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Survey of poliovirus antibodies in Kano, Northern Nigeria

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ABSTRACT

Introduction: In 1988, the World Health Assembly resolved to eradicate poliomyelitis. Since then, much progress towards this goal has been made, but three countries including Nigeria remain polio-endemic as of end 2012. To assess the immunity level against poliomyelitis in young children in Northern Nigeria, we conducted a seroprevalence survey in the Kano Metropolitan Area (KMA) in May 2011.
Methods: Parents or guardians of infants aged 6–9 months or children aged 36–47 months presenting to the outpatient department of Murtala Mohammad Specialist Hospital were approached for participation, screened for eligibility and were asked to provide informed consent. After that, a questionnaire was administered and blood was collected for neutralization assay.
Results: A total of 327 subjects were enrolled. Of these, 313 (96%) met the study requirements and were analyzed (161 [51%] aged 6–9 months and 152 [49%] aged 36–47 months). Among subjects aged 6–9 months, seroprevalence was 81% (95% confidence interval [CI] 75–87%) to poliovirus type 1, 76% (95% CI 68–81%) to poliovirus type 2, and 73% (95% CI 67–80%) to poliovirus type 3. Among subjects aged 36–47 months, the seroprevalence was 91% (95% CI 86–95%) to poliovirus type 1, 87% (95% CI 82–92%) for poliovirus type 2, and 86% (95% CI 80–91%) to poliovirus type 3. Seroprevalence was associated with history of oral poliovirus vaccine (OPV) doses, maternal education and gender.
Conclusions: Seroprevalence is lower than required levels for poliovirus interruption in the KMA. Persistence of immunity gaps in the 36–47 months group is a big concern. Since higher number of vaccine doses is associated with higher seroprevalence, it implies that failure-to-vaccinate and not vaccine failure accounts for the suboptimal seroprevalence. Intensified efforts are necessary to administer polio vaccines to all target children and surpass the threshold levels for herd immunity.

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1. Introduction

Over two decades have passed since the World Health Assembly resolved in 1988 to eradicate poliomyelitis by 2000 [1], and great strides have been made towards achieving this goal. In 2012, the number of polio-endemic countries was reduced from 125 to only 3 (i.e., Afghanistan, Pakistan and Nigeria) [2] and the incidence of poliomyelitis decreased by more than 99% [3]. The main challenges to eradicating poliomyelitis in the remaining endemic countries include inadequate service delivery of oral poliovirus vaccine (OPV) and suboptimal OPV efficacy in the densely populated tropical reservoirs [4,5].

Nigeria is the only country in the world that is simultaneously endemic for wild poliovirus types 1 and 3 and circulating vaccine-derived poliovirus type 2 (cVDPV2) [6,7]. Trivalent OPV (tOPV) was exclusively used for polio eradication in Nigeria initially, followed by the introduction of more immunogenic polio vaccines in supplementary immunization activities (SIAs), including monovalent OPV (mOPVs) in 2006 and bivalent (types 1 and 3) OPV (bOPV) in 2010 [8,9].

Nigeria's polio control problems got aggravated in 2003, when despite having the highest number of polio cases in the world,

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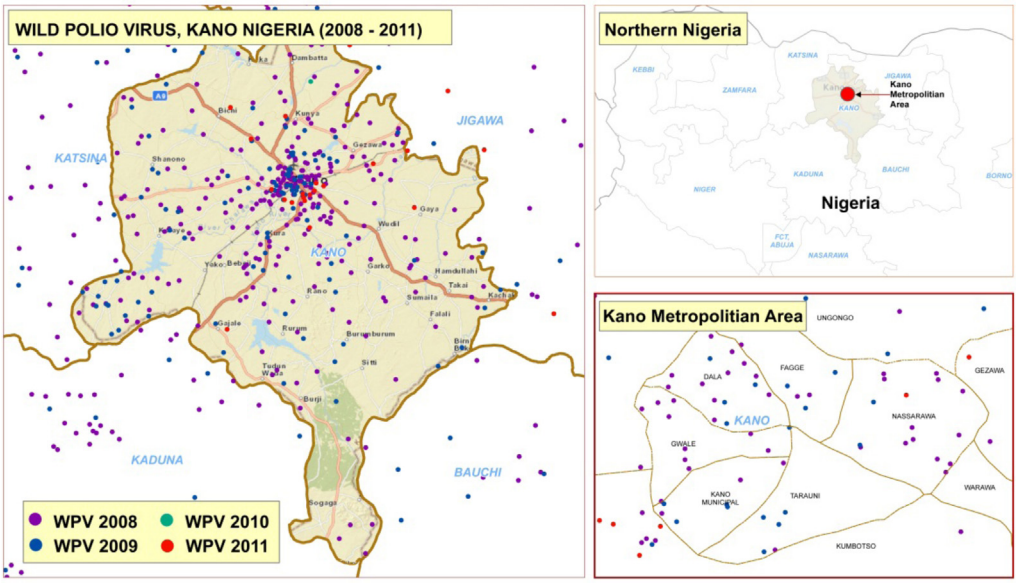

Fig. 1. Northern Nigeria Map showing polio cases in Kano and KMA from 2008–2011.

planned SIAs were suspended in some northern states because of OPV safety concerns [10]. Rumors circulated that the vaccine was deliberately tampered with anti-fertility agents and human immunodeficiency virus (HIV) [11]. Consequently, the number of poliomyelitis cases in Nigeria increased to 1122 in 2006. This case count dropped to 285 polio cases in 2007 but in 2008, the number of cases rebounded to 798. Following renewed efforts a downward trend started and was sustained throughout 2010 [2,3].

However, in 2011 and 2012, there was a relative upsurge of wild poliovirus cases in Nigeria with 62 cases in 2011 and 122 in 2012 (WHO unpublished data, as of 2 April 2013). All northern states remain endemic, including the most populous Kano state which reported 28 wild poliovirus cases and 3 cVDPV2 cases in 2012 (WHO unpublished data, as of 2 April 2013). In addition, cVDPV2 was repeatedly detected in sewage samples collected through environmental surveillance in the state.

Although there are some published reports [12–16] of seroprevalence studies in Nigeria, this study in Kano was undertaken by the Global Polio Eradication Initiative (GPEI) partners and the Nigeria national government to provide an immunity benchmark to reflect program performance and to guide future program action.

2. Methods

2.1. Study objectives

The objectives of this study were: (1) to assess the seroprevalence to poliovirus type 1, type 2 and type 3 among infants aged 6–9 months and children aged 36–47 months in the Kano Metropolitan Area (KMA) of Nigeria; and (2) to evaluate specific risk factors for low seroprevalence.

2.2. Study design and its rationale

Health facility based design was preferred over population-based survey. Since there is resistance to polio vaccination in this area, the health facility based design had a better possibility of including both those accepting and refusing vaccination; and in addition provided an operational advantage in this area.

The choice of the age groups was based on two factors: (a) expected immunity profile; and (b) comparability with other serosurveys conducted elsewhere (i.e., India, Pakistan, Egypt). Regarding the immunity profile, infants (i.e., 6–9 months) would be expected to have the lowest immunity profile because they have by-and-large lost maternally derived antibodies against polioviruses and might not have received sufficient doses of polio vaccine to have very high seroprevalence. The older age group (36–47 months) with potentially higher vaccine and secondary exposure is expected to have very high immunity in areas that have interrupted or are close to interruption of poliovirus transmission. Regarding the comparability with other serosurveys, this gives us a sense of how far KMA still has to go in terms of interrupting transmission. The selection of age groups also had relevance to the epidemiology of poliomyelitis cases in endemic areas, where approximately 75% cases were in children <3 years of age.

2.3. Selection of the study area

Kano state and KMA within the state was selected for seroprevalence primarily due to high incidence of polio cases in the recent years of all three serotypes (i.e., wild poliovirus types 1 and 3, and cVDPV2). KMA comprised of eight local government areas (LGAs): Kano Municipal, Fagge, Nassarawa, Dala, Gwale, Tarauni, Ungogo and Kumbotso. So the study area was representative of the northern Nigeria with endemic poliovirus transmission. Location of Kano state and KMA within the state can be seen in the northern Nigeria map (Fig. 1) showing polio cases (as wild poliovirus (WPV) cases) from 2008–2011.

2.4. Routine and SIA doses

In this area, routine immunization (RI) doses of trivalent OPV (tOPV) are given at birth, 6, 10, 14 weeks and multiple SIAs are implemented every year with bOPV or tOPV wherein all children up to 5 years are expected to receive additional OPV dose every time. The study participants could have received up to 4 routine doses and a variable number of SIA doses depending on age of the child and completeness of coverage in SIA. A total of 8 SIAs including one partial (not covering all LGAs of KMA) were conducted in Kano State from July 2010 (starting age for 6–9 months cohort) to May 2011 (start of survey), 5 using bOPV and 3 using tOPV. Therefore 6–9 month infants could have received 3–5 bOPV and 2–3 tOPV doses through SIAs since birth.

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