

Assessing the Impact of Polio Eradication Initiative and Routine Immunization in Zamfara State, North-West, Nigeria

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Abstract

Background: Evaluation of effectiveness of polio immunization has to be monitored continuously, particularly in endemic countries so that the immunity status can be precisely and effectively established. The aim of the present study was to determine the seroprevalence of poliovirus antibody in Zamfara State, Nigeria. **Materials and Methods:** This was a cross-sectional study of children aged 0–59 months. The children were randomly selected across the state. Blood samples collected from the children were tested for the presence of antibodies to poliovirus. **Results:** Blood samples from 63 (78.8%) of the 80 children had antibodies to all the three poliovirus serotypes. Seventy-five (93.8%), 68 (85.0%), and 75 (93.8%) of blood samples had antibodies to poliovirus serotypes 1, 2, and 3 respectively. All (100.0%) blood samples from children in the age group of 48–59 months tested positive for poliovirus. All (100.0%) the females had poliovirus antibody. In general, poliovirus antibody prevalence increased with increase in oral polio vaccine doses received. Urban children had higher poliovirus antibody prevalence of 81.0%, higher than their rural counterpart. Children whose fathers were educated up to tertiary level had 100.0% poliovirus antibody. There was no association among seroprevalence of poliovirus antibody and number of vaccine doses received and location of child's place of residence. Prevalence of poliovirus antibody was statistically significant based on age and father's educational level ($\chi^2 = 0.1360$, $\chi^2 = 0.2923$, respectively, $P < 0.05$). **Conclusion:** For the state to sustain the gains made in interrupting poliovirus transmission, more work need to be done so as to close the gap observed in the study.

Key words: Antibodies, children, prevalence, Zamfara State

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INTRODUCTION

The world has witnessed a remarkable reduction in paralytic poliomyelitis cases from 350,000 in more than 125 countries in 1988 to around 247 cases in 10 countries as on October 2014.¹ The worldwide sustained use of polio vaccines since 1988 has led to a precipitous reduction in the number of cases of poliomyelitis by more than 99% globally. The cornerstone of the global polio eradication initiative is the immunization of children with multiple doses of oral poliovirus vaccine (OPV), through both routine immunization (RI) and supplementary immunization activities (SIAs).² The key advantages in the usage of OPV are ease of administration and efficient induction of mucosal immunity, thereby limiting poliovirus shedding and person-to-person transmission poliovirus.³ With the use of OPV coupled with good surveillance, indigenous wild

poliovirus (WPV) transmission has stopped in all but three countries. These are Nigeria, Pakistan, and Afghanistan.^{4,5}

For many years, Nigeria had a high incidence of WPV cases due to the persistently low quality of both routine and SIAs, particularly in the Northern States of Nigeria. This had resulted in a major reservoir for WPV in some of the states in the Northern region.^{5,6} Low trivalent OPV coverage in the RI program, suspension of SIAs in some states in 2003–2004, and low coverage in SIAs had contributed to ongoing transmission of WPV.⁷ Reported cases of WPV in Nigeria, however, decreased from 798 in 2008 to 6 in 2014, representing 48% and 2% of global cases, respectively. The incidence of WPV cases in Nigeria had once reached an all-time low during January–June 2010 period, with only three reported cases

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of WPV accounting for <1% of 456 global cases.⁸ Despite substantial progress toward national eradication of polio, several challenges still remain.

Factors which contributed to suboptimal vaccination coverage in areas with on-going poliovirus circulation are varied. The most important ones include (a) poor political commitment and accountability, (b) poor quality micro-planning, (c) sub-optimal motivation of vaccination teams and supervisors as well as (d) low uptake of vaccination services in hard-to-reach and security compromised areas.

Since it is not all OPV recipients seroconvert,⁹ it is recommended and advised for any country where a comprehensive program to vaccinate children against polioviruses was being undertaken that from time to time, laboratory studies aimed at determining the immune status to polioviruses of eligible children or even the entire population has to be assessed.¹⁰

MATERIALS AND METHODS

This was a cross-sectional study, carried out between 3 March, 2012 and 27 June, 2012. Children aged 0–59 months were randomly selected in Zamfara State, Northern Nigeria. Children of mothers attending health facilities (HFs) across the state were enrolled where possible. The State Ethical Committee gave approval for the study. In addition, consent was sought and obtained from each caregiver before enrolling the child. Only children whose caregivers gave consents were enrolled for the study. Questionnaire was administered to capture all relevant information and bio-data of each participant. The estimated sample size for the study was 80 children.

About 5 ml of blood sample was collected from each child into a labeled plain tube. The tubes were transported to the laboratory in cold boxes in which ice-packs were placed to preserve the samples. Each tube with its content was centrifuged at 3000 revolutions/min for 5 min. Serum from the centrifuged sample was collected in another labeled tube and processed immediately or stored at -20°C , until analyzed on a later date.

The polio ELISA test kit (manufactured by antibodies-online GmbH) was used for the detection of specific antibodies against specific poliovirus in the sera.

Data were analyzed using Epi Info version 3.5.4 (Centers for Disease Control and Prevention, Atlanta, GA 30333, USA). Measure of independence and association was tested using Chi-square (χ^2) test and linear regression, respectively. Statistically, significant level was set at $P < 0.05$.

DISCUSSION

The relatively high prevalence of 78.8% antibodies to all the poliovirus serotypes observed in the present study compared to another study conducted by Adewumi *et al.*¹¹ in the country, might be as a result of improved access to immunization services across the country by successive governments through constructing HFs that are effectively offering RI services.

On the other hand, the seronegative rate 17.2% for all the poliovirus serotypes in the children sample was quite high, when compared with some studies conducted in Europe, where for example, not a single individual was reported as being seronegative.¹² The highest seronegative rate of about 15.0% was observed for antibodies to poliovirus serotype 2. These relatively high seronegative rates may account for the pockets of polio being observed in parts of Northern Nigeria.

The age group with the highest prevalence of poliovirus antibodies was 48–59 months. Prevalence of poliovirus antibodies was found to be age-dependent. This might be as a consequence of antibody boosting through campaigns and probable exposure to the WPV through unsanitary habits.¹³ The findings in the present study agreed closely with that of Adewumi *et al.*¹¹ Seropositivity was related to age except for 12–23 months age bracket. Moreover, the number of doses taken by a child had a direct bearing on the prevalence of poliovirus antibodies as in other studies.¹⁴ It was observed that the higher the number of doses of vaccine a child received, the higher the prevalence of poliovirus antibody. The much higher seronegative rates in age groups before 36 months means the younger children in the population surveyed were at a greater risk of infection with WPV. More effort must be made to increase vaccination in these age groups.

The reason for the higher prevalence of poliovirus antibodies in females when compared with their males counterpart, despite the fact that there was no special preference was given to either sex by the program implementers, is not clear. A previous study indicated there a complete absence of association between the sexes and prevalence of poliovirus antibodies.¹¹

Urban children were found to have higher poliovirus antibody prevalence than their rural counterparts. This was possibly due to close proximity of urban children to HFs rendering RI, which enabled mothers to take their children for services. On the other hand, outreach services might have helped to reach greater number of children in the rural areas, which may partly explain the association between and prevalence of poliovirus antibodies. These contrasting findings would probably explain why the difference in prevalence between the two areas was not statistically significant. The finding demonstrated that parents in both urban and rural areas had almost equal chance of accessing immunization services.

Children of fathers with a higher level of formal education had a higher prevalence of poliovirus antibody levels than those whose fathers' had lower levels of formal education. Level of awareness could have played a significant role, as most of the messages relating to immunization were broadcasted in English, with few translated into the local languages. From the result, it could be inferred that education had certainly helped in dispelling rumors and other negative things affecting OPV vaccine acceptance. This research underscores the fact that, the more knowledgeable the parents, the more the percentage positivity. More broadcast in the local language may, however, have a positive effect on the less educated parents.

It was surprising that those children whose parents live close to HF's rendering immunization services had a lower prevalence of poliovirus antibodies. The numbers involved were rather small for a valid conclusion. This observation might be purely behavioral, as such only mass education and awareness sensitization may possibly and positively change the parent's attitude toward vaccinating their children. Benefits of short distance from child's household to immunization point have been fully studied in Bangladesh, Nepal, and China.¹⁵⁻¹⁷ Bishai *et al.*¹⁸ reported that outreach services offered to clients by health workers in rural areas, who were far away from HF's rendering RI services, had reduced access problems among poor rural clients. The finding in the present study in this regard was in agreement with their finding. It was possible that those who were very close to the immunization sites took the services for granted, or possibly were not well sensitized as to see the reason for taking their children for immunization services, while more of those far away from HF's for RI were reached through outreach services by the immunization personnel or were more sensitized on the need to vaccinate their children.

The gaps observed in the prevalence of poliovirus antibody in the present study among the variables were of great concern. These might be as a result of not reaching all eligible children or other factors related to the vaccine usage and availability. Effects of lower immunogenicity of OPV had been documented in developing countries.¹⁹ This could as well be an important factor. That was why Anderson²⁰ advised for a high OPV vaccination coverage needed to block the transmission of poliovirus.

Serological studies are useful in defining the regions of suboptimal immunity, to enable special targeted vaccination campaigns to be mounted so as to close any noticeable gap. The results obtained in the present study were in agreement with the findings of other workers.²¹

We acknowledge that more samples should have been taken if not for financial limitation faced in the present study. More samples would provide basis for more meaningful interpretation of results. Therefore, further studies in this and neighboring states are recommended involving larger samples to comprehensively evaluate the progress made so far, not only for polio eradication, but also for all vaccine-preventable diseases.

CONCLUSION

Identification of some children without detectable poliovirus antibodies in their sera, particularly in children younger than 36 months means that pockets of susceptible children were present within the population surveyed. Therefore, all efforts should be directed toward increase in vaccination coverage, so as to reduce the number of unvaccinated children in an effort to totally eradicate polio in the area.

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Conflicts of interest

There are no conflicts of interest.

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