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## Persistence of immunity to poliomyelitis among a southern population that received four doses of OPV 5 to over 15 years before

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**Abstract.** The immune status against polioviruses was investigated in a population of 545 students aged 11–20 years residing in the Neapolitan area, who had completed the vaccination cycle with four doses of OPV 5 to over 15 years before. Assuming as un-protected those individuals without detectable neutralizing antibodies at the dilution 1:2, nobody resulted without protection against all types of poliovirus; 0.7% lacked antibodies only against type 1, 0.6% only against type 3 and none against type 2. A very slight decreasing trend was observed for GMT values in function of the distance from the last dose of OPV for polio 1 and 2, but not for polio 3. As expected, GMT values for polio 2 resulted higher

than those for polio 1 and both were higher than those for polio 3, when calculated by age groups as well as by distance groups. The last four Italian cases of autoctonous paralytic poliomyelitis, occurred in the period 1981/83, regarded unvaccinated children aged 6 months – 2 years, residing in the same geographical area to which the study population belong. In the same area a delay of immunization practices was also ascertained in the recent past. Results of this study confirm that a priority for public health services is to devote their human and economic resources to reduce the vaccination delay more than administrate a further fifth dose of OPV at the age of twelve.

**Key words:** OPV vaccine, Poliomyelitis, Seroimmunity

### Introduction

The elimination of paralytic poliomyelitis caused by wild polioviruses in Italy – the last autoctonous case had been confirmed in 1983 [1] – represents a good indicator of the effectiveness of the national strategy against poliomyelitis, adopted since 1964. In that year, a mass vaccination campaign was conducted aiming to immunize with Sabin oral polio vaccine all people aged 0–20 years. Over 90% reduction of poliomyelitis incidence was obtained in one year. In the following years all newborns were actively searched for vaccination with 3 doses of OPV in the first year of life and a fourth dose during the third year of life. The vaccination against poliomyelitis became compulsory by law since 1966, and the local public health services were responsible for the action. The vaccination status is checked for entry to school. The effectiveness of public health services resulted crucial in achieving optimal vaccination rates at the scheduled times; social deprivation associated with health service inefficiency is the main risk factor for delaying immunization practices. At the end of the 1970s a national seroepidemiological survey demonstrated a perfect welding between induced and natural immunity. A complete immunity resulted almost all over the country and in all age groups (6 months –

79 years) with the exception of the neapolitan area, where about 17% of subjects aged 6 months – 2 years resulted lacking antibodies against all the three types of poliovirus, as a consequence of a delay of the vaccination practice [2].

In effects, the four last autoctonous cases (in unvaccinated children aged 6 months – 2 years) occurred in this area in the period 1981–83 [1].

In 1985 a special survey was conducted in selected geographical areas (Bologna, Northern Italy; Catania, Bari, Venosa, Napoli, Southern Italy) to evaluate the vaccination coverage rates within 24 months of life in all resident children, born in June 1985. OPV3 vaccination rates resulted 95.5% in the area of Bari, 93.7% in Venosa, 93.4% in Bologna, 83.3% in Catania and 60.4% in Naples. The vaccination rates resulted associated with the effectiveness of the active public health services searching for vaccination of newborns. Where the effectiveness was high, social deprivation did not affect the vaccination rates; where it was low, social deprived sections of the population resulted at higher risk to remain unvaccinated at least until the entry to school [3].

Several serological investigations were conducted in Italy in recent years to evaluate the persistence of induced immunity after a complete course of four doses of OPV [4–7]. This study aims to give a

contribution to the knowledge of the persistence of humoral protection in a Southern area of Italy, in a population at 5 to over 15 years after the fourth dose of OPV attending the secondary and high school.

### Materials and methods

All students attending the secondary and the high school and residing in the Local Health Unit N. 42 of Campania Region (Naples) during the school year 1992–93 were recruited into the study. In 1993 data regarding age, sex and vaccination status were collected for each subjects that accepted to be bled. Neutralization test was performed according to Santoro et al. [2] Titres, expressed as reciprocal of dilution, were considered positive if higher than or equal to 2. GMT values were calculated for positive titres. Regression lines of positive titres by distance from the last dose of OPV were also estimated.

### Results

Sera were collected from all 564 students aged 11 to 21 years, 364 (64.5%) females, attending the two schools of the Local Health Unit. Sufficient blood samples were collected from 545 (96.6%), whereas information on the last vaccination date were available for 501 (88.8%).

Almost all subjects resulted with antibody titres higher than or equal to 2. Detectable antibodies against type 1 were not present in four (0.7%) and against type 3 in three (0.6%). Nobody showed susceptibility to type 2. Table 1 gives the percent of susceptible subjects and GMT values for positive ones by poliovirus type, by age at bleeding and by distance of bleeding from the last vaccination date.

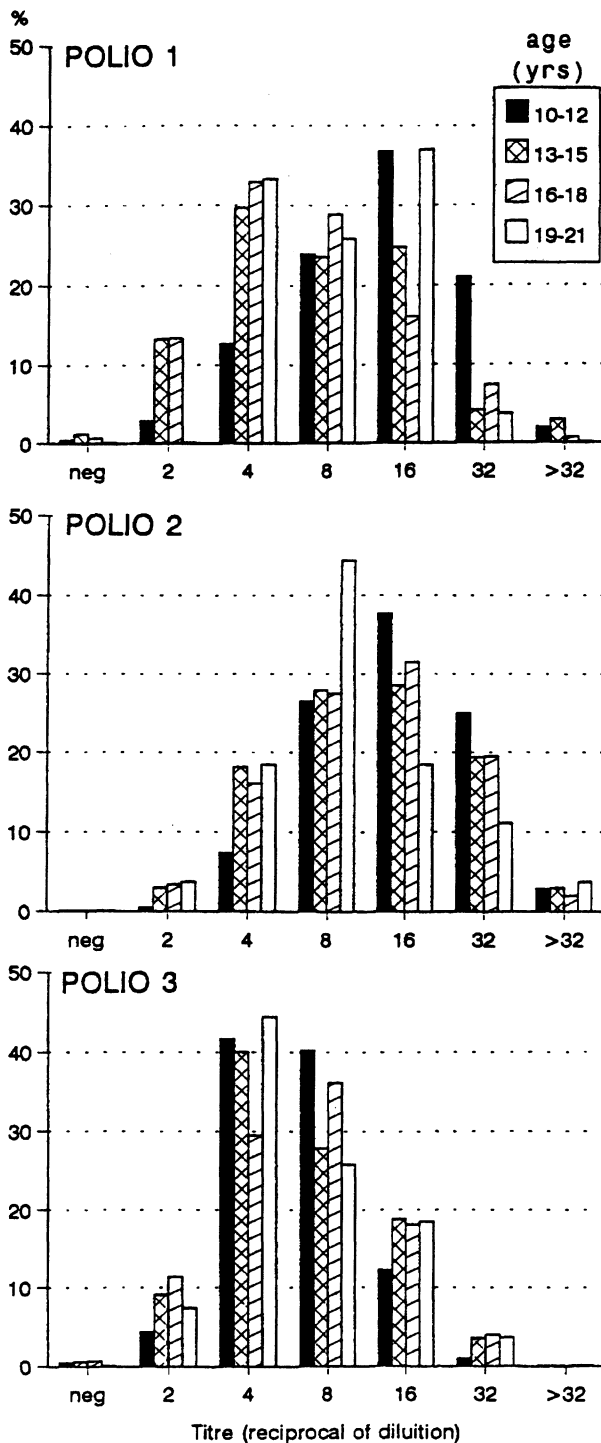
In the age group section GMT values ranged 5.9 to 11.9 for polio 1, 8.7 to 13.4 for polio 2 and 5.4 to 5.8 for polio 3. A slight decreasing trend of titre values by increasing age is perceivable mainly for polio 2 and 1. In the distance section, GMT values ranged 6.0 to 12.9 for polio 1, 7.4 to 19.7 for polio 2 and

**Table 1.** Percent (95% CI) of susceptible subjects, GMT (95% CI) in positive subjects, by age (A), by distance from the last dose (B) and by poliovirus type

		Polio 1		Polio 2		Polio 3	
		% susceptible (95% CI)	GMT (95% CI)	% susceptible (95% CI)	GMT (95% CI)	% susceptible (95% CI)	GMT (95% CI)
<b>A. Age (years) N</b>							
10–12	204	0.5 (0.01, 2.7)	11.9 (10.7, 13.2)	0.0 (0.0, 1.8)	13.4 (12.2, 14.7)	0.5 (0.01, 2.7)	5.8 (5.4, 6.2)
13–15	165	1.2 (0.1, 4.4)	6.4 (5.7, 7.3)	0.0 (0.0, 2.2)	10.3 (9.1, 11.7)	0.6 (0.02, 3.4)	5.4 (4.9, 6.0)
16–18	149	0.7 (0.0, 3.7)	5.9 (5.2, 6.7)	0.0 (0.0, 2.5)	10.5 (9.2, 11.9)	0.7 (0.0, 3.7)	5.9 (5.3, 6.5)
19–21	27	0.0 (0.0, 12.8)	7.6 (6.0, 9.8)	0.0 (0.0, 12.8)	8.7 (6.4, 11.9)	0.0 (0.0, 12.8)	5.4 (4.2, 7.0)
Regression coefficient			–0.0367 (–0.0475, –0.0259)		–0.0163 (0.0269, –0.0057)		0.0012 (–0.0072, 0.0096)
<b>B. Distance (km) N</b>							
≤ 5	31	0.0 (0.0, 11.2)	12.9 (10.0, 16.5)	0.0 (0.0, 11.2)	19.7 (15.5, 25.0)	0.0 (0.0, 12.2)	6.4 (5.3, 7.7)
6–10	231	0.4 (0.0, 2.4)	10.0 (9.0, 11.1)	0.0 (0.0, 1.6)	12.0 (11.0, 13.2)	0.4 (0.0, 2.4)	5.9 (5.4, 6.3)
11–15	211	1.4 (0.3, 4.1)	6.0 (5.4, 6.8)	0.0 (0.0, 1.8)	10.3 (9.3, 11.6)	0.9 (0.1, 3.4)	5.3 (4.9, 5.8)
≥ 16	28	0.0 (0.0, 12.3)	6.8 (5.4, 8.5)	0.0 (0.0, 12.3)	7.4 (5.6, 9.9)	0.0 (0.0, 12.3)	5.9 (4.5, 7.7)
Regression coefficient			–0.0332 (–0.0420, –0.0244)		–0.0205 (–0.0293, –0.0125)		–0.0032 (–0.0101, 0.0037)

Regression coefficients (95% CI) for logarithms of titres.

5.3 to 6.4 for polio 3. Also in this case a slight decreasing trend of titre is present for polio 1 and 2, less evident for polio 3. Figure 1 gives the percent distribution of subjects by serological titre, age group and poliovirus type.



**Figure 1.** Percent distribution of positive subjects by titre and by poliovirus type.

## Discussion

Our results confirm the presence of an almost complete immunity to all three types of poliovirus in the studied population. This immunity tends to persist at distance over 15 years from the last fourth dose of OPV. This results are consistent with other serological investigations conducted in other Italian geographical areas, if the differences on the minimum dilution level are considered. The presence of a decreasing trend of titres for polio 1 and 2 ad not for polio 3 could be a consequence of an earlier reachment of the plateau level in the case of polio 3. The study population was residing in a critical geographical area, where there is social deprivation as well as delayed immunization practices. It must be considered that in the studied area 20 to 25% of boys and girls do not attend the secondary school and 40 to 60% the high school. It is out of question that those who do not attend schools belong to the social deprived section of the population. It could be possible that in this case the level of immunity could be worse.

The assumption that a neutralizing titre equal to 4 or even equal to 2 still indicates protection may be questionable. But the assumption of a threshold level equal to 8 would evidentiate a level of immunity (66% against type 1, 84% for type 2 and 54% for type 3) insufficient to maintain a herd immunity [8] and this is incompatible with the absence of autoctonous cases of paralytic poliomyelitis caused by wild polioviruses since 1983, in a situation where the introduction of wild polioviruses is possible and in which delaying immunization practices are present. Nonetheless, the last cases in Italy occurred only in unvaccinated children residing in the same geographical area of this study.

It is unlikely that the investigated subjects did experience natural infection. In fact, there is absence of evidence of circulation of wild polioviruses since 1983, and the occurrence of the last cases in the period 1981–83, stimulated an enforcement of the immunization practices in the Neapolitan area.

Furthermore, it was demonstrated that a further dose of IPV administrated to subjects, with a history of a complete course of OPV vaccination, and lacking detectable antibodies at the dilution 1:4 10 years after, produced a high response after few days [7].

It could be reasonable, in any case, to consider the possibility of the administration of a booster dose at 12 years of age to all children, in coincidence with the first dose of HBV (compulsory by law at this age in Italy since 1991) but resources needed to this task could be better devoted to reduce the immunization delay in the first year of life, particularly in the deprived situations, being this the highest priority in Italy for maintaining the country free from poliomyelitis caused by wild polioviruses.

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