

BCG PROGRAMME IN THE REPUBLIC OF SINGAPORE*

By C. H. Chew and P. Y. Hu

SYNOPSIS

Mass BCG Vaccination is an effective and an inexpensive method of tuberculosis control. In Singapore, a nation wide BCG Vaccination programme was implemented in 1957, and from 1957 to 1972, i.e. a 16 year period, over 1 million vaccinations had been performed: 680,098 for infants, 512,797 for school students, 49,417 for contacts of tuberculosis patients and 7,775 for other special groups. The coverage of new-born infants has been over 90% from 1967 to 1972. In 1972, it was estimated that 90% of primary school children and 75% of secondary school students have been covered with BCG vaccinations. Although no controlled studies have been done in Singapore, it is observed from our analysis that the BCG programme has contributed in no small measure to the decline in tuberculosis incidence and mortality rates. Thus for 1972, the tuberculosis incidence rates per 100,000 were 5 for the BCG vaccinated group and 37 for the non-vaccinated group of primary school students, and 34 and 127 for the corresponding groups of secondary school students. In 1956, the death rate per 100,000 of respiratory tuberculosis was 4 and that of non-respiratory tuberculosis was 23 for children aged 4 and below, and the corresponding rates were 0.5 and 6.7 for those aged 5 to 9, and 0.8 and 3.7 for the group aged 10 to 14. In 1971 there were no tuberculosis deaths in children under 10 years of age, and the death rates for the age group 10-14 were 0.3 per 100,000 for either form of tuberculosis.

Although BCG vaccination was first used in the Island of Singapore as far back as in 1951 in a small pilot project through the auspices of UNICEF, it was not until 1957 that a systematic programme for mass BCG vaccination was implemented. It could perhaps be recalled that it was about this time that good evidence was obtained from the United States, Britain and Scandinavia of its protective value (Aronson *et al*, 1958; Medical Research Council, 1956; Dahlstrom 1959). We refer particularly to the controlled trials which were carried out by Aronson and his wife on North American Indians, and by the British Medical Research Council on urban school leavers. A high degree of protection which persisted for 20 years and an 80% efficacy were demonstrated in the former and 79% protection in the latter.

However, it was also at this time that Carroll Palmer and his colleagues (1958) reported much less favourable results in the southern United States of Alabama and Georgia and amongst Puerto Ricans: a report which led a few prominent

members of the profession in Singapore amongst other countries to express some measure of scepticism concerning the value of BCG. Fortunately, this was soon dispelled for in subsequent years, Rosenthal and his colleagues (1961) published their results on Chicago infants and the Medical Research Council (1963) reported further on its follow-up of the trial on urban school leavers, which clearly indicated that, with an effective vaccine, a high level of protection can be obtained. These studies had a profound influence on the Tuberculosis Control Programme of Singapore.

It was stated by the WHO Expert Committee on Tuberculosis in its Eighth Report (1964) that "epidemiological considerations require that the National Tuberculosis Programme must be on a country-wide and permanent basis—not sporadic or patchy", and again "in countries with a high level of transmission, the widest possible coverage with BCG vaccination should be ensured as early in life as feasible". Singapore was no exception, particularly in 1957, when her mass BCG programme was introduced. It is in the light of these statements that the policy in Singapore and its results for the last 16 years are presented.

Chest and Medical Unit IV, Tan Tock Seng Hospital, Singapore.

C. H. CHEW, A.M., M.B., F.R.C.P. (Edin.), F.R.C.P. (Glasg.),
Senior Consultant Chest Physician and
Head of Unit.

Tuberculosis Control Unit, Singapore.

P. Y. HU, A.M., M.B., F.C.C.P., D.P.H., Senior Registrar.

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THE PRACTICE IN SINGAPORE

Since its inception, BCG vaccination in Singapore has always been given on a voluntary basis, and has been accepted with increasing confidence by the general public as an essential control measure.

TABLE I
SINGAPORE BCG PROGRAMME

Groups	Status	Place of Vaccination
Newborns	Direct	Government Hospitals/ Maternal & Child Health Clinics
Preschool <6 yrs.	Direct	Maternal & Child Health Clinics
Primary School Entrants 6 yrs.	Negative Reactors*	School
Primary School Leavers 12 - 13 yrs.	Negative Reactors	School
Secondary School Leavers 16 - 18 yrs.	Negative Reactors	School
Contacts	Negative Reactors	Contact Clinic
Special Groups	Negative Reactors	Contact Clinic

*Previously unvaccinated as from 1969.

The BCG vaccination programme in Singapore, as shown in Table I, includes newborn babies, young children at the preschool age, school students, family contacts of tuberculosis patients and other special groups of people. Secondary school leavers are included in the programme since 1965. Direct vaccinations are given by BCG teams to newborn babies and preschool children in the government maternity hospitals or in the Maternal and Child Health Clinics. Indirect vaccinations (after a tuberculin test) are given to the negative tuberculin reactors among school students, contacts of tuberculosis patients and other groups of people.

With regard to the tuberculin test, Heaf Multiple Puncture method was employed up to 1965, and thereafter Mantoux intracutaneous test, using 1 TU PPD with Tween 80, has been performed and an induration of 10mm. or more in diameter is taken as a positive reaction.

Intradermal injection, using freeze-dried BCG vaccine, is the method of choice for vaccination. As a rule, not more than two BCG vaccinations are given to any one person in Singapore. Since it was felt with good reason that the high degree of protection from BCG may well persist for a decade or even more (Aronson *et al.*, 1958; Medical Research Council, 1963), the practice of giving BCG to all negative tuberculin reactors among the primary school entrants was modified in 1969 when BCG was administered to them only if they have not been previously vaccinated.

RESULTS AND DISCUSSION

Table II shows the number of BCG vaccinations done in Singapore from 1957 to 1972. Altogether

TABLE II
BCG VACCINATION DONE IN SINGAPORE
1957 - 1972

Group	Number BCG Vaccinated
Newborn infants	675,335
Preschool children	4,763
Primary School Students	467,887
Secondary School Students	44,910
Contacts of TB patients	49,417
Others	7,775
TOTAL	1,250,087*

*First vaccinations: 1,069,547.

one and a quarter million BCG vaccinations have been given in Singapore including about one million first vaccinations. It is estimated that nearly 50% of Singapore's population have been vaccinated with BCG in the past 16 years. Special attention is paid to newborn infants and primary school students: these two groups of people being readily accessible at an early age. It is seen that the number of BCG vaccinations of newborns constitutes over 60% of all the first vaccinations while that of the primary school students nearly 40% of all vaccinations.

The newborn infants have always been our first priority. The island Republic of Singapore with a land area of 581 sq. kms. lends herself to be particularly advantageous and conducive to a mass programme of this kind. Furthermore, this is facilitated by the fact that some 65% of newborns are delivered in government hospitals and the

remainder are easily defined at the nearby Maternal and Child Health Clinics. Thus a highly satisfactory coverage is possible for this age-group. Table III

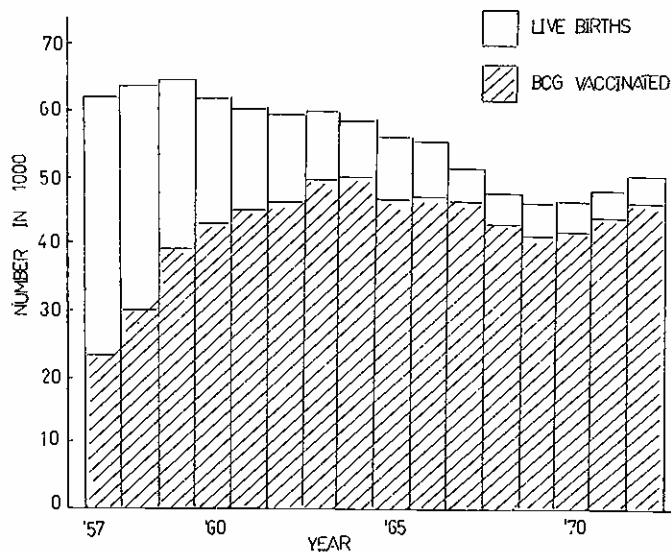
TABLE III
BCG VACCINATION OF NEW BORN
INFANTS IN SINGAPORE, 1957 ONWARDS

Year	Live Births	BCG Vaccinations	Coverage (%)
1957	61,757	22,685	36.7
1958	63,534	29,659	46.7
1959	64,041	38,595	60.3
1960	61,824	42,506	68.7
1961	59,941	44,835	74.8
1962	59,084	45,654	77.3
1963	59,578	49,225	82.6
1964	58,456	49,125	84.4
1965	46,519	46,519	83.5
1966	54,680	47,120	86.2
1967	50,560	45,906	90.8
1968	47,241	42,936	90.9
1969	44,562	40,377	90.6
1970	45,934	41,630	90.6
1971	47,088	43,001	91.3
1972	*49,448	45,562	92.1

*Provisional

and Fig. 1 show the number of live births and BCG vaccinations of newborn infants in Singapore from 1957 to 1972. The BCG coverage rate of newborn babies was only 36% in 1957; it increased gradually to 90% in 1967 and has since been over this figure. As an aside it is also interesting to note that the number of live births on the other hand has steadily fallen over these years from 60,000 to less than 50,000.

FIG. 1. LIVE BIRTHS & BCG VACCINATION OF NEW-BORNS
IN SINGAPORE
1957 - 1972



The School Tuberculosis Section of the Tuberculosis Control Unit is responsible for the tuberculosis control work in schools in Singapore and for preserving detailed records of BCG vaccinations, case-finding and treatment of tuberculosis in schools. It has been a routine practice to examine all primary school entrants and primary and secondary school leavers for the presence of BCG scars. The results of such an examination in 1972 are summarised in Table IV. 93% of primary

TABLE IV
PRESENCE OF BCG SCAR IN SINGAPORE
STUDENTS, 1972

School and Class	No. of Students checked	BCG Scar Present	
		No.	(%)
Primary I	48,461	45,037	93
Primary VI	47,559	41,652	88
Secondary School Leavers	30,894	22,812	74

school entrants, 88% of primary school leavers and 74% of secondary school leavers were found to have been vaccinated with BCG as revealed by the presence of BCG scars. Based on these findings, it was estimated in 1972 that 90% of primary school students and 75% of secondary school students have been BCG vaccinated.

Although no controlled study on the efficacy of BCG vaccination has been done in Singapore, it is observed that the BCG vaccination programme has contributed to the reduction of tuberculosis incidence and death rates in children in Singapore. Thus the latest available data in Table V show that for 1972 the estimated tuberculosis incidence rates per 100,000 were 5 for the BCG vaccinated group and 37 for the non-vaccinated group of the primary school students, giving a ratio of 1:7, and 34 and 127 for the corresponding groups of the secondary school students, giving a ratio of 1:4.

The tuberculosis death rates for Singapore children under 14 years old by age groups and form of disease from 1956 to 1971 are shown in Table VI and Fig. 2. A marked decline in tuberculosis death rates is noted, particularly of the non-respiratory form of disease and for the young children under 5 years of age. In 1956, the year prior to the implementation of the mass BCG programme, the death rate of non-respiratory tuberculosis was 23 per 100,000 population and that of respiratory tuberculosis was 4 for children under 5 years old, and the corresponding rates were 6.7 and 0.5 for those aged 5 to 9 years,

TABLE V

ESTIMATED INCIDENCE RATES OF ACTIVE TUBERCULOSIS FOR SINGAPORE STUDENTS, ACCORDING TO BCG VACCINATION, 1972

School	Estimated Number of Students		Number of New Cases of Active Tuberculosis		Incidence rates per 100,000	
	BCG vaccinated	BCG unvaccinated	BCG vaccinated	BCG unvaccinated	BCG vaccinated	BCG unvaccinated
Primary	318,600	35,400	16	13	5	37
Secondary	120,750	40,250	41	51	34	127

TABLE VI

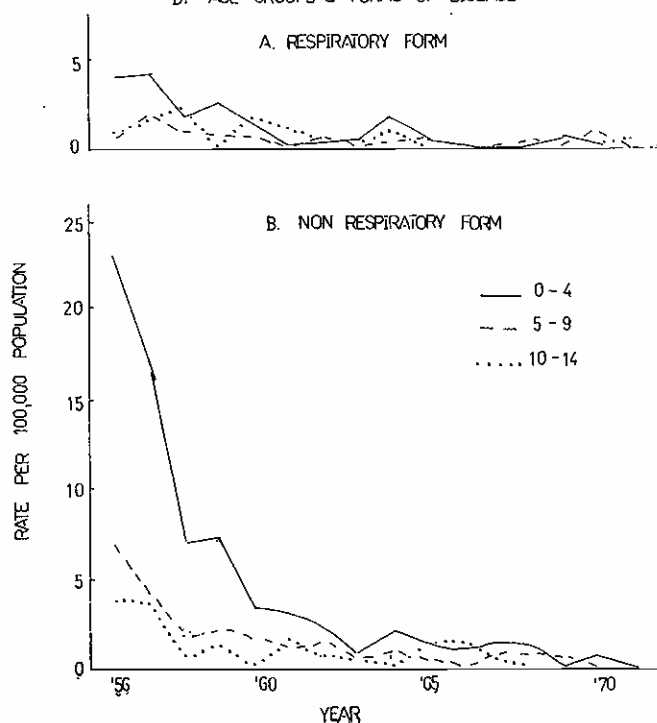
TUBERCULOSIS DEATH RATE FOR SINGAPORE CHILDREN BY FORM OF DISEASE AND AGE GROUPS, 1956 - 1971

Form of disease	Age Group	Tuberculosis Death Rate (per 100,000) in Year															
		1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Respiratory Form	0-4	4.0	4.2	1.8	2.5	1.4	0	0.3	0.3	1.7	0.4	0	0	0	0.4	0	0
	5-9	0.5	1.8	0.9	0.8	0.5	0	0.4	0	0.4	0.4	0	0	0.3	0	0.7	0
	10-14	0.8	1.5	1.9	0	1.6	1.0	0.5	0	0.8	0	0	0	0	0	0	0.3
Non-Respiratory Form	0-4	23.2	17.5	6.9	7.4	3.4	3.1	2.3	0.7	2.0	1.4	1.1	1.4	1.1	0	0.4	0
	5-9	6.7	4.2	1.8	2.1	1.6	1.2	1.9	0.4	0.7	0.4	0	0.7	0.7	0.3	0	0
	10-14	3.7	3.6	0.6	1.2	0	1.4	0.5	0.4	0	1.2	1.2	0.4	0	0	0	0.3

and 3.7 and 0.8 for the group aged 10 to 14 years. In 1971, there were no tuberculosis deaths in children under 10 years of age, and the death rates

for the age-group 10-14 were 0.3 per 100,000 for both forms of tuberculosis. These are indeed gratifying figures.

FIG. 2. TUBERCULOSIS DEATH RATES FOR SINGAPORE CHILDREN, 1956-71 BY AGE-GROUPS & FORMS OF DISEASE



CONCLUSION

At the 20th International Tuberculosis Conference in New York in 1969, it was stated that one of the basic objectives of a modern tuberculosis programme required that at least three-quarters of the eligible population be protected with BCG vaccination (Sodhy, 1970). This we feel has been attained in Singapore.

We further feel that this programme has contributed in no small measure to the decline in tuberculosis incidence and mortality rates, particularly of children in Singapore. Besides the other control measures, this programme should be continued and the high level of coverage should be maintained and raised further, in order to bring tuberculosis under control in Singapore in the not too distant future.

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