SURVEY OF TUBERCULOSIS PREVALENCE IN JAPAN, 1953

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SYNOPSIS

In 1953 the first systematic survey of tuberculosis prevalence in Japan was carried out by the Ministry of Health and Welfare. The preliminary report on the survey includes a description of the choice of sampling-unit areas, of the process of organization, of the method of execution, of the techniques employed, and of the diagnostic standards adopted. The results of the survey are summarized with reference to age; sex; tuberculin reaction; tuberculosis pathology (all forms, pulmonary, and extrapulmonary); disease type; the type of management, medical treatment, and hospitalization required; and previous case-history and notification statistics. The method followed in extrapolating the survey results to cover the total population of Japan is defined, and the most important estimates computed from the findings are tabulated.

The survey revealed that even in the area where the lowest prevalence was found, the proportion of cases in the population was still as high as 3.6%, and that throughout the areas surveyed the pathology present averaged 16.0% and the proportion of cases 6.1%. Comparison of the data obtained in this survey with previous case-histories showed that 68.2% of persons with unhealed pathology had been unaware of being infected, thus giving strong proof of the fallibility of estimating the number of tuberculous patients on the basis of the number of cases reported by doctors. In addition, the survey proved that the tuberculosis morbidity estimates previously available for Japan—and calculated by multiplying the tuberculosis mortality figures by a fixed coefficient of 10-12—were totally inaccurate.

The tuberculosis mortality in Japan has decreased very rapidly since 1945. A figure of less than 100 000 annual deaths was recorded for the first time in 1951, when 93 654 deaths—a mortality of 111.1 per 100 000 population—were notified. This was also the first year since the introduction of vital statistics records in Japan in which tuberculosis ranked second in the list...
of causes of death. In 1952, deaths decreased to 70,499, with a death-rate of 82.1 per 100,000 population; the same trend was observed in 1953, when 57,571 deaths—a rate of 66.4 per 100,000 population—were notified.

Despite such a rapid decrease in mortality, there was no definite proof of a decrease in the number of tuberculosis cases. Although many attempts have been made to estimate the national tuberculosis morbidity, the picture has never been clear. Estimates based on the conventional method of multiplying the number of deaths per annum by a fixed coefficient, supplemented by data obtained at the health examinations conducted in some areas, are of little scientific value. Nevertheless, the planning of tuberculosis control measures has necessarily been based on these very approximate figures.

While it is true that the position could be clarified by examining every person in the country, the time, money, and labour involved in such an undertaking would be beyond Japan’s capacities. Furthermore, an increase in the number of persons examined, with the resultant increase in the number of physicians and technicians responsible for the examinations, might well lead to a greater number of technical errors. It must, however, be recognized that a morbidity estimate may have a certain bias when data obtained in certain restricted regions are extrapolated for the country as a whole.

The technique of the sampling survey has recently been developed in Japan to such an extent that its application in some socio-economic fields—for example, labour statistics and surveys on the nutritional status of the population—has produced reliable results. The sampling survey can be applied to tuberculosis morbidity if the prerequisites of the method are fulfilled. The recent development of phthisiology and its increasing application in Japan now make it possible for the majority of leading phthisiologists to diagnose various forms of tuberculosis with comparable accuracy, for X-ray technicians to produce miniature radiographs of a similar standard, for laboratory technicians to stain and cultivate tubercle bacilli by uniform methods, and so on. The health centre network is sufficiently well established to permit a nation-wide survey; the centres are staffed by physicians, public health nurses, and auxiliaries, on whom reliance may be placed in the collection of data. Furthermore, people have been made tuberculosis-conscious, and are willing to co-operate in undergoing the complicated examinations required by the survey.

In view of these considerations, the Ministry of Health and Welfare determined to conduct a survey in 1953 of the prevalence of tuberculosis in Japan with the object of improving and, if necessary, strengthening the measures of tuberculosis control at present in force.
Review of Previous Surveys of Tuberculosis Prevalence

Tuberculin-testing, which was introduced by Pirquet in 1907, was used for the first time in a mass survey by Hamburger & Monti in their investigation of the slums of Vienna, Austria: 95% of those 12 years of age were found to be tuberculin positive.

X-rays were utilized for mass tuberculosis surveys in the forms of fluoroscopy and paper-film photography, until de Abreu and Koga, independently of each other, invented photofluorography in 1936. This technique was adjudged indispensable in health examinations on a large scale after Aikawa in Japan and Holfelder in Germany had testified to its usefulness in 1938. Before that date, tuberculosis morbidity had always been computed in relation to its mortality.

The famous model survey of tuberculosis carried out in Framingham, Mass., USA, revealed three open and nine active tuberculosis cases to each annual death from tuberculosis. This coefficient was used for many years as one of the basic factors in the epidemiology of tuberculosis. The health authorities of the city of New York reported that chronic pulmonary tuberculosis was found in 4% and clinically significant cases were found in 2.5% of 225 000 persons in that city when a mass survey of tuberculosis, from the social, economic, and racial points of view, was conducted by means of X-ray photography in 1936-40.

In 1939, a mass photofluorographic survey of tuberculosis was conducted in Mecklenburg, Germany: 95% of the city's 664 500 inhabitants reported for examination, and a proportion of cases of 1.37% was found.

Surveys using tuberculin-testing and fluoroscopy, were made in Bornholm Island, Denmark, in 1940 on grammar-school children and persons under 35 years of age with a response of 95.7% and 71.5% respectively; and in 1946 on all adults with a response of 68.6%. A proportion of new cases of 0.05% was then observed. Since 1946, the mass survey programme, using tuberculin-testing and miniature radiography, has been expanded to cover all Danish home territory. A proportion of tuberculosis cases of 0.2% was reported in Copenhagen in 1946-48, when 60% of the citizens were examined.

When 78% of the inhabitants of Aker district, Norway, were examined by means of tuberculin-testing and miniature radiography in 1947-49, a percentage of cases of 0.3 was revealed.

In England and Wales, a sample survey of tuberculin reactors was conducted in 22 districts in 1949-50: a total of 94 221 inhabitants, approximately 2050 males and 2050 females per district in the age-group 5-20 years, were tested. Independently of this survey, the inhabitants of Rhondda Fach were examined with miniature radiography in 1950-51, when a study of progressive massive fibrosis in relation to tuberculosis was started: 89% of the 19 218 inhabitants were examined and 0.6% of the
males and 0.7% of the females were found to be suffering from open pulmonary tuberculosis.  

Since 1945, mass surveys of persons 15 years of age and over have been conducted in 31 districts in the USA; 7,364,940 people had been covered by 1953. The rate of response averaged 64.9%, with a maximum of 93%; the proportion of cases, including tuberculosis suspects, averaged 2.1%. The Los Angeles survey of 1950 was the largest in the series: 1,736,703 people—54.3% of the citizens 15 years of age and over—were examined and gave a proportion of cases of 1.4%, including suspects.

In Japan, a survey of tuberculosis prevalence, using tuberculin-testing and miniature radiography, was initiated in 1940 by T. Kumagai (personal communication) and Arima et al. Between 1941 and 1945, Adachi surveyed five purely agricultural villages in Ehime Prefecture, examining approximately 90% of the 15,600 inhabitants. He reported that 3% of the persons examined were either tuberculous or suspected of being so, and that 0.8% had open pulmonary tuberculosis; a ratio of 12 cases to each annual death from tuberculosis was reported. A coefficient of 12 was used thenceforward throughout Japan when an estimate had to be made of the number of tuberculosis patients. It is clear that such an estimate is scientifically unsound, as there is no justification for extrapolation for every kind of community, let alone the total population of Japan, from data obtained in districts so unrepresentative in epidemiological and social structure. There was, however, no choice.

**Outline of Present Survey**

**Method**

Since the main objective of this survey was to discover the total number of tuberculous patients and their distribution by age and sex, the theory of stochastic processes was used to the fullest possible extent, taking into account the available funds, personnel, organization, and other resources. Briefly, the total territory of Japan was divided into many small areas, sampled statistically so as to represent the entire nation, and as many of the inhabitants as possible were examined in the sample areas. Homogeneity of the collected data, including X-ray results and diagnoses, was, of course, ensured so far as possible.

The whole of Japan has been divided into 338,522 sampling units; these units, called "primary national sampling-unit areas", consist of census areas reorganized for sampling purposes. The units average 50 households and the coefficient of variation (CV) is approximately 30%. When the Ministry of Health and Welfare conducted a survey on 1 April 1953 to collect basic administrative data, 3383 of these areas, arranged in seven categories, were sampled (a ratio of 1:100). For the tuberculosis survey,
211 unit areas were sampled at random from within these categories (see Table I).

**TABLE I. SAMPLING-UNIT AREAS**

<table>
<thead>
<tr>
<th>Type of area</th>
<th>Number of areas examined in Ministry of Health and Welfare administrative survey</th>
<th>Number of areas examined in tuberculosis survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dormitory and hospital area</td>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>2. Fishing area</td>
<td>56</td>
<td>4</td>
</tr>
<tr>
<td>3. Farming and fishing area</td>
<td>78</td>
<td>5</td>
</tr>
<tr>
<td>4. Industrial area</td>
<td>68</td>
<td>4</td>
</tr>
<tr>
<td>5. Commercial area</td>
<td>462</td>
<td>29</td>
</tr>
<tr>
<td>6. Farming area</td>
<td>1490</td>
<td>93</td>
</tr>
<tr>
<td>7. Residential area</td>
<td>1139</td>
<td>71</td>
</tr>
<tr>
<td>Total</td>
<td>3383</td>
<td>211</td>
</tr>
</tbody>
</table>

The sampling ratio was determined from the following basic formula:

\[
\text{Sampling error } CV = \sqrt{\frac{1}{n} \left( C_x^2 + C_y^2 - 2 \rho C_x C_y \right)}
\]

where \(C_y\) = CV of the population in the sampling-unit areas  
\(C_x\) = CV of the tuberculosis cases in the sampling-unit areas  
\(\rho\) = correlation coefficient between the population and the number of tuberculosis cases in the sampling-unit areas  
\(n\) = number of sampling-unit areas required

Assuming that \(C_y = 0.3\), \(C_x = 0.8\), \(\rho = 0.5\), and \(CV = 0.05\) (on the basis of an average proportion of tuberculosis cases of approximately 2%, which was calculated in the light of past clinical experience and epidemiological investigations), the number of sampling-unit areas required \((n)\) was computed as 200. The sampling ratio, therefore, was 200:3383, which was approximated to 1:16.

The sampling unit areas were dispersed widely throughout Japan, from Onbetsu Town, Hokkaido, in the extreme north, to Kasasa Town, Kagoshima Prefecture, in the extreme south.
A provisional organization was formed at the Ministry of Health and Welfare. It comprised expert phthisiologists, statisticians, and administrative officers of various government agencies, and was named the "Council on the 1953 Survey of Tuberculosis Prevalence" (abbreviated to "Tuberculosis Survey Council"). Its main duties were planning, co-ordination, supervision, and evaluation. Three committees were set up under the chairman of the Council; one on technical supervision and assistance, one on diagnosis, and one on analysis and evaluation. In addition, at the planning stage, a temporary planning committee was established, consisting of representatives of those three committees.

The functions of the committees were as follows: The committee on technical supervision and assistance co-operated with the local survey teams in conducting model surveys in model areas (see section on "execution"), and co-ordinated the activities of all the local teams, giving advice as required. The committee on diagnosis formulated the standardized diagnostic methods which were used, and re-checked the diagnoses made by the local survey teams. The committee on analysis and evaluation planned the tabulation of the items on the survey case-cards and analysed the tabulated data for the final evaluation.

The prefectures and cities in which the sampling areas were located were requested to organize local survey teams; one team was established at each health centre having jurisdiction in the sampling areas. Each team was in the charge of the chief of the health centre concerned, and was made up of his staff plus one or more physicians and X-ray technicians detached from the prefectural or city office exclusively for the survey work. The latter personnel were appointed by the health commissioner of the prefecture or city from among his most experienced technical staff and moved from one team to another within the limits of the prefecture or city.

The planning phase ended at the beginning of June after a tentative project had been examined in detail during the execution of two pilot surveys conducted near Tokyo; final adjustment was made by the planning committee. In late June and early July, the Ministry of Health and Welfare and the Tuberculosis Survey Council sent their staffs jointly to eleven different cities where the representatives of the prefectures and cities and all technical staff of the local survey teams assembled to hear the details of the survey plan and to co-ordinate techniques. Three weeks later, they
met again to participate in the model survey—which formed part of the survey proper and was the first examination in each district—to observe the project in action, and to re-adjust their own plans, if necessary. This model survey contributed considerably to the homogeneity of the data collected in various places by different persons.

The full survey, including the period of observation of tubercle bacillus cultivation on culture media, took from late July until the beginning of November. Only one initially chosen area had to be omitted from the survey; this was in consequence of a typhoon in late August. The survey was completed as planned in the remaining 210 areas.

The individual case-cards, on completion, were sent to the Tuberculosis Survey Council, together with their corresponding miniature radiographs or X-ray films, or both, by the end of November. They were re-checked by the Council and passed to the Statistical and Research Division of the Ministry of Health and Welfare, where they were tabulated according to the plan made by the Council. This tabulation was finished in January and preliminary analysis and evaluation were completed by the beginning of March 1954.

Techniques

*Tuberculin-testing*

All persons in the survey area were tuberculin-tested, regardless of age, sex, past reaction to tuberculin, etc., with the exception of those who were markedly ill-nourished, who were severely ill or had high fever, or who were suffering from generalized skin disease (exceptions for which provision is made in the Enforcement Regulations of the Tuberculosis Control Law, 1951)*b*).

Dilutions of the same lot of tuberculin were used throughout. The tuberculin was injected intradermally into the flexor surface of the forearm and the reaction was read approximately 48 hours after the injection. Interpretation was made on the principles outlined in the following tabulation:

<table>
<thead>
<tr>
<th>Reading</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythema of less than 5 mm in diameter</td>
<td>negative (−)</td>
</tr>
<tr>
<td>Erythema of 5-9 mm in diameter</td>
<td>doubtful positive (±)</td>
</tr>
<tr>
<td>Erythema of 10 mm and over, with no induration and no double erythema</td>
<td>weak positive (+)</td>
</tr>
<tr>
<td>Erythema of 10 mm and over, with induration</td>
<td>medium positive (+++)</td>
</tr>
<tr>
<td>Erythema of 10 mm and over, with induration, vesication, necrosis, etc.</td>
<td>strong positive (+++)</td>
</tr>
</tbody>
</table>

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All persons were given an X-ray examination. Infants and pre-school children were exempted from the preliminary photofluorography and reported directly for X-ray photography, but all other persons were examined photofluorographically for screening purposes. X-ray photography was carried out if they showed any of the following conditions:

(a) pulmonary calcification,  
(b) abnormal pleural findings,  
(c) pathological pulmonary conditions.  
(d) pathological hilar conditions,  
(e) abnormality of ribs and sternum,  
(f) marked history of tuberculosis, including extrapulmonary tuberculous lesions.

Persons who failed to report for photofluorography were given the later X-ray examination. In addition to the ordinary dorsoventral X-ray picture other specific photography was employed if necessary. When the X-ray findings suggested non-specific pneumonitis, a confirmatory X-ray photograph one month later was recommended.

**Sputum examination**

Examination for tubercle bacilli in early-morning sputum was made in the case of all persons of school age and above in whom pathological conditions were revealed by X-ray examination. Collection of specimens was made by visiting public health nurses. In the case of pre-school children and infants, collection of sputum whenever possible was recommended, but no gastric lavage was proposed. When sputum was not obtainable, an aseptic normal saline gargle was substituted.

**Examination for extrapulmonary tuberculosis**

When extrapulmonary tuberculosis was diagnosed, no particular recommendation for specialist consultation was made; the local survey teams made the diagnosis in the course of ordinary clinical examinations. When a case was diagnosed as suspect, it was so recorded on the case-card without further investigation.

**Interview, inspection, and physical examination**

A preliminary interview was held by a public health nurse, whose entries on the case-card were reviewed by physicians in the team when carrying out inspections and physical examinations. No blood-sedimentation tests were made in the survey.
**Diagnostic standards**

*Classification of pulmonary X-ray findings by pathological type*

Classification in accordance with the morphological findings from the chest X-ray photographs was made as follows:

I. Primary tuberculosis
   A. bipolar primary complex
   B. unipolar primary complex
      (a) hilar lymph-node enlargement
      (b) primary pulmonary lesion
   C. infiltrative tuberculosis with primary complex

II. Disseminated tuberculosis
   A. miliary tuberculosis
   B. disseminative acinous tuberculosis

III. Pneumonic-type tuberculosis
   A. bronchopneumonic-type tuberculosis
   B. lobar-pneumonic-type tuberculosis

IV. Infiltrative tuberculosis
   A. with cavity 
      (a) with drainage   | 1. with dissemination
   B. without cavity  
      (b) without drainage | 2. without dissemination

V. Nodular tuberculosis

VI. Indurative tuberculosis
   A. circumscribed induration
   B. lobar induration

VII. Mixed-type tuberculosis

VIII. Pleurisy
   A. with effusion
   B. with adhesion
      (a) without thickening
      (b) with thickening

IX. Displacement of organs
   A. mediastinum
   B. diaphragm
   C. rib
X. Calcification
   A. in lung
   B. in hilar lymph-nodes
   C. in pleura

XI. Deformation by treatment
   A. pneumothorax
   B. thoracoplasty
   C. extrapleural plombage
   D. phrenic paralysis
   E. pneumoperitoneum
   F. pulmonary resection

Classification of pulmonary X-ray findings by grade of severity

The classification of pulmonary tuberculosis proposed by the WHO Expert Committee on Tuberculosis\(^\text{19}\) was adopted for provisional purposes to classify pulmonary X-ray findings by their severity (definite calcification excepted):

0. No pathology
1. Pulmonary pathology on one side only, no suspicion of cavity
2. Pulmonary pathology on both sides, no suspicion of cavity
3. Pulmonary pathology on one side only, suspicion of cavity
4. Pulmonary pathology on one side only, definite cavity
5. Pulmonary pathology on both sides, suspicion of cavity on one side
6. Pulmonary pathology on both sides, definite cavity on one side
7. Pulmonary pathology on both sides, suspicion of cavity on both sides
8. Pulmonary pathology on both sides, definite cavity on one side, suspicion of cavity on other side
9. Pulmonary pathology on both sides, definite cavity on both sides.

Classification of extrapulmonary tuberculosis

Extrapulmonary tuberculosis was classified in accordance with the International Statistical Classification of Diseases, Injuries, and Causes of Death,\(^\text{18}\) modified to some extent, as follows:

1. Tuberculosis of meninges and central nervous system
2. Tuberculosis of intestines, peritoneum, and mesenteric glands
3. Tuberculosis of vertebrae
4. Tuberculosis of bones and joints
5. Tuberculosis of lymphatic system
6. Tuberculosis of genito-urinary system  
7. Tuberculosis of adrenal glands  
8. Tuberculosis of other organs  
9. Healed tuberculosis of the above-mentioned organs

Suspects were classified according to the appropriate disease category, and healed tuberculosis of bones and joints was classified under item 9.

Management

The idea that tuberculous patients and suspects should be classified according to the type of management required for their recovery was followed in the survey, and the following three categories were established:

1. Individuals requiring medical treatment of any kind, specific or non-specific, from fresh-air rest therapy to pneumonectomy. Both the patient being given artificial pneumothorax on an ambulatory basis while still at work and the advanced case for whom there was no hope of cure by specific therapy and for whom even chemotherapy was merely symptomatic were included in this category.

2. Individuals solely requiring rest, without medical treatment. Examples of this category are patients with very slight pulmonary pathological conditions, patients suffering from slight swelling of the hilar lymph-nodes, or those with slight pleurisy.

3. Individuals needing to exercise caution: persons who have recently recovered from tuberculosis or within the past year from pleurisy, for example, may lead a normal life but must exercise caution.

Persons with healed lesions only were classified as healthy.

As the subjective attitudes of physicians may influence decisions based on these not very clearly defined categories, it was suggested that, in order to minimize individual discrepancies, the following factors should be taken into consideration by all participating physicians:

(a) the size, extent, and quality of the pathological condition revealed by the X-ray film;
(b) clinical findings (including subjective feelings of the individual and the result of the examination for tubercle bacilli);
(c) tuberculosis case-history (recent or not, and period since recovery);
(d) age;
(e) presence of extrapulmonary tuberculous lesion.

An example of classification made with particular reference to type of pulmonary pathology is given in Table II.
TABLE II. MANAGEMENT REQUIRED ACCORDING TO TYPE OF PULMONARY PATHOLOGY

<table>
<thead>
<tr>
<th>Pathological type</th>
<th>Conditions requiring</th>
<th>medical treatment</th>
<th>rest</th>
<th>caution</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB(a)</td>
<td>clinical symptoms present, or high degree of swelling</td>
<td>no symptoms or moderate swelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVB(b)2</td>
<td>extensive and severe pathology</td>
<td>moderate pathology, bacillus negative</td>
<td></td>
<td>very slight pathology, foci well separated from each other, no bacillus</td>
</tr>
<tr>
<td>V</td>
<td>extensive and severe pathology</td>
<td>pathology of medium extent and severity, no bacillus</td>
<td></td>
<td>pathology of slight extent and severity, no bacillus</td>
</tr>
<tr>
<td>VIA</td>
<td>diffuse pathology, bacillus positive</td>
<td>limited pathology, no bacillus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIB</td>
<td>young age</td>
<td>old age, bacillus either positive or negative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIIIIB</td>
<td></td>
<td>recent (within 6 months)</td>
<td></td>
<td>old (within one year)</td>
</tr>
<tr>
<td>XI</td>
<td></td>
<td>within one year after thoracoplasty, plombage, or exeresis</td>
<td></td>
<td>over one year after thoracoplasty, plombage, or exeresis</td>
</tr>
<tr>
<td>Meningeal tuberculosis</td>
<td>within one year after recovery</td>
<td>within one year after resection, with almost no pathology</td>
<td></td>
<td>over one year after resection, with almost no pathology</td>
</tr>
</tbody>
</table>

Medical treatment indicated

The medical treatment indicated for the tuberculous patients and suspects was classified in the following categories:

A. Treatment for pulmonary tuberculosis
   1. Medical collapse therapy
      (a) artificial pneumothorax
      (b) artificial pneumoperitoneum
   2. Surgical treatment
      (a) thoracoplasty
      (b) other types of collapse therapy
      (c) pulmonary resection (all types)
   3. Chemotherapy
   4. Unspecified treatment

B. Treatment for extrapulmonary tuberculosis
   1. Chemotherapy
   2. Unspecified treatment
An explanation of some of the items included in the classification follows.

*Artificial pneumothorax.* In principle, this treatment is indicated for cases curable by temporary collapse of the lung alone and in whom the pathological condition is limited to the apex or upper region of the lung. The best results are obtained with unipolar pathology, but such treatment is often also indicated for bipolar cases.

Indications:

1. Solitary thin-walled cavity of small size (up to 2 cm in diameter) with or without slight dissemination.
2. Infiltrative tuberculosis of extent no greater than a lobule. (It should be noted, however, that chemotherapy may sometimes be indicated for this state.)
3. Non-diffuse pathology of small extent without clear drainage. (If drainage is clearly diagnosed, chemotherapy is indicated.)

*Artificial pneumoperitoneum.* This is indicated when there is a pathological condition approximately similar to that requiring artificial pneumothorax but located in the middle or lower pulmonary region.

*Thoracoplasty.* This is indicated when the X-ray finding shows a definite cavity or suspicion of cavity in the upper or middle lobe of the lung. This treatment is generally for persons 20-50 years of age.

Indications:

1. The pathology is chiefly productive, cirrhotic, fibrotic, or of stabilized mixed nature.
2. The cavity is accompanied by some exudations, small (less than 5 cm in diameter), and few.
3. The cavity is of a type for which pneumothorax is ineffective.

*Pulmonary resection.* This is indicated in any one of the following cases if the condition of the remaining lung is such that there is no fear of regression, and it is normally performed on persons under 50 years old:

1. Where thoracoplasty and extrapleural plombage have proved ineffective.
2. Where the cavity is of a type for which pneumothorax has proved unsuccessful.
3. Where the cavity is located in the hilar, middle, or lower region, and is of a type for which phrenic nerve exeresis or pneumoperitoneum are considered to be or have been ineffective.
4. Where there is tuberculoma which tends to grow or to be softened and broken.
(5) With localized caseous bronchitis.
(6) For a destroyed lung.

Chemotherapy. This may be indicated for any of the following conditions:

A. Without other treatment
   (a) Miliary tuberculosis
   (b) New exudative pathology: in both adults and children, IVB, IIIA, IIIB, and part of VII; and in children, IIB
   (c) New primary lesion of lung: 1A, IB (b)
   (d) Acinous, disseminated tuberculosis: IIB
   (e) Severe swelling of hilar lymph-nodes

B. Accompanied by surgery
   (a) Cavity with diffuse exudation around it: IVA
   (b) Cavity with exudative dissemination in relatively wide region: IVA, IVB (a), and sometimes VII
   (c) Pathology with marked caverno-hilar connexion: IVA IVB (a), and sometimes VII
   (d) Cavity with exudative dissemination on the other lung

Unspecified treatment. This includes fresh-air treatment, with rest in bed, symptomatic treatment, etc.

Classification, by treatment, of patients requiring hospitalization

Patients are classified for hospitalization as follows:

A. For specific treatment
   (a) surgery, immediate or in the future
   (b) chemotherapy
   (c) artificial pneumothorax or pneumoperitoneum
   (d) treatment of extrapulmonary tuberculosis

B. For general treatment
   (a) severe case

Definition of terms

"Tuberculosis", "pulmonary tuberculosis", "extrapulmonary tuberculosis"

"Tuberculosis" refers to all forms of tuberculosis.

"Pulmonary tuberculosis" refers to tuberculosis of lung, bronchus, trachea, hilar lymph-nodes, and pleura.
"Extrapulmonary tuberculosis" refers to tuberculosis other than "pulmonary tuberculosis".

*Pathology present*

Persons examined were divided into three groups: those who showed "unhealed" pathology, those who showed "healed" pathology, and those who showed no sign of tuberculosis pathology: "pathology present" refers to the first two groups.

*Case*

"Case" refers to "unhealed" pathology. As used in the survey, the term "case" does not necessarily have the same implications as the term "patient".

*Prevalence*

is the percentage of "cases" observed at the time of the survey in the population examined.

Persons referred to as "pulmonary-tuberculosis cases" are those who showed "unhealed" pulmonary tuberculosis; persons referred to as "extrapulmonary-tuberculosis cases" are those who showed "unhealed" extrapulmonary tuberculosis.

*Active X-ray pathology*

"Active" pathology refers to pathological findings shown on the X-ray film, with the exception of calcification, callosity of pleura, and displacement of viscera.

*Age*

The "age" of the person examined is given as at the first day of the examination period in each survey area.

*Household*

"Household" refers to those who were living as a group under one roof on the day of examination or to a single person who kept his own house. While those who were absent on the day of the examination on account of hospitalization were included in the household, those who were living away from home in a school or factory dormitory were excluded. If the householder was a foreigner, the household was exempted from the survey, but if a foreigner was a member of a household kept by a Japanese he was included.

**Results of Survey**

**Response**

Of the 51,011 inhabitants of the survey areas, 50,668 reported for the X-ray examination—that is, an average response of 99.3%. A response of 100% was obtained in 135 of the 210 survey areas, while the lowest response

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c Detailed tables have been deposited in the WHO Library, and may be obtained in the form of microfilm, free of charge, by interested research workers.—Ed.
was 90.5%. The survey was not completed in the case of 343 persons: 112 inhabitants were absent at the time of the survey, and it was not possible—for reasons such as lack of time in which to carry out the X-ray re-takes recommended by the Council—to finish the examination of the other 231. The tuberculin test was completed in 50 340 cases (98.7%).

**Tuberculin tests**

**Results**

The tuberculin reactors formed 60.1% of the population tested. The proportion of reactors was low (16.4%) up to the age of 4 years, then increased very rapidly, reaching almost the highest proportion recorded at between 10 and 14 years (71.0%), and continued at approximately the same level until it began to decrease at 50-54 years of age.

The percentage of tuberculin reactors in males at all ages was 62.5%, and in females at all ages, 57.8%. It was a little higher for females than for males up to 20 years of age; reversal of this tendency was observed at between 20 and 24 years; the difference became greatest in the age-group 35-39 years and then decreased.

The average percentage of medium-positive plus strong-positive reactors at all ages was 29.8. The proportion, which began as 6.6% in the age-group 0-4 years, slowly increased, reaching its peak in the age-group 30-34 years (45.4%); the decrease, which began in the group 40-44 years, was more rapid in the later age-groups than the decrease in the proportion for all types of positive reactions. The average in males at all ages was 31.9%; that in females, 27.8%. The same effect of age on trend was seen in both sexes.

The proportion of reactors, by area, was as follows: urban areas, all ages, 68.4%; rural areas, all ages, 55.0%. The urban areas showed the following trend: 0-4 years, 20.8%; a rapid increase, reaching almost the highest proportion recorded, at 10-14 years (78.0%); a slight decrease at 15-24 years; an increase to the peak figure at 25-29 years (81.5%); and then no important fluctuation until a final decrease in the oldest age-groups. The trend was similar but generally slower in the rural areas; 0-4 years, 14.1%; 10-14 years, 66.7%; 15-19 years, 68.8% (the peak). In the age-groups above 30 years, a difference of approximately 20% was seen between urban and rural areas. Trends in the proportion of reactors of each sex were affected by location only to the extent that the difference between proportions of reactors in the two sexes was greater in rural areas than in urban areas.

**Discussion**

An explanation of the fact that the percentage of tuberculin reactors was highest at such an early age as the age-group 10-14 years may be found
when BCG vaccination—which is commonest in the younger age-groups (5-19), and more particularly the age-group 10-14 years—is taken into consideration. Also, the percentage of medium-positive plus strong-positive tuberculin reactions was not the highest in such a young age-group, but showed an almost parallel increase with the percentage of tuberculosis pathology present, which is mentioned later. Persons vaccinated with BCG who have not yet been exposed to natural infection usually react weakly to tuberculin; the weak-positive group included many such cases. The trend of the natural tuberculin reactors by age may move between that of the tuberculin reactors of all types and that of the medium positive and strong positive, and parallel with the latter or with the rate of tuberculosis pathology present by age.

The higher proportion of tuberculin reactors in females under 20 years than in males of the same age may be explained by the fact that females are more sensitive to tuberculin than males; for example, the proportion of tuberculin conversion after BCG vaccination is much higher in females. The lower proportion in females over 20 years is caused chiefly by the fact that females are less likely to be exposed to tuberculosis.

While it is true that the difference between the urban and rural areas, or between the different types of area—farming, commercial, etc.—should be compared only after correction has been made for age and sex in the former case, and for age, sex, and composition of area in the latter, the apparent difference observed between the urban and rural areas may be a true one, as the age and sex composition of the inhabitants of both types of area was essentially the same.

**Tuberculosis, all forms**

*Results*

The prevalence of all forms of tuberculous pathology present was 16.0% at all ages, 13.9% at 20-24 years, 23.9% at 30-34 years, followed by a gradual increase to approximately 30%. The prevalence of tuberculosis cases was as follows: all ages, 6.1%; 20-24 years, 5.9%; 30-34 years, 11%; older age-groups, approximately 10%. The curves of both rates seemed to be exponential, ascending with increase in age and approaching the horizontal at about 30 years.

The curve of the prevalence of cases rose at a continuous rate up to 29 years of age. The curve of the prevalence of pathology present by age was of the same shape as that for the medium-positive plus strong-positive tuberculin reactors for the age-groups up to 39; the latter curve then descends, crossing the former at 60-64 years.

The percentage of pathology present by sex was as follows: males, all ages, 17.1%; females, all ages, 14.9%. The percentage of cases, by sex,
was: males, 7.4%; and females, 4.9%. The percentages in both were higher in males than in females for all age-groups except 5-9 years.

Again, the percentages for both pathology present and cases were higher in the urban than in the rural areas. In the case of pathology present, the urban areas showed the following trend: 0-4 years, 3.8%; an almost linear increase to 29.4% at 30-34 years; followed by a continual gradual increase to 35% at ages above 50 years. The trend was similar, but at a lower level, in the rural areas: 2.1% at 0-4 years, increasing to 7.2% at 15-19 years, and followed by an increase almost parallel to that in the urban areas but at a level as much as 10% lower.

The proportion of cases showed the following trend in the urban areas: 1.8% at 0-4 years, with a rapid increase beginning at 15-19 years to reach 13.8% at 30-34 years, and finally levelling out at 12%-15%. The percentage of cases in the rural areas was in general lower: 0-4 years, a little lower; 5-14 years, almost the same; 15-19 years, 2.4%; and, finally, maintained at a much lower level, and reaching the maximum at 30-34 years (8.8%) and then fluctuating at about 8%.

No difference in the percentage of cases by sex was observed in the urban areas up to 24 years, but, with further increase in age, males showed higher proportions than females. In the rural areas, males showed higher proportions at all ages, the difference becoming marked after 30-34 years.

Classified by type of area, the proportion of pathology present was highest (reaching 21.4%) in the commercial areas and next highest in the residential areas. The level was more or less uniform in all other areas, with the exception of the fishing and farming districts, where the proportion was as low as 11.4%. The proportion of cases showed almost the same trend, ranging from 8.5% in the commercial areas to 3.6% in the fishing and farming areas.

Classified by occupation, the proportion of pathology present was highest (reaching 30.7%) in the administrative group; almost identical in the professional and trading groups (29.3% and 29.2% respectively); and lowest in the unclassified-occupation group. The same trend was observed in the proportion of cases: administrative group, 17.5%; mining and professional groups, 14.0% and 13.7% respectively; unclassified-occupation group, 4.6%.

Classified by pulmonary findings, 98.2% of the persons with pathology present showed presence of pulmonary tuberculosis, and the rest (1.8%) showed extrapulmonary tuberculosis only; of the persons with unhealed pathology, 96.6% showed signs of pulmonary tuberculosis, and the rest (3.4%) showed signs of extrapulmonary tuberculosis only. Extrapulmonary tuberculosis was also seen in 2.1% of the persons with pulmonary tuberculosis, 0.8% of those with healed pulmonary tuberculosis, and 0.1% of those showing no sign of pulmonary tuberculosis.
Discussion

The survey revealed that even in the area with the lowest proportions of pathology present and the lowest percentage of cases—the fishing and farming area—the proportion of cases was as high as 3.6%, and that throughout the areas surveyed the two proportions averaged 16.0% and 6.1% respectively, which clearly shows that tuberculosis is highly prevalent throughout Japan.

The increase in the proportions of pathology present and of cases was seen to become slower after 30 years of age. The crossing of the curves of the proportions of pathology present and of medium-positive plus strong-positive tuberculin reactors in old age may be caused by the diminishing general biological reactivity of skin in old age as well as by weakened tuberculin allergy.

The number of extrapulmonary tuberculosis cases was so small that the general trend of tuberculosis of all forms differed very little from that of pulmonary tuberculosis alone.

Pulmonary tuberculosis

Results

As already stated, the proportions of pathology present and of cases of pulmonary tuberculosis showed almost the same trends as those of tuberculosis of all forms.

The X-ray pulmonary findings were regrouped, for convenience, as shown in Table III.

<table>
<thead>
<tr>
<th>New groupings</th>
<th>Original classification</th>
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<tbody>
<tr>
<td>1. Primary tuberculosis</td>
<td>IA, IB(a), IB(b), and IC</td>
</tr>
<tr>
<td>2. Miliary tuberculosis</td>
<td>IIA</td>
</tr>
<tr>
<td>3. Pleurisy</td>
<td>VIIA</td>
</tr>
<tr>
<td>4. Active tuberculosis</td>
<td>IIB, III, IV, VIIB, and VII</td>
</tr>
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<td>5. Stationary tuberculosis</td>
<td>V and VIA</td>
</tr>
<tr>
<td>6. Deformation by treatment</td>
<td>XI</td>
</tr>
<tr>
<td>7. Adhesion and calcification</td>
<td>VIIIB, IX, and X</td>
</tr>
</tbody>
</table>

Classification of pathology revealed by X-ray examination gave the following results: calcification-cicatricial type, 55.2% (classified as "healthy"); of the remaining 44.8%, the productive-fibrotic type made
up 47.1%, the infiltrative-mixed type, 46.8%, the primary-tuberculosis type, 4.1%, and the remaining groups, 2.0%.

Primary-tuberculosis type: 97.3% of the cases in this group, which undoubtedly did not include all cases of primary tuberculosis, were in the age-groups 0-19 years. Among children with "active" X-ray findings, 81.3% of those 0-4 years old and 45.9% of those 5-9 years old were classified in this group.

Pleurisy type: 0.2% of those with "active" X-ray findings were found in this group. Pleurisy-type cases occurred in all age-groups up to 44 years.

Infiltrative-mixed type: of all those with "active" X-ray pathology, 46.8% fell in this group. The percentage increased with age above 10 years, reached 67.7% at 15-19 years, fluctuated at approximately 60% at 20-34 years, and then decreased to some extent, although never falling below about 30%.

Subdivision of this group into infiltrative type (IV) and mixed type (VII) revealed interesting trends by age and sex. The percentage of the infiltrative type in the whole group was: 0-4 years, 10%; 15-24 years, 56.7%; decreasing gradually to 11.8% at 60 years. Cases of mixed type, occurring in small numbers at 10-14 years, increased rapidly with age: 30-34 years, 18.1%, and at 60 years, 25.9%. Both types were more frequent in males than in females, the difference in frequency by sex being most marked in the mixed type at ages above 30-34 years.

The percentages of the other subgroups included in the infiltrative-mixed group were as follows: disseminative-acinous type (IIB), 0.5% of persons showing "active" X-ray pathology, with no particular variation by age or sex; pneumonic type (III), 0.2%; lobar-indurative type (VIB), 0.7%, with the greatest number of cases in age-groups above 35 years.

Productive-fibrotic type: 47.1% of all persons showing "active" X-ray pathology were classified in this group, the number of cases increasing with advance in age: 0-20 years, very few; at 20 years, 31.2%; over 40 years, more than 50%; above 55 years, 60%.

Subdivision of the group into fibrotic type (VIA) and nodular type (V) gave a ratio of 10:1. Of the persons with "active" X-ray findings, 42.9% were of the fibrotic type. While the fibrotic type showed no particular relation to age, the number of cases of nodular type tended to increase with age.

Comparison of the infiltrative-mixed and the productive-fibrotic types by sex showed that the latter type was more frequent in women at all ages and the former more frequent in men.

Cavity. Classification of X-ray pathology by grade of severity gave the following results:

Of those persons with "active" X-ray findings, definite cavity was found in 8.9%, suspicion of cavity in 24.8%, and no suspicion of cavity
in 66.3%. Comparison by age-group revealed the following variations: the percentage of persons with definite cavity or suspicion of cavity among all persons with "active" X-ray findings was very low under 14 years, increased very rapidly to 43.3% at 15-19 years, remained at approximately the same level up to 34 years, and then tended to decrease, fluctuating at about 30%. The percentage appeared to be lower in females than in males.

Of those persons with "active" X-ray findings, definite cavity or suspicion of cavity on both sides was found in 7.7%; definite cavity or suspicion of cavity on one side in 26%; pulmonary pathology on both sides with no suspicion of cavity in 3.7%; and pulmonary pathology on one side only with no suspicion of cavity in the remaining 62.6%. Definite cavity or suspicion of cavity on one side only occurred in 30.1% of the males and 25.7% of the females between 20 and 49 years of age.

Combined classification by type and cavity gave the following results: 79.1% of the persons with definite cavity or suspicion of cavity in both sides of lung were type VII cases; conversely, 38.7% of the type VII cases were of this category. Of those with pulmonary pathology on one side only and no suspicion of cavity, 6.2% were in the primary-tuberculosis group, 74.2% in the productive-fibrotic group (type V, 5.8%), and 16.2% were type IV cases in the infiltrative-mixed group. Conversely, 93.9% of the primary-tuberculosis group, almost all cases of the productive-fibrotic group (type V, 86.6%), and 34.2% of the type IV cases in the infiltrative-mixed group, were in the category of pulmonary pathology on one side only with no suspicion of cavity.

*Sputum examination.* Examination for tubercle bacillus—which was done once only—was carried out on 49.5% of those persons showing presence of pulmonary tuberculosis pathology, and on 54.7% of those with "active" X-ray findings; of the latter, 11.6% were positive.

Smear and culture results, respectively, were positive in 4.7% and 10.9% of the cases with "active" X-ray pathology.

Results in the primary-tuberculosis group—only 34.2% of whom were examined—were uniformly negative. Positive results were obtained in 19.9% of the infiltrative-mixed group, 1.9% of the productive-fibrotic group, and 15.4% of the post-operative deformation group.

*Discussion*

The percentages of pulmonary tuberculosis pathology present and of cases were 15.7% and 5.9%, respectively.

The number of cases of infiltrative-mixed type increased with age up to 30 years, remained more or less level, and then decreased in the higher age-groups. Cases of productive-fibrotic type occurred at a later age, and also increased in number with advancing years. The number of cases with definite cavity or suspicion of cavity ran almost parallel to those of infiltrative-mixed type.
Results, by age, may be summarized as follows:

(a) 0-14 years: 1.7% showed "active" X-ray pulmonary pathology; 45.2% of the cases were of primary-tuberculosis type, 36.4% of infiltrative-mixed type, and 16.4% of productive-fibrotic type.

(b) 15-49 years: 8.7% showed "active" X-ray pulmonary pathology; 52.1% of the cases were of infiltrative-mixed type and 44.5% of productive-fibrotic type, and 37.9% showed definite cavity or cavities or suspicion of cavity.

Further subdivision by age-group gave the following results: at the age of 30-34 years, 11.8% showed "active" X-ray pulmonary pathology, of which 40.3% had definite cavity or suspicion of cavity. At 35-39 years approximately 10% showed "active" X-ray pathology, with an equal percentage of cases of infiltrative-mixed type and of productive-fibrotic type. At 40-49 years the percentage of cases of productive-fibrotic type was higher than the percentage of infiltrative-mixed type. In these later age-groups, 31% of those examined showed definite cavity or suspicion of cavity.

(c) 50 years and over: 13.8% showed "active" X-ray pulmonary pathology; 39.3% of the cases were of infiltrative-mixed type and 60.6% of productive-fibrotic type (93.6% of these were fibrotic). The percentage of cases showing definite cavity or suspicion of cavity decreased to 30.8%, and 96.3% of the remainder—in whom no suspicion of cavity was found—had pulmonary pathology on one side only. From these results it may be assumed that most of the people of these age-groups with "active" X-ray pathology had lesions which were almost healed.

The number of tubercle-bacillus-positive cases revealed by the survey was lower than expected; the reasons for this are probably that examination by staining and culture methods was carried out only once, and that no examination techniques of a more refined nature were used.

Extrapulmonary tuberculosis

Results

The percentages of unhealed pathology and healed pathology were 0.3% and 0.4% respectively.

The proportion of cases of tuberculosis of vertebrae and of bones and joints was relatively large: 26.8% and 19.0% respectively of the extrapulmonary tuberculosis cases.

The proportions of pathology present and of cases were highest in the age-group 30-34 years.

Discussion

As no examination of extrapulmonary tuberculosis cases by specialists was made during the survey, no precise observations could be made.
Management

The types of management required by the persons examined were as follows: guidance, 6.4%; medical treatment, 3.4%; rest, 0.4%; exercise of caution, 2.6%.

Of the cases needing guidance, 52.8% required medical treatment, 5.7% required rest, and 41.5% needed to exercise caution.

No significant differences by sex were revealed in the cases needing guidance.

The age distribution of the cases needing guidance showed almost the same trend as that of all cases showing unhealed pathology.

The percentage of cases requiring medical treatment reached its peak in the age-group 30-34 years, and then decreased.

The percentage of cases requiring medical treatment among those needing guidance, by age, was as follows: 0-4 years, 71.1%; 5-14 years, 54.6%; 15-24 years, 69.3%; decreasing gradually to 48.1% at 40-44 years; and finally fluctuating at about 40%-50%.

Medical treatment required

Recommendations for medical treatment by category were as follows: medical collapse therapy, 6.2%; surgical treatment, 7.7% (resection, 3.3%; thoracoplasty, 4.4%); chemotherapy (including cases later requiring surgery), 79.2%; unspecified treatment—that is, fresh-air rest and symptomatic treatment—13.7%.

Surgical treatment was indicated for approximately twice as many male as female cases. Only negligible differences by sex were observed in the other categories.

Chemotherapy was indicated in a very high percentage of cases in the younger age-groups: 0-4 years, 87.5%; 5-9 years, 89.7%; 10-14 years, 75.7%.

Among the cases requiring medical treatment at 20-49 years of age, medical collapse therapy was indicated for 6.6%, surgical treatment for 10.9%, and chemotherapy for 70.9%.

Hospitalization

Of the cases for which medical treatment was recommended, 46.8% (or 1.6% of all persons examined) required hospitalization, with the following treatment: surgery, 30.8%; chemotherapy, 37.3%; unspecified, 26.5%; artificial pneumothorax or pneumoperitoneum, 2.0%; treatment for extrapulmonary tuberculosis, 3.5%.

Of these cases needing hospitalization, 5.9% were under 15 years old.

Surgery was indicated for 33.1% of the males and 26.4% of the females requiring hospitalization. The ratio of males to females was 3:2.
Management, medical treatment, and hospitalization according to tuberculosis type

*Primary-tuberculosis type:* medical treatment was required by 62.5% (chemotherapy, 88%; unspecified treatment, 10.7%), rest by 14.6%, and exercise of caution by 22.9%.

The majority of cases of infants and children needing unspecified treatment occurred in this group. Among those for whom chemotherapy was indicated, as many as 18.5% required hospitalization.

*Infiltrative-mixed type:* medical treatment was required by 87.9%, as follows: chemotherapy, 79.8%; surgical treatment, 8.0%; medical collapse therapy, 6.0%; and unspecified treatment, 12.7%. Although recommendations for chemotherapy predominated, this did not necessarily mean that the treatment of the cases concerned would be completed without additional therapy of other types.

Hospitalization was recommended for 50.4% of those requiring medical treatment, as follows: surgical treatment (including post-chemotherapeutic), 32.6%; chemotherapy, 37.0%; unspecified treatment, 28.1%; pneumoperitoneum, 1.6%; and treatment for extrapulmonary tuberculosis, 0.7%.

*Productive-fibrotic type:* medical treatment was required by 2.1%, exercise of caution by 62.9%. Chemotherapy, surgical treatment, and unspecified treatment were also indicated in certain cases, and hospitalization was indicated for 20%.

Classification according to type of tuberculosis of persons requiring medical treatment gave the following results: infiltrative-mixed type, 89.7%; productive-fibrotic type, 2.3%; primary-tuberculosis type, 5.7%; other types, 2.3%. Of the cases for whom hospitalization was indicated, 92.1% were of infiltrative-mixed type.

Of the cases needing hospitalization for unspecified treatment, 65.1% showed definite cavity or suspicion of cavity.

Case-history, reporting, and morbidity

*Case-history*

Previous history of tuberculosis was reported by 31.8% of the persons examined showing unhealed pathology, 16.0% of those showing healed pathology, and 3.3% of those showing no sign of tuberculosis. In other words, 68.2% of the cases showing unhealed pathology had been unaware that they were infected until their condition was revealed by the survey.

Evidence of unhealed pathology was found in 4.4% of the cases who reported no previous history of tuberculosis.
Reporting

The following proportions of persons had been registered as tuberculous by the health authorities: 12.3% of those showing unhealed pathology; 1.1% of those showing healed pathology; and 0.2% of those showing no sign of tuberculosis.

Unhealed pathology was found in 71.6% of previously reported cases and in 5.4% of those not previously reported, including healthy people.

Discussion

The survey gave strong proof of the fallibility of estimating the number of “cases” of tuberculosis on the basis of the number of cases reported by doctors. Of necessity, such reports cover only a fraction of the total number of cases, as many persons who have contracted tuberculosis are unaware of their condition and therefore do not seek medical advice.

Estimates and Errors

Method of estimation

The figures obtained in the survey were related to the total population of Japan in the following way:

Estimates could have been based on (a) the total number of inhabitants in Japan, (b) the number of notified cases of tuberculosis, or (c) the number of cases of tuberculosis reported at the time of the previously-mentioned Ministry of Health and Welfare administrative survey. Of these possibilities, the first was chosen. The estimates were calculated by the following formula:

\[
Z' = P \left( \sum_{i=1}^{L} \frac{N_i}{n_i} \sum_{j=1}^{n_i} \frac{x'_{ij}}{y'_{ij}} \right) = P \left( \sum_{i=1}^{L} \frac{n_i}{N_i} \sum_{j=1}^{n_i} \frac{x'_{ij}}{y'_{ij}} \right)
\]

where

- \( x'_{ij} \) = the number of patients, etc., obtained in area \( j \) of region \( i \)
- \( y'_{ij} \) = the population of area \( j \) of region \( i \)
- \( N_i \) = the total number of sampling-unit areas in region \( i \)
- \( n_i \) = the total number of sampling-unit areas surveyed in region \( i \)
- \( L \) = the total number of regions
- \( P \) = the estimated population of Japan on 1 August 1953 (86 600 000).
As \( \sum_{i=1}^{L} \sum_{j=1}^{n_i} x'_{ij} \) is the total number of patients, etc., noted in the survey, and \( \sum_{i=1}^{L} \sum_{j=1}^{n_i} y'_{ij} \) is the total number of persons examined in the survey areas, the estimate \( (Z') \) was determined by multiplying the total number of patients, etc., by

\[
\frac{P}{\sum_{i=1}^{L} \sum_{j=1}^{n_i} y'} = \frac{86 600 000}{50 668} = 1708.5
\]

**Errors**

Errors in the estimates were represented by the coefficient of variation (CV), which was determined from the following equation:

\[
CV(Z') = \sqrt{\sum_{i=1}^{L} \frac{N_i^2}{N_t n_t} \frac{1}{n_t} \left( \frac{\sigma^{2ix}}{X^2} + \frac{\sigma^{2iy}}{Y^2} \right) - 2 \frac{Cov_j(x,y)}{XY}}
\]

where \( \sigma^{2ix} = \frac{1}{N_i} \sum_{j=1}^{N_i} (x_{ij} - \bar{x}_i)^2 \)

\[
\bar{x}_i = \frac{1}{N_i} \sum_{j=1}^{N_i} x_{ij}
\]

\( \sigma^{2iy} = \frac{1}{N_i} \sum_{j=1}^{N_i} (y_{ij} - \bar{y}_j)^2 \)

\[
\bar{y}_j = \frac{1}{N_i} \sum_{i=1}^{N_i} y_{ij}
\]

\[
Cov_j(x,y) = \frac{1}{N_i} \sum_{j=1}^{N_i} (x_{ij} - \bar{x}_i) (y_{ij} - \bar{y}_j)
\]

\[
X = \sum_{i=1}^{L} \sum_{j=1}^{N_i} x_{ij}
\]

\[
Y = \sum_{i=1}^{L} \sum_{j=1}^{N_i} y_{ij}
\]
## TABLE IV. ESTIMATES OF UNHEALED AND HEALED CASES OF PULMONARY TUBERCULOSIS BY AGE AND SEX

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Sex</th>
<th>Pulmonary tuberculosis</th>
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<th></th>
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</tr>
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<tr>
<td></td>
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<td></td>
<td>M</td>
<td>304</td>
<td>405</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>205</td>
<td>442</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>both sexes</td>
<td>510</td>
<td>847</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unit of estimate: 10,000

* Estimates with an error-rate of 15% and above
### TABLE V. ESTIMATES OF MANAGEMENT REQUIRED, BY AGE AND SEX

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Sex</th>
<th>Management required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>medical treatment</td>
</tr>
<tr>
<td>0-4</td>
<td>M</td>
<td>7*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>4*</td>
</tr>
<tr>
<td>5-9</td>
<td>M</td>
<td>5*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>6*</td>
</tr>
<tr>
<td>10-14</td>
<td>M</td>
<td>9*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>4*</td>
</tr>
<tr>
<td>15-19</td>
<td>M</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>8*</td>
</tr>
<tr>
<td>20-24</td>
<td>M</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>13</td>
</tr>
<tr>
<td>25-29</td>
<td>M</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>16</td>
</tr>
<tr>
<td>30-34</td>
<td>M</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>16</td>
</tr>
<tr>
<td>35-39</td>
<td>M</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>10</td>
</tr>
<tr>
<td>40-44</td>
<td>M</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>10</td>
</tr>
<tr>
<td>45-49</td>
<td>M</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>7*</td>
</tr>
<tr>
<td>50-54</td>
<td>M</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>6*</td>
</tr>
<tr>
<td>55-59</td>
<td>M</td>
<td>8*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>5*</td>
</tr>
<tr>
<td>60-64</td>
<td>M</td>
<td>8*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>4*</td>
</tr>
<tr>
<td>65-69</td>
<td>M</td>
<td>5*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>4*</td>
</tr>
<tr>
<td>70-74</td>
<td>M</td>
<td>4*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>3*</td>
</tr>
<tr>
<td>75-79</td>
<td>M</td>
<td>3*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>2*</td>
</tr>
<tr>
<td>80-84</td>
<td>M</td>
<td>0*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>1*</td>
</tr>
<tr>
<td>85-89</td>
<td>M</td>
<td>0*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>0*</td>
</tr>
<tr>
<td>90-94</td>
<td>M</td>
<td>0*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>0*</td>
</tr>
<tr>
<td>95-99</td>
<td>M</td>
<td>0*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>0*</td>
</tr>
<tr>
<td>100+</td>
<td>M</td>
<td>0*</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>0*</td>
</tr>
<tr>
<td>Unknown</td>
<td></td>
<td>0*</td>
</tr>
<tr>
<td>Total</td>
<td>M</td>
<td>176</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>116</td>
</tr>
<tr>
<td>both sexes</td>
<td></td>
<td>292</td>
</tr>
</tbody>
</table>

* Estimates with an error-rate of 15% and above

Unit of estimate: 10,000
Errors in the estimates

The estimates computed from major items noted in the survey are shown in Tables IV-X and their errors in Fig. 1. The larger the estimate, the smaller the error.

**TABLE VI. ESTIMATES OF CASES SHOWING TUBERCULOUS PATHOLOGY, BY TYPE OF DISEASE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary tuberculosis</td>
<td>25</td>
</tr>
<tr>
<td>Miliary tuberculosis</td>
<td>1*</td>
</tr>
<tr>
<td>Pleurisy</td>
<td>1*</td>
</tr>
<tr>
<td>Active tuberculosis</td>
<td>284</td>
</tr>
<tr>
<td>Stationary tuberculosis</td>
<td>286</td>
</tr>
<tr>
<td>Deformation by treatment</td>
<td>10</td>
</tr>
<tr>
<td>Adhesion and calcification</td>
<td>750</td>
</tr>
<tr>
<td>Total</td>
<td>1356</td>
</tr>
</tbody>
</table>

Unit of estimate : 10 000

* Estimates with an error-rate of 15% and above

**TABLE VII. ESTIMATES OF CASES SHOWING TUBERCULOSIS PATHOLOGY, BY PRESENCE OF CAVITY**

<table>
<thead>
<tr>
<th>Pulmonary pathology</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite cavity, with active pulmonary pathology</td>
<td>54</td>
</tr>
<tr>
<td>Suspicion of cavity, with active pulmonary pathology</td>
<td>150</td>
</tr>
<tr>
<td>No suspicion of cavity, with active pulmonary pathology</td>
<td>402</td>
</tr>
<tr>
<td>No active pulmonary pathology, but with pathology</td>
<td>750</td>
</tr>
<tr>
<td>Total</td>
<td>1356</td>
</tr>
</tbody>
</table>

Unit of estimate : 10 000
TABLE VIII. ESTIMATES OF MEDICAL TREATMENT REQUIRED

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>For pulmonary tuberculosis</td>
<td></td>
</tr>
<tr>
<td>Medical collapse therapy</td>
<td></td>
</tr>
<tr>
<td>pneumothorax</td>
<td>15</td>
</tr>
<tr>
<td>pneumoperitoneum</td>
<td>2*</td>
</tr>
<tr>
<td>Surgical treatment</td>
<td></td>
</tr>
<tr>
<td>thoracoplasty</td>
<td>12</td>
</tr>
<tr>
<td>other types of collapse therapy</td>
<td>0*</td>
</tr>
<tr>
<td>pulmonary resection</td>
<td>9*</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>214</td>
</tr>
<tr>
<td>Unspecified treatment</td>
<td>37</td>
</tr>
<tr>
<td>For extrapulmonary tuberculosis</td>
<td></td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>5*</td>
</tr>
<tr>
<td>Unspecified treatment</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>305</td>
</tr>
</tbody>
</table>

Unit of estimate: 10,000

* Estimates with an error-rate of 15% and above

TABLE IX. ESTIMATES, BY TREATMENT, OF PATIENTS REQUIRING HOSPITALIZATION

<table>
<thead>
<tr>
<th>Hospitalization treatment</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical treatment, including that preceded by chemotherapy</td>
<td>42</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>51</td>
</tr>
<tr>
<td>Medical collapse therapy</td>
<td>3*</td>
</tr>
<tr>
<td>Treatment for extrapulmonary tuberculosis</td>
<td>5*</td>
</tr>
<tr>
<td>Unspecified treatment</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>137</td>
</tr>
</tbody>
</table>

Unit of estimate: 10,000

* Estimates with an error-rate of 15% and above
TABLE X. ESTIMATES OF PERSONS VACCINATED WITH BCG

<table>
<thead>
<tr>
<th>Frequency of vaccination</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once</td>
<td>1225</td>
</tr>
<tr>
<td>2-3 times</td>
<td>1155</td>
</tr>
<tr>
<td>4 or more times</td>
<td>575</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2955</strong></td>
</tr>
</tbody>
</table>

Unit of estimate: 10,000

**FIG. 1. ERRORS IN THE ESTIMATES**

Conclusions

Basic data on the prevalence of tuberculosis in Japan were obtained for the first time by this survey.

The survey proved that the long-established method of estimating the number of tuberculosis cases by multiplying the annual number of deaths from tuberculosis by a coefficient of 10-12 gives totally inaccurate results.
The importance of conventional prophylactic measures, such as prevention of infection, prevention of development of tuberculosis, early diagnosis, and early treatment, was confirmed. It was also made apparent that such fundamental control measures, government sponsored, have not only failed to reach a sufficient number of infants and children, but have not even touched the adult age-groups, among whom an unexpectedly large number of tuberculosis cases—especially unrecognized cases with cavity—were found. The necessity of reaching these age-groups as soon as possible was recognized.

Assessment of the distribution of cases showing unhealed pathology, by age, sex, type of disease, management required, medical treatment required, hospitalization, etc., revealed the necessity for reorganizing the medical care of tuberculosis cases so as to maintain an adequate balance between the preventive and curative aspects of tuberculosis control.

As the data obtained differed completely in quality from the data of earlier surveys, no direct comparison was possible; consequently, no assessment of the trend of tuberculosis in Japan in recent years could be made. Further surveys of this type are recommended so that such comparisons may be made in the future.

RÉSUMÉ

Le Ministère japonais de la santé publique et de l’assistance sociale a pris en 1953 l’initiative d’une enquête sur la fréquence de la tuberculose au Japon.

Le Japon a été divisé en 338 522 unités élémentaires, chaque unité représentant environ 50 maisonnées. On a choisi au hasard une sur cent de ces unités puis, par un nouveau sondage, on en a retenu 211 pour les besoins de l’enquête, choisies dans l’ensemble du Japon et représentant environ 50 000 individus.

L’examen comprenait : 1) un test tuberculinique pour tous les habitants (injection intradermique, lecture au bout de 48 heures); on utilisait partout des dilutions du même lot de tuberculine; 2) une radiographie suivie d’une radiographie s’il y avait une image pathologique; les jeunes enfants et les personnes qui ne s’étaient pas présenté à la radiographie n’avaient que le test tuberculinique; on classait les observations radiologiques conformément au code proposé par le Comité d’experts de l’OMS; 3) la recherche des bacilles tuberculeux dans les crachats des personnes (à partir de l’âge scolaire) chez lesquelles l’examen radiologique avait révélé une image pulmonaire pathologique (examen direct et culture, sans inoculation au cobaye).

Sur les 51 011 habitants que comptait l’ensemble des secteurs choisis, 50 668, soit 99,3%, ont subi l’examen radiologique et 50 340, soit 98,7%, le test tuberculinique.

De tous les sujets examinés, 16,0% présentaient une image pathologique tuberculeuse, y compris les lésions cicatrisées. Chez 6,1% des sujets, il s’agissait d’une tuberculose non cicatrisée (5,9% de 20 à 24 ans, 11% de 30 à 34 ans et environ 10% dans les groupes d’âge suivants). Même dans les secteurs où la tuberculose était le plus rare (régions de pêche et de culture) la proportion des tubercules non cicatrisées était encore de 3,6%. Il apparaît que la tuberculose est relativement fréquente au Japon.

La tuberculose extra-pulmonaire compte pour très peu de choses dans ces chiffres: 0,3% des sujets (non cicatrisée) et 0,4% (cicatrisée).
 Parmi les personnes chez lesquelles l’enquête a révélé la présence d’une tuberculose pulmonaire non cicatrisée, 68,2 % ignoraient qu’elles étaient infectées. Et 12,3 % seulement avaient été déclarées comme tuberculeuses aux autorités.

L’enquête a montré combien l’on peut se tromper en évaluant le nombre des cas de tuberculose d’après le nombre des cas déclarés par les médecins. Un grand nombre de personnes ignorent qu’elles sont malades et ne consultent point le médecin.

L’enquête a montré également que les mesures antituberculeuses appliquées au Japon n’étaient pas suffisantes et n’atteignaient pas les groupes d’âge adultes, parmi lesquels on a trouvé une forte proportion de tuberculoses, et notamment de tuberculoses graves, avec cavernes, et jusque-là, ignorées.

Comme les résultats de cette enquête sont très différents de ceux des enquêtes précédentes et beaucoup plus dignes de foi, on manque d’éléments de comparaison pour en déduire des indications sur les tendances de la morbidité tuberculeuse au Japon. Pour déterminer ces tendances, il faudra exécuter plus tard d’autres enquêtes du même genre que celle-ci.

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5. Arima, E. et al. (1940) Kekkaku, 18, 388
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