Tuberculosis Problem of Various Countries, Particularly in Asia

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SYNOPSIS

This is a report made at the meeting of Korean Academy of Tuberculosis, Seoul, November 1978. The gravity of tuberculosis problem in Asia is discussed in comparison with that in other regions of the world. The risk of infection indicates that the problem is focused in Asia, and Africa as well, while it is much slighter in Europe and North America. There is a common shortage of health services in areas suffering from the problem, where also epidemiological informations are mostly insufficient. Those conditions are estimated by comparing the values of the risk of infection and the incidence of reported cases, and those of the tuberculosis prevalence and mortality as well. A patient and strong support is wished to be given to tuberculosis control programme of every country suffering from the problem, since the problem is a product of the past epidemiological history and can be countered by means to produce effects only in the future.

INTRODUCTION

Tuberculosis problem is a suffering of the community from tuberculosis, namely the community's problem with its members suffering from, breaking down into and dying on tuberculosis. Therefore, the tuberculosis problem can

be quantitatively indicated by the prevalence, incidence and mortality rates. Their fidelity in reflecting the real situation of tuberculosis epidemiology varies much, depending on their sources. Those rates are often based on reports from routine health services. In such occasions, the fidelity varies depending on the extent of the coverage of health services and their quality in the country.

Due to the chronic character of the disease, the incidence rate does not directly indicate the present status of tuberculosis problem, while the prevalence rate is a most direct index. However, a well-planned survey is needed for revealing the prevalence of tuberculosis cases existing, but not of known cases only. Due to its cost, time and man-power needed, and the requirement of a high standard of techniques, prevalence survey cannot be made often in many countries.

There is an index, the risk of infection, to indicate the prevalence of infection sources by the frequency of primary infections in non-infected population in a time unit, one year usually. That can be revealed by tuberculin survey in carefully selected sample populations with a fairly low cost and simple techniques. Its data are available in many countries, although a reservation should be made on their accuracy which could be affected by some

bias in the tuberculin testing, selection of population, BCG vaccinations given in the subjected age group with tuberculin screening in the past, etc.

The tuberculosis mortality rate can indicate the gravity of the tuberculosis problem, namely deaths occurring in tuberculosis population under the influence of existing tuberculosis services. This can be affected by the accuracy of the reporting, depending on the extent of the coverage of health services and their quality in the country. The proportion of deaths, really caused by tuberculosis in the total of reported tuberculosis deaths, may vary between countries.

TUBERCULOSIS PROBLEM INDICATED BY THE RISK OF INFECTION

The risk of infection was estimated using the tuberculin positive rate in unvaccinated children, mostly 5-9 year age group in 1966-1976, reported in World Health Statistics Report, 1977, WHO¹¹. The following formula was used in the calculation.

Writing n =mid-point age of the age group,
 P_n =tuberculin positive rate of the age group,
 N_n =tuberculin negative rate of the age group,
 r =risk of infection average for the last n years,
 $1 - P_n = N_n, \quad r = 1 - N_n^{1/n}.$

Table 1 gives the distribution of countries by the risk of infection thus calculated and region. It can be seen in the table that countries are distributed towards higher rate in Asia and the distribution shifts towards lower rate side in the order, Asia, Africa, America, Oceania and Europe. In Asia, all the listed countries are distributed in a range over 1% inclusive, with six out of ten countries showing the value not less than 2%. African

countries are also distributed in the same range of the Asian. Latin American countries are showing the rate over 1% inclusive, but below 3%. In contrast with those, most of the European countries are lying in a range below 0.6%. The South Pacific countries are showing a trend between the former three regions and Europe. So far as indicated by the risk of infection, the tuberculosis problem seems to be heavily focused in Asia, and in Africa as well.

The risk of infection is considered to be proportional to the tuberculosis prevalence, namely

$$r/\text{prev.} = k,$$

writing the risk of infection r and the prevalence prev. , and k being a proportional constant, which is determined by living conditions and the coverage of effective tuberculosis treatment in the country. As the value of k is roughly estimated about 5 for many of Asian countries, by dividing the value of the risk of infection by 5, the prevalence of tuberculosis in Asia may be roughly estimated to be likely between 0.2% and 0.8% by bacteriology, which could be applicable also to Africa.

TUBERCULOSIS PREVALENCE BY SURVEY

Table 2 gives the tuberculosis prevalence by survey for some Asian countries. As can be seen, many of the informations are over 10-year old. Since the epidemiological situation cannot be static, the present status cannot be indicated accurately by many of those. Anyhow it may be said that in 1960s the prevalence was about 1-3% by X-ray, 0.4-0.7% by smear/culture and 0.15-0.35% by smear alone, while in 1970s it was about 1-3% by X-ray, 0.2-0.7% by smear/culture and 0.1-0.5% by smear. The tuberculosis prevalence in Asia seems not declining fast in the overall.

It could very roughly be said that in Asia

TABLE 1. Distribution of countries by the risk of infection estimated by tuberculin positive rate in children, 1966/1976.¹⁾

	< 0.6%	0.6% ~	1.0% ~	2.0% ~	3.0% ~	4.0% ~
ASIA	Japan		Laos Bangladesh Burma Singapore	Cambodia Afghanistan	Pakistan Yemen D. Maldivs Is.	Korea
AFRICA			Sudan Tanzania Liberia Rwanda		Swaziland Tunisia	Algeria
AMERICA	United States		Panama Venezuela Brazil Argentina	Mexico		
OCEANIA	W. Samoa	Tonga	Fr. Polynesia New Hebrides			
EUROPE	Netherland United Kingdom Czechoslovakia Belgium W. Germany France	Spain	Yugoslavia			

TABLE 2 Tuberculosis prevalence by survey and tuberculosis mortality.

Country	Year	TB PREVALANCE			TB MORTALITY per 100,000
		X-ray	sm/ cult	Smear	
JAPAN	1973	0.7%	0.09%	0.02%	11.1 (1973)
INDIA	1960	1.35	...	0.20	82.7 (1961, all forms)
IRAQ	1961	1.9	0.4	0.17	...
VIETNAM S.	1962	...	...	0.35	...
INDONESIA	1962	2.6	0.65	0.22	...
THAILAND	1963	2.1	0.53	0.18	32.8 (all forms)
PHILIPPINES	1964	3.33	0.58	0.30	88.7 (1965, all forms)
BANGLADESH	64/66	1.9	...	0.2	...
TAIWAN	1967	2.07	0.37	0.15	...
W. SAMOA	1968	2.3	...	...	6.2 (1971)
CAMBODIA	1969	...	...	0.26	2.7 (1971, all forms)
MALAYSIA W.	1970	...	0.57	0.29	8.9 (1971, all forms)
BURMA	1972	2.05	0.34	0.17	...
SINGAPORE	1975	0.8	0.16	0.08	22.0 (1977)
KOREA	1975	2.9	0.66	0.48	...

the tuberculosis prevalence may be in a range of about 1-3% by X-ray, of those, about 1/5 confirmable by smear/culture, and about 1/2 of the latter by sputum smear examination alone. This may be applicable also to Africa, lying in the same range of the value of the risk of infection.

TUBERCULOSIS MORTALITY

The tuberculosis mortality is also given for some countries in Table 2. Comparing values in the last two columns of the table, the ratio of the mortality against the prevalence can be obtained, which lies between 0.18 (Thailand) and 0.41 (India) by the prevalence by smear examination, except Cambodia (0.01) and Malaysia W. (0.03). Those two countries' mortalities must be underestimates, likely due to under-reporting, since the tuberculosis fatality in untreated cases cannot be much less than 10-20%, and the treatment coverage in those countries cannot be very high.

Table 3 gives the distribution of countries of the five regions by the tuberculosis mortality of 1971, reported in World Health Statistics Report, 1977¹⁾. As shown in the table, the majority (22/29) of European countries are distributed in a range below 10 per 100,000, of which one half being below 5 per, 100,000 while the countries are spreading towards higher rate

in Asia, Africa and America. The mortality must be higher than in the table in many of the countries in those three regions with possible under-reporting having to be considered.

TUBERCULOSIS INCIDENCE

Due to difficulties in making surveys, and particularly in making follow-up surveys, there are not much survey data of the prevalence and incidence rates. Data from routine service reports are easier to be obtained. In that case, the incidence of reported cases is easier than the prevalence, the latter being dependent on the case registration system and the duration of individual cases on the registration.

The incidence reported in World Health Statistics Report, 1977, is that of reported cases, and, for some countries, including bacteriologically unconfirmed "X-ray actives". Therefore, it is not necessarily reflecting the real situation of the incidence.

Using the above-mentioned tuberculosis incidence, the ratio of the risk of infection against that was calculated. Table 4 gives the distribution of countries by region and the above-mentioned ratio. As shown in the table, there is a remarkable difference between the regions. While most of European countries are distributed below 5, most of Asian and

TABLE 3. Distribution of countries by TB mortality rate (1971 all forms)

TB MORTAULTY pv 100,000	ASIA	AFRICA	AMERICA	EUROPE	OCEANIA
0~	2	3	3	11	4
5~	3	8	8	11	3
10~	4	3	3	2	1
15~	1	2	4	4	
20~	4	3	2	1	3
30~	1	1	1		
40~					
50~					
60~	2				

Latin American countries are over 20.

As already mentioned,

$$r / \text{prev.} = k,$$

while, $\text{prev.} = \text{inc.} \cdot D$, inc. = real incidence

and D = average duration of the disease,

$$r / \text{inc.} = k \cdot D.$$

As $k \simeq 5$, as already mentioned, and $D \simeq 2.5$

years, as will be discussed later,

$$r / \text{inc.} \simeq 10.$$

With poorer health services, the incidence of reported cases (written "inc." in the following) must be much lower than the real incidence, to result a larger value of $r / \text{"inc."}$, namely,

$$r / \text{"inc."} > 10.$$

With a better health, "inc." will approach the value of the real incidence, and, with accompanying better living conditions, the risk of infection will be smaller, to result a smaller value of $r / \text{"inc."}$

When a demarkation line is drawn at 10 in Table 4, most of Asian, African and Latin American countries are included in the area

below the line. For those countries, it should be considered that either the risk of infection is over-estimated, or, more likely, the incidence of reported cases is much lower than the incidence, due to a poor health service coverage.

ROUGH ESTIMATION OF TUBERCULOSIS PREVALENCE

As there are not much informations available on the prevalence of tuberculosis in many countries, a very wild estimation was tried as following.

The annual loss from a tuberculosis population is the total of the number of deaths in non-treated cases and the numbers of deaths and healings in treated cases, neglecting natural healings for the sake of simplicity. Namely, $\text{ANNUAL LOSS} = (\text{DEATHS in NOTREATED}) + (\text{DEATHS \& HEALS in TREATED})$. Dividing the above equation by the total number of cases (TB)

$$L = T \cdot (1 - \text{COV}) + (T' + C) \cdot \text{COV},$$

TABLE 4. Ratio between the risk of infection and the incidence of reported TB (1968/1973)

r/inc	ASIA	AFRICA	AMERICA	OCEANIA	EUROPE
0~				W. Samoa	Czechoslovakia W. Germany U. K. Netherland Poland Belgium
5~	Burma		U. S. Panama	Tonga Australia	Yugoslavia
10~	Korea Laos	Rwanda Tanzania Swaziland			Spain
20~	Thailand Vietnam S.		Venezuela Argentina		
30~	Singapore Pakistan	Sudan	Brazil		
40~	Sarawak		Mexico		
50~	Cambodia Afghanistan	Tunisia		Pacific Is.	

here, L = annual loss rate in TB, $COV = \frac{TREATED}{TB}$ = treatment coverage,

$T = \frac{DEATHS \text{ in } NONTREATED}{NON-TREATED}$ = death rate in non-treated TB,

$T' = \frac{DEATHS \text{ in } TREATED}{TREATED}$ = death rate in treated TB,

$C = \frac{HEALS}{TREATED}$ = cure rate in treated cases.

Namely, $L = T + (C + T' - T) \cdot COV \dots \dots (1)$

Taking in consideration non-tuberculosis deaths possibly included in deaths occurring in tuberculosis cases, and the drop-out rate in treated cases to be often not less than 50%, the following assumptions were made:

$T = 28\%$, $T' = 6\%$ and $C = 80\% / 2$.

Under the assumptions, from (1),

$$L = 0.28 + 0.18 \cdot COV.$$

Therefore, for $COV = 10\%$ to 50% , $L = 0.298$ to 0.370 . Namely, the value of L is considered to be between 30% and 37%,

On the other hand, the average duration of the disease, D , can be approximated as following :

$$D \approx \frac{1}{L} - 0.5^y.$$

Therefore, $D \approx 2.2^y$ to $2.8^y \approx 2.5^y$.

Thus the prevalence of tuberculosis may be very roughly approximated by multiplying the

annual incidence rate by 2.5,
prev. $\approx 2.5 \cdot \text{inc.}$

In fact, from 1970 survey and 1970/71 follow-up survey data of Korea,
prev./inc. = 2.56,

which tallies with the above equation,

Table 5 gives the minimum and maximum incidence rates of reported cases in tropical countries of Africa and Oceania. By multiplying those figures by 2.5, the range of prevalence in the last column of the table was obtained. Those estimates must be lower than the real prevalence, as the incidence used in the calculation must be lower than the real incidence

Anyhow, the tuberculosis problem should be regarded as a severe health problem with a fairly high prevalence in the greater part of the world, particularly in Asia.

SHORTAGE OF HEALTH SERVICES

The shortage of health services in Asia, and in other parts of the world as well, may need not to be observed in details, since it is a well known fact. Table 6 gives the distribution of countries, mainly in Asia, by population per doctor. In one half of the listed countries, the population size per doctor is 5,000 persons or more, and it is over 10,000

TABLE 5. A wild estimation of the range of TB prevalence for tropical countries

REGION	Year	"INCIDENCE"		Range of Prevalence
		min.	max.	
ASIA	67/71	(Syria) (Philippines) 0.03% ~ 0.32%		0.08% ~ 0.8%
AFRICA	67/71	(Upper Volta (Swaziland) & Egypt) 0.01% ~ 0.24%		0.03% ~ 0.6%
AMERICA	1971	(Mexico) (Panama) 0.04% ~ 0.14%		0.10% ~ 0.4%
OCEANIA	1971	(Gillert & (Papua New Guinea) Tuvalu 0.06% ~ 0.25%		0.15% ~ 0.6%

TABLE 6. Population per Doctor (1970-1974)

Pop. per doctor pers.	Countries
<1,000	Japan
1,000~	Philippines, Singapore, Turkey
2,000~	Egypt, Iraq
3,000~	Taiwan, Iran, India
5,000~	Thailand, Pakistan, Burma, Bangladesh
10,000~	Vietnam S., Afghanistan
20,000~	Indonesia
30,000~	Nepal, Laos

TABLE 7. Average radius of area per health service (1970-1974)

RADIUS	COUNTRIES
km	
1 ~	Japan, Singapore, Taiwan
2~	Vietnam S., Philippines, India
4~	Thailand
6~	Turkey, Indonesia, Iran, Nepal
8~	Pakistan, Iraq, Egypt
10~	Burma, Laos
20~	Afghanistan
...	...
60~	Sundan
$\text{Radius} = \sqrt{\frac{\text{Area of country}}{\pi * \text{No. Health services}}}$	

in five of the countries.

In many Asian countries, the health service network is not well developed. Table 7 gives the distribution of countries in Asia and Africa by the average radius of area per health service (including from hospitals to peripheral health stations). The average radius is not less than 6km in over one half of the listed countries. This means that a trip well nuch over 6km is needed for many patients to reach a nearest health service. This must be one of main reasons of a low coverage of health service with diagnosis and treatment of tuberculosis, and also of the irregularity

and high drop-out rate in the tuberculosis treatment in many countries.

TUBERCULOSIS PROBLEM AND ITS COUNTER PROGRAMME

Tuberculosis is really a problem in many areas of the world, particularly in Asia, while the epidemiological effect of tuberculosis control programme seems not rapidly showing up. Because of that, there seem to be some people disappointed by the programme. However, it should be remembered that the tuberculosis problem is quite different from problems of acute infectious disease etc. The tuberculosis problem is a product of the past history of its epidemiology. Annually occurring incidence cases are from the infected population, which is a product of past primary infections. On the other hand, epidemiological effect of tuberculosis control appears not instantly, but only in the future. A number of cases cured now will result a number of infections to be prevented now so as to reduce future break-downs. A number of BCG vaccinations given now will result a reduction of break-downs also in the long future. Thus, the tuberculosis programme has to fight against the product of the past by means producing only a future impact. It is strongly wished that a continuous support will be given to national tuberculosis programmes, not considering the present only, but the future of the nations.

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