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DIFFERENTIAL MORTALITY IN COLONIAL TAIWAN (1895-1945)

par Liu SHI-YUNG

Japan defeated Qing China and took over Taiwan in 1895. Two things disturbed the Government of General-Governor during the early stage of occupation: armed resistance of the Taiwanese people and an unhealthy environment. To solve the health problems, the colonial government in Taiwan launched medical and public health reforms in the 1900s and declared victory in eliminating major epidemics in the late 1920s. This study aims to explore the ethnic-sex differential in mortality trends during the colonial years of Taiwan. To determine the distribution of mortality for the Taiwanese and the Japanese nationals in Taiwan, death certificates issued by the government after 1905, and four reports of the dynamic census in Taiwan (1906, 1910, 1915, 1925) will be examined. This study applies two methodologies to Taiwanese life tables and cause-of-death: (1) the estimation of the ethnic influence on public health policies showed by changes in mortality and (2) the decomposition of sex differentials in life expectancy. Age-adjusted death rates by ethnic groups (Taiwanese and Japanese nationals in Taiwan) and cause of death will be computed based on the colonial population data published in 1947. Also, standard mortality ratios and excess mortality will be calculated using the Taiwanese mortality rates as references. Of the male-female discrepancy in the mortality rates, this study tends to reveal the difference between sexes in the mortality rates by counting the impact of various causes of death. In short, this paper will reveal that public health reform by the colonial government was selective by ethnic base and sex, and had an impact on mortality rates.

THE GENERAL MORTALITY TREND IN COLONIAL TAIWAN

The growth of Taiwanese population before 1895 could have been deterred by the prevalence of epidemics and by a big population gap between the sexes? Most immigrants from Mainland China were males and not allowed to bring their families to Taiwan. A study suggests that Taiwan had a population of around five million in the 1650s, and reached 2,545,731 in 1894. This population growth was caused more by immigration than an improvement in birth rate or mortality rate (Shaoxin, 1979). From 1895 to 1945, the colonial government tried to control major epidemics, improve public health conditions, and increase medical resources. Followed by efforts to reform the medical system and to improve the sex ratio, the birth rate and mortality rate in colonial Taiwan got better. According to population statistics between 1906 and 1942, the total birth rate in Taiwan

(including Taiwanese and Japanese nationals in Taiwan) was around 40-45% with a death rate declined from 33% to 16%. This improvement increased the population growth rate from 5% in 1906 to 25% after the 1930s (Shaoxin, 1979, 96-97) Figure 1 shows the changes in birth rate and death rate in Taiwan from 1906 to 1942.

Compared to the increase in birth rate, the gross mortality rate significantly declined. Figure 2 shows the gross mortality rate of Taiwanese population between 1906 and 1942.

Figure 2 shows that the gross mortality rate declined from 33% in 1906 to below 20% in 1942. As mortality rate improved, the life expectancy of Taiwanese people was extended. Life expectancy at birth, which was 29.7 years in 1906, increased to 36.1 years in 1910. Futhermore, in the 1940s this figure improved to more than 44.8 years. A

Fig. 1 *Changes of Birth and Death in Taiwan (1906 to 1942)*

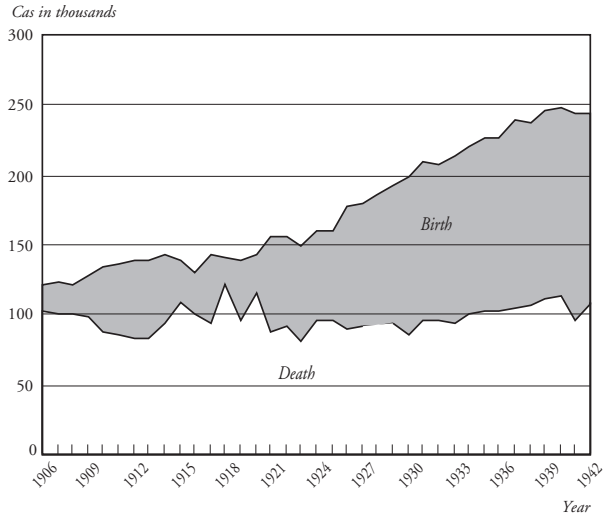
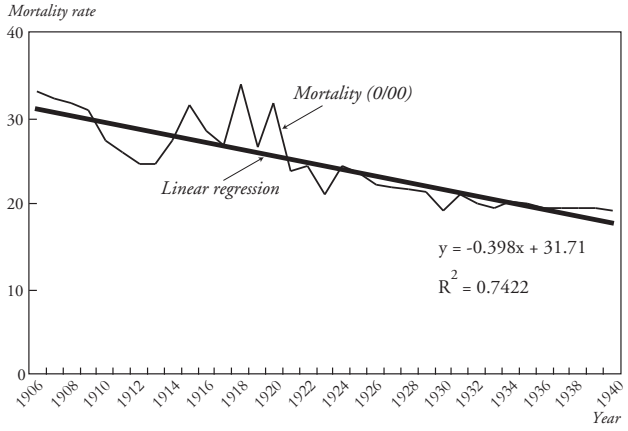


Fig. 2 *Changes of Mortality Rate in Taiwan (1906-1942)*



study suggested that such an improvement in life expectancy since 1906 probably contributed to the rapid decline in female mortality rates between 1920 and 1925 (Jow-Ching, 1991). In fact, the mortality rates of Taiwanese males was stably declining since 1910 and declined faster after 1925.

George Barclay is the first western scholar to discuss the changing mortality in colonial Taiwan and has been frequently cited by later researchers. Barclay argued that the reduction in mortality in Taiwan started in 1900 and that mortality declined continuously since the 1920s. He suggested that 1920 should be considered the onset of the mortality transition in Taiwan. Barclay attributed the demographic changes to the decline of many vital infectious diseases using mass vaccinations (Barclay, 1954, 133-173). He did not, however, provide discussion of differential mortality by sex. Later Mohammad Mirzaee traced a long-term trend in mortality in Taiwan between 1895 and 1975 and concluded that "colonial development reduced Taiwanese mortality from a high pre-transitional level to an intermediate level by 1940. Improvements in the environment, changes in the relation between microorganism and human host (primarily as a result of increase in the resistance of the host), and therapy were regarded as immediate determinants of the reduction in mortality (Mirzaee, 1979, 205)". J. D. Durand attributed these changes to factors such as Japanese political interference in hygienic affairs, prevalence of public health education, and effective prevention and therapeutic works (Durand, 1980).

My recent study on the top ten causes of death between 1906 and 1942 had a slightly different conclusion about these positive factors. During thirty-seven years (1906-1942), unknown illness was the number one cause of death during twelve years (1906-1916 and 1923), and pneumonia was the number one cause during the remaining twenty-five years. Between the late-1910s and mid-1920s, the diagnosis of cause of death in colonial Taiwan was significantly improved. This improvement made death records more reliable after 1925, and even more significantly after the 1930s (Shi-yung, 2000b). Unknown illness remained the second most important cause of death between 1924 and 1931, occupying 16 to 17% of death cases, but was no longer a top-ten cause of death after 1932. Compared to the progress in diagnosis, therapeutic works did not reveal the same development. Although Taiwanese physicians used antibiotics and sulfadiazine after the mid-1930s, the permanent change in the top-ten causes of death should be attributed to the increased prevalence of public health knowledge. In addition, the colonial government applied the latest methods of controling major epidemics such as cholera, plague, and malaria. The progress of malaria study in the West (Taverner, 1968, 16-17) has had an especially strong influence on Taiwan's malaria control program since 1910 (Shi-yung, 1999). An analysis of the top-ten causes of death is not sufficient enough to explain the decline in mortality rates. A decomposition analysis of life expectancy, however, may reveal some key factors of mortality decline in colonial Taiwan.

For the purpose of calculating the decomposition of differences in life expectancy for certain causes-of-death, necessary figures were taken from the

dynamic censuses (1906, 1915, 1920, 1925, 1930, and 1935). The colonial government published census reports after 1906, but the accuracy of reports before the 1910s is questionable. Fortunately, the government left the *Taiwan jinko dotai tokei (Taiwan Population Dynamics Statistics)* data files for 1906, 1915, 1925, and 1935. I can use this data to double-check and correct the original census data. It is also worth noting that the *Taiwan Population Dynamics Statistics* data file for 1940 is unreliable because it lacks census data for each age group and cause of death.

Taking Preston's classification of seven causes of death as the base for this study, in some cases it may be necessary to approximate the classification because of changes to the original category (Preston *et al.,* 1972). The cause-of-death categories examined here include the seventh one named all "other and ill-defined illnesses". This seventh category consists largely of non-specific causes such as "die in old age" and "unknown fever". An extra composite cause of death category gradually decreases the combined effects of all the major infectious diseases associated with the senescent component of mortality. The extra decreased life table is useful for examining the trends in overall degenerative mortality, that is, neoplasm, cardiovascular disease and so on.

Tab. 1 *The Classification of Causes of Death*

Category	Common names
Respiratory illness	Respiratory tuberculosis, influenza, pneumonia, and bronchitis.
Infectious disease	Tuberculosis (other form), syphilis, typhoid, cholera, scarlet fever, diphtheria, whooping cough, meningococcal infections, plagu e, poliomyelitis, smallpox, measles, typhus, malaria, and all other infectious diseases.
Neoplasm	Cancer, malignant, and benign.
Cardiovascular disease	Vascular lesions, rheumatic fever, and heart disease.
Digestive problems	Diarrhea, Gastritis, duodeni tis, enteritis, and colitis.
Infancy illness	Birth injuries, infections of the newborn, other diseases of infancy and immaturity.
Other ill-defined disease	

Several diseases have been re-classified. For example, hematuria was classified as a vascular disease before the 1920s. I moved this disease to the category of other ill-defined disease because it could be a symptom of many illnesses. Anemia was also classified a vascular disease before the 1930s, but this illness could in fact be a result of many medical problems. I thus separated the figures of anemia into three categories by their causes: malaria anemia in the category of infectious disease, malnutrition anemia in other ill-defined disease, and aplastic anemia in infancy illness. In short, the adjustment of original data is based on Preston's classification and the final official classification in 1939.

Siler's model is employed for this study (Siler, 1979). Tests of Siler's model indicate that it fits human mortality curves and has a continuous competing-hazards function (Gage, 1993, 49-50). The decomposition model is given in Equation 1.

Equation 1: $h_t = a_1 e^{b1t} + a_2 + a_3 e^{b3t}$

The first component of Equation 1 accounts for the decline in mortality with age during childhood, and is called the *immature* component (Gage, Dyke,

1988, 430). It is defined by two parameters:

a_1=the magnitude of immature mortality at birth.

b_1=the rate of decline in immature mortality with age.

The second component is designated the *residual* component of mortality and consists of a single parameter:

a_2=deaths occuring independently of age.

The final one is the *senescent* component. It represents causes of death that increase as a result of the decline in physiological function with age. It consists of two parameters:

a_3=the initial magnitude of senescent mortality at the moment of birth.

b_3=the rate of increase in senescent mortality with age.

Finally, h_t represents the total hazard rate from all three competing hazards of mortality at exact age *t*.

Based on Equation 1, an aggregated equation can be produced to examine the impact of each category on a standardized death rate. For instance, at birth, an overall mortality:

$$h_t=a_1e^{b1t} + a_2 + a_3e^{b3t} \qquad E_1 \text{ (t= age)}$$

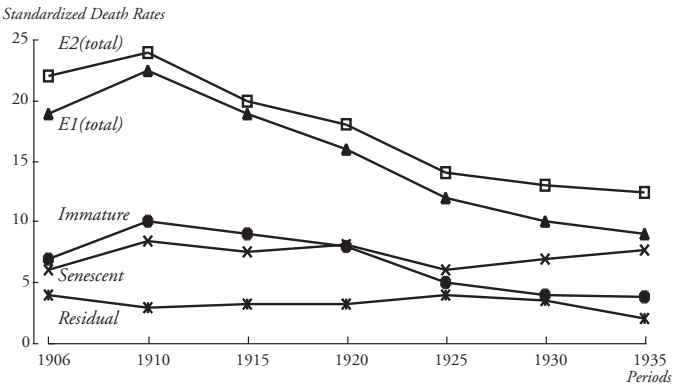
and an aggregated equation:

$$Y(p)=a + bh_{p(\text{respiratory illness})} + ch_{p(\text{infectious disease})} + dh_{p(\text{neoplasm})} + eh_{p(\text{cardiovascular disease})} + fh_{p(\text{digestive problems})} + gh_{p(\text{infancy illness})} + hh_{p(\text{other ill-defined disease})} \quad E_2(p=\text{periods})$$

The value of the *F*-test ($-1.357 \leq 0.4788 \leq 4.257$, when $\alpha=0.005$) shows that equations E_1 and E_2 are statistically similar.

All categories can be examined by the three components of Siler's model. The results reveal how these diseases affected different age groups and help us to identify their trends in time. In equation E_1, since it provides standardized death rates, the three variables are independent of the changes in age structure experienced by the population between 1906 and 1935. The following Figure 3 again shows the relationship between equations E_1 and E_2, and the trend in the overall standardized death rates and component-specific death rates.

Fig. 3 *Trends of E_1 and E_2, and Three Component-Specific Death Rates of E_1*



The results of Equation 1 and Figure 3 show three periods (1906-1915, 1915-1925, 1925-1935). The first period consists of a decline in an age-independent mortality. The second period shows more clearly the trend away from an age-independent toward an increasingly age-dependent pattern. Declines during this period are the result of declines in infectious disease mortality, probably because

these diseases became less virulent or because the population became more resistant to these infections. The mortality trend during the third period consisted of a continuous pattern since the second period. The impact of increases in respiratory diseases and some aging illness, however, became serious, while the mortality of infancy illness did not drop and remained almost constant at the level of the 1920s. It is worth noting that deaths from "other ill-defined diseases" continuously declined in all three periods. By taking the calculation of E_1, the result shows that these declines are distributed among all three components: *immature*, *residual*, and *senescent*. And the declines in the residual component of mortality had more serious impact on the overall mortality of "other ill-defined disease". Some possible explanations for this rapid decline in the mortality of "other ill-defined disease" could be improvements in diagnosis, new classification of diseases, and the general decline in mortality.

DIFFERENTIAL MORTALITY BY SEX

As mortality declined, life expectancy in colonial Taiwan increased. The values for life expectancy reveal mortality differences between the sexes. From the life tables of Taiwanese population before 1945[1], we can see that life expectancy at birth in 1906 was 28.9 years for males and 30.5 years for females; by 1910 life expectancy at birth was 34.1 years for males and 38.0 years for females. From 1920 to 1940, life expectancy at birth increased from 29.1 years for males and 31.3 years for females to 42.5 and 47.0 years respectively. As mentioned previously, only one study suggested that the Taiwanese female population had the fastest decline from 1920 to 1925 (Jow-ching, 1991). No further study has been done, however, on this difference in mortality by sex.

Before we study the decomposition trend of mortality in colonial Taiwan, we have to identify the decline in overall standardized life expectancy. Table 2 and Figure 4 show the results:

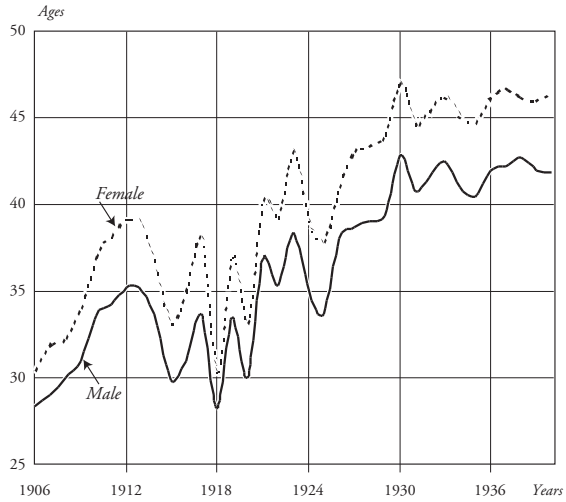
Table 2 *Life Expectancy at Birth and Age One, and the Differentials by Sex*

Years	Male	Female	Sex-Differential
	At birth		
1906	27.67	28.97	1.30
1915	27.09	29.49	2.40
1925	32.02	36.57	4.55
1935	40.86	44.79	3.93
	At age one		
1906	33.16	33.94	0.78
1915	35.45	37.58	2.13
1925	42.03	45.63	3.60
1935	47.67	50.57	2.90

Source: Taiwan jinko dotai tokei.

*Note: The numbers come from the census data. A t-test shows that both sets of data (Dynamics Statistics and regular censuses) are not different in the population. I thus used the dynamic data to present the trend.

Fig. 4 *Changing Life Expectancy at Birth (1906-1940)*



Sex differences in life expectancy were greater at birth, and at age one the differences were reduced somewhat but females still enjoyed a higher life expectancy. Mortality trends are more accurately measured by life expectancy at birth. As shown in Figure 4, the changing life expectancy of both sexes in Taiwan since 1906 reveals many irregularities during the earlier period of mortality transition.

Life expectancy for males and females fluctuated before the 1920s. The epidemics of infectious diseases could be an important factor accounting for this fluctuation (Ts'ui-jung, Shi-yung, 1996, 11-16). The mortality transition occurred only after the mid-1920s. During the later stage of the military mobilization (1935-1941), there was a slowdown in this rise in life expectancy, particularly for males, but female life expectancy continued to rise during the same period.

Recent research used the probability of death to show that the changes in risks of death at each age are independent of other ages. Such changes in life expectancy before the 1940s were associated with the decline in mortality first in infancy and, second, in early childhood (Siler, 1979). In addition, the earlier changes represent the results of selective improvement in sanitation works in major cities, and public health intervention by the Japanese authorities (Wenshan,1996, 4-5). The reduction in mortality before the mid-1910s, however, was not very established. Only after the 1930s, as the effects of medical reform gradually took hold, did mortality risks come down to much lower levels.

Barclay suggests that the increase in life expectancy became possible only when childhood mortality began a steep decline after 1935 (Barclay, 1954, 160-164). According to the life table calculation, the decline in infant mortality in fact occurred before 1935. Infant mortality for males fluctuated from about 298 per thousand in 1918 for the high estimate to 231 per thousand for the low estimate in 1930. For females, infant mortality was around 254 per thousand for the high estimate and 191 per thousand for the low estimate

during 1906 and 1940 respectively. The fact that male and female children shared a similar trend in mortality rates shows that some components equally affected their mortality trend. In 1918 and 1930, for example, a deep drop in life expectancy was caused by serious epidemics. In addition, the high rate of infant and childhood mortality was another major contributor to low life expectancy. Many Taiwanese physicians also noticed the situation. From the late 1920s on, they encouraged the Japanese authorities to address the high infant and childhood mortality rates. There was no solid evidence, however, to prove the linkage between the pleas of Taiwanese physicians after the late 1920s and the governmental policy to improve infant health after 1932 (*Taiwan minpo*, 1925). The pleas of Taiwanese physicians followed by effective intervention seems to have begun to have an effect after the mid-1930s.

Statistics indicate that a substantial gain in life expectancy for males and females was achieved between 1906 and 1940. By the end of the 1930s, a Taiwanese male could expect to live 41.4 years at birth and a female could expect to live 45.2 years. Meanwhile, detailed analysis of differences in life expectancy suggest that patterns of disease in Taiwan changed between 1906 and 1940. Following this conclusion, the next section will estimate the patterns of disease by analyzing the data of cause of death. The changes in cause of death will help us to evaluate the contribution of medical reform in colonial Taiwan.

By taking the calculation of Equation 1, Table 3 reports the decomposition of differences in life expectancy to certain causes of death. The result of Equation 1 for each category is an estimate of the standardized death rates by cause and component of mortality. Finally, the cause- and component-specific standardized death rates are normalized. The three cause- and component-specific rates sum to the cause-specific rates. As a result, deaths attributed to one component when the model is fitted to all causes of mortality are attributed to another component when the model is fitted to a decremental life table. Since these are standardized death rates, they are independent of the changes in age structure experienced by the Taiwanese population before the 1940s.

I analyzed the standardized data to check the impact of certain causes of the differential between two periods of life expectancy. The decomposition method helps us identify the impact of certain causes of death on the changes in mortality between two periods. This method provides a way to check several causes of death at one time and reveal their different impact on a general mortality trend.

In Table 3, changes in life expectancy between 1906 and 1915 had a rise of 1.32 for women and a decline of 0.8 years for men. The difference between men and women was approximately 2.1 years. This difference reveals that the decline of infectious disease (0.28 for males and 0.45 for females) greatly improved life expectancy. The differential of 2.1 years between the two sexes, however, shows that some medical problems hit males harder than females. For example, respiratory illness contributed more to male mortality than female (-2.60 versus -2.00). In addition, male infancy disease mortality actually increased between 1906 and 1915.

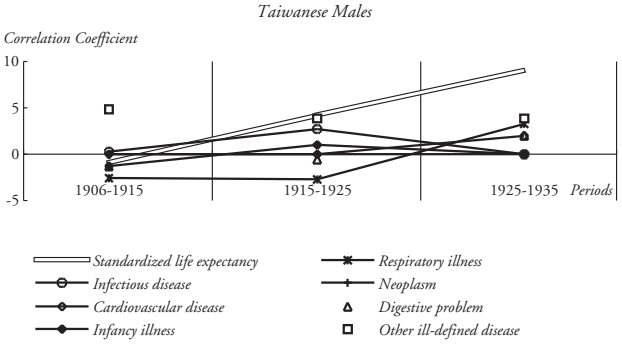
During the period of 1915-1925, life expectancy increased 4.34 years for males and 5.62 years for females. For males, the annual rate of gain in life expectancy turned out to be positive.

Tab. 3 *Decomposition of Differences in Life Expectancy from Birth to Age 70*

Periods	Difference	Males Correlation to	Coefficient
1906 vs. 1915	-0.80	Respiratory illness	-2.60
		Infectious disease	0.28
		Neoplasm	-0.02
		Cardiovascular disease	-0.03
		Digestive problem	-1.34
		Infancy illness	-1.25
		Other ill-defined disease	4.86
1915 vs. 1925	4.34	Respiratory illness	-2.68
		Infectious disease	2.70
		Neoplasm	-0.02
		Cardiovascular disease	0.01
		Digestive problem	-0.51
		Infancy illness	1.03
		Other ill-defined disease	3.80
1925 vs. 1935	9.10	Respiratory illnes s	3.33
		Infectious disease	0.02
		Neoplasm	0.04
		Cardiovascular disease	0.04
		Digestive problem	1.97
		Infancy illness	-0.03
		Other ill-defined disease	3.91
Periods	Difference	Females Correlation to	Coefficient
1906 vs. 1915	1.32	Respirator y illness	-2.00
		Infectious disease	0.45
		Neoplasm	-0.03
		Cardiovascular disease	-0.02
		Digestive problem	-0.54
		Infancy illness	-0.87
		Other ill-defined disease	4.34
1915 vs. 1925	5.62	Respiratory illness	-3.39
		Infectious disease	3.36
		Neoplasm	-0.06
		Cardiovascular disease	-0.04
		Digestive problem	-0.72
		Infancy illness	0.68
		Other ill-defined disease	5.71
1925 vs. 1935	8.09	Respiratory illness	3.03
		Infectious disease	0.02
		Neoplasm	-0.09
		Cardiovascular disease	-0.10
		Digestive problem	1.89
		Infancy illness	0.02
		Other ill-defined disease	3.33

Sources: Taiwan jinko dotai tokei.

Fig. 5 *The Changing Pattern of Health Transition*



For females, it was about four times greater than during the 1900s. The two most important sources for gains in life expectancy for both sexes were reductions in infectious diseases and infancy diseases. Again, respiratory disease was the major contributor to reduction in life expectancy. During the period, male mortality declined faster than female mortality (male versus female: -2.68 versus -3.39 in the difference of life expectancy). Moreover, progress against death-causing digestive problems advanced rapidly in 1915, tending to improve the life expectancy for males. Contrary to the previous period, infant disease mortality declined over the 1912-25 period. This effect was particularly pronounced for males, being almost fifty times less prevalent than in the earlier period.

During the period of 1925-1935, as the table highlights, respiratory illness and digestive problems were important sources of changing life expectancy. It is worth noting that Yang Wenshan had indicated the fundamental changes of the respiratory illness between 1906 and 1935. He argued that influenza continuously reduced life expectancy before 1925 but lost its negative effect after that year (Wenshan, 1996, 9-10). That is, influenza was the major killer in the category of respiratory illness until the mid-1920s. Additionally, although the colonial government began to make concerted efforts in the 1930s (National Health Administration, 1997, 198-199) to prevent tuberculosis, the disease accounted for less than 3 percent and 2 percent of total life gains for males and females, respectively[2]. In short, the pattern of causes of death changed after 1925. Figure 5 illustrates this aspect. A turning point of the old pattern of causes of death occurred during the period 1925-35. It is worth noting that the steep drop in the category "other ill-defined illness" represented the progress of medical diagnoses rather than real reductions in these causes of death. To both males and females, the threat of deadly infectious disease declined before this turning point appeared. The categories including some chronic diseases such as neoplasm and cardiovascular diseases were a bigger hazard to people's health. However, since respiratory diseases rapidly increased and played the most important role in damaging the Taiwanese population after the mid-1920s, I can only suggest that the second health transition was about to begin its earliest stage after 1925. From the viewpoint of epidemiology, Taiwan began the earliest stage of epidemiological transition as infectious diseases declined and life expectancy increased. However, considering the low impact of neoplasm and cardiovascular disease on mortality rates, colonial Taiwan was not yet in the later stages of epidemiological transition[3].

The above analysis suggests that a shift in mortality rates and in epidemiology occurred after the 1920s. This could be the reason why the investigations during the 1920s do not fit the long-term trend for cause of death. Based on previous analysis, one important feature of the transitions was that infectious disease and digestive problems gradually lost their importance in determining life expectancy.

Barclay attributes these improvements to medical reforms, public health interventions, and educational campaigns undertaken by the Japanese authorities(Barclay, 1954, 257-258). Taiwanese medical practitioners, however, including physicians, nurses, and midwives, also deserve some of the credit. For

example, infant mortality declined during the period under discussion. Midwives delivered about half of the babies in 1911 and about eighty percent by 1932. Where the midwife program was successfully implemented, the mortality rate of babies delivered by midwives even fell below average (Chialing, 1997, 1-22). In addition, the general therapeutics and prescriptions of regular clinical doctors changed over time. In the treatment of diarrhea, before the mid-1920s, doctors were advised to give cathartics because of the prevalent germ theory. Most of the doctors believed in the germ theory and tried to use cathartics to exclude "diarrhea germs" from the body (Shigeo, 1998, 158-161). Until the 1930s, the techniques used to treat diarrhea were remarkably varied. In 1928, although the diarrhea vaccine was not successful, a section on related vaccines and intraperitoneal injections was added; and finally in 1936, intravenous introduction of fluids was described (Shigeo, 1998, 160). In general, clinical physicians in colonial Taiwan were sensitive to the progress of medical knowledge and current treatments. They had several new and effective drugs at their disposal and an increased appreciation of Japanese medicine. Therefore, private medical practitioners probably played a prominent role in the mortality decline.

Differential mortality by ethnic group (the Taiwanese versus Japanese nationals in Taiwan)

After the occupation (1895), the Japanese blocked Chinese immigration. Natural growth thus contributed to population growth more than immigration during the Japanese colonial period. There was a steady and continuous decline in mortality beginning in the 1920s. The morbidity of several infectious diseases also declined. The life expectancy of a Taiwanese born in 1945 was almost 20 years greater than that of a Taiwanese born in 1920. Mortality decline and increased fertility caused rapid population growth (Shaoxin, 1979, 101-103). Table 4 shows the little change in the ethnic composition of colonial Taiwan's population.

Tab. 4 *Proportions according to Origins in Colonial Taiwan*

Year	Taiwanese	Chinese	Aborigine	Japanese
1900	95.12	0.18	3.36	1.33
1904	94.67	0.19	3.39	1.73
1905	94.20	0.26	3.62	1.91

Source: Chen Shaoxin, "Taiwan renkoushi de jigewenti," 96-97.

As shown in Table 4, the ethnic mix in the colonial period was more stable than in the Qing (Shaoxin, 1979, 89-91). The proportions of Taiwanese and aborigine slightly declined while the population of Chinese and Japanese increased a little. Generally speaking, the increase of Chinese residents in Taiwan and the decrease of the aboriginal population were not significant by statistical standards. Table 4 does not provide information, however, to understand differential mortality by ethnic group, especially not by the Taiwanese and the Japanese nationals in Taiwan.

Between these two main population groups (Taiwanese vs. Japanese) in colonial Taiwan, there were certain differences in their ways of life that are clearly reflected in all matters of sanitation and general hygiene. In order to understand the differential mortality between these two ethnic components, I studied the Taiwanese mortality statistics from 1906 till 1942, and compared them with those of the Japanese nationals in Taiwan.

Looking at the increasing rate of each ethnic population (Taiwanese vs. Japanese) in colonial Taiwan, the Japanese nationals were faster than the Taiwanese in the under 10 years old age group, especially under 5 years of age, but increased less for those over 49 years old. However, for the ages between 10 and 49 years old, the rates hardly differed (Sadamaru, 1941). In other words, as the Taiwanese population continuously occupied greater proportion in colonial period, Taiwanese were comparatively more numerous in the period of childhood, especially early childhood, while the Japanese nationals in Taiwan had higher childhood survival rate. Because of lower life expectancy, the Taiwanese were less numerous in old age than the corresponding parts of the Japanese nationals in Taiwan.

The mortality rates according to age and sex are given in Table 5. Mortality rates according to age and sex of the Taiwanese are compared with those of the Japanese nationals in Taiwan based on 1,000 of the population.

In Table 5, the mortality rates of the Taiwanese in age groups under 1, 1-4 and 30-69, were markedly higher than those of the Japanese nationals in Taiwan in the same age groups. In addition, the mortality rates of the Japanese nationals in Taiwan in the age group of 70 and over were slightly higher, and in that of ages 15 to 24 much higher than the rates of the Taiwanese.

To access decomposition analysis, it is desirable to examine the ethnic mortality rates by the classification of Table 1. The details are shown in Table 6.

As shown in Table 6, the mortality rates for the Taiwanese by infectious illness were 2.5 times, by respiratory

Tab. 5 *Mortality Rates according to Age and Sex*

Age	Taiwanese		Japanese nationals in Taiwan	
	Male	Female	Male	Female
under 1	190.88	155.42	158.83	137.82
1—4	31.40	36.48	23.01	22.98
5—9	5.24	5.37	4.23	4.47
10—14	3.41	3.17	2.90	4.01
15—19	4.96	4.81	7.32	8.84
20—24	7.75	7.11	9.27	10.19
25—29	9.78	8.28	7.86	9.11
30—34	12.24	10.04	7.24	8.86
35—39	16.50	12.65	8.30	9.84
40—44	21.62	14.25	10.61	10.25
45—49	25.30	14.85	14.80	11.14
50—54	32.74	19.39	19.69	13.80
55—59	39.75	24.52	29.52	19.41
60—64	56.39	35.00	43.96	28.50
65—69	82.83	55.03	68.11	46.54
70 and over	131.51	104.59	131.81	105.88

Source: Taiwansheng wushiyinianlai tongjitiyao, 104-105, and Taiwan jinko dotai tokei.

Tab. 6 *Mortality Rates by Cause of Death per 10,000 Population.*

Category	Taiwanese		Japanese nationals in Taiwan	
	Males	Females	Males	Females
Respiratory illness	93.37	74.08	49.01	45.99
Infectious disease	35.02	29.31	13.36	12.65
Neoplasm	10.92	10.89	32.09	27.01
Cardiovascular disease	3.88	3.98	7.15	7.27
Digestive problem	48.67	47.48	33.92	33.42
Infancy illness	1.23	3.67	1.94	1.87
Other ill-defined disease	7.01	6.91	6.86	6.56

Source: Taiwansheng wushiyinianlai tongjitiyao, 269-285, and Taiwan jinko dotai tokei.

illness 1.8 times, by digestive problems 1.4 times, and by infancy illness 1.9 times as frequent as for the Japanese nationals in Taiwan. On the contrary, cardiovascular disease was lower by 45%, and neoplasm by 63% in the Taiwanese population than among the Japanese nationals in Taiwan. Statistical analysis of cause of death for the Taiwanese and the Japanese nationals in Taiwan shows that the mortality rates of the Taiwanese, except for the ages of 70 and over, and for those between 15-25 years old, were higher. Although the main causes of death would be different by ages, as Japanese scholars already found before the 1940s, the main causes of death among the Taiwanese were respiratory illness, infectious diseases, and digestive problems; the Japanese nationals in Taiwan showed a similar but much lower mortality rates (Taiwan eipo sha, 1932, 176-179).

At almost all ages, respiratory illness was the most frequent cause of death for the Taiwanese, namely pneumonia for those under 40 years old and tuberculosis for those over 39 years old, the latter increasing parallel to the progress of age (Yoschito, 1957, 138-139). Respiratory illness remained the number one cause of death for the Taiwanese of all ages, comprising about one-third of all deaths. Among them in turn pneumonia was the highest and amounted to 66.6 per 1000 deaths of all respiratory illness (Figure 7).

Considered according to classes of age per 10,000 of the population dying at the specified age, the indices were for Taiwanese under one year old 377.41 as the maximum, and for the Taiwanese between 10 and 14 years old 6.43 as the minimum, and for the Taiwanese of all ages 44.54 as the average index. All these Taiwanese indices were considerably higher than those found for the Japanese nationals in Taiwan, for whom they were 130.05 per 10,000 cases as the maximum, 4.17 as the minimum, and 25.83 as the average of all ages.

Tuberculosis mortality rates also differed between the Taiwanese and the Japanese nationals in Taiwan (Takena, 1937, 56-58). The Taiwanese mortality curve was steadily ascending beginning at 15 years old while the Japanese curve, on the contrary, reached its highest level between 20 and 24 years old, and from there was steadily descending with progressing age (Figure 8).

Figure 8 shows that the tuberculosis mortality indices per 10,000 fluctuated between 59.79 and 0.76, the former at ages over 60, the latter at ages between 5 and 9 years old. Examining sex differences, males showed as a rule higher

Fig. 6 *The Mortality of Respiratory Illness per 10,000 Deaths*

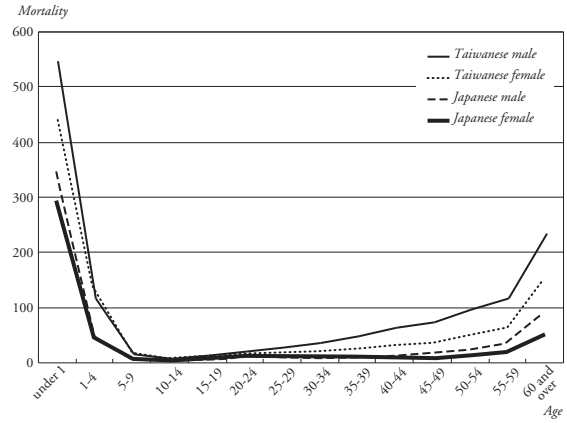


Fig. 7 *Pneumonia Mortality per 10,000 Deaths*

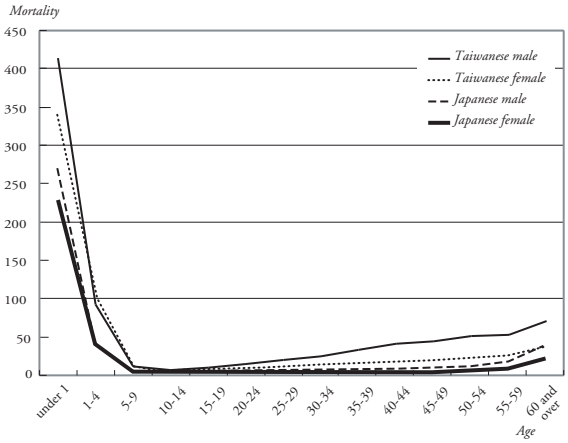
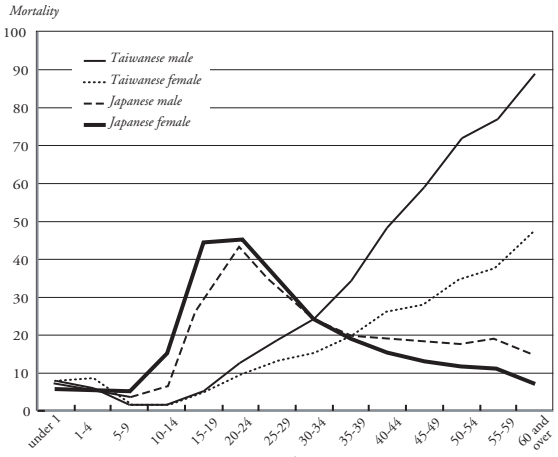


Fig. 8 *Tuberculosis Mortality by per 10,000 Deaths*



Tab. 7 *The Mortality Rates by Digestive Problems per 10,000 Cases*

	Digestive problem				Diarrhea and enteritis			
	Taiwanese		Japanese nationals		Taiwanese		Japanese nationals	
Age	male	female	male	female	male	female	male	female
Under 1	396.26	357.47	358.90	312.74	344.84	315.69	330.84	291.25
1—4	95.82	133.62	64.70	64.93	74.07	102.44	63.72	64.29
5—9	10.97	11.67	4.66	5.57	6.27	6.75	4.14	5.15
10--14	5.61	4.99	1.94	2.29	2.38	2.16	1.23	1.76
15--19	6.60	5.36	3.03	3.53	2.61	1.91	1.91	2.79
20--24	10.05	8.11	3.40	4.06	3.75	2.98	2.16	3.23
25--29	12.90	10.40	3.17	4.23	5.17	4.31	1.92	3.30
30--34	17.81	13.21	3.27	4.53	7.06	5.22	1.85	3.48
35--39	25.50	17.56	4.15	5.47	10.24	7.00	2.23	4.06
40--44	33.93	21.37	5.66	6.11	14.37	8.41	2.99	4.41
45--49	41.72	22.57	8.17	7.69	17.19	8.91	4.45	5.53
50--54	54.22	30.61	11.08	10.32	23.00	12.07	6.38	7.70
55--59	67.52	40.19	17.28	16.10	28.47	17.79	11.01	12.66
60 and over	124.05	94.02	48.00	49.58	60.39	47.26	38.45	44.19

Source: Taiwansheng wushiyinianlai tongjitiyao, 269-285.

Tab. 8 *Mortality Rates of Major Infectious Diseases per 10,000 Cases*

Death cause	Taiwanese Mortality rate	Japanese nationals Mortality rate
Typhoid fever	0.24	1.49
Malaria	10.96	3.54
Cerebrospinal meningitis	0.06	0.05
Tetanus	11.68	0.42
Measles	2.37	1.79
Congenital syphilis	1.74	1.04
Erysipelas	0.96	0.77

Source: Taiwansheng wushiyinianlai tongjitiyao, 269-285.

indices at all ages among the Taiwanese, but indices for young women were higher than those for young men among the Japanese nationals in Taiwan (Takena, 1937, 21).

After mortality from respiratory illness, digestive problems were the most frequent cause of death among the Taiwanese. In fact, as mentioned previously, respiratory illness and digestive problems were responsible for more than half of all deaths in colonial Taiwan.

Among the gastro-intestinal afflictions, the most common, 71.3%, was diarrhea plus enteritis, whose index per 10,000 among the Taiwanese fluctuated between 330.47 under one year of age, and 2.27 for the age groups 10 to14 years old as well as 15 to 19 years old. For the Japanese nationals in Taiwan, the indices were 311.25 under 1 year and 1.49 between 10 and 14 years old. Mortality from digestive problems among the Japanese was obviously less frequent than among the Taiwanese.

Mortality by infectious disease was an important factor influencing the trend of the crude mortality rate in colonial Taiwan. Contrary to common ideas, mortality by infectious disease was lower among the Taiwanese than among the Japanese nationals in Taiwan. It is worth noting that typhoid fever and epidemic cerebrospinal meningitis tended to increase after the mid-1920s. Among the principal diseases of little children, tetanus, measles, congenital syphilis,

and erysipelas all led more frequently to death in Taiwanese than in Japanese nationals. The index of tetanus among Taiwanese especially exceeded that observed among the Japanese nationals in Taiwan.

In addition, mortality by malaria, a former major killer in Taiwan, was fast declining after the 1920s. A decided improvement program in malarial control was put in place that contributed to reducing mortality by malaria between 1906 and 1942 (Kaoru, 1976, 1-8). The indices of malarial mortality among the Taiwanese fluctuated between 20.99 and 6.56 per 10,000, while the malarial mortality rate among the Japanese nationals in Taiwan was between 6.34 and 1.68. It is obvious that the malarial mortality rate among the Japanese nationals in Taiwan were markedly lower than those among the Taiwanese.

The high mortality rate among the Taiwanese could have been caused by unhealthy lifestyle conditions, although there might have been some additional peculiar causes. Personal and social factors should be cited first, such as bad nursing methods, especially with infant feedings, and the lack of knowledge about infectious diseases in general. Also, a general aversion to notification of patients and faulty traditional treatments of some diseases, a lower standard of living, habitual overworking of males, and opium addiction could all have caused the unhealthy conditions among the Taiwanese (Togaku, 1938, 717-718). Compared to the Taiwanese, the Japanese nationals in Taiwan enjoyed a better standard of health. First, the Japanese children showed a very low mortality rate. Some studies attributed this to the high standards of the nursing methods (Togaku, 1938, 1146-1149). Secondly, the low mortality among the Japanese adolescents in Taiwan may have been due to the colonial immigration policy. The colonial government selected immigrants in Japan by health status and eliminated unsuitable individuals from the immigrant population in Taiwan by their early return to Japan (Gintsuro, 1933). It is easy to understand that a healthy Japanese immigrant population with higher standards of living and medical knowledge would certainly have enjoyed a lower mortality rate than the Taiwanese.

Concluding remark

Generally speaking, the life expectancy of the Taiwanese gradually improved during the colonial period. In order to create a safe place for Japanese settlers, the authorities had to intervene in public hygiene and promote medical reform. Eventually, these governmental interferences created better health conditions for all populations living in colonial Taiwan. Previous analyses show the different mortality changes by sex and by ethnic group. It seems that the Taiwanese population experienced mortality and epidemiological transitions in a very short period of nearly ten years.

As mentioned previously, the colonial government attempted to build a modern system of public health and medical care beginning in the 1910s. By the end of the 1920s, Taiwan already revealed some signs of the transitions. However, the question remains whether the beginning and end of these mortality and epidemiological transitions should be based on trends in all causes of mortality or on changes in cause-of-

death patterns. The analysis of differential mortality by sex shows that females were more affected by public health improvements. Among ethnic groups, the differential mortality between the Taiwanese and the Japanese nationals in Taiwan showed that this difference could have mainly depended upon human factors such as public health policy, immigration policy, and the prevalence of health knowledge. However, some evidence also revealed that the Japanese settlers might have been exposed to additional dangers coming from Taiwan's geographical surroundings and, probably, their physical heritages as well.

Although I analyzed the differential mortality by sex and ethnic group, this study cannot answer all the questions related to the mortality and epidemiological trends in colonial Taiwan, nor can I draw a clear linkage between mortality changes and related policies from Japanese colonization in Taiwan. This study might help, however, in identifying the possible time and pattern of these transitions, and their different impacts on sex and ethnic groups in colonial Taiwan from historical data.

Liu SHI-YUNG
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NOTES

1. For the detailed number of these life tables, Shi-yung 2000a appendix 2.

2. I took the numbers of tuberculosis from the governmental statistics. It is worth to note that the statistics of tuberculosis was very reliable because of the restrictive prevention. The rate of tuberculosis contributed to the mortality was calculated by the same method of previous analysis.

3. Most epidemiologists suggest that in the earlier stages of the epidemiological transition increments to life expectancy come as infectious diseases decline and are replaced by deaths from degenerative illness. In the later stages of epidemiological transition, neoplasm and cardiovascular disease are major killers to the mortality. See (Omran, 1997).

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SUMMARY

Japan occupied Taiwan between 1895 and 1945. During the colonial period, the colonial government in Taiwan launched various public health reforms and declared their victory of colonization in the late 1920s. This study -using the life tables and the causes of death series- explores the ethnic-sex differential in mortality trends during the colonial years of Taiwan. The analysis of the differential mortality by sex shows that women were was more sensitive to the progress of the public health improvement. To the ethnic groups, the differential mortality between the Taiwanese and the Japanese nationals in Taiwan showed that the difference could mainly depend upon many human factors such as public health policy, immigration policy, and prevalence of health knowledge. In general, this study may contribute to identify the possible time and pattern of health transitions, and their different impacts on sexes and ethnic groups in colonial Taiwan from historical data.

RÉSUMÉ

Le Japon occupa Taiwan de 1895 à 1945. Au cours de cette période, dite coloniale, le gouvernement colonial à Taiwan lança plusieurs réformes de santé publique et proclama leur réussite dès les années 1920. Cet article explore, à partir de l'exploitation des tables de mortalité et des séries des causes de décès, les différences de mortalité par origine et par sexe apparues au cours de cette phase de changement. Les femmes s'avèrent bénéficier plus que les hommes des progrès liés à l'amélioration de la santé publique. Quant à la différence entre les Taiwanais et les Japonais, elle dépend de nombreux facteurs qui vont des conséquences de la politique de santé publique, de celles de la politique d'immigration aux écarts dans la diffusion des connaissances sur la santé. À partir de données historiques, cette étude contribue à la mise en évidence des processus de differentiation qui apparaissent lors des phases de la transition épidémiologique et sanitaire.