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Polio-Specific Immunoglobulin G Antibodies among Children in Jos, Nigeria.

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Abstract:

Background: Concerns on the safety of polio vaccine in some parts of northern Nigeria that led to the suspension of the immunization efforts in those parts of the country, informed our design of this prospective study.

Objective: To determine polio-specific Immunoglobulin G antibodies among children (seven months - seven years) in Jos.

Methods: Within the months of March and April 2007, One hundred and eighty two blood samples were collected from children in the Emergency Paediatric Unit of the Jos University Teaching Hospital and tested for the presence of polio-specific IgG antibodies using Poliomyelitis IgG ELISA Test Kit produced and described by DEMEDITEC Diagnostic GmbH Germany.

Results: One hundred and seventy eight percent (97.8%) of the tested children had detectable antibodies against poliovirus. The study population had appreciable levels of protection against poliovirus. There was no significant association between the detection of the IgG in children in relation to gender, age, religion, and number of doses. Only educational status of fathers had statistically significant relationship with the detection of the antibodies.

Conclusion: This study demonstrated that progress has been made towards the eradication of poliomyelitis in Nigeria. To further strengthen the gains made and weaken the barriers to immunization, there is an increasing need for more funding to increase awareness and intensify the final efforts targeted at 'kicking polio' out of Nigeria.

Keywords: Immunoglobulin G (IgG) antibodies, Children, Jos, Nigeria

Introduction:

In 1988, the World Health Organization (WHO) passed a resolution committed to the eradication of poliomyelitis globally by the year 2000.⁽¹⁾ This global polio eradication initiative resulted in a world-wide campaign involving the immunization of children. Progress toward global polio eradication continued during 2006 and the first 5 months of 2007, although the number of countries where wild poliovirus (WPV) transmission has never been interrupted remained at four (Afghanistan, India, Nigeria, and Pakistan).^(2, 3, 4, 5) Following the launching of the Expanded Programme on Immunization in Nigeria in 1979, Supplementary Immunization Activities (SIA) targeting children aged <5 years have been conducted annually in Nigeria since 1996.⁽⁶⁾ Recognizing that sustaining high immunization coverage is an important disease control strategy, the Federal Government of Nigeria established the National Programme on Immunization in August 1997 with the mandate to effectively control, through immunization and the provision of vaccines, the occurrence of the some deadly diseases, including poliomyelitis.⁽⁷⁾

The suspension of polio immunization campaigns in a number of northern States of Nigeria in August 2002, following concerns by influential persons regarding the safety of polio vaccine resulted in a new outbreak. This new outbreak originated from the state of Kano, and re-infected previously polio-free areas within Nigeria, as well as eight previously polio free countries across West and Central Africa.⁽⁶⁾ As a result, there was a rise in the number of cases of poli-

omyelitis in Nigeria in December 2005, and Nigeria became the highest endemic country in January 2006 with 675(38.6%) of the 1749 Global Cases.⁽⁸⁾

In the same year, 187 SIAs (86 national immunization days [NIDs], 84 sub national immunization days [SNIDs], and 17 mop-up rounds) with OPV were conducted in 36 countries, using a total of 2.12 billion OPV doses. Doses were delivered to 375 million children aged <5 years. Use of mOPV1 increased from 22% of all administered doses in 2005 to 46% in 2006, reflecting the programmatic shift in campaign strategy.⁽⁹⁾ A total of 58 (31%) of the 187 SIAs were conducted in the four polio-endemic countries: 17 each in India and Pakistan and 12 each in Afghanistan and Nigeria. By May 30, 2007, a total of 90 cases with onset in 2007 had been reported from Nigeria, compared with 371 reported for the same period in 2006⁽¹⁰⁾ and 675 in January 2006.⁽⁸⁾

As we work towards achieving the goal of eradicating polio, a serologic survey to determine the status of immunity of children against poliomyelitis was carried out in Jos. An attempt was also made to determine the factors that contributed to the observed level of immunity and provide government with information applicable to assessing the national programme on immunization in particular and the Global Polio Eradication efforts in general.

Materials and Methods:

Study Area

The Emergency Paediatrics Unit (EPU) of Jos University Teaching Hospital (JUTH)

was utilized as the study area for this study. The Hospital being the only teaching Hospital in the State serves the health need of patients not only from within the state, but also from about 10 neighbouring states. Samples were collected and analyzed at the Human Virology Research Centre, Plateau Specialist Hospital Jos.

Study Population

All children between the ages of seven months and seven years consecutively brought to the EPU during the period of March and April 2007 were recruited as the study population irrespective of whether or not they had been previously immunized against polio. A total of 182 blood samples were collected.

Survey and Laboratory Analysis

A written informed consent was sought and obtained from the parents/guardians before inclusion in the study. The demographic data and other relevant information of each participant were obtained using a questionnaire. About two mls of blood was aseptically drawn by venipuncture, after swabbing the area of interest for sample collection with alcohol. The serum was separated from the blood after allowing clotting and centrifuging. The serum samples were labelled and stored at -200C until processed.

The Polio IgG antibody ELISA test Kit manufactured and described by DEMEDI-TEC Diagnostic GmbH Germany was used for the detection of specific IgG antibodies against polio in serum of children with strict adherence to the manufacturer's instructional manual.

Ethical Consideration

Ethical clearance for the study was sought and obtained from the ethical committee of JUTH. A written permission was also obtained from the Paediatrics Department of the Hospital for the use of the EPU.

Statistical Analysis

The data was analyzed using the SPSS computer software program. Pearson chi-square was used to test for association between discrete variables. Statistical significance was accepted at $P < 0.05$ (95% confidence level).

Results:

A total of 182 samples were tested for polio-specific IgG antibodies, out of which 106 (58.2%) were males and 76 (41.8%) were females. Out of the 182 samples tested for Polio-specific IgG antibodies, 178 (97.8%) tested positive. Of the 106 male children tested, 103 (95.2%) were positive for the antibodies; and 75 (98.7%) of the 76 female children tested positive. Children aged 0-3 had up to 97.8% positivity while older children (4-7 years) had 100% positivity. Age and sex distribution of the antibody positivity was not statistically significant ($P > 0.05$) (Table 1).

The number of doses of the polio vaccine that was administered to the children was also determined in relation to the polio-specific IgG antibodies (Table 2). Those that had received; 0-1 dose, more than one dose and those that were not certain of the number of doses administered had the highest percentage positivity of 100%. Those that received 4-5 doses, 6-7 doses and 2-3 doses had 97.4%, 96.3% and 92.3% positivity re-

spectively. There was no significant difference in the detection of antibodies in relation to the number of doses ($P>0.05$).

The positivity of Polio IgG antibodies in relation to the educational status of parents is shown in figure 1. Immunoglobulin positivity increased with increased education of the parents. About 55.9% of the children who tested positive to the antibodies had fathers with tertiary education. Only 4.0% of fathers and 3.0% of mothers who did not have any formal education had children who tested positive. This factor did not have any statistically significant impact on the detection nor the positivity of the IgG antibodies ($P>0.05$).

The occupation of the fathers of the children in relation to Polio-specific IgG

antibodies is shown in table 3. Most of the fathers who participated in the research were civil servants and businessmen and their children had percentage positivity of greater than 90.0%. Those fathers who are missionaries had a percentage positivity of 85.7%. For those children that their fathers had no occupation, a detection rate of 88.9% for the Polio-specific IgG antibodies was recorded.

Of the 93 Christians and 89 Muslims who participated in the research, 92 (98.9%) and 86 (96.6%) tested positive to the antibodies respectively. There was also no significant difference in antibody detection in relation to religion ($P>0.05$).

One out of the 2 children who were not breast fed at all had no detectable antibodies against Poliovirus.

Table 1: Age and sex distribution of polio-specific of immunoglobulin G antibodies among children.

Age (Years)	Number Tested	Number Positive		
		Male	Female	Total (%)
0-1	71	32	36	68 (95.8)
2-3	46	26	19	5 (97.8)
4-5	38	29	9	38 (100.0)
6-7	27	16	11	27 (100.0)
Total	182	103	75	178 (97.8)

$\chi^2=8.59$

$P>0.05$

Table 2: Polio-specific immunoglobulin G antibodies among children in relation to number of doses.

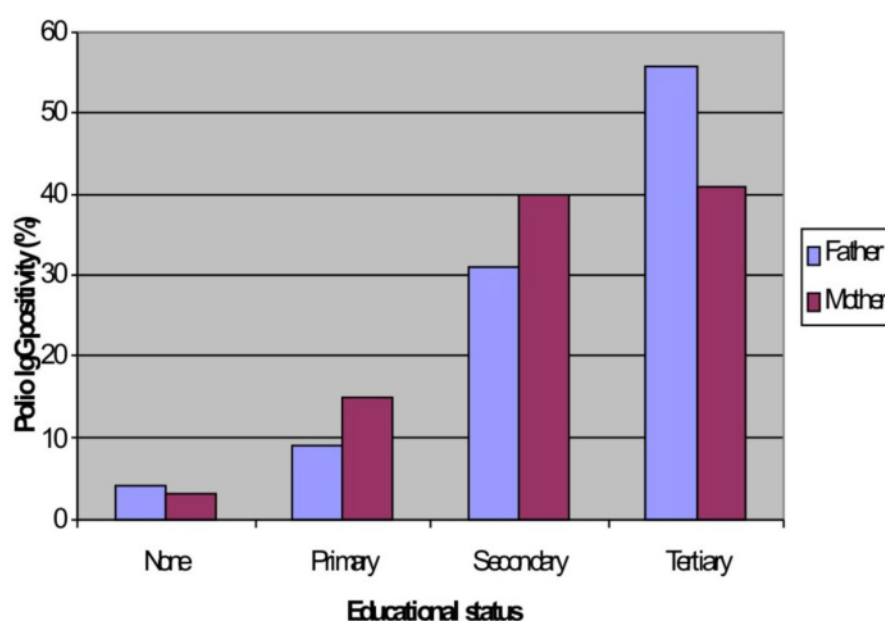
Number of doses	Number Tested	Number Positive	Percent
0-1	4	4	100.0
2-3	26	24	92.3
4-5	39	38	97.4
6-7	27	26	96.3
Many	60	60	100.0
Not certain	26	26	100.0
Total	182	187	9708

$\chi^2=5.98$

$P>0.05$

Table 3: Polio-specific immunoglobulin G antibodies among children in relation to occupation of fathers.

Occupation	Number Tested	Number Positive	Percent
Civil Servant	65	65	100.0
Businessman	64	63	98.4
Driver	17	17	100.0
Missionary	7	6	85.7
Student	4	4	100.0
Military	2	2	100.0
Farmer	2	2	100.0
Others	12	11	91.7
None	9	8	88.9
Total	182	178	97.8

Figure1: Polio-specific immunoglobulin G antibodies among children in relation to the educational status of parents.

Discussion:

A total of 182 serum samples were collected and analyzed in this study for polio-specific IgG antibodies, with a seroprevalence of 97.8%. Similar serologic surveys had been carried out in the south-western Nigeria.^(11, 12)

The high seroprevalence of 97.8% recorded in this study indicates children have effectively responded to the vaccine being used in the ongoing polio eradication initiative. This finding agrees with those of the United States in which it was reported that greater than 90% of school

age children, adolescent and young adults had detectable antibodies to Poliovirus.^(13, 14)

However, the percentage is higher than the findings in Ibadan, Nigeria, in which only 59.6% herd immunity for the three Poliovirus serotypes was recorded.⁽¹³⁾

The higher prevalence also shows that from the time of their study in 1990 to this time, immunization coverage have increased to produce a higher seroprevalence. The level of awareness on the need to get children immunized against the virus has also increased, as in their

study; they recorded about 13 unvaccinated children. In this study, only two out of the 182 recruited for the study had never been vaccinated.

Like the works done by Williams and David-West ⁽¹¹⁾ and Adewumi and colleagues ⁽¹²⁾ both in south-western Nigeria, gender had no statistical significant in relation to polio-specific IgG, even though there were more females, immune than males, as reported by Giddings and co-workers.⁽¹⁵⁾ This is explained by the fact that both sexes have equal chances of exposure to either natural infection or the vaccine. Percentage detection of antibodies increased with age. About 95.8%, 97.8%, 100% and 100% detection were obtained for age groups ≤ 1 , 2-3, 4-5 and 6-7 years respectively. This agrees with the findings of Williams and David-West ⁽¹¹⁾ that immunity increases with age in children, but differs in the fact that for all the age groups in our own study, more than 90% detection rate was recorded. Their findings recorded only 57% for children less than two years of age and 75% for those 3-5 years. The variation in seroprevalence between these two reports affirms the fact that progress has been made in Nigeria towards the global initiative to eradicate Poliomyelitis.

It is interesting to note that in spite of the global efforts being made to get children maximally immunized for the achievement of the goal of eradicating polio globally, there are people who still believe that the vaccine is not safe for use. Two (50.0%) of those shown to have received 0-1 dose of the vaccine had actually never had immunization against Polio. But interestingly, they all

had detectable antibodies to the virus. This agrees with the documentation that immunization is not the only way of acquisition of immunity against polio, as immunity can also be due to natural infection to the virus.⁽¹⁶⁾ A survey carried out in an Eskimo village showed that IgG antibodies produced from subclinical infection with wild virus persisted for at least 40 years without subsequent exposure.⁽¹⁷⁾

With the controversies associated with the safety of Polio vaccine in some northern States of Nigeria, one would expect that there would be a significant difference in the detection of Polio-specific IgG antibodies in relation to religion. But contrary to expectation, there were in fact similar detection rates of the antibodies among the Muslims and Christians respectively. The number of outbreaks recorded amongst children residing in residential areas dominated by Muslims and the acceptance of the vaccine now, may have compensated for the suspension of immunization, ⁽¹⁸⁾ as only two children out of the 93 Muslims who participated in this study never had prior exposure to the vaccine. And the two children had detectable antibodies to the poliovirus.

This research underscores the fact that, the more knowledgeable the parents, the more the percentage positivity. But that notwithstanding, even those children whose parents never had any form of formal education had detectable antibodies to poliovirus. This reflects the fact that irrespective of educational status, the general population has been sensitized on the need for the immunization of children, and, may be attributed to the high level of detection of polio-specific

IgG antibodies in this study. Natural infection with the virus could also be a factor.

The occupation of the fathers and whether the children presented with diarrhoea during the time of sample collection was also considered. All those that had diarrhoea during the time of sample collection had detectable antibodies to the virus. Since diarrhoea is one of the clinical presentations of polio, this research was limited in its inability to determine IgM. According to the findings of this study about 35.0% of those who had diarrhoea were weakly positive. This may probably mean that they had recent infection to polio, and testing for IgM would have confirmed this.

One out of the two children who were not breast fed at all had no detectable antibodies to the virus. Since only two of them had no history of breast feeding, a clear conclusion about the factor as it relates to polio-specific IgG antibodies cannot be drawn. However, it is important to note that the mother of this baby was HIV positive, and therefore, the baby was not breast fed completely. The lack of detection of antibodies to poliovirus in this child may probably mean that the child may also have been infected with the HIV virus; or may have some form of immune impairment, as the child had received about six doses of the Polio vaccine; or the mother must have given wrong information on the number of doses. This is because oral polio vaccine is effective in producing immunity to poliovirus. A single dose of the vaccine produces immunity in approximately 50% of recipients. Three doses will produce immunity to all three poliovirus types in

more than 95% of recipients.⁽¹⁹⁾ It is therefore expected that the six doses the child had received was enough to produce detectable levels of antibodies.

The results of this serological survey offer a particularly important optimistic view considering the fact that even low levels of neutralizing antibodies create the condition for an immunological memory that can promptly respond to antigenic stimuli and prevent potential vi-raemias.⁽²⁰⁾

This study demonstrates the fact that progress has been made toward the eradication of poliomyelitis in Nigeria. To further strengthen the gains made in polio eradication efforts and weaken the barriers to immunization there is a need for more funding to increase awareness and intensify the final efforts targeted at 'kicking out' polio in Nigeria.

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