

## EPIDEMIOLOGIC CHARACTERISTICS OF MALIGNANT NEOPLASMS IN TAIWAN:

### IV. LUNG CANCER

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In order to examine the epidemiologic characteristics of lung cancer in Taiwan, its mortality rates from 1954 to 1983 and incidence rates from 1983 to 1985 were analyzed. The age-adjusted mortality rate of lung cancer has been increasing since early 1950s. During recent three decades, there was an eight-fold increase in lung cancer mortality but the sex (male to female) ratio remained consistently around two-folds. In both males and females, the higher the age, the greater the lung cancer mortality. The age-specific mortality rates of lung cancer significantly higher in recent cohorts than old cohorts. Among the 18 countries and areas compared, the cumulative mortality of lung cancer ranked in Taiwan as the 17th and the 9th, respectively, for males and females, and the sex ratio was the lowest. Chinese in Hong Kong and Singapore had a much higher mortality rates of lung cancer than those in Taiwan and mainland China for all age groups. Areas of high mortality rates of lung cancer in Taiwan were found to cluster in metropolitan precincts and the blackfoot disease endemic area. Incidence rates of lung cancer increased with age and peaked at age of 75. Migrant study showed a significant difference in the incidence rate of lung cancer among Chinese men in Singapore, San Francisco, Hong Kong, Shanghai, Los Angeles, Hawaii and Taipei; while the difference was much less striking among Chinese women in these areas. Ethnic difference in the age-adjusted incidence rate of lung cancer was also observed in these cities.

(Key words: *lung cancer, epidemiology, Taiwan.*)

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#### Introduction

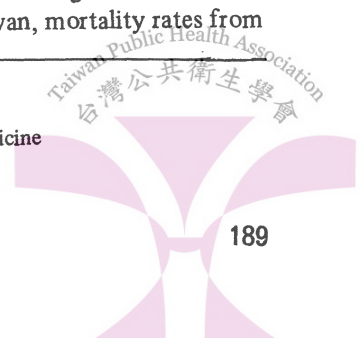
A true steady increase in the morbidity and mortality of lung cancer is a well-documented fact in developed countries[1]. Lung cancer was the second leading cancer deaths among males, and the first among females in Taiwan in 1986. As the treatment

and prognosis of lung cancer are far from satisfactory by now, the disease causes a significant impact to its patients, their families and even the whole society. However, there were only few epidemiological studies on lung cancer in Taiwan. In order to examine comprehensively the epidemiologic characteristics of lung cancer in Taiwan, mortality rates from

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1954 through 1983 and incidence rates from 1983 through 1985 were analyzed.

## Materials and Methods

**Mortality data:** As the death registration system was completely computerized in 1972, all the numbers of lung cancer death by age and sex before 1972 were abstracted from the Vital Statistics in Taiwan[2], and the age-sex-specific population data in Taiwan from 1954 to 1972 were obtained from the Demographic Facts in Taiwan[3]. Data of lung cancer deaths and population from 1972 through 1983 were obtained from the Information Center of the Taiwan Provincial Department of Health to derive age-specific mortality rates of lung cancer by sex for the general population as a whole and for the 361 townships and metropolitan precincts in Taiwan. The mortality rates of lung cancer by age and sex of 17 selected countries and areas in the world were abstracted from the Annual Vital Statistics published by the World Health Organization[4].

**Incidence data:** Data of reported new cases of lung cancer in Taipei City from 1983 to 1985 were obtained from the Cancer Registration

System of the Department of Health, Executive Yuan[5]. Population by age and sex in Taipei City from 1983 to 1985 was abstracted from Demographic Facts. The age-adjusted lung cancer incidence rates by sex and ethnic group in Hong Kong, Singapore, San Francisco, Los Angeles, Hawaii and Shanghai were abstracted from the Cancer Incidence in Five Continents published by the World Health Organization, 1983[6].

**Analytical methods:** In the analysis of secular trend, geographical clustering, and migrant difference, mortality rates of lung cancer by sex and age were first calculated, then adjusted for age by using the world population in 1976 as the standard population. Cumulative mortality rates of lung cancer derived from mortality rates of 10 age groups (i.e., 0, 1-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84) were used in the international comparison.

## Results

**Secular trend:** The age-adjusted mortality rates of lung cancer in Taiwan from 1954 to 1983 are shown in Table 1. Age-adjusted mortality rates increased rapidly from 2.67

**Table 1. Age-adjusted Mortality Rates of Lung Cancer by Sex in Taiwan, 1954-1983.**

Year	Age-adjusted Mortality		Sex ratio
	Male	Female	
1954-55	2.67	1.25	2.14
1956-57	3.88	1.91	2.03
1958-59	5.08	3.03	1.68
1960-61	6.89	3.74	1.84
1962-63	7.51	3.81	1.97
1964-68	10.35	5.84	1.77
1969-73	13.97	6.68	2.09
1974-78	16.64	8.29	2.01
1979-83	21.79	10.42	2.09

per 100,000 in 1954-1955 to 21.79 per 100,000 in 1979-1983 for males, and from 1.25 to 10.42 per 100,000 for females. Males had significantly higher lung cancer mortality than females with a consistent sex ratio of 2.0 over the three decades.

**Age curve and sex ratio:** Age-specific mortality rates of lung cancer in three consecutive periods, i.e., 1954-1963, 1964-1973 and 1947-1983, for males and females in Taiwan are illustrated in Figures 1 and 2, respectively. Mortality rates of lung cancer increased with age exponentially from the age of 25-29 to the age of 60-64 for both males and females in these periods. There was a significant increase in lung cancer mortality rates for all age groups greater than 25 years in recent decades. Age-specific mortality rates of lung

cancer were significantly greater in recent cohorts than old cohorts.

**International comparison:** The cumulative mortality rates of lung cancer in 18 selected countries and areas for 1983 are shown in Table 2. The rates for males and females ranked in Taiwan as the 17th and the 9th, respectively, among the countries and areas compared. The sex ratio was the lowest in Taiwan. Chinese in mainland China, Hong Kong and Singapore also had lower sex ratio than other populations in the world.

**Migrant differences:** Age-specific mortality rates of lung cancer in Hong Kong, Singapore, mainland China and Taiwan for 1983 are depicted in Figures 3 and 4 for males and females, respectively. Mortality rates of lung

Table 2. Cumulative Mortality Rates of Lung Cancer by Sex in 18 Selected Countries and Areas, 1983.

Country	Trachea, bronchus and lung (162)				Sex Ratio
	Male		Female		
	CMR*	Rank	CMR	Rank	
Australia	12.59	11	2.02	11	5.9
Austria	13.52	7	2.05	13	6.6
Canada	13.16	8	2.79	7	4.7
Chile	5.08	16	1.45	16	4.4
Taiwan, China	4.98	17	2.52	9	2.0
Mainland, China	1.95	18	0.93	18	2.1
England and Wales	18.61	3	3.97	4	4.7
Hong Kong	13.97	4	5.95	1	2.3
Hungary	13.82	6	2.56	8	5.4
Ireland	11.05	13	3.24	6	3.4
Israel	7.14	15	2.39	10	3.0
Italy	11.47	12	1.48	15	7.7
Japan	7.38	14	2.06	12	3.6
Netherlands	20.04	2	1.43	17	14.0
Scotland	21.22	1	4.40	2	4.8
Singapore	13.87	5	4.37	3	3.2
U.S.A.	13.04	9	3.48	5	3.8
West Germany	12.99	10	1.56	14	8.3

\*CMR: Cumulative mortality rate over the age from 0 to 84 years

cancer were the highest in Hong Kong and the lowest in mainland China for all age groups greater than 25 years for both males and females.

**Geographical clustering:** The geographical variation of age-adjusted mortality rates of lung cancer in 361 townships and metropolitan precincts in Taiwan are illustrated in Figures 5 and 6 for males and females, respectively. High age-adjusted mortality rates of lung cancer were found to cluster in the blackfoot disease-endemic area as well as the metropolitan precincts in Keelung, Taipei, and Kaohsiung for both males and females. Low age-adjusted mortality rates of lung cancer were observed in townships where the Hakka and aborigines reside.

**Age-sex-specific incidence:** Age-specific incidence rates of lung cancer by sex in Taipei for 1983-1985 are shown in Figure 7. The higher the age, the greater the incidence rate of lung cancer for both sexes. The sex ratio of incidence rates of lung cancer was consistently around 2.0 for all age groups greater than age of 45 years.

**Migrant and ethnic differences in incidence rates of lung cancer:** Age-adjusted incidence rates of lung cancer by sex in Taipei, Hong Kong, Singapore, San Francisco, Los Angeles, Hawaii, and Shanghai are shown in Figure 8. The comparison among Chinese in different cities showed the highest age-adjusted incidence rate of lung cancer in Singapore and San Francisco, respectively, for males and females; while the lowest rates were observed in Taipei and Los Angeles for males and females, respectively. The sex ratio of age-adjusted incidence rates of lung cancer was the lowest in Hawaii and the highest in Singapore. A great ethnic difference in the age-adjusted incidence rate of lung cancer was observed in these cities. For instance, Chinese in Singapore had much higher incidence rate of lung cancer than the Malay and Indian; while the rates of the black and white were higher than those of Chinese and Japanese in

San Francisco and Los Angeles.

## Discussion

The increasing secular trend of age-adjusted mortality rates of lung cancer may be resulted from the improved diagnosis of the disease, increased exposure to environmental pollution, changing life style and dietary patterns, and/or increased cigarette consumption. The higher age-adjusted mortality and incidence rates of lung cancer in males than females may imply different life style and/or environmental exposure between males and females. However, the constant sex ratio around 2.0 over the three decades suggests that increasing risks for lung cancer have similar impact to both males and females.

Both the international comparison and migrant study showed a fairly low mortality and morbidity of lung cancer in Taiwan as compared with the figures in other countries and areas. Differences in life style and environmental exposure, especially the active and passive cigarette smoking and the air pollution due to urbanization and industrialization should be considered in the explanation of this international discrepancy. The low sex ratio of lung cancer among Chinese in Hong Kong, Singapore, Taiwan, mainland China and even in San Francisco, Los Angeles and Hawaii, is an interesting finding. It had been found that Chinese women have much higher proportion of adenocarcinoma of the lung than women of other populations in the world[8]. The reasons for the low sex ratio of lung cancer among Chinese and the high incidence of adenocarcinoma of lung in Chinese women still remain to be investigated. The great differences in mortality and incidence rates of lung cancer among Chinese living in different countries and areas suggest that environmental factors play much more important role in the causation of lung cancer than genetic factors. The ethnic difference in incidence rates of lung cancer in cities of Singapore, San Francisco and Los Angeles

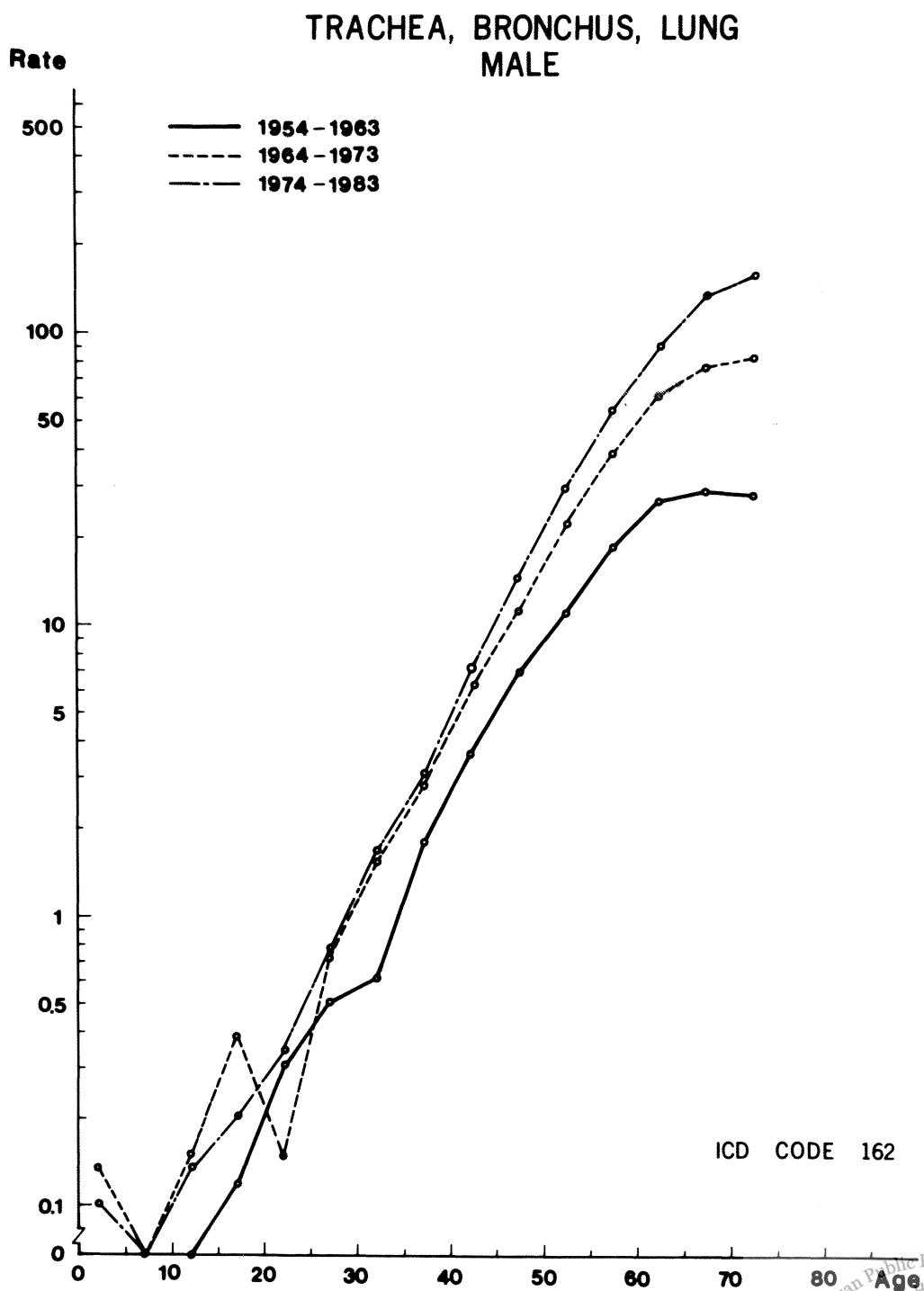


Fig. 1. Age-specific mortality rates of lung cancer for males in Taiwan, 1954-1983.

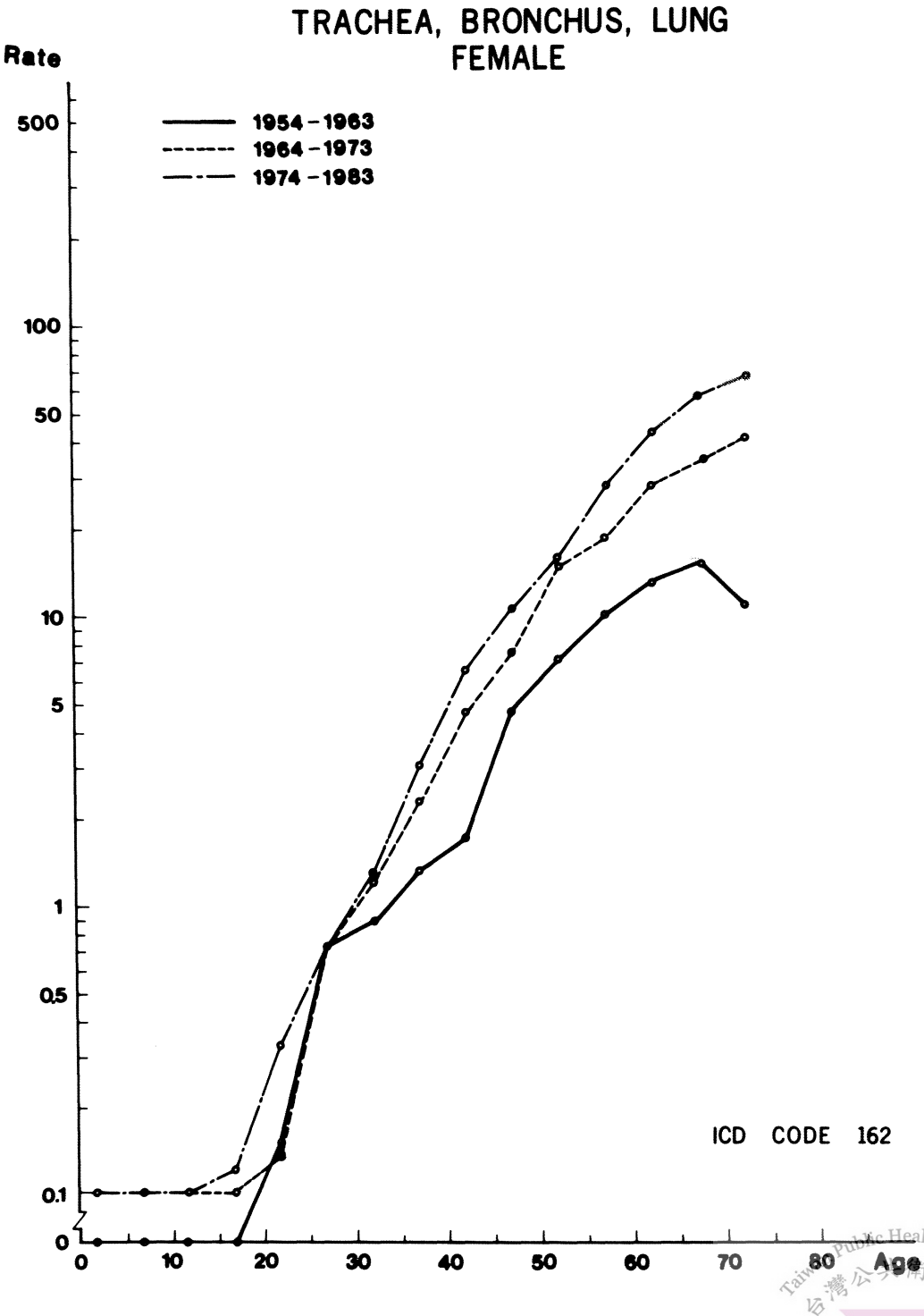


Fig. 2. Age-specific mortality rates of lung cancer for females in Taiwan, 1954-1983.

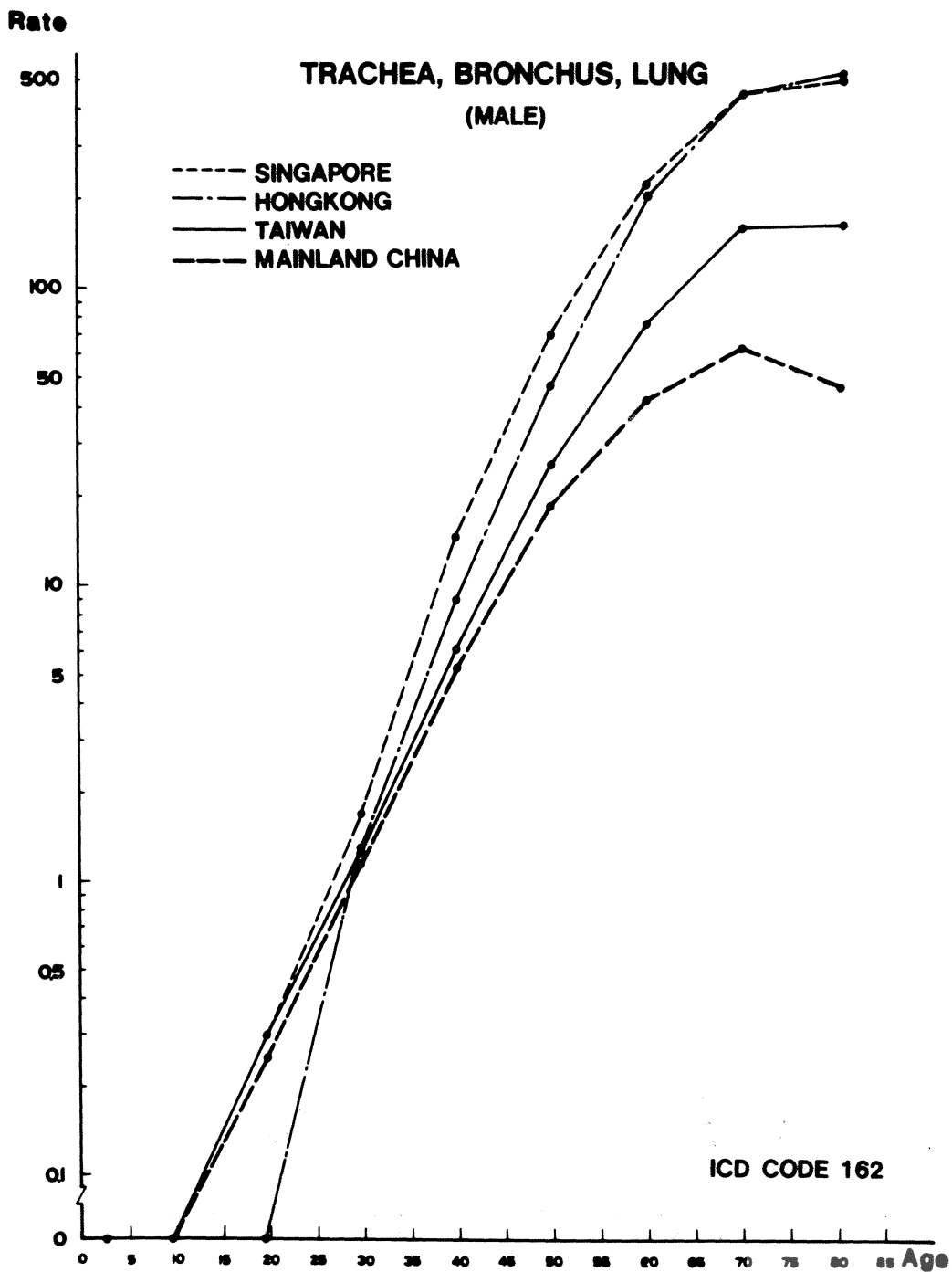
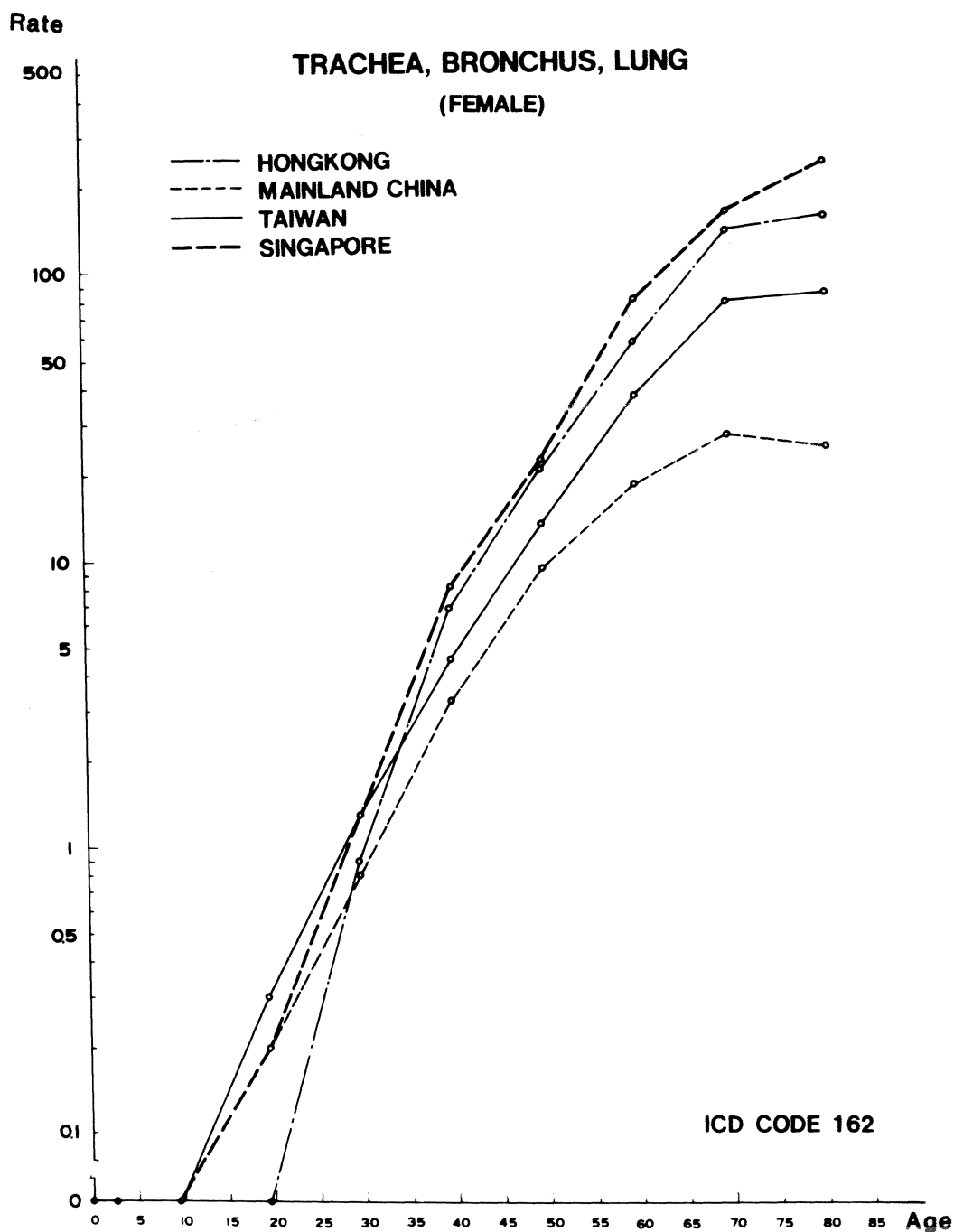


Fig. 3. Age-adjusted mortality rates of lung cancer for males in 361 townships and precincts of Taiwan, 1972-1983.





**Fig. 4. Age-adjusted mortality rates of lung cancer for females in 361 townships and precincts of Taiwan, 1972-1983.**



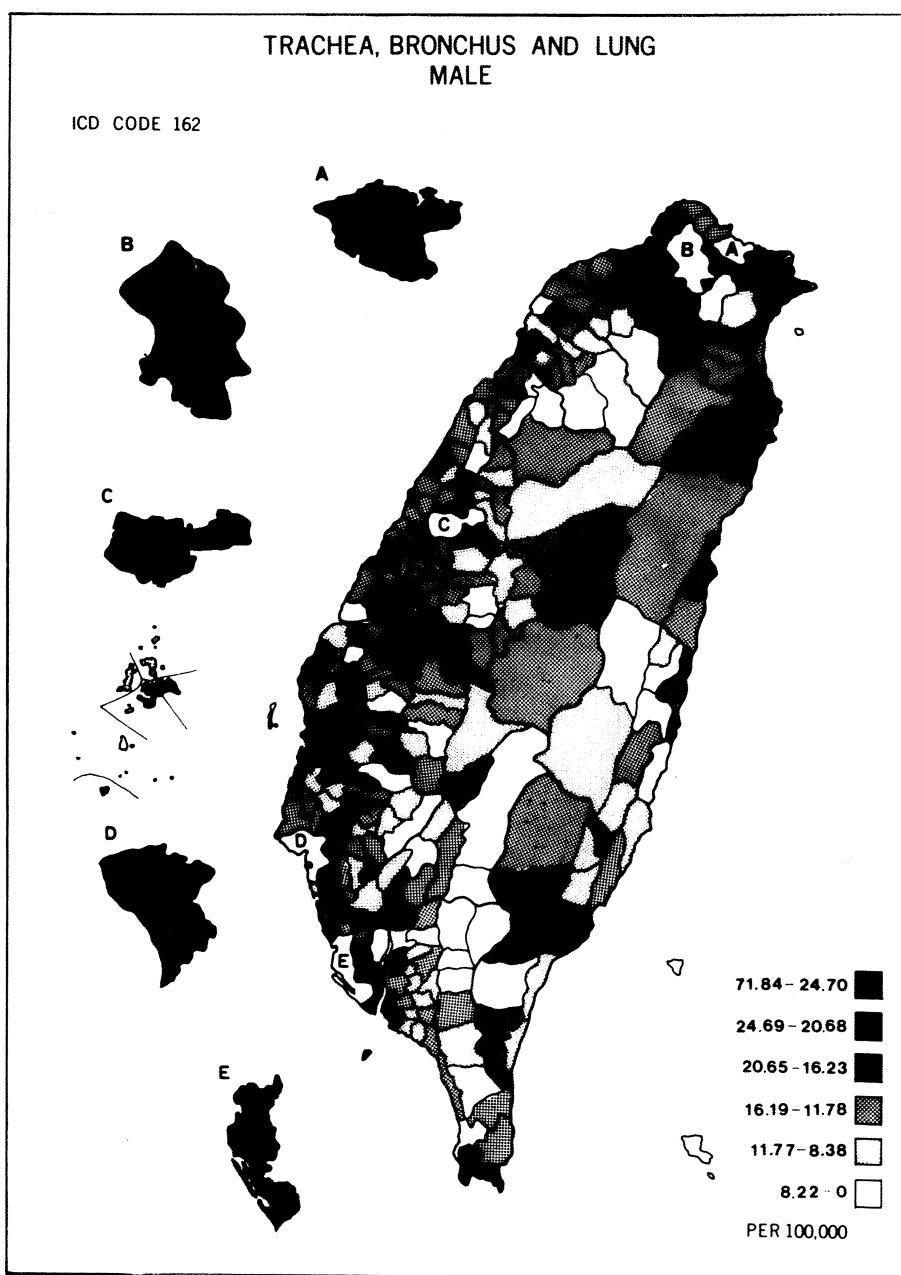
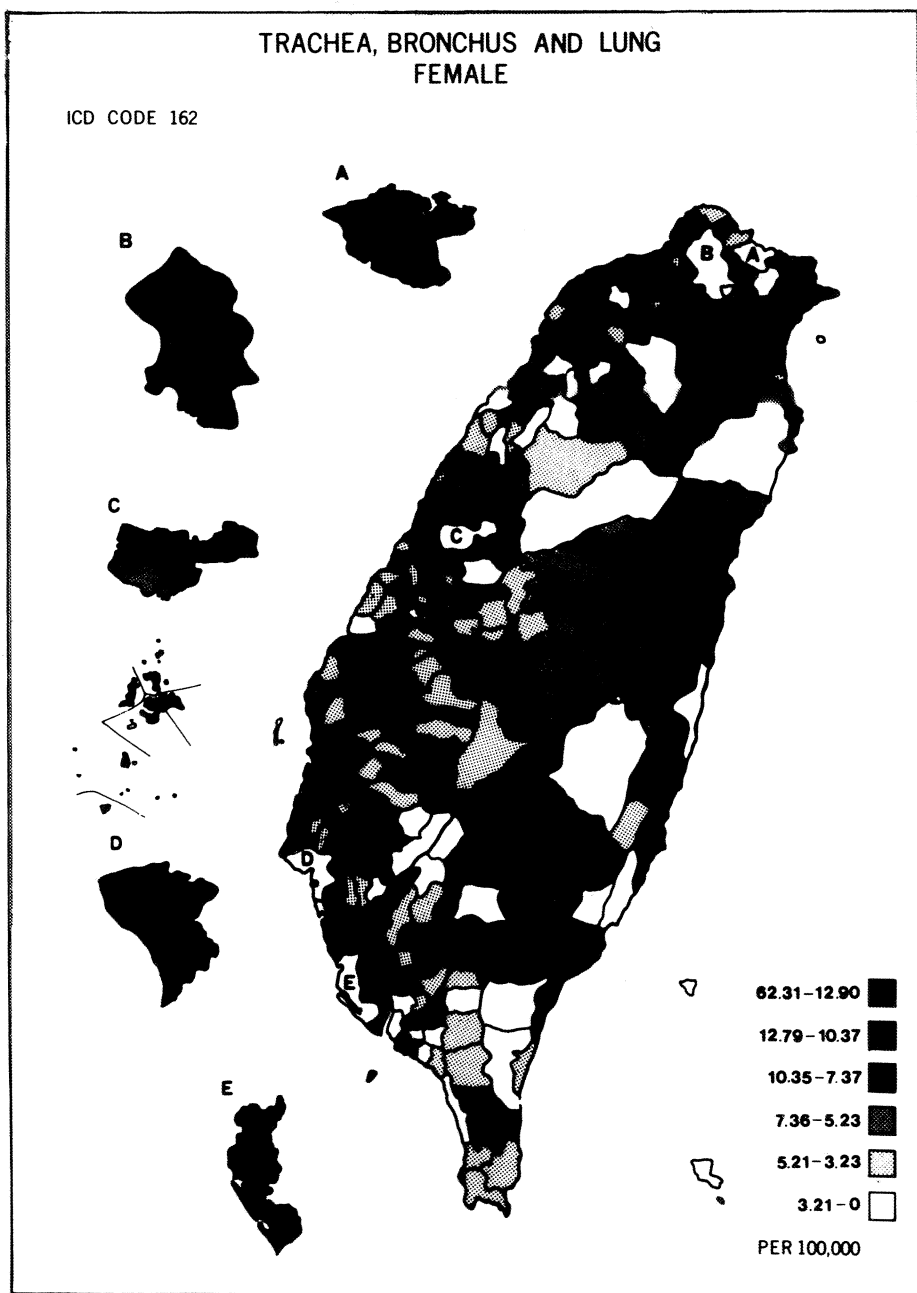


Fig. 5. Age-specific incidence rates of lung cancer by sex in Taipei, 1983-1985.



**Fig. 6. Age-adjusted incidence rates of lung cancer by sex in Taipei, Hong Kong, Singapore, San Francisco, Los Angeles, Hawaii and Shanghai.**

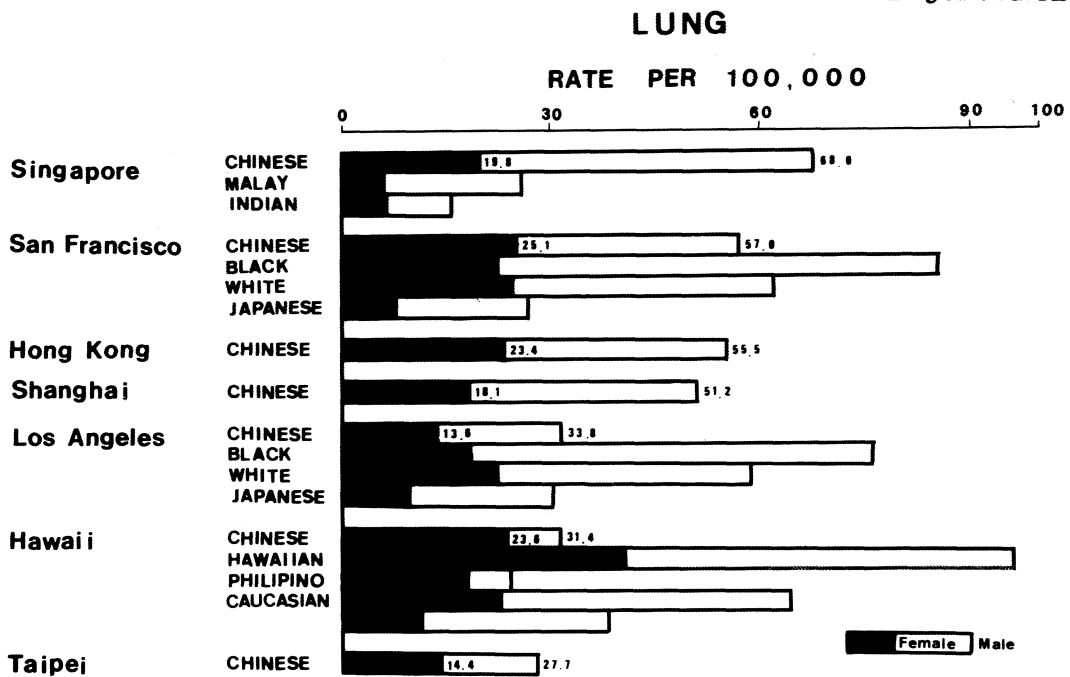


Fig. 7. Age-specific incidence rates of lung cancer by sex in Taipei, 1983-1985.

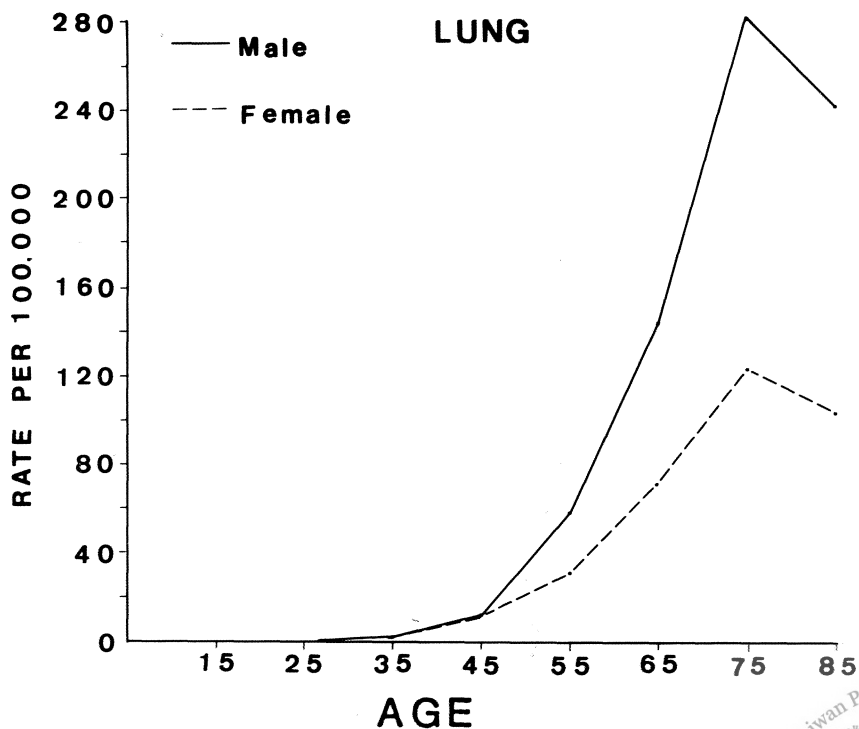


Fig. 8. Age-adjusted incidence rates of lung cancer by sex in Taipei, Hong Kong, Singapore, San Francisco, Los Angeles, Hawaii and Shanghai.

may be resulted from different life style, dietary habits, environmental exposures and/or genetic composition of different race groups.

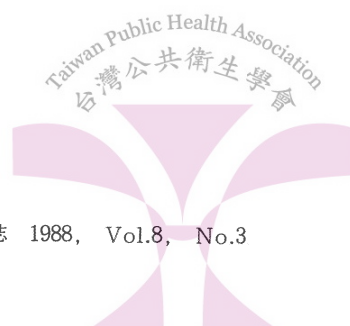
High mortality of lung cancer in Taiwan was found to cluster in the blackfoot disease endemic area and metropolitan precincts. Long term consumption of artesian well water has been reported to be related to the high mortality rate of lung cancer in the blackfoot disease endemic area. Although better diagnosis may contribute to a higher mortality rate of lung cancer in metropolitan areas than in elsewhere, the effects of pollutions resulted from urbanization and industrialization as well as other hazardous exposures in life style of metropolitan residents should be further assessed.

#### Acknowledgements

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## 台灣地區惡性贅瘤之流行病學特徵：Ⅳ. 肺癌

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本研究分析台灣地區 1954 至 1983 的肺癌死亡率和 1983 至 1985 的肺癌發生率，以期瞭解台灣地區肺癌的長期趨勢、年齡曲線、性比例、地理聚集、國際比較和移民差異等流行病學特徵。台灣地區的年齡標準化肺癌死亡率，自 1954 年起即呈明顯的增加趨勢；在近三十年來，增加達八倍之多。但男女性比例均維持在 2.0 左右。男女性之年齡別肺癌死亡率，均隨年齡的增加而呈倍數增加；而且越年輕的出生世代，年齡別死亡率越高。在 18 個國家或地區當中，台灣地區的肺癌累積死亡率在男性佔第 17 位，僅高於中國大陸，在女性則居第 9 位，男女性比例為各國最低者。就華人地區而言，肺癌死

亡率以香港最高，新加坡、台灣次之，而以中國大陸最低，且各年齡層均如此。台灣地區男女性之年齡標準化肺癌死亡率偏高的鄉鎮區，都明顯聚集在大都市和烏腳病盛行地區。肺癌之年齡別發生率同樣的隨著年齡增加而增加，而且各年齡之男女性比例均在 2.0 倍左右。就華人之年齡標準化肺癌發生率的移民比較而言，男性以新加坡、舊金山較高，香港、上海居中，而洛杉磯、夏威夷台北較低；女性則以舊金山、夏威夷和香港較高，新加坡、上海居次，而洛杉磯與台北較低，至於相同地區不同種族間的肺癌發生率也有很大的差異。

關鍵字：肺癌、流行病學、台灣地區

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