of the response of the individual student) and usual sources of domestic water supply were collected from each pupil using a simple questionnaire. The teachers assisted in administering the questionnaire in the students' own language (Yoruba or English). Weight to the nearest 0.1 kg was obtained using a bathroom scale while a calibrated pole was used to measure height to the nearest cm. Each pupil was given a clean white plastic container (bowl) and instructed to completely urinate into it. Each sample was visually examined for hematuria before a sub-sample of 10 ml was transferred into a labeled 30 ml bottle with a conical bottom, using a syringe. Samples were obtained from students between 10:00 AM and 2:00 PM [1]. Specimens were preserved in 40% formaldehyde and returned to the laboratory to determine the presence and number of *S. haematobium* eggs using the sedimentation by gravity method [14].

Statistical analysis

Statistical analysis was performed using Epi-Info version 6.0. For anthropometric data, a software package based on the National Center for Health Statistics (NCHS) database provided with Epi-Info software was used. Differences in the prevalence of infection and comparison of proportions between the sub-groups were determined by Chi-square or Student's t-test. A p-value less than 0.05 was considered significant for two-tailed tests. Children with a Z-score below -2 on the NCHS reference charts for height-for-age, weight-for-height or weight-for-age were considered to be stunted, wasted or underweight, respectively while those with a Z-score greater than -2 on NCHS reference charts were considered well nourished. The hypothesis was that school children infected with *S. haematobium* were at higher risk of being malnourished.

Results

Nutritional status in Aye-Oba and Iloko-Ijesa

Table 1 shows the distribution of underweight (WFA), wasting (WFH) and stunting (HFA) in Iloko-Ijesa and Aye-Oba. It can be seen from this Table the prevalence of under-nutrition was higher in Aye-Oba than in Iloko-Ijesa, especially underweight and stunting.

Age-specific nutritional status of students in Iloko-Ijesa and Aye-Oba

Fifty students (16.4%) were stunted and 22 (7.2%) were underweight in Iloko-Ijesa (Table 2). The highest numbers of stunting and underweight were in students aged 11-15 years in Iloko-Ijesa at 17 students (25.4%) and 8 students (11.9%), respectively. Wasting was not significantly manifestedin the students studied. There were significant differences in stunting and underweight by age. In Aye-Oba the numbers with stunting, wasting and underweight were 77 (19.8%), 5 (1.3%) and 69 (17.7%), respectively. In the 11-15 year old age group peak numbers were 46 (31.5%) and 33 (22.6%) for stunting and underweight, respectively. There wwere significant differences among age groups for stunting, wasting and underweight.

Sex-specific nutritional status of pupils in Iloko-Ijesa and Aye-Oba

Table 3 shows there were no significant differences in prevalences of stunting, wasting and underweight between males and females in Iloko-Ijesa and Aye-Oba. There were also no significant differences in nutritional status between the sexes.

Relationship between intensity of infection and nutritional status in Aye-Oba

Table 4 shows that out of 115 infected students, 41 (35.7%) were stunted, 1 (0.9%) was categorized as wasted and 23 (20.0%) were underweight. A large percentage of infected students had anthropometric signs of undernourishment. There was no significant relationship between intensity of infection and measurements of nutritional status (Fig 1).

Table 1 Nutritional status in Iloko-Ijesa and Aye-Oba.

Nutritional status	Iloko-Ijesa	Aye-Oba	Total
	*N (%)	*N (%)	*N (%)
Underweight			
Not underweight ≥ -2.00 SD	283 (92.8)	320 (82.3)	603 (86.9)
Underweight < -2.00 SD	22 (7.2)	69 (17.7)	91 (13.1)
Total	305 (100)	389 (100)	694 (100)
Wasting			
No wasting ≥ -2.00 SD	295 (96.7)	384 (98.7)	679 (97.8)
Wasting < -2.00 SD	10 (3.3)	5 (1.3)	15 (2.2)
Total	305 (100)	389 (100)	694 (100)
Stunting			
Not stunted ≥ -2.00 SD	255 (83.6)	312 (80.2)	567 (81.7)
Stunted < -2.00 SD	50 (16.4)	77 (19.8)	127 (18.3)
Total	305 (100)	389 (100)	694 (100)

*N = Number of individuals

Table 2 Age-specific nutritional status of pupils in Iloko-Ijesa and Aye-Oba.

Age (years)	Stunting		Wasting		Underweight	
	≥ -2.00 SD *f (%)	< -2.00 SD f (%)	≥ -2.00 SD f (%)	< -2.00 SD f (%)	≥ -2.00 SD f (%)	< -2.00 SD f (%)
Iloko-Ijesa						
1-5	85 (85.0)	15 (15.0)	91 (91.0)	9 (9.0)	91 (91.0)	9 (9.0)
6-10	120 87.0)	18 (13.0)	137 (99.3)	1 (0.7)	133 (96.4)	5 (3.6)
11-15	50 (74.6)	17 (25.4)	67 (100)	0 (0)	59 (88.1)	8 (11.9)
Total	255 (83.6)	50 (16.4)	295 (96.7)	10 (3.3)	283 (92.8)	22 (7.2)
	χ^2 = 5.213, df = 4, p = 0.156		χ^2 = 15.432, df = 4, p = 0.0014		χ^2 = 5.37, df = 4, p = 0.147	
Aye-Oba						
1-5	44 (86.3)	7 (13.7)	48 (94.1)	3 (5.9)	45 (88.2)	6 (11.8)
6-10	119 (83.2)	24 (16.8)	143 (100)	0 (0)	116 (81.1)	27 (18.9)
11-15	100 (68.5)	46 (31.5)	114 (98.6)	2 (1.4)	113 (77.4)	33 (22.6)
16-20	48 (100)	0 (0)	48 (100)	0 (0)	45 (93.8)	3 (6.2)
> 20	1 (100)	0 (0)	1 (100)	0 (0)	1 (100)	0 (0)
Total	312 (80.2)	77 (19.8)	384 (98.7)	5 (1.3)	320 (82.3)	69 (17.7)
	χ^2 = 34.95, df = 4, p= 0.001		χ^2 = 10.29, df = 4, p= 0.035		χ^2 = 8.30, df = 4, p= 0.081	

*f = frequency = the number of occurrence of the parameter within the age group.

Table 3 Sex-specific nutritional status of pupils in Iloko-Ijesa and Aye-Oba.

Sex	Stunting		Wasting		Underweight	
	≥ -2.00SD *f (%)	< -2.00SD f (%)	≥ -2.00SD f (%)	< -2.00SD f (%)	≥ -2.00SD f (%)	< -2.00SD f (%)
Iloko-Ijesa						
Female	125 (84.5)	23 (15.5)	143 (96.6)	5 (3.4)	138 (93.2)	10 (6.8)
Male	130 (82.8)	27 (17.2)	152 (96.8)	5 (3.2)	145 (92.4)	12 (7.6)
Total	255 (83.6)	50 (16.4)	295 (96.7)	10 (3.3)	283 (92.8)	22 (7.2)
	χ^2 = 0.153, df = 1, p = 0.696		χ^2 = 0.009, df = 1, p = 0.924		χ^2 = 0.089, df = 1, p = 0.764	
Aye-Oba						
Female	153 (77.7)	44 (22.3)	195 (99.0)	2 (1.0)	159 (80.7)	38 (19.3)
Male	159 (82.8)	33 (17.2)	189 (98.4)	3 (1.6)	161 (83.9)	31 (16.1)
Total	312 (80.2)	77 (19.8)	384 (98.7)	5 (1.3)	320 (82.3)	69 (17.7)
	χ^2 = 1.622, df = 1, p = 0.203		χ^2 = 0.229, df = 1, p = 0.631		χ^2 = 0.658, df = 1, p = 0.417	

*f = frequency = the number of occurrence of the parameter within the age group

Table 4 Intensity of Infection and nutritional status of pupils in Aye-Oba.

Intensity of infection	Stunting		Wasting		Underweight	
	≥ -2.00SD *f (%)	< -2.00SD f (%)	≥ -2.00SD f (%)	< -2.00SD f (%)	≥ -2.00SD f (%)	< -2.00SD f (%)
Light infection	43 (63.2)	25 (36.8)	67 (98.5)	1 (1.5)	57 (83.8)	11 (16.2)
Heavy infection	31 (66.0)	16 (34.0)	47 (100)	0 (0)	35 (74.5)	12 (25.5)
Total	74 (64.3)	41 (35.7)	114 (99.1)	1 (0.9)	92 (80.0)	23 (20.0)
	χ^2 = 0.0898, df = 1, p = 0.764		χ^2 = 0.697, df = 1, p = 0.401		χ^2 = 1.520, df = 1, p =0.218	

*f = frequency = the number of occurrence of the parameter within the age group.

Discussion

Nutritional evaluation of individuals is a complex process. The World Health Organization has favored the use of the anthropometric indices of weight-for-age (WFA), height-for-age (HFA) and weight-for height (WFH) that are simple to obtain and accurate for the purpose of most studies.

The two rural communities selected for this study represent contrasting levels of environmental modification which provide conditions suitable for the spread of urinary schistosomiasis infection. Iloko-Ijesa is a rural settlement with a dam under construction. As the time of this investigation, water flow had not yet been impeded. Aye-Oba, is another rural community with a fully operational dam whose stream the inhabitants use for various domestic activities. The dam provides conditions conducive for the spread of urinary schistosomiasis.

The prevalence of underweight was 7.2% in Iloko-Ijesa and 17.7% in Aye-Oba. The prevalence of stunting and wasting were 16.4% and 3.3%

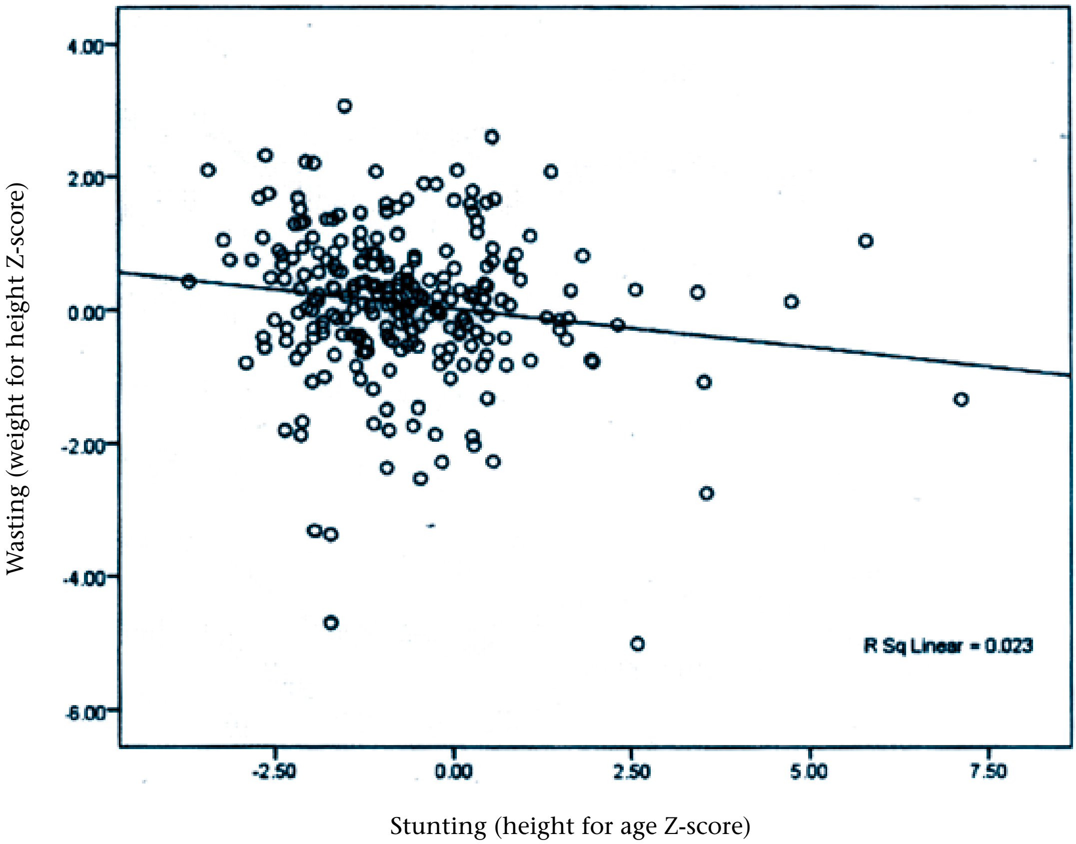

Fig 1 Relationship between Z-score values for wasting and stunting in the population.

in Iloko-Ijesa and 19.8% and 1.3% in Aye-Oba, respectively (Table 1).

An epidemiological survey suggests the first indication of a nutritional defect and/or infection is weight loss (wasting) followed by retardation in linear growth [15]. Some common causes are inadequate dietary intake, disease, inadequate health services, unhealthy environment, inadequate household food security and inadequate mother-and-children caring practices [16,17]. Under-nutrition was most pronounced in children aged 11-15 years. This age group was also shown to be more susceptible to urinary schistosomiasis infection with a prevalence of 33.6% (Table 2). This corroborates with the findings of other studies showing the prevalence of underweight in children in developing countries is high [18].

The prevalence of urinary schistosomiasis infection among the students was 29.6%. Females had a slightly higher prevalence (31%) than males (28.1%). The prevalence of infection was highest in students aged 11-20 years at approximately 34%. This corroborates the findings of other studies [19,20] which found the variation index increases from about 6 years to 10 years, climbing to a peak during the second decade of life, and declining gradually in older age groups.

35.7% of *S. haematobium* infected students were stunted, 0.9% were wasted and 20.0% were underweight (Table 4). Infected children had lower Z-score values. This shows a high prevalence of stunting and underweight among the infected population. However, this difference was not statistically significant and no positive correlation was established between infection and

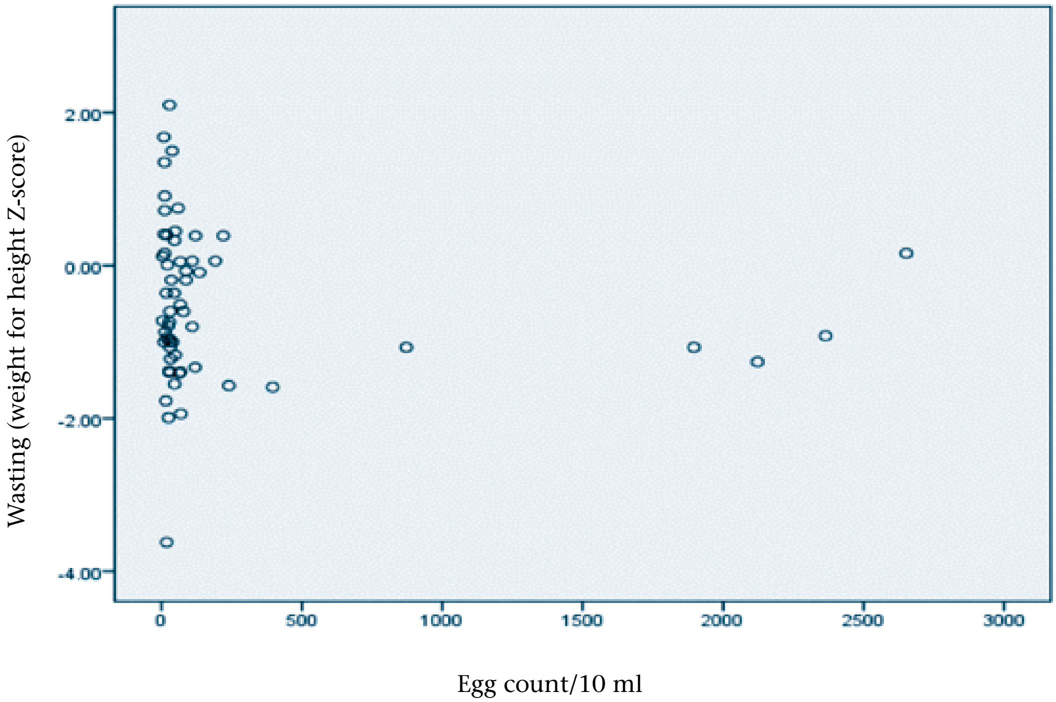

Fig 2 Relationship between Z-score values for wasting and intensity of *S. haematobium* infection in Aye-Oba.

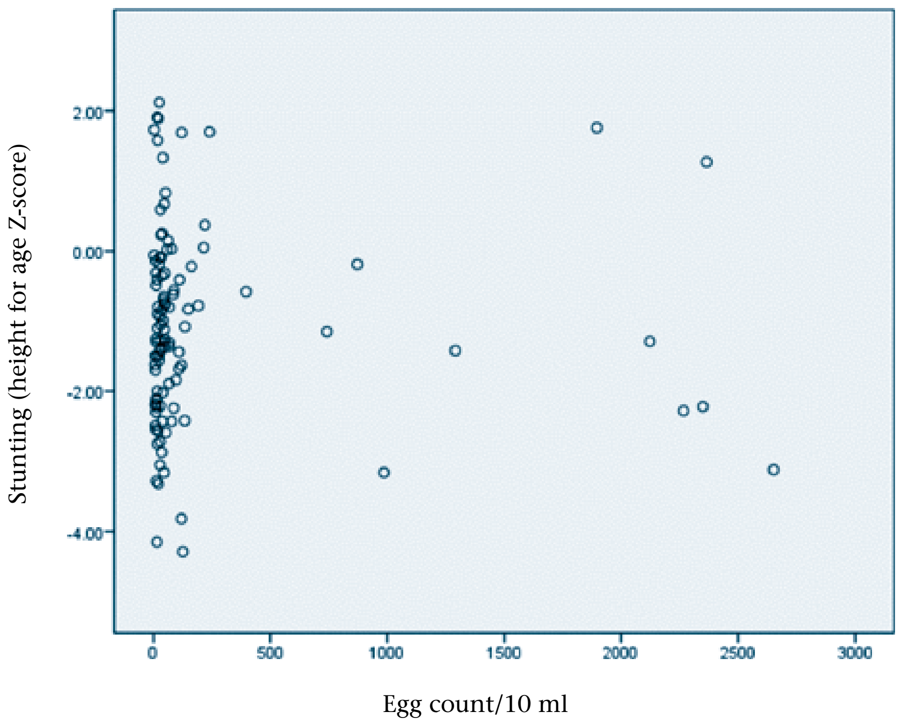

Fig 3 Relationship between Z-score values for stunting and intensity of *S. haematobium* infection in Aye-Oba.

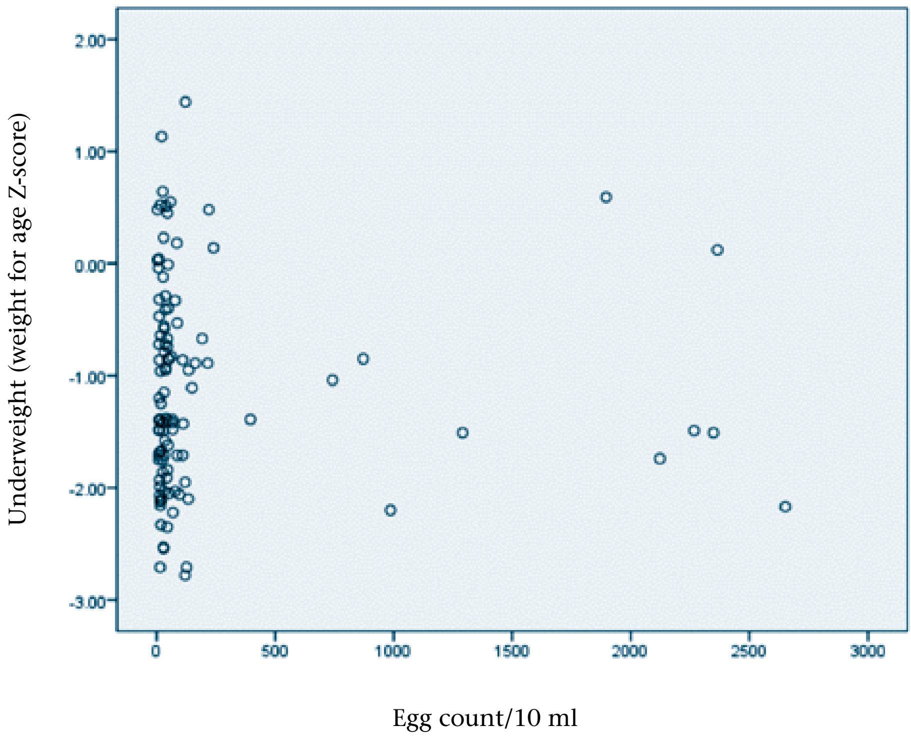

Fig 4 Relationship between Z-score values for underweight and intensity of *S. haematobium* infection in Aye-Oba.

nutritional status (Fig 2-4). The studied children belonged to a low socio-economic group and came from similar backgrounds. The high prevalence of children with stunting and underweight indicates malnutrition [21,22]. Stunting indicates long term, cumulative inadequacies in health, nutrition or both. The deficit in linear growth is a result of sub-optimal health or nutritional conditions. It should be noted that underweight is a function of short stature, low tissue mass or both. Although it is more difficult to interpret, WFA is often used to screen for under-nutrition because it does not require measurement of height. On the other hand, wasting refers to thinness that is often due to a recent or severe event leading to significant weight loss, which may result from acute starvation, severe disease, chronic dietary deficits and/or disease.

The prevalence of wasting in this study was less than that of stunting and underweight (Table 4). The prevalence of stunting was greater in males (17.2%) than females (15.5%) in Iloko-Ijesa, while in Aye-Oba females were more likely to be stunted (22.3%) than the males (17.2%) (Table 3). The same trend was observed for underweight with females having a higher prevalence than males in Aye-Oba. This is corroborated by other studies [22,23]. The causes of poor growth in children in developing countries have been attributed to poor maternal nutritional status at conception, under-nutrition *in utero*, inadequate breast-feeding, delayed complementary feeding [21,24], inadequate quality or quantity of complementary feeding, impaired absorption of nutrients due to intestinal infections or parasites, or a combination of these problems. There was no significant impact of *S. haematobium* infection on nutritional status in students. The findings of more frequent (Z-score < -2.00 SD) in stunting than in wasting in our study support the concept that they represent two different biological processes; the former more dependent on food intake and the latter on overall socio-demographic conditions [25].

The results indicate the prevalence of under-nutrition was high among school children and was higher in females than the males; and was higher in Aye-Oba than in Iloko-Ijesa. Females were more likely to be infected with *S. haematobium* than males. In the studied population, the presence of *S. haematobium* infection did not significantly affect the nutritional status of the infected individual, and the small differences were likely due to socio-demographic factors.

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