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Seroprevalence of Varicella Zoster Virus Infection among Primary school Children In Northern Nigeria

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Abstract *Background:* Varicella Zoster infection occurs exclusively in man and commonly affects children with predilection for school age children. Following infection the course of the disease in immunocompetent children is often mild and self limited but in older age groups infection may be severe with poor outcomes ranging from complicating bacterial morbidities to death. In Kaduna State, Northern Nigeria the seroprevalence of Varicella - zoster virus (VZV) infection is unknown. The current cross - sectional study was conducted to assess the seroprevalence of VZV infection among nursery and primary school pupils in Kaduna State.

Methods: Nursery and primary school pupils between the ages 4 and 15 years were randomly selected from the three geopolitical zones of Kaduna State. Demographic data on each subject were obtained by administration of a questionnaire and blood samples were collected for serum analysis of Varicella - zoster virus immunoglobulin G (IgG) using the Automation ELISA IgG Kit manufactured by Automation INC. USA. Data obtained were summarized using percentages and frequency tables. Results were analyzed using Epi- info version 3.0.

Results: Three hundred and fifty three pupils were recruited for the study. The overall prevalence rate for VZV infection was 66.3% with the value in males being 68.5% and in females 63.9%. The prevalence of VZV infection increased with age in both sexes. A high percentage of children (60%) were seropositive at 4-6 years.

Conclusion: The study shows a 66.3% prevalence of VZV infection among children in Kaduna State. This high prevalence rate necessitates further studies to establish the burden of the problem in Nigeria and rationalize the institution of preventive measures against the infection, particularly immunocompromised young children.

Introduction

Varicella otherwise referred to as chickenpox is caused by the DNA virus Varicella zoster virus and belongs to the Herpesviridae family. This virus is exclusively found in man. [1, 2] Infection is highly contagious with a clinical attack rate of 65% to 85% following exposure and it usually spreads from an infected individual to a susceptible host via droplet infection and or contact. [1 - 3] Children are most susceptible to infection. In non vaccinated populations, primary infection tends to occur at a younger age.[4] Varicella zoster infection generally follows a benign course particularly in children with a normally functioning immune system but can sometimes be accompanied with complications ranging from pneumonia to other more serious ones like varicella encephalitis, hepatitis purpura fulminans to cerebella ataxia.[4] Rarely it may mimic acute abdomen.[5] In the immunocompromised child such as the child with HIV infection, malignancy and those on immunosuppressive therapy, varicella

infection may be severe and fatal.[4] Children who have leukaemia have a 30% rate of disseminated varicella, with a 7% mortality rate. [4] The Center for Disease Control estimates that 60 to 100 individuals die annually from complications of varicella.[3] Following resolution of varicella infection, Varicella - zoster virus becomes latent in the peripheral ganglia and persists throughout life and may be reactivated later. Vaccination is about 80-85% effective in prevention of all varicella disease and more than 95% effective in prevention of severe disease.[6] All over the world, because majority of cases of varicella are self limiting and uncomplicated, there tends to be a dearth of information on the epidemiology of Varicella. In a seroepidemiology survey of 160 children in Brazil, a prevalence of 58.1% was documented[7] several other researchers have documented varying prevalence rates from various part of the world.[8-16]

With the current HIV pandemic world over and the absence of routine varicella virus vaccine in Nigeria, varicella virus infection may pose a threat to children particularly the immunocompromised with a risk of developing more severe disease, complications and mortality. There is therefore the need to study the epidemiology of the disease. This study was thus designed to look at the prevalence of VZV infection in primary school children in Kaduna State Northern Nigeria.

Materials and Methods

The study was conducted in Kaduna State from January 1st to September 30th 2008. Kaduna State is located at the centre of northern Nigeria. It has a political significance as the former administrative headquarters of the north during the colonial era. The State shares boundaries with Niger State to the west, Zamfara, Katsina and Kano States to the north, Bauchi and Plateau States to the east and Federal Capital Territory Abuja and Nasarawa State to the south. It occupies approximately 48,473.2 square kilometers and has 23 local government areas (LGAs). It is divided into three geopolitical zones namely north, central and south zones, with each having eight, seven and eight local government areas respectively. The State has a total of 1510 primary schools.

Prevalence of Varicella Zoster Virus was studied among primary school children between the ages of 4 15 years in Kaduna state. Ethical clearance was obtained from the State Ministry of Education, the Zonal Inspectorate Division of each local government area and the school management of selected schools. Informed written and verbal consent was obtained from parents/guardians of all subjects.

A total of 353 pupils were selected by multistage random sampling. One LGA was selected from each of the three geopolitical zones. The three LGAs randomly selected were Makarfi (north), Kagarko (south) and Igabi (central) with each having 10, 11 and 11 districts respectively. Using a sample frame of public primary schools in the three selected LGAs, 32 primary schools were randomly selected. One primary school was selected from each of the district areas constituting the three selected LGAs. The study subjects were then randomly selected across classes from primary 1 6 from the sampled schools. An average of 11 subjects was selected per school, making a total of 91, 110 and 152 subjects in Makarfi, Kagarko and Igabi respectively. Only subjects whose parents or guardians consented to the study were included.

Questionnaires were administered to all subjects to document their demographic data which include age and sex of subjects, vaccinations received and history of recent contact with a case of chickenpox. Venous blood sample was then collected from each subject, centrifuged for two minutes and the separated sera was stored at -20^{0}C until tested for IgG. The analysis for VZV IgG antibodies was conducted using a commercialized IgG enzyme-linked immunosorbent assay (ELISA) kit manufactured by Diagnostic Automation INC USA which uses cell- culture-derived VZV antigens for the detection of anti -VZV IgG antibodies in the serum. The serum assay was conducted according to the manufacturer's instruction in the department of microbiology, Ahmadu Bello University Zaria. Data were analyzed using EPI-info version 3.0. Chi-square test was performed to analyzed association between qualitative variables, and statistical significance was established at p- value of < 0.05.

Results

A total of 353 pupils were studied. I84 were males while the remaining 169 were females with a M: F ratio of 1.1: 1. Of the 353 pupils studied, 234 were found to be seropositive for VZV IgG antibody, giving an overall seroprevalence of 66.3%. Corresponding figures for males and females were 126 (68.4%) and 108 (63.9%) respectively. There was therefore no significant gender predilection ($x^2 = 0.48$, $p>0.05$).

Table 1 shows the seroprevalence of VZV according to age group in male subjects. The seroprevalence was highest in the oldest age-group (13 to 15 years) having increased progressively from 60% among the youngest children aged four to six years. A similar trend was observed among female subjects with the highest seropositivity rate among the 13 to 15 year old age group. Comparing the percentage seropositivity between the age groups the youngest and the oldest showed significant variability. Chi-square = 9.02, p= 0.000 in boys while in girls X^2 = 7.43, p= 0.000. (Tables 1 and 2 respectively)

Table 1: Distribution of VZV IgG by Age among Primary School Boys in Kaduna State, Nigeria.

Age group in (years)	Number of samples	No of positive samples	Prevalence %*	95% confidence interval
4 – 6	20	12	60.0	39.0 – 78.0
7 - 9	46	31	67.4	47.3 – 87.0
10 - 12	59	41	69.5	47.5 – 88.4
13 – 15	59	42	71.2	50.2 – 92.5
Total	184	126	68.5	

*χ^2 = 9.02, p = 0.000 (Chi-square analysis showed association between age and % VZV IgG antibody seroprevalence)

Table 2: Distribution of VZV IgG by Age among Primary School Girls in Kaduna State, Nigeria.

Age group in (years)	Number of samples	No of positive samples	Prevalence %*	95% confidence interval
4 – 6	17	7	41.2	26.5 – 48.4
7 - 9	39	24	61.5	40.5 – 76.2
10 - 12	55	37	67.3	47.0 – 84.3
13 – 15	58	40	69.0	48.6 – 88.0
Total	169	108	63.9	

*χ^2 = 7.43, p= 0.000 (Chi-square analysis showed association between age and % VZV IgG antibody seroprevalence)

Discussion

The study found a prevalence of 66.3% for varicella zoster infection among primary school children in Kaduna State. To the best of our knowledge there has not been any previous study investigating the prevalence of VZV infection among children in this locality and thus, it is difficult to compare our study to any other local finding. This dearth of local data could be attributed to the general perception that varicella zoster virus infection particularly in children is benign and self limiting without serious outcomes or fatality. Our finding however shows a high prevalence and is comparable to findings from other international studies. Semenovitch and Lupi[7] in Brazil found a prevalence of 58.1% among a population of 160 children in the State of Rio de Janeiro.

Our finding was however much lower than those of Perez-Farinos et al[10] in Madrid, Spain and Heininger et al[11] in Switzerland where they documented prevalence of 90.2% and 96.5% respectively. The difference in study design could have accounted for this observed difference in prevalence. While in both our study and that of Semenovitch and Lupi[7] in Brazil the population was limited to children 15 years and below, the study by Perez-Farinos et al[10] included both adults and children with age range two to 40 years. This difference in age range of study subjects may have accounted for the high prevalence they documented. Heininger et al[11] studied only adolescents aged 13 to 15 years, the age established by various studies to be the peak age for VZV infection could explain the high variability. Also routine vaccination against VZV infection in developed countries may account for the apparent high prevalence rate observed compared to our study.

An earlier study from Western Nigeria[16] in the 80s documented a low prevalence rate of 30% among 188 blood samples. Comparison with that study however has to be done with caution as the age range in the earlier study was not specified.[16]

The age group specific prevalence from our study showed that seroprevalence of VZV infection rose with age among the study population steadily. This is in consonance with findings from other studies. In Turkey Savas et al[12] in their study of 885 children found that seropositivity rate for VZV infection among children 0 15 years rose with increasing age. Semenovitch and Lupi[7] also documented a similar finding. The age group 13 to 15 years had the highest prevalence in our study which is similar with findings from other studies.[7, 12-14] The high infection rate in older children could be due to increased VZV transmission as the child gets older, as a result of increased exposure.[13] Also emergence of new VZV strains,

spreading among susceptible individuals has been advocated by Lee.[13]

The finding of similar prevalence rate of VZV IgG among the sexes in the present study is not surprising, as other available reports have consistently found similar prevalence rates. This indicates that both sexes have equal risk of infection. Other Studies have shown variable results of prevalence rate of varicella zoster virus infection among males and female subjects.[7, 11, 12] The variations observed were higher prevalence in males in some studies, while others found higher prevalence in females.[7, 11, 12]

Our study found 60% of children under the age of six years to be seropositive. This finding suggests that children in the north are exposed to infection in early life similar to the findings in most temperate countries.[2, 8, 17] The present observation contrasts with previous reports of high seropositivity in later life in tropical countries.[17] These differences have been attributed to difference in geographical conditions between temperate and tropical countries.

The study has shown that VZV infection is prevalent among children in Kaduna State. There is a need to carry out more extensive studies involving other parts of the country to provide evidence based arguments to substantiate the need for support and provision of preventive measures in the form of vaccination to children, particularly those at risk of developing severe infection, complications and increased risk of mortality.

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