©Sierra Leone Journal of Biomedical Research ISSN 2076-6270 (Print)
Vol. 3(3) pp. 157-162, December, 2011 ISSN 2219-3170 (Online)

Original Article

Asymptomatic Giardiasis and Nutritional Status of Children in Two Local Government Areas in Kaduna State, Nigeria

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ABSTRACT

Giardiasis is found throughout the world but more prevalent in developing countries. The present study utilised ELISA coproantigen to determine the prevalence of *Giardia lamblia* in stool samples of children in day-care centres, nursery and primary schools in two Local Government Areas, Sabon-Gari and Zaria, in Kaduna State, Nigeria. Of 374 samples examined, 150 (41.45%) were positive for Giardia *lamblia.* The prevalence of giardiasis was higher in males (50.3%) than females (49.7%). There was no significant difference in the level of infection in both sexes (p = 0.808). The highest prevalence of asymptomatic giardiasis was in the age group 3-5 years (32.9%) while the lowest was in the 0-2 years (11.6%).There was no significant difference in the prevalence of the disease between the age groups (p = 0.414). There was association between asymptomatic giardiasis and wasting **(**p = 0.030, ANOVA). There was also a positive association between asymptomatic giardiasis and Body Mass Index (p = 0.024, ANOVA) indicating malnutrition. In this study, giardiasis was a predictor of wasting and malnutrition in Sabo-Gari Local Government Area. It is therefore recommended that parents or guardians should provide nutritious meals for school-aged children and treatment of parasitic infections be included in the curriculum of school children.

Keywords: Body Mass Index, Giardiasis, Nigeria, Nutritional Status

Received 13 June 2011/ Accepted 30 November 2011

INTRODUCTION

Giardia lambia is the most common human enteropathogenic protozoan that can cause acute and chronic diarrhoea (Garba and Mbofung, 2010). However, most humans with giardiasis are asymptomatic and continue to shed cysts in their stools for several months. The infection in immunocompetent individuals is self-limiting (US EPA, 1999).

Although, factors in the host-parasite relationship that allow infection but prevent expression of diarrhoeal disease have not been defined (Farthing, 1996), abnormalities of intestinal malabsorption contribute to nutritional deficiency (Hesham *et al*., 2004). Nutrition plays a major role in maintaining health and malnutrition appears to generate vulnerability to a wide variety of diseases and general ill-health (Garba and Mbofung, 2010). While low and poor food intake is the major recognised causes of protein-energy malnutrition in children worldwide, giardiasis could be implicated in influencing this condition (Muniz-Junqueira and Queiroz, 2002). It is common for acute symptomatic individuals to present with diarrhoea or clinical manifestations of mal-absorption (Al-Mekhiafi *et al*., 2005).

Giardia intestinalis can produce a wide spectrum of clinical manifestations, from asymptomatic to acute or chronic diarrhoea with mal-absorption syndrome and weight loss. The infection in children can interfere with growth and development (Adam, 1991; Katz and Taylor, 2001, Amuta *et al*., 2009). However, Hall (1994) observed that the epidemiological association between malnutrition and *Giardia* infection was not consistent, and it is not clear whether *Giardia* is a cause of malnutrition or malnutrition predisposes people to giardiasis. There are contradictory results published about the

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effects of giardiasis on the nutritional status of children. Some authors found that giardiasis was related to growth retardation (Al-Mekhiafi *et al*., 2005; Garba and Mbofung, 2010) while others reported no relationship (Fraser, 1994; Farthing, 1996).

Growth failure is associated with increased morbidity and mortality in children and it is estimated that as many as 182 million children in developing countries are affected (WHO, 2000). Although the etiology of growth failure is multifactorial, malnutrition and repeated infections in children have been documented as causative agents, among which *G. intestinalis* is a hallmark cause (Amuta *et al*., 2009). Growth failure, indicated by stunting, wasting and underweight conditions, can be assessed by anthropometric indices of Height-for-Age (HAZ), Weight-for-Age (WAZ), and weight-for-height (WHZ). Stunting is a consequence of long-term poor nutritional intake and is the best indicator of growth retardation in children over an extended period, because stunting has been associated with poorer cognition and school achievement in later childhood.

Most Nigerian children from low socio-economic class have been found to be anaemic, stunted with retarded growth and underweight due to malnutrition (Adekunle 2002; Oninla *et al*., 2010). In developing countries such as Nigeria, giardiasis is endemic and commonly reported in pre-school and school aged children (Adekunle, 2002; Amuta *et al*., 2009). Against this background, this study was undertaken to assess the relationship between asymptomatic giardiasis and nutritional status of children aged 0-12 years in two local government areas of Zaria, Kaduna State, Nigeria. The rationale for choosing this age group is because children of this age group are more susceptible to intestinal parasitic infections than the older ones. They are in close contact with sand where some of the soil-transmitted parasites are found. They are known to eat indiscriminately with unwashed hands.

MATERIALS AND METHODS

Sample Selection

Sixteen (16) randomly selected schools comprising of 5 day-care centres, 5 nursery schools and 6 primary schools were used in this study. A total of 374 subjects (both boys and girls) with ages ranging from 6 months-12 years were selected from each class using random number table.

Study Area and Study population

This was a cross-sectional study on the relationship between giardiasis and nutritional status of children aged 0-12 years in Sabo-Gari and Zaria local government areas of Zaria, Kaduna State, Nigeria. Three hundred and seventy-four (374) stool specimens were collected early in the morning in sterile plastic, wide-mouthed containers and stored at -20^{0}C and the copro-antigen for *Giardia lamblia* was detected by the Enzyme Linked Immunosorbent Assay (ELISA)(Al-Saeed and Issa, 2010). Results were obtained by the use of a micro-plate reader with wave-length capacity of 450 nm using a reference wave length of ≥ 600nm. In order to establish the cut-off, 0.15 extinction units were added to the measured extinction for the negative control. Samples were considered positive if the extinction is more than 10% above the calculated cut-off.

Ethical Clearance

Permission was obtained from the Kaduna State Ministry of Health Ethical Committee (Ref No: KDSUBEB/SUBEB/831/VOL 1/285) before sample collection. The aim of the study was clearly explained to the head teachers, parents of children in day-care centers and nursery schools as while as primary school pupils who were enrolled for this study. Informed consent was obtained from parents and guardians before administering the questionnaire. To ensure confidentiality, names of respondents were not recorded on the questionnaire. The questionnaire was interpreted in local language for those who did not understand English.

Anthropometric Measurements

All children underwent anthropometric measurements. The children were weighed without shoes using a portable distal electronic balance. The height was measured using a Holtan stadiometer while children under 2 years were measured while lying in their mother's arms. Both measurements were performed following standardised procedures (Gibson, 1990). To reduce intra-individual error, weight and height were measured twice and the mean value was used for the analysis. The Weight-for-Age *Z*-scores (WAZ) were used to denote wasting; Height-for-Age *Z*-scores (HAZ) were used as an indicator for stunting (chronic malnutrition). Body mass index (kg/m^2) is defined as weight in kilograms divided by the square height in meters.
Height and weight were recorded to the nearest

0.1 kg cm and 0.5 kg respectively. The BMI was computed as follows: BMI = Weight (kg)/Height (m^2)

BMI scores were used to denote under nutrition and these were calculated from measurements of weight (kg) and the height (m). (Weight for Height-WHZ scores). The *Z*-scores were calculated based on the median values of World Health Organization (WHO) Reference Growth Standard (2000). In this study, children who obtained *Z*-scores between 1 to –2 standard deviations (SD) were considered mildly malnourished, and <-2 to>-3 Z-scores were moderately malnourished and <-3 Z scores were severely malnourished. Values above the mean were considered excess of the mean growth.

Statistical Analysis

Data analysis was performed using Statistical Package for Social Science (SPSS) version 16.0. Means were compared through analysis of variance (ANOVA) and frequencies by the Chi-square test. Correlation was used to assess the association between giardiasis and malnutrition in children. *P*-values less than 0.05 ($P< 0.05$) were considered significant.

RESULTS

In this study, 374 stool samples collected from 374 children (191 males and 183 females) in primary and nursery schools as well as day-care centers were examined for *Giardia lamblia*. One hundred and fifty- five (155) subjects were positive for *Giardia* coproantigen, with a prevalence of 41.4%. The highest prevalence of asymptomatic giardiasis was in the age group 3-5 years (32.9%) and lowest was in the 0-2 years (11.6%). There was no significant difference observed between age groups ($p = 0.414$). A total of 78 (50.3%) and 77 (49.7%) of the 191 males and 183 females were infected respectively. However, the variation observed in the prevalence of the infection in both sexes was not statistically significant ($p>0.005$) (Table 1).

Table 2 shows the *G. lamblia* infection and nutritional status classification by Weight-for-Age Z scores (WAZ) among children aged 0-12 years in the two local government areas studied. In Sabon-Gari LGA, 13% of the subjects were severely wasted, 14% were moderately wasted; others were mildly wasted (36.2%), some had normal Weight-for-Age Z-Scores (30.6%), and 4.7% had excess of normal WAZ scores. While in Zaria LGA 9(13.0%) were severely wasted, 16(23.2%) moderately wasted, 33(47.8%) mildly wasted, 10(14.5%), normal, 1(1.4%) excess of normal. The WAZ scores of children who were infected with *G. lamblia* were lower than those who were not infected in Sabon-Gari LGA, Zaria, Nigeria. It could be assumed that there is an association between asymptomatic giardiasis and wasting among the children examined ($p>0.05$; p- value 0.030, ANOVA).

Table 1: Prevalence of *Giardia lamblia* Infection in According to Age and Gender

Age (in years)	*Giardia lamblia* infection	
	No. Examined	No (% positive)
0-2	50	18 (11.6)
3-5	107	51 (32.9)
6-8	109	45 (29.0)
9-12	108	41 (26.5)
Total	**374**	**155**
Gender		
Male	191	78 (50.3)
Female	183	77 (49.7)
Total	**374**	**155**

Table 3 presents the results of stunting among the children at the study area by using the Height-for-Age Z- scores (HAZ). In Sabo-Gari, about 8.4% of the children who had lower Height-for Age Z scores (HAZ) were severely stunted, 16.9% were moderately stunted, 22.9% were mildly stunted and 41.0% had normal Height- for- Age Z scores. However, 10.8% of the subjects had Height-for-Age Z scores above normal. In Zaria LGA, 5.6% were severely stunted, 13.9% moderately stunted, 31.9% were mildly stunted, 37.5% normal and 11.1% had excess of normal. There was no significant association between asymptomatic giardiasis and nutritional status among the children examined at both LGAs ($p>0.05$; p- value 0.623, 0.802).

Using the Body Mass Index (BMI), the nutritional status classification for severely, moderately, and mildly malnourished among the infected children in Sabon-Gari LGA were 9.6%, 30.1%, 26.5% respectively. However, 24.1% of the children had normal BMI and 4.2% above normal. There was significant difference in the nutritional status of the infected and non-infected children ($p<0.05$; $p = 0.024$) (Table 4).

Table 2: *Giardia lamblia* Infection and Weight-for-Age Status the Study Population

Giardia lamblia infection				
Nutritional Status by weight-for - age (measuring wasting)	Sabon-Gari LGA		Zaria LGA	
	Positive	Negative	Positive	Negative
Severely Wasted	9(13%)	25(29.4%)	9(13%)	18(17.5%)
Moderately Wasted	10(14%)	19(22.4%)	16(23.2%)	19(18.4%)
Mildly Wasted	25(36.2%)	26(30.6%)	33(47.8%)	43(41.7%)
Normal	21(30.4%)	11(12.9%)	10(14.5%)	21(20.4%)
Excess of Normal	4(4.7%)	4(5.8%)	1(1.4%)	2(1.9%)
p- value	0.030		0.720	

Table 3. *Giardia lamblia* infection and Height-for- Age Z scores (HAZ) of Children Examined in the Two Local Government Areas

Giardia lamblia infection				
Nutritional Status by Height-for - Age (Measuring Stunting)	Sabon-Gari LGA		Zaria LGA	
	Positive	Negative	Positive	Negative
Severely Stunted	7(8.4%)	10(9.3%)	4(5.6%)	10(8.9%)
Moderately Stunted	14(16.9%)	19(17.8%)	10(13.9%)	14(12.5%)
Mildly Stunted	19(22.9%)	35(32.7%)	23(31.9%)	30(26.8%)
Normal	34(41.0%)	32(299%)	27(37.5%)	46(41.1%)
Excess of Normal	9(10.8%)	11(10.2%)	8(11.1%)	12(10.7%)
p value	0.623		0.802	

Table 4: *Giardia lamblia* infection and Body Mass Index (BMI) among Children in the Two local Government Areas Investigated

Giardia lamblia infection				
Nutritional Status by BMI(Kg/m^2)(Measuring Underweight)	Sabon-Gari LGA		Zaria LGA	
	Positive	Negative	Positive	Negative
Severely malnourished	8(9.6%)	27(25.2%)	18(25.0%)	25(22.3%)
Moderately malnourished	25(30.1%)	28(26.2%)	13(18.1%)	27(24.1%)
Mildly malnourished	22(26.5%)	32(29.9%)	21(29.2%)	26(23.2%)
Normal	20(24.1%)	16(15.0%)	17(23.6%)	24(21.4%)
Excess of normal	8(9.6%)	4(3.7%)	3(4.2%)	9(8.0%)
p - value	0.024		0.697	

DISCUSSION

In this study, the prevalence of 41.4% for asymptomatic giardiasis in children in Zaria area of Kaduna, Nigeria as determined by ELISA coproantigen detection technique compares well with previous studies in other parts of the world. Zaki *et al.* (1986) reported a prevalence of 44% in eight villages of rural North-eastern Egypt. Salem *et al* (1994) reported a prevalence of 43.7% in children between 0-5 years in Pikine, Senegal. The non-significant variation in the infection status in both sexes is also in agreement with reports of Sadjjadi and Tanidhe (2005), Botero-Garces *et al*. (2009) and Garba and Mbofung (2010). Although, the prevalence of giardiasis according to age group was not statistically significant, a slightly higher prevalence was observed among children between the ages of 3-5 years (32.9%) than among those in the age group 0 to 2 years (11.6%) and <6 year-old subjects (29.0%). This could indicate that infection transmission occurs, perhaps when children play in very close contact. This is in consonance with the surmise of US EPA (1999) that secondary transmission of giardiasis does occur among children in day-care centers.

In this study, asymptomatic giardiasis did not significantly affect the height – for - age Z scores (HAZ). Similar reports have been documented in literature. In two prevalence studies of 660 children enrolled in 30 day care centres, Pickering *et al*. (1984) found *Giardia* cysts in 21% and 26% of the children. No association was found between diarrheal episodes and *Giardia* detection. Also,

asymptomatic infection did not affect monthly height and weight. Fraser (1994) reported that *G. lamblia* infections in children attending day-care centres in Israel have been largely asymptomatic with no adverse growth effects and no association with higher rates of diarrhoea.

In contrast, a cross-sectional study in Guatemala involving children with asymptomatic *Giardia* infection concluded that only the literacy status of the primary caregiver and the number of children in the household was related to the prediction of stunting among the children participating in the study (Sereebutra *et al*., 2006). Although recurrent gastrointestinal infection can retard growth in children and giardiasis has been epidemiologically associated with growth impairment, the importance of *Giardia* itself as a cause of growth impairment continues to be debated, especially for children who are asymptomatic (Farthing, 1996; Muniz-Junqueira and Queiroz, 2002).

However, Hall *et al*. (1994) stated that the epidemiological association between malnutrition and *Giardia* infection is not consistent, and it is not clear whether giardiasis is a cause of malnutrition or whether malnutrition predisposes people to giardiasis. Data obtained from this present study suggests that giardiasis may influence the Body Mass Index (BMI) significantly (p = 0.0024). This is in consonance with other studies which have suggested this association with different anthropometric variables such as height for age and weight for age (Muniz-Junqueira and Queiroz, 2002; Nematian *et al*., 2008; Durán *et al*., 2010). Chronic infection can potentially contribute to lower height-for-weight Z scores. This may possibly be one of the multiple determinants of the high prevalence of underweight subjects.

The present study showed that giardiasis may be a predictor of wasting indicated by lower weight for age Z scores. This agrees with earlier studies by Ikeh *et al*. (2007) who reported higher *G. lamblia* infection rates in undernourished children. Previous studies have demonstrated that there is higher prevalence of *G. lamblia* infection in malnourished patients (Patel and Khandekar, 2006; Duran *et al*., 2010). This may be due to the parasite interfering with intestinal absorption leading to malnutrition (Ikeh *et al*., 2007). Thus, children may appear to have normal weight-for-age (underweight) and weight-for-height (wasting), but actually, have very low stature that only becomes visible at a later stage of development. However, giardiasis did not show a strong association with stunting in this study. Perhaps the undernourished children progressively adapt until maximum adaptation is reached even in the presence of *Giardia* infection. Early treatment of giardiasis may improve nutritional status of subjects.

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