



# Poliovirus seroprevalence before and after interruption of poliovirus transmission in Kano State, Nigeria



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## ABSTRACT

**Introduction:** In September 2015, Nigeria was removed from the list of polio-endemic countries after more than 12 months had passed since the detection of last wild poliovirus case in the country on 24 July 2014. We are presenting here a report of two polio seroprevalence surveys conducted in September 2013 and October 2014, respectively, in the Kano state of northern Nigeria.

**Methods:** Health facility based seroprevalence surveys were undertaken at Murtala Mohammad Specialist Hospital, Kano. Parents or guardians of children aged 6–9 months, 36–47 months, 5–9 years and 10–14 years in 2013 and 6–9 months and 19–22 months (corresponding to 6–9 months range at the time of 2013 survey) in 2014 presenting to the outpatient department, were approached for participation, screened for eligibility and asked to provide informed consent. A questionnaire was administered and a blood sample collected for polio neutralization assay.

**Results:** Among subjects aged 6–9 months in the 2013 survey, seroprevalence was 58% (95% confidence interval [CI] 51–66%) to poliovirus type 1, 42% (95% CI 34–50%) to poliovirus type 2, and 52% (95% CI 44–60%) to poliovirus type 3. Among children 36–47 months and older, seroprevalence was 85% or higher for all three serotypes. In 2014, seroprevalence in 6–9 month infants was 72% (95% CI 65–79%) for type 1, 59% (95% CI 52–66%) for type 2, and 65% (95% CI 57–72%) for type 3 and in 19–22 months, 80% (95% CI 74–85%), 57% (49–63%) and 78% (71–83%) respectively. Seroprevalence was positively associated with history of increasing oral poliovirus vaccine doses.

**Conclusions:** There was significant improvement in seroprevalence in 2014 over the 2013 levels indicating a positive impact of recent programmatic interventions. However the continued low seroprevalence in 6–9 month age is a concern and calls for improved immunization efforts to sustain the polio-free Nigeria.

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## 1. Introduction

Since the World Health Assembly resolved in 1988 to eradicate poliomyelitis globally [1], great strides have been made towards achieving this goal. The overall incidence of poliomyelitis has declined by more than 99% [2], wild poliovirus (WPV) type 2 has

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been certified eradicated globally [3], and more than three years have passed since the last case of WPV type 3 was detected in November 2012 in Nigeria [2,4].

Nigeria has been removed from the list of polio endemic countries by World Health Organization (WHO) after more than 12 months having passed since the detection of the last case of WPV type 1 in the country having onset of paralysis on 24 July 2014 [5]. Only two countries, Pakistan and Afghanistan remain endemic for WPV type 1. The main challenges to eradicating poliomyelitis in the remaining endemic countries include limited access to children in security compromised areas and inadequate service delivery of oral poliovirus vaccine (OPV) [6,7].

Nigeria has been polio-endemic all along and achieved the milestone of interrupting poliovirus transmission after a long fought battle. Historically, Nigeria has been reporting a large proportion of global polio case burden. A consistent downward trend in the number of confirmed WPV cases started in 2012, leading to the current polio-free status. As per WHO data (as of 05 May 2016), Nigeria had 53 cases of confirmed WPV1 in 9 States in 2013, 6 cases in 2 States in 2014, and no cases in 2015 [8]. Recent detection of WPV1 cases in Borno state is under investigation.

Besides WPV transmission, Nigeria has the problem of persistent transmission of circulating vaccine-derived poliovirus type 2 (cVDPV2) [9–11]. Cases of cVDPV2 detected increased from 4 in 2013 to 30 in 2014. Bivalent (types 1 and 3) OPV (bOPV) was used in most Supplementary Immunization Activities (SIAs) covering the 11 high-risk northern Nigerian states during this period. The associated decline in type 2 immunity is likely to have caused the increase in cVDPV2 cases in 2014. However, a number of trivalent OPV (tOPV) SIA rounds conducted since August 2014, as well as targeted campaigns with inactivated polio vaccine (IPV), are likely to have improved levels of immunity to type 2 poliovirus and subsequent decline in cVDPV2. In 2015, one case of cVDPV2 was detected in the country in the Federal Capital Territory (FCT) Abuja and this year in 2016, one case of VDPV2 has been reported from Jigawa state and one environmental isolation from Borno state of Nigeria.

Poliovirus transmission in Nigeria in the last two years preceding the last case has largely been confined to North West and North East zones, and most cases having been reported from Kano, Borno and the Yobe states. Kano State, the most populous in northern Nigeria with 44 LGAs, has had the most intractable transmission of poliovirus in the region. Even when there was a persistent decline in the number of polio cases in Nigeria, Kano reported a relatively large number of cases: 15 WPV1 cases in 2013 and 5 WPV1 and 10 cVDPV2 cases in 2014. Within Kano, Kano Metropolitan Area (KMA), the urban area comprising of 8 very high risk local government areas (LGAs), has always been categorized as very high risk for polio.

We conducted seroprevalence surveys in KMA to measure polio seroprevalence levels in 2013 and then repeated in 2014 in the different age groups of interest. In addition, we evaluated factors probably associated with seroprevalence levels. The data were intended for assessment of program performance and to guide future actions. An earlier seroprevalence carried out in this area in 2011 was published in *Vaccine* [12], and preliminary data summarized in JID supplement in 2016 [13].

## 2. Methods

### 2.1. Study design and its rationale

A health facility-based cross-sectional design was used in both the surveys. Experience of 2011 survey had shown that the sample representation from 8 LGAs of KMA was quite proportionate to the population. Both the vaccine acceptors and refusers had partici-

pated. Moreover, health facility based was an operational advantage in this area with considerable security risk for field operations.

Seroprevalence levels were assessed in four age groups in the 2013 survey: 6–9 months, 36–47 months, 5–9 years, and 10–14 years. Seroprevalence was found to be quite low in 6–9 month group, possibly attributed to a dip in the quality of SIAs due to killing of polio vaccinators in Kano during that period [14]. So it was decided to do a follow-up survey in 2014 in 6–9 month and 19–22 month age groups, the latter corresponding to 6–9 month cohort at the time of 2013 survey.

### 2.2. Objectives of 2014 survey were

- (1) To assess seroprevalence in 6–9 month olds and compare it with levels in 2013, as an indicator of recent program quality.
- (2) To demonstrate improvement in seroprevalence in 19–22 month olds, birth cohort that was aged 6–9 months at the time of 2013 survey.

### 2.3. Selection of the study area

Kano state and KMA within the state were selected for assessment of seroprevalence primarily due to the high incidence of poliomyelitis cases in recent years. KMA comprises eight local government areas (LGAs): Kano Municipal, Fagge, Nassarawa, Dala, Gwale, Tarauni, Ungogo, and Kumbotso. The location of Kano state and KMA are indicated in the map of northern Nigeria, see previous publication 12.

### 2.4. Selection of study site

Murtala Mohammad Specialist Hospital (MMSH) was selected as the study site because it is the largest hospital in KMA. This public sector hospital has a very high turnover of patients in the pediatrics outpatient department (OPD). Patients come from a wide catchment area including our area of interest i.e. the 8 LGAs of KMA, with a total population of around 3.7 million.

### 2.5. Sample size

For the 2013 survey, the actual seroprevalence from the 2011 survey was used for sample size calculations. A total of 600 children were required to be enrolled: 150 from each of the four age groups. For the 2014 follow-up survey, due to much lower seroprevalence in 2013, a somewhat larger sample size was needed to maintain the same precision of  $\pm 7.5\%$  and 95% confidence. Using the type 3 seroprevalence for the 6–9 month age group of 51% from the 2013 survey, sample size of 171 was arrived at. It was inflated to 180 per age group to account for withdrawal and inability to draw sufficient quantity of blood, the total sample size used for two age groups was 360.

### 2.6. Eligibility criteria

Infants fulfilling age requirement and residing for at least one month in KMA with consenting care-givers were eligible to participate, except those with (a) contraindication to venipuncture; (b) serious acute illness requiring hospitalization; or (c) diagnosed or suspected congenital immunodeficiency disorder in the subject or an immediate family member.

### 2.7. Enrollment and survey procedures

Enrollment for the 2013 survey was done between 12 September and 2 October. Corresponding period for the 2014 survey was

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