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Cross-sectional study and spatial distribution of schistosomiasis among children in Northeastern Nigeria

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ABSTRACT

Objective: To determine schistosomiasis level and risk factors that exposed school-aged children to infection as well as to model schistosomiasis map in relation to altitude and rainfall in Gashaka Local Government Area, Taraba State, Nigeria.

Methods: The study was conducted between January 2014 and June 2014. Urine and faecal samples were collected from 1080 school-aged children and processed using the filtration and formol–ether concentration techniques, respectively.

Results: Irrespective of the schistosomes species, a point prevalence of 10.18% was reported out of the 1080 children examined. Males were significantly infected than their female counterparts (11.75% *vs.* 8.43%) (χ^2 = 4.86; P = 0.027), as well as children aged 6–10 (11.65%, 72/618) and 11–15 years (10.29%, 35/340) than the other age groups (χ^2 = 9.274; P = 0.026). No significant difference was observed in schistosomiasis between children whose parents were educated (11.11%, 57/513) and not educated (9.88%, 53/536) (χ^2 = 1.342; P = 0.247) and those whose parents are farmers (9.74%, 53/544) and non-farmers (10.63%, 57/536) (χ^2 = 0.787; P = 0.375). Proximity to water bodies (distance < 500 m) (odds ratio = 1.809, confidence interval = 1.057–3.094; P = 0.003 1) and fishing (odds ratio = 2.632, confidence interval = 1.397–4.958; P = 0.003) were the risk factors exposing children to infection. The spatial distribution pattern of schistosomiasis showed that the infection was significantly higher in Serti A (22.2%, 26/180) and Mayo-Selbe (21.1%, 38/180) than the other localities (χ^2 = 92.99; P = 0.000).

Conclusions: This study reported a moderate level of infection among school-aged children with proximity to water bodies and fishing as the main risk factors. The spatial distribution of schistosomiasis in the area will guide in efficient and effective control programmes at local level. It is recommended that continued efforts be made to scale-up distribution of praziquantel to high risk areas so as to curb the progression of the disease.

1. Introduction

Schistosomiasis caused by *Schistosoma mansoni* (*S. mansoni*) and *Schistosoma haematobium* (*S. haematobium*) continues to remain a public health problem in many parts of developing countries most especially sub-Saharan Africa where there is inadequate supply of clean drinking water. This constrains inhabitants to rely on cercariae infested ponds, streams,

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The study protocol was performed according to the Helsinki declaration and approved by the Directorate of Health, Gashaka Local Government Area, Taraba State. Informed written consent was obtained from parents.

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rivers and water from irrigation canals purposed for agriculture. It is estimated that 249 million people are infected worldwide with schistosomiasis among which an estimated 231 million live in sub-Saharan Africa [1]. In most endemic areas, the disease has been linked to epidemiological, socio-economic and environmental factors [2–4].

In recent years, geographic information systems and remote sensing have been used to spatially determine distribution patterns and predictive maps model of schistosomiasis with environmental factors so as to guide and ensure effectiveness of control programmes. In sub-Saharan Africa, the use of such technological innovations in the control and prediction of schistosomiasis is poorly utilized and limited to only few studies: Cameroon [5], Kenya [6–8], Nigeria [9,10] and Tanzania [11].

Nigeria like most of the countries in sub-Saharan Africa has not achieved the Millennium Development Goals for access to safe drinking water and reduction by half of infections due to neglected tropical diseases. The number of people treated with preventive chemotherapy (praziquantel) was estimated at only 5.4% out of the 60.6 million requiring the chemotherapy [12]. Taraba State is one of such states in North East Nigeria where little has been done to improve access to safe drinking water and healthcare services to rural dwellers. Gashaka is one of such Local Government Areas (LGAs) where little progress has been made within the concept of the Millennium Development Goals to reduce schistosomiasis and soil-transmitted helminths among school-aged children. Majority of the inhabitants in the area depend on ponds, streams and rivers for drinking water and daily chores activities. Effective control interventions in the area only started within the past five years when there was a need to scale-up the distribution of praziquantel and albendazole to school children. These interventions were always done haphazardly with no prior epidemiological studies that would have guided efficient control programmes in the area. Previous studies extensively used published schistosomiasis studies and remotely sensed environmental data to model and predict infection for control purposes; this might consequently over or underestimate the real infection level of the disease in some areas which might subsequently affect control programmes. We attempted in this study to merge our understanding of both parasitological cross-sectional study and remotely sensed environmental data such as rainfall and altitude derived from satellite datasets to create an instrumental map that will help in guiding schistosomiasis control programme in Gashaka LGA, Taraba State, Nigeria where part of the Nigerian largest national park, the Gashaka Gumti National Park is located. Therefore, this study was conducted to determine schistosomiasis level in relation to some epidemiological factors among school-aged children and risk factors that exposed them to infection, as well as to model schistosomiasis maps in relation to environmental factors such as altitude and rainfall.

2. Materials and methods

2.1. Study area

Gashaka LGA is situated in the southeast of Taraba State and extends to approximately between 11°00′–12°00′ E and 07°30′–08°00′ N. The Local Government is bordered to the north and east by Adamawa State, to the southeast by the Republic of Cameroon, to the south by Sardauna LGA and to the west by Kurmi and Bali LGAs. The area lies within the typical Guinea savannah of Nigeria with a mountainous terrain and varying weather conditions ranging from dry-humid to tropical moist-humid in the lowlands, to sub-temperate climate on the highlands. The dry season starts from November to April and the rainy season from April to November. The area is mainly inhabited by civil servants, petty traders and military in the local government headquarters, Serti. Inhabitants living in the rural areas are mainly peasant farmers, fishermen and hunters who depend mostly on subsistence agriculture.

2.2. Study design, sample size determination and sampling procedures

This study was cross-sectional in design and conducted between January 2014 and June 2014. Prior to the commencement of the study, ethical approval and permission were obtained from the Directorate of Health, Gashaka LGA, Taraba State. Headmasters of the selected primary schools were duly informed by the Directorate of Health about the study. Written informed consent was obtained from parents and enrolled children were briefed on the significance of the study before sample collection. Equal number of samples was drawn from all the six localities, namely, Gashaka, Garbabi, Kwagin, Mayo-Selbe, Serti A and Serti B. The population size in each school was calculated using the following formula at 5% precision.

$$N = \frac{p\ (1-p)\left(Z_{1-\alpha/2}\right)^2}{d^2}$$

with p = 85% as the estimated prevalence in the area, $Z_{1-\alpha/2} = 1.96$, $d^2 = 0.002\,5$.

The calculated population size N was approximately 196 which was rounded-up to 200 to avoid bias in the selection of the pupils. A systematic random sample was then conducted to enroll 180 pupils with 10 as sample interval from the available 200 school children population in each school. In all, 1 080 pupils were enrolled for the study from the six localities.

2.3. Questionnaire administration

A structured questionnaire was given to each enrolled pupil to collect information on some epidemiological factors such as age, sex, level of education and occupation of parents, as well as risk factors for schistosomiasis such as water contact activities and distance from water sources. We only considered paternal factor for children that have both parents and maternal factor for those that are under maternal care.

2.4. Samples collection and laboratory procedures

Both 20 mL of urine and 2 g of stool samples were collected from each child using labeled universal bottles. The urine samples were collected between 10:00 h and 14:00 h during the day each child brought his/her early morning stool for examination. All specimens were analyzed within the premises of the school. Urine samples were analyzed by the standard filtration technique using 10 mL syringe, swinnex polypropylene filter holder (13 mm diameter) and polycarbonate membrane filters (12 μm porosity) (Sterlitech Corporation, Kent, USA), while stool samples were