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Short communication

Seroprevalence of anti-polio antibodies in children from polio high risk area of Afghanistan: A cross sectional survey 2017

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ABSTRACT

Background: Afghanistan is one of the remaining wild-poliovirus (WPV) endemic countries. We conducted a seroprevalence survey of anti-poliovirus antibodies in Kandahar Province.
Methods: Children in two age groups (6–11 months and 36–48 months) visiting Mirwais hospital in Kandahar for minor ailments unrelated to polio were enrolled. After obtaining informed consent, we collected venous blood and conducted neutralization assay to detect poliovirus neutralizing antibodies.
Results: A total of 420 children were enrolled and 409/420 (97%) were analysed. Seroprevalence to poliovirus type 1 (PV1) was 97% and 100% in the younger and older age groups respectively; it was 71% and 91% for PV2; 93% and 98% for PV3. Age group (RR = 3.6, CI 95% = 2.2–5.6) and place of residence outside of Kandahar city (RR = 1.8, CI 95% = 1.2–2.6) were found to be significant risk factors for seronegativity.
Conclusions: The polio eradication program in Kandahar achieved high serological protection, especially against PV1 and PV3. Lower PV2 seroprevalence in the younger age group is a result of a withdrawal of live type 2 vaccine in 2016 and is expected. Ability to reach all children with poliovirus vaccines is a prerequisite for achieving poliovirus eradication.

1. Introduction

During 2017, cases of poliomyelitis caused by wild poliovirus type 1 (WPV1) were detected only in Afghanistan (14 cases) and Pakistan (8 cases) where endemic WPV1 circulation still persists [1]. In this period, 7/14 (50%) cases of poliomyelitis in Afghanistan were reported from Kandahar province. Wild poliovirus type 2 has been declared eradicated; and wild poliovirus type 3 has not been detected anywhere in the world since 2012 [2,3].

To complete WPV1 eradication, the Global Polio Eradication Initiative (GPEI) strives to strengthen routine immunization programs and conducts poliovirus vaccine immunization campaigns to raise population immunity to a level sufficient for interruption of poliovirus circulation. In high-risk areas, such as Kandahar province of Afghanistan, these campaigns are conducted on an almost monthly basis. Despite the sustained efforts, however, WPV1 continues to circulate [4]. In some instances, the security situation in Afghanistan limits vaccination teams from reaching high-risk populations; however, suboptimal campaign coverage in areas with no security limitations also contributes to continued circulation of WPV1. Recent population movements between Pakistan and Afghanistan further contributed to the risk of transmission of WPV1.

In April 2016, the World Health Organization (WHO) implemented a worldwide switch from trivalent oral poliovirus vaccine (tOPV) to a bivalent OPV (bOPV) removing live poliovirus serotype 2 from global use [5]. Inactivated poliovirus vaccine (IPV) was introduced to routine immunization programs prior to the switch. In addition to IPV use in routine immunization, this vaccine is also occasionally used in vaccination campaigns to accelerate eradication of WPV1 or to control outbreaks of wild or vaccine-derived polioviruses [6]. This was the case in Kandahar where an IPV vaccination campaign was carried out in the end of 2016.

Surveys of seroprevalence of anti-polio antibodies have been carried out in many countries as a tool for program performance

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evaluation and to assess population immunity in targeted age groups and areas of high risk for poliovirus transmission [7–11]. In Afghanistan, the polio eradication program has focused on conducting immunization campaigns; in the year preceding this survey (June 2016-June 2017), there had been 12 campaigns targeting children below 5 years of age with bOPV; and one campaign in Kandahar with IPV. The estimated routine immunization coverage with the third OPV dose was 60% in both 2015 and 2016; and it was 65% with IPV in 2016 which was the first year after introduction of this vaccine into routine immunization schedule [12]. The routine immunization schedule in Afghanistan includes OPV administered at birth, 6, 10, and 14 weeks of age; and IPV administered at 14 weeks of age.

We conducted an anti-polio antibody serological survey among children visiting Mirwais Regional Hospital in Kandahar, Afghanistan. This state-run hospital is a secondary care referral hospital which predominantly serves the population of Kandahar province, however; due to its good reputation, patients from other areas of the country often seek medical care in this hospital.

2. Methods

This was a facility-based survey among children in two age groups: 6–11 months and 36–48 months. Children of target age groups visiting Mirwais Regional Hospital for polio-unrelated minor ailments and accompanied by an adult primary care giver (in most instances a parent) were eligible for enrolment if consent from child's adult primary care giver was obtained. Children with any severe acute or chronic illness requiring immediate medical attention were excluded. The enrolment and sample collection were carried out between June 1 and July 15, 2017.

Survey teams collected data on key indicators related to socioeconomic status and immunization history. Vaccination history for OPV and IPV received through routine immunization was assessed from vaccination cards when available or by parental recall if cards were not available. The number of OPV or IPV doses received through campaigns was always obtained by parental recall as no documentation exists.

Trained phlebotomists collected 2 mL of peripheral blood using standard venepuncture technique. After clotting and centrifugation, serum was separated and transferred to the Centers for Disease Control and Prevention in Atlanta, USA, for performance of neutralization assays [13]. Seropositivity was defined as reciprocal titers of poliovirus neutralizing antibodies >8 [8].

We calculated a required sample size in each age group assuming seroprevalence of 90%, error margin of ±5%, alpha = 0.05, and a power of at least 80%. The sample was further inflated by approximately 10% to account for potential non-consent or for those children in whom the blood sample was not obtained or was obtained in insufficient quantity, which resulted in the final sample size of 205 children in each age group.

Analysis was performed using STATA version 12. Frequencies and percentages were calculated for categorical variables. For seroprevalence, percentages with 95% CI were reported. Medians with 95% confidence intervals were reported for reciprocal antibody titers using the bootstrap method.

This study received approval from the Ethical Review Committees of the World Health Organization, Aga Khan University, and National Bioethics Committee of the Government of Pakistan, and from the Afghani Institutional Review Board of the Ministry of Public Health.

3. Results

There were 420 children whose parents consented to participate in the study. We obtained 418/420 (100%) blood samples; in two children the venepuncture was unsuccessful. Of these samples 409/418 (98%) were received by CDC with sufficient quantity of sera and were analysed. We report results from these 409 children, including 200 in the 6–11 month-old group and 209 in the 36–48 month-old group.

Table 1 shows demographic indicators, residence, and vaccination history of the study population. Of note, there were 34% girls among the enrolled children; the median age in the 6–11 month-old age group was 10 months; 15% of the enrolled children resided outside of Kandahar province; and 41% outside of Kandahar Dand (urban) district. The retention of vaccination card was 96% and the total doses of OPV received were 11 and 30 in the younger and older age groups, respectively; 90% of children in both age groups reported receiving at least one IPV dose.

Seroprevalence to PV1 was 97% and 100% in the younger and older age groups respectively; it was 71% and 91% for PV2; 93% and 98% for PV3 (Fig. 1). In the younger age group, the median

Table 1
Demographic indicators, residence, and vaccination history of the study population.

	6–11 months n = 200	36–48 months n = 209	Total N = 409
Gender female	71/200 (36%)	67/209 (32%)	138/409 (34%)
Mean age (months)	10	42	27
Province of Residence			
Kandahar	166/200 (83%)	180/209 (86%)	346/409 (85%)
Hilmand	18/200 (9%)	19/209 (9%)	37/409 (9%)
Uruzgan	7/200 (4%)	2/209 (1%)	9/409 (2%)
Zabul	4/200 (2%)	3/209 (1%)	7/409 (2%)
Other	5/200 (3%)	5/209 (3%)	10/409 (2%)
District of residence (PROVINCE)			
Dand (KANDAHAR)	109/200 (55%)	133/209 (64%)	242/409 (59%)
Zheray (KANDAHAR)	21/200 (11%)	13/209 (6%)	34/409 (8%)
Panjwayi (KANDAHAR)	14/200 (7%)	15/209 (7%)	29/409 (7%)
Arghandab (KANDAHAR)	11/200 (6%)	14/209 (7%)	25/409 (6%)
Lashkargah (HILMAND)	9/200 (5%)	6/209 (3%)	15/409 (4%)
Other	36/200 (18%)	28/209 (13%)	64/409 (16%)
Vaccination card available	196/200 (98%)	198/209 (95%)	394/409 (96%)
Total OPV doses received from routine immunization and campaigns (mean)	11	30	21
Zero OPV doses received	1/200 (1%)	0/209 0%	1/409 (0%)
<3 OPV doses received	3/200 (2%)	1/209 (0%)	3/409 (1%)
Received POL 3 in routine immunization	172/200 (86%)	185/209 (89%)	357/409 (87%)
IPV received (at least one dose)	180/200 (90%)	188/209 (90%)	368/409 (90%)
OPV received during last campaign	185/200 (93%)	197/209 (94%)	382/409 (93%)

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