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Seroprevalence against Polioviruses in Sri Lanka, 2014

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Abstract

Immunization coverage with oral poliovirus vaccines in Sri Lanka consistently reaches >90%. We evaluated seroprevalence of poliovirus neutralizing antibodies in 400 randomly selected children aged 9–11 months, 3–4 years, 7–9 years and 15 years, from three districts of Sri Lanka. Seroprevalence of antibodies against types 1 and 2 was above 95% in all age groups; for type 3 it was 95%, 90%, 77% and 75% in the respective age groups. The declining seroprevalence with age for serotype 3 is likely not correlated with protection. This survey provides baseline data prior to introduction of inactivated poliovirus vaccine in Sri Lanka.

Introduction

With polio eradication making rapid progress, only three countries remain in 2014 which have never eradicated wild poliovirus (Afghanistan, Nigeria, and Pakistan) [1]. In this context, a high priority is assigned to preparations for the post-eradication era. The key policy changes described in the Polio Eradication & Endgame Strategic Plan 2013–2018 [2] are global cessation of the type-2 component of oral poliovirus vaccine (OPV) (meaning switch from trivalent OPV [tOPV] to bivalent OPV [bOPV]); and the global introduction of at least one dose of inactivated poliovirus vaccine (IPV) into every country's routine immunization schedule. The strategy will allow for cessation of circulation and emergence of vaccine-derived poliovirus type 2 (VDPV2) while the last endemic foci of wild poliovirus are cleared [3].

The last case of poliomyelitis in Sri Lanka was reported in 1993 [4]. The routine immunization program in Sri Lanka is considered to be well performing and includes five

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Declaration of interests
Authors did not declare any conflict of interest

Role of medical writer or editor
No medical writer or editor was engaged.

Ethics Committee Approval
This study was approved by the Ethics Review Committee of the Ministry of Health, Sri Lanka and by the WHO's Ethics Review Committee in Geneva.

doses of OPV administered at 2, 4, and 6 months of age as a primary series followed by revaccinations at 18 months and 5 years of age. The vaccination coverage with the third OPV dose has consistently exceeded 95% nationwide with unimportant sub-national variations [5]. Supplementary immunization activities (SIAs) have been conducted to address known population immunity gaps from 1995–2003 but there have been no polio vaccination campaigns since 2003.

Sri Lanka plans to introduce one dose of IPV into its routine immunization schedule in 2015. Following the recommendation of the Strategic Advisory Group of Experts, IPV will be co-administered with a dose of OPV after 14 weeks of age [6]. The switch from tOPV to bOPV is planned for April 2016.

This study provides baseline data on seroprevalence of polio neutralizing antibodies in targeted age groups in Sri Lanka in anticipation of the IPV introduction and tOPV to bOPV switch.

Methods

We performed a cross-sectional community-based survey in three districts of Sri Lanka: Colombo, Badulla and Killinochchi. The study area represented lower socio-economic strata of Sri Lankan society. Children in four age groups were selected: 9–11 months, 3–4 years, 7–9 years and 15 years of age.

The subjects were randomly selected from field-level health registers kept with the Medical Officers of Health. Parents of eligible children were approached during regular visits of Public Health Midwives, consented and enrolled. On the same day, the subjects were transported to the nearest health center where one 1ml blood sample was collected and a short questionnaire administered.

The blood specimens were allowed to clot. Sera were separated and transported to Colombo, where they were stored at −20° C until shipment to the Centers for Disease Control and Prevention (CDC) in Atlanta, USA. The sera were tested for the presence of poliovirus neutralizing antibodies using standard microneutralization assays [7, 8]. Seropositivity was defined as reciprocal titers of poliovirus neutralizing antibodies ≥8.

Vaccination history of the enrolled children was recorded from vaccination cards when available; otherwise, the history was obtained through parental recall.

A sample size of 100 children in each age group (to a total of 400 children) was calculated to be sufficient to detect, at the 95% confidence level, a seroprevalence point estimate with a precision of approximately +/− 5% assuming ≥ 90% seroprevalence.

Ethical clearance was obtained by the Ethical Committees of the Ministry of Health, Sri Lanka and of the World Health Organization, Geneva, Switzerland.

Results

We enrolled 400 eligible children and 400/400 (100%) completed the study. There was no drop-out because enrolment and the blood collection occurred on the same day. All collected blood samples were of sufficient quantity and were properly managed and analysed.

The female-to-male ratio in the sample was 1:1.3 and there were more families living with average monthly income of USD <75 in Killinochi than in Badulla or Colombo. The vaccination history with OPV was >90% in all areas and for all age groups (Table 1).

There were no significant differences in the serological results between the three districts (data not shown). The seroprevalence to all three serotypes was above 90% for the 9–11 months and 3–4 years age groups. For the 7–9 years and 15 years age groups, the proportion of seropositive children for poliovirus types 1 and 2 remained above 90%, but for serotype 3 it dropped to 77% for 7–9-year olds and to 75% in 15-year olds. (Table 1, Figure 1) The median titers were high for all three serotypes in the youngest age groups and decreased with increasing age (Table 1, Figure 1). No children were found to be seronegative to all three poliovirus types but there were 7/400 (1.8%) children seronegative for 2 of the 3 serotypes.

Discussion

In our study we observed high serological protection against polioviruses in all age groups and for all three serotypes. The Sri Lankan immunization program has achieved a high level of population immunity through its routine immunization program and without polio supplementary immunization activities. Our study purposefully selected areas with a higher proportion of children from lower socio-economic strata to specifically address the population assumed to be at highest risk; we therefore hypothesize that seroprevalence in other populations of Sri Lanka would likely be equal or higher than our findings.

We observed declining seroprevalence of poliovirus type 3 neutralizing antibodies in the older age groups, while seroprevalence against poliovirus types 1 and 2 remained unchanged with age. Further, as expected, the median titer of poliovirus neutralizing antibodies declined for all three serotypes with interval from last vaccination, which in this study, corresponds with increasing age [9, 10]. This decline, including to non-detectable titers (i.e., <1:8) for some subjects, does not imply loss of protection against paralytic disease, as demonstrated by rapid anamnestic responses following re-vaccination in older adults [11, 12]. However, because of rapidly waning mucosal immunity, these individuals would likely excrete polioviruses in stool and therefore participate in the chain of transmission if exposed to live polioviruses [13].

This study had some limitations. Selection of subjects was based on the knowledge of the area Public Health Midwife and available field-level registers kept with the Medical Officers of Health. This may have resulted in exclusion of some households because they were not included in the registers. However, the Sri Lankan health system provides registration of all births. In Sri Lanka, very few children are unregistered with the Medical Officers and therefore we believe that this bias was unimportant.

Sri Lanka is well positioned to implement the changes to its immunization program recommended by the Strategic Advisory Group of Experts of the WHO – the introduction of one dose of IPV and the switch from tOPV to bOPV. Our results provide important baseline data prior to the switch; repeating similar survey after the switch will allow assessment of population immunity to polioviruses achieved with the new polio immunization schedule.

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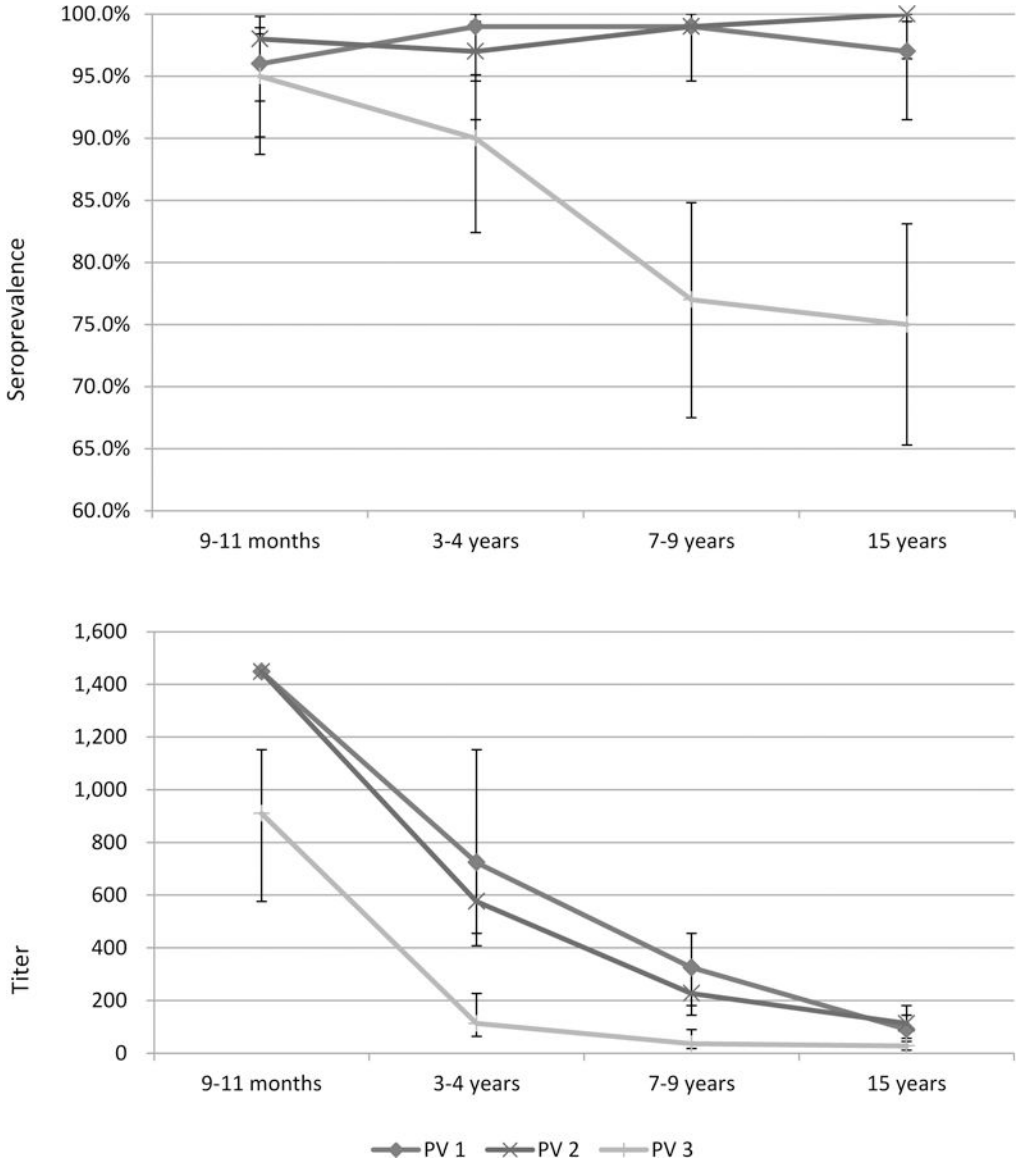

Figure 1.
Seroprevalence and reciprocal antibody titers in the selected age groups [with 95% CI]

Table 1:

Baseline characteristics and serological results

	9–11 months	3–4 years	7–9 years	15 years	Total
BASELINE CHARACTERISTICS					
Enrolled	100	100	100	100	400
Colombo	37	34	33	33	137
Badulla	30	32	33	34	129
Killinochi	33	34	34	33	134
Gender (% Female)					
Colombo	54%	41%	39%	33%	42%
Badulla	37%	47%	52%	44%	45%
Killinochi	36%	44%	41%	42%	41%
Fully Vaccinated with OPV (%)					
Colombo	100%	100%	100%	100%	100%
Badulla	97%	100%	100%	100%	99%
Killinochi	100%	100%	100%	91%	98%
Average Monthly Income per Household < $ 75 (%)					
Colombo	0%	0%	3%	0%	1%
Badulla	3%	0%	9%	6%	5%
Killinochi	36%	18%	0%	9%	16%
SEROLOGICAL RESULTS					
Poliovirus Type 1					
% positive (95% CI)	96 (90.1, 98.9)	99 (94.6, 100)	99 (94.6, 100)	97 (91.5, 99.4)	98 (95.6, 98.9)
Median Titer, (95% CI)	≥1448 (≥1448, ≥1448)	724.1 (455, 1152)	325 (181, 455)	90.5 (56, 144)	455 (455, 724)
Poliovirus Type 2					
% positive (95% CI)	98 (93, 99.8)	97 (91.5, 99.4)	99 (94.6, 100)	100 (96.4,100)	99 (96.6, 99.4)
Median Titer, (95% CI)	≥1448 (≥1448, ≥1448)	576 (408, 724)	227 (144, 455)	113 (90, 181)	455 (362, 576)
Poliovirus Type 3					
% positive (95% CI)	95 (88.7, 98.4)	90 (82.4, 95.1)	77 (67.5, 84.8)	75 (65.3, 83.1)	84 (80.3, 87.7)
Median Titer, (95% CI)	910 (576, 1152)	113 (64, 227)	36 (18, 90)	28 (11, 45)	91 (72, 144)