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Regional and ethnic variation in mortality in Japanese colonial period Taiwan

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"For a land so small, and a population of so few, sectional differences of this magnitude are indeed surprising."
George W. Barclay, Colonial Development and Population in Taiwan, 1954: 168.

Introduction

This paper explores the degree to which mortality in colonial Taiwan followed regional and/or ethnic lines of differentiation. The impact of mortality varies across many axes of human society, differentially affecting groups defined by age, sex, marital status, legitimacy status, wealth and class, educational level, and many other determinants of position in the social structure. Several of these factors are the focus of other papers in this collection. The current paper explores whether regional and ethnic differences should also be included in the list of significant determinants of mortality levels. The paper begins by exploring regional differences in mortality, and then moves to a discussion of ethnic variation. The paper provides a basis for comparison with Dutch society in the nineteenth and early twentieth centuries where regional and religious (rather than 'ethnic') differences in mortality are well known (see Engelen and Schoonheim, this volume).

High quality reporting of demographic information on the Taiwanese population in the Japanese period begins in October 1905, when the first census was conducted and a vital statistics reporting system based on household registration was inaugurated. Annual volumes of vital statistics were published through 1942 and these, along with frequent censuses provide the data for this analysis. The discussion here treats only the population of 'islanders' (J; *hontōjin*, C: *bendaoren* 本島人) in the terminology of the census and vital statistics, which I will refer to as 'Taiwanese,' and excludes the Japanese resident in the island (J: *naichijin*, C: *neidiren* 内地人).

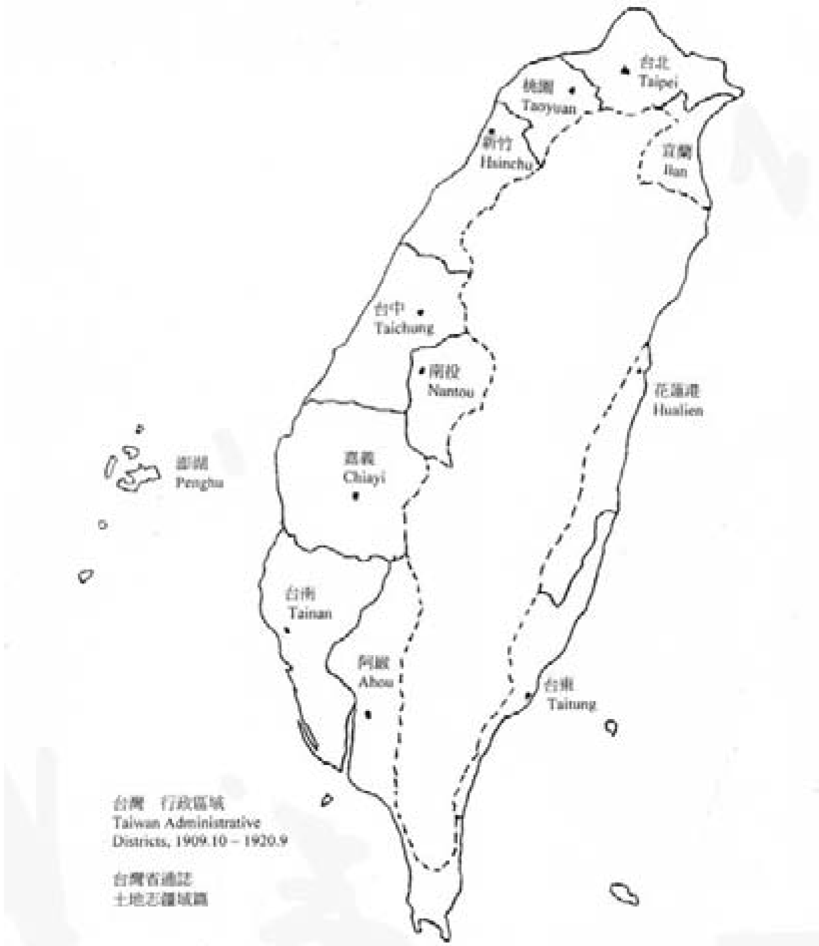
Demographic studies of regional variation in mortality in Japanese period Taiwan are of course constrained by the kinds of data reported by regional subunits in the censuses and vital statistics (J: *Taiwan jinkō dōtai tōkei* 台灣人口動態統計) which are available from 1905-1942. In general, the degree of detail reported in the vital statistics varies by administrative level, with less detail at the lower levels. Vital statistics data is reported in the greatest detail at the all-island level. Data on cause of death by age and sex, cause of death by sex and season, cause of death by provenance and sex, and cause of death by occupation and sex are only reported at the all-Taiwan level, and thus are not available for use in the study of regional variation. But many more tables also report data by prefectural units. Thus the vital statistics tables report deaths by age, sex, and prefecture, deaths by cause, sex and prefecture, deaths by season, sex and prefecture, deaths by provenance, sex and prefecture (up to 1935), deaths in infancy by age, sex, legitimacy status, and prefecture, and stillbirths by gestational age, sex, legitimacy status, and prefecture. After 1920, deaths by cause and sex and deaths by provenance (up to 1931) and sex are also reported at the district and city level (J: *gun, shi,* C: *jun shi,* 郡市). At the lowest level of detail, the vital statistics reported total deaths by sex at the subprefectural level (J: *shichō,* C: *zhiting* 支廳) up to1919, and from 1920 at the district level. An additional annual series, statistics of the defacto population (J: *Genju jinko tokei,* 現住人口統計), reported deaths by sex down to the lowest township level (J: *gai shō,* C: *jie zhuang* 街庄) for the entire period, 1905-1942. We shall make use of many of these tables for the analysis presented in this paper, while focusing on variation at the prefectural level.

Changing Boundaries and the Regional Distribution of the Population

Not only does the nature of the information on mortality vary by administrative level, the number and boundaries of the reporting units themselves change over time. To document this we must describe the changing nature of prefectural boundaries in the Japanese period.

From 1901 to 1909 Taiwan was divided administratively into twenty prefectural units (J: *chō,* C: *ting* 廳). In 1909 nineteen of these units were consolidated into ten and Taitung was divided in two. In 1920 another consolidation reduced these twelve units to seven prefectures (I refer in English to all the post 1920 units as prefectures and ignore the different administrative nomenclature for the five large (J: *shū,* C: *zhou* 州) vs. the smaller two or three units, as this difference had little bearing on reporting in the vital statistics and censuses). In 1926 an eighth prefecture was added when the Penghu islands were divided from Kaohsiung prefecture and made once again an independent prefectural unit. These eight prefectures remained in place until the end of the Japanese period in 1945. The table below gives a rough approximation of the territorial changes. Prefectures are listed counterclockwise from the northeast to southwest, followed by Penghu, and the east coast prefectures of Taitung and Hualien (which brings us back to Ilan on the northeast coast).

The consolidation of the prefectures into larger and larger units created five prefectures which from 1920 contained in excess of 96% of the total population. For reasons of space and time, this presentation will focus on mortality trends in these five units, and their namesake predecessors before 1920. In the pre-1920 period four of these prefectures occupy the cores of the large consolidated prefectures created in 1920 that bore the same name. The spatial discontinuity is greatest in the case of Ahou - Kaohsiung, as Ahou did not include the Fengshan area that would become the core of Kaohsiung prefecture. Before 1920 the five namesake prefectures accounted for a much smaller proportion of the total population, 33% in 1905 and 65% in 1915 (see table below). Mortality levels in the namesake prefectures in 1905 and 1915 are close to those in the neigh-



boring prefectures they would incorporate by 1920, and are representative of the regional variation in mortality that characterized the island pre-1920.

Regional Differences in Mortality

In his 1954 classic on the demography of Taiwan George W. Barclay made note of extreme regional differences in mortality rates in colonial Taiwan. "Whatever the causes, there were wide disparities in age-specific mortality among the various Prefectures as late as 1925... For some unknown reason Hsinchu was the most favored part of the island, followed by Taipei. The range from highest to lowest at this date was almost as great as between the beginning and the end of the Japanese period." (Barclay 1954: 166, cf. Li T'eng-yueh 1938b:1144, 1152). While puzzled by Hsinchu's low mortality rates, Barclay seems to have assumed that low mortality in Taipei was due largely to Japanese colonial public health

Prefectural boundary changes, 1901-1945.

1901-1909: 20 units	*1909-1920:12 units*	*1920-1926: 7 units*	*1926-1945: 8 units*
Ilan	Ilan		
Taipei	Taipei	Taipei	Taipei
Keelung			
Shenkeng			
Taoyuan	Taoyuan*		
Hsinchu	Hsinchu	Hsinchu	Hsinchu
Miaoli*			
Taichung	Taichung	Taichung	Taichung
Changhua			
Nantou	Nantou		
Touliu*	Chiayi		
Chiayi			
Yenshuikang*	Tainan	Tainan	Tainan
Tainan			
Fengshan	Tainan		
Fanshuliao		Kaohsiung	Kaohsiung
Ahou	Ahou		
Hengchun			
Penghu	Penghu	Kaohsiung	Penghu
Taitung	Taitung	Taitung	Taitung
	Hualien	Hualien	Hualien

Boundary changes are documented in *Taiwan Sheng Tongzhi*, Vol.1, *Tudizhi*, *Jiangyupian*, book 1 (台灣省通志, 卷一, 土地志, 疆域篇, 第一冊) 1970: 54b-74b.

* indicates that in the subsequent consolidation a subportion of this unit was allocated to a neighboring unit other than the one indicated in the chart.

measures: "As the site of the most modern cities and the favorite residence of Japanese, Taipei Prefecture was one of the safest places in which to live. It was also more liberally supplied with medical facilities than any other Prefecture... It was relatively free from malaria, and contained the most elaborate sanitary facilities in the island." (Barclay 1954: 166). We follow Barclay's lead by extending to all periods the analysis of regional variation in mortality Barclay conducted only for the 1924-25 period, and by adding the cause of death reports by prefecture to the analysis. The results will underline the exceptionalism of Hsinchu and call into question Barclay's notion that colonial public health efforts can explain the low rates of mortality in Taipei and Hsinchu.

Distribution of the Taiwanese population among the Prefectures, 1905-1920.

1920	*Taiwanese Population*			*% of Total Taiwanese Population*		
Prefecture	*1905*	*1915*	*1920*	*1905*	*1915*	*1920*
Taipei	265832	459353	658184	8.94%	13.81%	18.99%
Hsinchu	168684	321020	549401	5.67	9.65	15.85
Taichung	203802	579726	754466	6.85	17.43	21.76
Tainan	184396	545609	922337	6.20	16.41	26.61
Kaohsiung	162196*	252067*	509270	5.46	7.58	14.69
Taitung	48480	34824	35260	1.63	1.05	1.02
Hualien	-	33114	37589	-	1.00	1.08
Taiwan	2973280	3325755	3466507	100.00	100.00	100.00
Five Prefectures	984910	2157775	3393658	33.13	64.88	97.90

*Ahou prefecture.

Source: *Census of 1905, kekka hyō* p.8-9, *Census of 1915, kekka hyō* p. 8-9, *Census of 1920, Daiikkai Taiwan kokusei chosa yoran hyō*, table 1, pp. 2-7.

We begin our analysis of prefectural variation with tables showing life expectancies by sex for all Taiwan and the five major prefectures. Economy of presentation prevents showing the small east coast prefectures of Taitung and Hualien, and the Penghu islands; they contribute to the all Taiwan average, but they will not be discussed individually here. [Several additional factors complicate the analysis of mortality in these prefectures: small numbers, substantial migration, and in the east coast prefectures, administrative expansion to include new populations of aborigines, and low levels of reporting quality. Migration is an important factor affecting the age composition of the three smaller prefectures, which has to be taken into account in assessing the mortality indicators.] The five major prefectures following the 1920 administrative reorganization occupied the entire western coast of Taiwan and all major population centers, and contained 96% of the Taiwanese population in 1930. For the periods 1906-1919 the rates reported in the tables are for the smaller prefectures that formed the core of the prefectures (of the same name, but Ahou in the case of Kaohsiung) consolidated in 1909 and then again in 1920; please refer to the table documenting the prefectural consolidations 1901-1945 above. Continuity across the 1920 divide is least in the case of Ahou-Kaohsiung, which in 1920 acquired the coastal area (old Fengshan) that contained what would become the port of Kaohsiung city.

Variations in Life Expectancy among the Prefectures

One of the most detailed tables in the annual vital statistics volumes reports deaths by single years of age and by sex at the prefectural level. When combined with the census tables of population by age and sex, these tables enable us to compute life tables for all Taiwan and for each prefecture. From life tables based on data for a given set of years, we can compute the expectation of life at birth, a figure which summarizes the impact of mortality across all ages for the given period. Because life table measures are based on age-specific measures, they are not subject to bias due to differences in age structures among the prefectures (as is the case of crude death rates). Thus life expectancy provides an ideal measure for comparing prefectural units.

The table below presents measures of life expectancy for all Taiwan and for the five prefectures across the entire period. Each figure is centered on a census year, with the exception of 1906-08, the first reporting years following the 1905 census, and 1920-22, which follows the administrative reorganization of the prefectures in 1920. The right hand side of the table presents indexed figures based on the all Taiwan life expectancy for the given year.

The most striking pattern the table reveals is that Hsinchu has the highest life expectancies for both men and women from the first period to the last. Hsinchu's life expectancies are considerably higher than the all Taiwan average, and are also substantially higher than Taipei's, which generally rank second, except for 1934-36 when Taipei's are the lowest! The lowest life expectancies are consistently reported in Tainan and Kaohsiung. Life expectancy in Taichung is regularly the closest to the all-Taiwan average. The general pattern is thus of a north-south gradient in mortality, with low mortality and high life expectancy in the north, and high mortality and low life expectancy in the south. But it is Hsinchu rather than Taipei that has the most favorable conditions. The life expectancies of women are consistently higher than those of men in every period and prefecture; the female advantage averages approximately 10% over the period.

Over time, the average life expectancy increases in all prefectures (the largest gains are in the southern prefectures) and the gap between the highest and the lowest expectancies narrows. Thus the degrees of Hsinchu's advantage and the southern prefectures' disadvantage gradually diminish. As we shall see below, the factors that likely were most important in raising the all Taiwan average life expectancy and lowering the very high death rates in Kaohsiung and Tainan were malaria suppression and other public health efforts that had their greatest impact in the south.

Regional divergences in life expectancy of similar magnitude were found by William Farr in nineteenth century Britain: he estimated life expectancy at birth in 1841 at 45.1 in rural Surrey, 36.7 in London, and only 25.7 in Liverpool (Szreter 1988: 20). The British pattern of large urban – rural differences reflects the much

Table 1. **Mean Life Expectancy *at Birth* of Taiwanese, by Prefecture*, Selected Years, 1906-1941.**

Year			*Prefectures**				*Indexed Life Expectancies in Years, All Taiwan =100*				
Eo	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung Ahou*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung Ahou*
Males											
06-08	28.1	31.5	39.3	29.0	25.4	22.6	*112.1*	*139.9*	*103.2*	*90.4*	*80.4*
14-16	29.8	34.5	38.9	29.5	25.7	26.6	*115.8*	*130.5*	*99.0*	*86.2*	*89.3*
20-22	34.5	35.8	40.3	33.4	33.2	33.4	*103.8*	*116.8*	*96.8*	*96.2*	*96.8*
24-26	35.6	39.0	44.1	36.6	31.2	32.4	*109.6*	*123.9*	*102.8*	*87.6*	*91.0*
29-31	40.5	41.0	47.0	41.5	38.3	36.9	*101.2*	*116.0*	*102.5*	*94.6*	*91.1*
34-36	41.2	40.1	44.8	40.6	40.9	40.2	*97.3*	*108.7*	*98.5*	*99.3*	*97.6*
39-41	42.7	44.6	49.7	41.2	39.6	41.9	*104.4*	*116.4*	*96.5*	*92.7*	*98.1*
Females											
06-08	29.0	34.2	44.2	31.7	26.7	22.8	*117.9*	*152.4*	*109.3*	*92.1*	*78.6*
14-16	32.7	35.6	41.8	32.7	29.2	28.6	*108.9*	*127.8*	*100.0*	*89.3*	*87.5*
20-22	38.2	39.4	43.7	38.6	36.6	36.4	*103.1*	*114.4*	*101.0*	*95.8*	*95.3*
24-26	39.7	43.0	47.8	41.5	35.5	35.3	*108.3*	*120.4*	*104.5*	*89.4*	*88.9*
29-31	44.8	44.3	56.4	46.5	43.3	40.7	*98.9*	*125.9*	*103.8*	*96.7*	*90.8*
34-36	45.4	42.5	47.4	45.6	46.0	44.2	*93.6*	*104.4*	*100.4*	*101.3*	*97.4*
39-41	47.4	49.4	53.5	46.5	44.7	46.2	*104.2*	*112.9*	*98.1*	*94.3*	*97.5*

* Pre-1920 boundaries enclosed only parts of the areas defined by the boundaries set in 1920. Figures for Kaohsiung in 1920-26 include Penghu.

greater role of crowded and unsanitary urban environments in raising death rates in England during industrialization. Taiwan's level of urbanization remained quite low in comparison throughout the Japanese period, and divergences in life expectancy in Taiwan reflect large regional rather than urban – rural differences. Regional differences in life expectancy in Japan were also great. In 1920-25 expectation of life at birth in Japan's prefectures ranged from 35.9 to 47.9 for males and 36.6 to 50.5 for females. In 1930-35 the range had narrowed to 39.2 to 49.2 for males and 40.7 to 51.8 for females (Taeuber 1958: 94). Regional divergences in Taiwan were extreme in 1906, when life expectancy ranged from 22.6 to 39.3 for males and 22.8 to 44.2 for females. Differences among Taiwan's prefectures narrowed in later years, but remain impressive, especially given the much smaller geographic expanse of Taiwan compared to Britain and Japan.

Crude Death Rates and Cause Specific Death Rates among the Prefectures

Life expectancies are a powerful measure and tell the story of regional variation in mortality very succinctly. However, to assess which factors gave rise to the large regional differences in life expectancies within Taiwan we need to look further. Most important for the analysis here are the tables in the vital statistics that report deaths by cause, sex and prefecture. These tables enable us to see the contributions different causes of death make to variation in mortality among the prefectures. We use these tables in conjunction with the total population by sex of each prefecture to compute crude death rates for all causes and cause specific death rates for major causes for each prefecture and period.

The table below presents the crude death rates for all causes for all Taiwan and the five larger prefectures by sex for the years 1906-1941. To facilitate comparison, rates for each year have been indexed on the all Taiwan rate to show where each prefecture stands in relation to the average death rate for the island as whole. The table reveals the same pattern documented by the life expectancies table above. That Hsinchu had the lowest crude death rates for males and females for all years, 1906-1941, is immediately clear. Taipei had the second lowest rates for years 1906-26, and 1939-41, but not for years 1929-36. Surprisingly, in 1934-36 when we would expect public health efforts to have been at their most effective, Taipei had the highest death rates of the five prefectures. In most other years the highest rates are consistently found in the southern prefectures of Tainan and Kaohsiung. Hsinchu's advantage over the other prefectures is substantial. From 1906-1926 Hsinchu enjoyed death rates ranging from 20-30% below the all island average, and from 1929-1941 from 10-20%. Moreover, Hsinchu's advantage predates all important public health interventions by the Japanese colonial government, and persists despite heavy public health investments in Taipei and across the island. Hsinchu also benefited from public health interventions and death rates in Hsinchu declined significantly from 1906 to 1941, but Hsinchu's mortality advantage throughout the colonial period stems from factors beyond these interventions.

The life expectancies and the crude death rates both confirm the wide differences in mortality among Taiwan's prefectures, the low mortality in Hsinchu and the north generally, and the much higher mortality in the south of Taiwan. Crude rates, however, because they combine age groups whose death rates vary widely, are less reliable indicators of difference when the populations being compared also vary widely in age structure (Barclay 1958: 135). In Japanese period Taiwan differences in age composition among the prefectures are not great enough to affect the agreement of the crude death rates with the life expectancies measure when comparing the prefectures. Differences in age composition among the five larger prefectures are small in Japanese period Taiwan, as shown

Table 2. **Cause Specific Crude Death Rates by Sex and Prefecture, *All Causes*, 1906-1941. Deaths per *100,000*.**

Year	Prefectures**						Indexed Crude Death Rates by Cause, All Taiwan =100				
All Causes	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung Ahou*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung Ahou*
Males											
06-08*	3582	3087	2441	3520	3880	4368	86.2	68.1	98.3	108.3	121.9
09-13*	2990	2597	2227	3110	3283	3384	86.9	74.5	104.0	109.8	113.2
14-16*	3192	2653	2272	3241	3841	3689	83.1	71.2	101.5	120.3	115.6
17-19	3178	2753	2324	3086	3742	3766	86.6	73.1	97.1	117.7	118.5
20-22	2918	2652	2403	3036	3290	3080	90.9	82.4	104.0	112.7	105.6
24-26	2611	2343	1968	2509	3029	2713	89.7	75.4	96.1	116.0	103.9
29-31	2242	2212	1799	2181	2455	2463	98.7	80.2	97.3	109.5	109.9
34-36	2198	2283	1961	2265	2231	2201	103.9	89.2	103.0	101.5	100.1
39-41	2060	1905	1615	2209	2330	2006	92.5	78.4	107.2	113.1	97.4
Females											
06-08*	3583	2876	2209	3387	3762	4303	80.3	61.7	94.5	105.0	120.1
09-13*	2789	2524	1975	2841	3046	3233	90.5	70.8	101.9	109.2	115.9
14-16*	2970	2628	2088	2993	3402	3542	88.5	70.3	100.8	114.5	119.3
17-19	2933	2640	2087	2675	3507	3564	90.0	71.2	91.2	119.6	121.5
20-22	2703	2474	2222	2702	2981	2909	91.5	82.2	100.0	110.3	107.6
24-26	2354	2173	1814	2185	2680	2467	92.3	77.1	92.8	113.8	104.8
29-31	2032	2102	1661	1929	2165	2265	103.4	81.7	94.9	106.5	111.5
34-36	1981	2128	1857	1963	1967	2002	107.4	93.7	99.1	99.3	101.1
39-41	1811	1696	1449	1886	2020	1821	93.6	80.0	104.1	111.5	100.6

* Rates for 1906-15 have been corrected for infant unregistered nonsurvivors.

** Pre-1920 boundaries enclosed only parts of the areas defined by the boundaries set in 1920. Figures for Kaohsiung in 1920-26 have been adjusted to exclude Penghu.

in the table below. Thus we are able to read differences in prefectural cause specific death rates as indicators of differences in the incidence and severity of disease rather than differences in age structure.

Table 3. **Age Composition of Prefectures, by Sex, 1925.**

*Year 1925 Sui Age**	*Prefectures: Per cent of total population in selected Age intervals* All Taiwan	Taipei	Hsinchu	Tai-chung	Tainan	Kao-hsiung Ahou	*Indexed per cent by age interval, All Taiwan =100* Taipei	Hsinchu	Tai-chung	Tainan	Kao-hsiung Ahou
Males											
1-5	14.98	13.83	15.39	15.57	14.90	15.54	0.92	1.03	1.04	0.99	1.04
6-15	24.83	23.20	25.48	25.13	25.40	25.51	0.93	1.03	1.01	1.02	1.03
16-30	28.27	28.86	27.35	28.35	28.61	27.49	1.02	0.97	1.00	1.01	0.97
31-45	18.56	18.52	16.80	17.89	19.20	19.61	1.00	0.91	0.96	1.03	1.06
45-60	10.22	11.63	10.57	10.36	9.32	9.27	1.14	1.03	1.01	0.91	0.91
60+	3.15	3.96	4.42	2.70	2.57	2.58	1.26	1.40	0.86	0.81	0.82
Total	100.00	100.00	100.00	100.00	100.00	100.00					
Females											
1-5	15.28	14.63	15.24	15.86	15.18	15.50	0.96	1.00	1.04	0.99	1.01
6-15	24.42	23.12	24.25	24.87	25.09	24.75	0.95	0.99	1.02	1.03	1.01
16-30	26.52	26.33	26.46	27.11	26.52	25.79	0.99	1.00	1.02	1.00	0.97
31-45	16.79	16.62	16.53	16.02	16.90	17.81	0.99	0.98	0.95	1.01	1.06
45-60	11.44	12.69	11.37	11.19	10.97	11.04	1.11	0.99	0.98	0.96	0.97
60+	5.55	6.60	6.15	4.95	5.33	5.10	1.19	1.11	0.89	0.96	0.92
Total	100.00	100.00	100.00	100.00	100.00	100.00					

* 'Sui Age by cohort': the censuses from 1905 to 1925 report 'age' by year of birth, beginning with those born in the year of the census, who are listed as sui age 1. Thus there is no age '0' by this reckoning. Note that this reckoning is by birth year cohort and does not correspond either to traditional Chinese lunar year 'sui' or to Western measures of age at last birthday.

Regional Differences in Mortality: Cause Specific Death Rates among the Prefectures

We turn now to an exploration of the leading causes of death among the different prefectures to understand what causes make Hsinchu death rates so much lower and the southern prefectures' death rates so much higher than the all Taiwan average. Cause of death data is reported in the Vital Statistics by prefecture and by sex but not by age so we can report only 'crude' cause specific rates for each prefecture. I should also note that the quality of cause of death reporting in the early periods was not as high as it would be in later years. The challenges of assessing the quality of cause of death reports is discussed in a separate paper on 'Trends in Mortality' elsewhere in this volume. I conclude that the general impressions these data convey are reliable, and increasingly so as reporting quality improves. The data series for several causes appear to be inconsistently reported across the periods. Such inconsistencies arise from improving diagnostics and training on the part of personnel filling out death certificates, and changes in the definitions of disease categories (and also rules for deciding between two or more contributing causes). These causes will be reported only for the years 1924-41, during which the third and fourth international cause of death lists were used to compile the cause of death reports. There are two causes, however, malaria and respiratory tuberculosis, that appear to provide relatively consistently reported series both before and after 1924. These causes of death present symptoms relatively easy for certifiers to identify, periodic chills and fevers and swollen spleens in the case of malaria, and bloody sputum in the case of respiratory tuberculosis. The international lists for compiling death statistics in use by the colonial authorities also consistently reserved separate categories specific to these causes, which immunized them from inconsistencies arising from changing category definitions.

The tables below report the death rates by cause for the leading causes of death. Death rates by cause are computed as a ratio of the deaths assigned to a specific cause to a mid-year population; demographers refer to these crude rates by cause as cause-specific death rates (Barclay 1958: 151-55). To facilitate comparison among the prefectures the prefectural death rates are indexed on the all Taiwan average cause-specific death rates by sex in each year.

Malaria. We look first at the death rates by prefecture and sex attributed to malaria. Malarial death rates in Taiwan are extremely high in the early years of the century, and remain high until a decline set in around 1920-22 that would continue to 1941. Through most of this period Hsinchu enjoyed the lowest malaria rates. The exceptions are 1909-13 and 1917-1919 when Taipei rates were lower, and 1934-36 when both Hsinchu and Taipei suffered a resurgence in malaria deaths. Otherwise Taipei regularly ranked second lowest, confirming the generalization that the northern prefectures suffered much less from malaria than did the southern prefectures of Kaohsiung and Tainan. Malaria death rates in Kaohsiung-Ahou are the highest in every year except 1920-26 when they rank second highest behind Tainan. Ahou's rates are extremely high 1906-1919; Kaohsiung's rates fall below those of Tainan in 1920-1926 (after Ahou was consolidated with less malarial areas in Fengshan to form Kaohsiung) but they surpass Tainan again in 1929-41. Tainan generally ranks second highest in years other than 1920-26 and the anomalous years 1934-36. The degree of prefectural difference is especially great in the early years when Hsinchu and Taipei malarial death rates were regularly less than half and Ahou/Kaohsiung's twice as high as the all Taiwan average. Even after declining rates brought down Kaohsiung's extreme rates, Hsinchu and Taipei regularly (excepting 1934-36) had only 50% to 60% of the all Taiwan rate.

Table 4. **Cause Specific Crude Death Rates by Sex and Prefecture, *Malaria*, 1906-1941. Deaths per *100,000*.**

Year	*Prefectures**						*Indexed Crude Death Rates by Cause, All Taiwan =100*				
Malaria	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung Ahou*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung Ahou*
Males											
06-08	356	196	89	200	329	831	55.1	25.0	56.2	92.4	233.4
09-13	257	116	116	218	263	664	45.1	45.1	84.8	102.3	258.4
14-16	324	134	121	272	375	726	41.4	37.3	84.0	115.7	224.1
17-19	250	104	115	169	314	556	41.6	46.0	67.6	125.6	222.4
20-22	222	133	110	205	325	255	59.9	49.5	92.3	146.4	114.9
24-26	177	83	56	133	296	251	46.9	31.6	75.1	167.2	141.8
29-31	76	45	34	59	90	131	59.2	44.7	77.6	118.4	172.4
34-36	71	81	55	61	57	95	114.1	77.5	85.9	80.3	133.8
39-41	70	40	34	72	80	99	57.1	48.6	102.9	114.3	141.4
Females											
06-08	381	135	90	187	377	896	35.4	23.6	49.1	99.0	235.2
09-13	251	98	118	202	264	722	39.0	47.0	80.5	105.2	287.6
14-16	333	111	108	276	378	795	33.3	32.4	82.9	113.5	238.7
17-19	250	78	108	152	343	597	31.2	43.2	60.8	137.2	238.8
20-22	216	100	91	177	349	266	46.3	42.1	81.9	161.6	123.1
24-26	173	64	51	126	298	264	37.0	29.5	72.8	172.3	152.6
29-31	73	35	30	56	90	140	47.9	41.1	76.7	123.3	191.8
34-36	66	71	61	54	57	93	107.6	92.4	81.8	86.4	140.9
39-41	62	32	21	54	73	98	51.6	33.9	87.1	117.7	158.1

* Pre-1920 boundaries enclosed only parts of the areas defined by the boundaries set in 1920. Figures for Kaohsiung in 1920-26 have been adjusted to exclude Penghu.

Malaria was consistently a leading cause of death in nineteenth and early twentieth century Taiwan and as such early became a target of Japanese colonial public health efforts. Malaria is clearly an important contributor to large differences among the prefectures in overall death rates especially in the early years before decline set in. Malarial death rates are highest in climates most favorable to the propagation of anopheline mosquitoes and the malaria plasmodium. Malaria is most deadly in warmer areas where the virulent falciparum variety can survive, as in southern Taiwan. As control efforts strengthened, malarial death rates declined most dramatically in the southern prefectures where they had been highest. The result is that malaria contributes less overall to prefectural differences in the last half of the period. Note that the sex differential in malarial deaths rates is small and often shows a slight female excess in the southern prefectures.

Respiratory Tuberculosis. Deaths attributed to respiratory tuberculosis are consistently reported up to 1938. In 1938 the adoption of the tuberculosis prevention law requiring mandatory reporting and invasive measures of prevention caused a sudden drop in the reported number of respiratory TB deaths, which doctors (at the urging of families) assigned to other causes (Kekkaku yobōhō 1938; Chen et al. 1961:16, Lee 2001:67; cf. Wm. Johnston 1995: 248, 268, 274-75). Death rates attributed to respiratory tuberculosis were regularly at their lowest in Hsinchu excepting only 1906-08 when Taichung rates were lower. The highest rates occurred in Tainan 1906-26; in 1929-31 the highest male rates were in Tainan and Kaohsiung but the highest female rates in Taipei. In 1934-1936 Taipei had the highest rates, followed by Tainan. Respiratory tuberculosis death rates declined from 1920 island wide, but the decline was interrupted in Taipei and Hsinchu in 1934-36. The 1934-36 upsurge in respiratory tuberculosis in Taipei and Hsinchu paralleled an upsurge in malaria in those prefectures. Male rates of death from respiratory tuberculosis were much higher than female rates in all prefectures and periods (sex ratios of mortality for respiratory tuberculosis generally range from 160 to 180).

Hypotheses accounting for differentials in the incidence of respiratory tuberculosis variously emphasize diet (TB is considered to be a nutritionally sensitive disease, The Conferees 1985), exposure to active cases (e.g. within the family), environmental conditions such as crowded living spaces, poor ventilation, and polluted cities, and reduced immune response due to co-morbidity. One or many of these factors may underlie the high rates in Tainan and Taipei. Why men were much more vulnerable to respiratory tuberculosis in Taiwan than women demands explanation; such a large male excess contrasts with more balanced rates between the sexes in Japan.

High respiratory tuberculosis death rates in Taipei and Tainan prefectures suggest the possibility that especially high rates in Taiwan's two largest cities, Taipei city and Tainan city, may account for the high prefectural rates. Tuberculosis is often associated with crowded living conditions among the urban poor. Is there evidence to support this hypothesis? We have reports of deaths by cause and sex broken down to subprefectural districts and cities for Taiwanese from 1929-1941. We can compute rates for each city and for the prefectures less the city to see if the nonurban prefectural rates remain high. In the case of Taipei prefecture, we include both Taipei and the port city of Keelung in the urban category, and the remainder of Taipei prefecture in the rural category.

Table 5. **Cause Specific Crude Death Rates by Sex and Prefecture,** ***Respiratory Tuberculosis*****, 1906-1936. Deaths per** ***100,000*****.**

Year	*Prefectures**						*Indexed Crude Death Rates by Cause, All Taiwan =100*				
Resp. TB	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung Ahou*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung Ahou*
Males											
06-08	172	228	157	152	325	202	*132.6*	*91.3*	*88.4*	*189.0*	*117.4*
09-13	153	164	82	148	214	157	*107.2*	*53.6*	*96.7*	*139.9*	*102.6*
14-16	169	172	83	161	237	165	*101.8*	*49.1*	*95.3*	*140.2*	*97.6*
17-19	211	214	113	218	292	213	*101.4*	*53.6*	*103.3*	*138.4*	*100.9*
20-22	211	204	94	232	291	206	*96.7*	*44.5*	*110.0*	*137.9*	*97.6*
24-26	205	180	90	229	273	223	*87.8*	*43.9*	*111.7*	*133.2*	*108.8*
29-31	174	177	80	186	214	190	*101.7*	*46.0*	*106.9*	*123.0*	*109.2*
34-36	174	194	109	183	187	183	*111.5*	*62.6*	*105.2*	*107.5*	*105.2*
Females											
06-08	94	142	97	83	189	129	*151.1*	*103.2*	*88.3*	*201.1*	*137.2*
09-13	85	111	47	77	117	84	*130.6*	*55.3*	*90.6*	*137.6*	*98.8*
14-16	97	116	48	89	139	92	*119.6*	*49.5*	*91.8*	*143.3*	*94.8*
17-19	126	137	56	119	187	123	*108.7*	*44.4*	*94.4*	*148.4*	*97.6*
20-22	131	131	47	145	174	139	*100.0*	*35.9*	*110.7*	*132.8*	*106.1*
24-26	122	124	46	128	157	144	*101.6*	*37.7*	*104.9*	*128.7*	*118.0*
29-31	110	131	41	110	130	130	*119.1*	*37.3*	*100.0*	*118.2*	*118.2*
34-36	109	129	61	101	123	120	*118.3*	*56.0*	*92.7*	*112.8*	*110.1*

* Pre-1920 boundaries enclosed only parts of the areas defined by the boundaries set in 1920. Figures for Kaohsiung in 1920-26 have been adjusted to exclude Penghu.

The table below reveals that Taipei-Keelung and Tainan cities had rates of respiratory tuberculosis mortality considerably above the surrounding countryside, and higher than any prefecture. Taipei-Keelung has the highest rates 1929-36. The urban population of Taipei-Keelung is a substantial proportion of the population of Taipei prefecture (26% in 1935) and the urban rates have a strong impact on the prefectural rates. Rural Taipei's respiratory tuberculosis death rates are thus much lower than that of the prefecture as a whole, and fall below the all-Taiwan average but above the Hsinchu rates. Tainan city is a much smaller proportion of Tainan prefecture's total population (7% in 1935), and the urban rates have a smaller impact on the prefectural rates. Thus the respiratory TB

Table 6. **Cause Specific Crude Death Rates by Sex, *Urban vs. Rural, Respiratory Tuberculosis*, 1929-1936. Deaths per *100,000*.**

Year	*Prefecture, Urban and Rural Districts*						*Indexed Crude Death Rates by Cause, All Taiwan =100*					
	Taipei Pref	*Urban Taipei & Keelung*	*Rural Taipei Pref.*	*Tainan Pref.*	*Urban Tainan*	*Rural Tainan Pref.*	*Taipei Pref.*	*Urban Taipei & Keelung*	*Rural Taipei Pref.*	*Tainan Pref.*	*Urban Tainan*	*Rural Tainan Pref.*
Males												
29-31	177	282	143	214	264	210	*101.7*	*162.1*	*82.2*	*123.0*	*151.7*	*120.7*
34-36	194	306	154	187	195	186	*111.5*	*175.9*	*88.5*	*107.5*	*112.1*	*106.9*
Females												
29-31	131	221	99	130	202	124	*119.1*	*200.9*	*90.0*	*118.2*	*183.6*	*112.7*
34-36	129	202	101	123	179	119	*118.3*	*185.3*	*92.7*	*112.8*	*164.2*	*109.2*

death rates of rural Tainan continue to rank high among the prefectures, and above the all-Taiwan average. So we find in Taipei high rates of respiratory tuberculosis are an urban phenomenon not shared by the surrounding countryside, but in Tainan and the south generally high rates of respiratory tuberculosis are also important in rural areas.

The remaining disease groups to be discussed, respiratory diseases, diarrhea and enteritis, and certain diseases of infancy are most consistently reported and defined in the period 1924-41.

Respiratory Diseases. "Respiratory diseases" is a broad category including pneumonia, bronchitis, influenza ("PBI"), and other respiratory diseases, that weighed heavily on the health of Taiwanese in this period. From 1924-1941 respiratory diseases accounted for 31 and 29 per cent of total deaths for males and females respectively. When combined they are the leading cause of death in all periods, and all prefectures suffered from high rates of these diseases. Death rates attributed to respiratory diseases were regularly at their lowest in Hsinchu, and second lowest in Taipei, excepting females 1929-31 when Taichung rates were lower. Tainan and Kaohsiung had the highest rates except 1934-36 when Taichung males had the highest rate, and 1939-41 when Taichung's rates exceeded those of Kaohsiung but not Tainan's. The degree of prefectural difference in respiratory disease death rates, while substantial, is much less extreme compared to malaria, and even respiratory tuberculosis. Hsinchu's advantage is nevertheless considerable as its respiratory disease death rates range between 70% and 80% of the all-Taiwan average

Table 7. **Cause Specific Crude Death Rates by Sex and Prefecture,** ***Respiratory Diseases (PBI)*****, 1924-1941. Deaths per** ***100,000*****.**

Year	*Prefectures**						*Indexed Crude Death Rates by Cause, All Taiwan =100*				
Resp. PBI	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*
Males											
24-26	809	687	575	870	957	874	*84.9*	*71.1*	*107.5*	*118.3*	*108.0*
29-31	697	673	562	743	766	804	*96.6*	*80.6*	*106.6*	*109.9*	*115.4*
34-36	704	648	618	759	749	730	*92.0*	*87.8*	*107.8*	*106.4*	*103.7*
39-41	683	530	509	760	838	671	*77.6*	*74.5*	*111.3*	*122.7*	*98.2*
Females											
24-26	671	606	469	685	788	735	*90.3*	*69.9*	*102.1*	*117.4*	*109.5*
29-31	586	600	465	563	633	688	*102.4*	*79.4*	*96.1*	*108.0*	*117.4*
34-36	579	567	534	590	601	621	*97.9*	*92.2*	*101.9*	*103.8*	*107.3*
39-41	542	422	417	580	653	561	*77.9*	*76.9*	*107.0*	*120.5*	*103.5*

* Figures for Kaohsiung in 1924-26 have been adjusted to exclude Penghu.

(excepting 1934-36). But the rates in the high ranking prefectures exceed the all-Taiwan average by only 10-20%. Still it is interesting to discover that the same north-south gradient in death rates (despite the north's having colder, wetter winters) appears in the case of respiratory diseases as in the case of malaria.

Pneumonia death rates were the highest of the three named diseases; cases of pneumonia often bring on death after a person has been stricken by some other disease. What accounts for the higher rates – diet (pneumonia is nutritionally sensitive, meaning that victims of the disease who are malnourished will suffer more serious cases), environmental and climatic conditions, lowered resistance due to a heavier incidence of concurrent diseases, or higher exposure rates? Tainan and Kaohsiung have already figured prominently in our discussion of malaria and respiratory tuberculosis, increasing the probability that comorbidity plays an important role in higher respiratory disease rates.

Diarrhea and Enteritis. Diarrhea and enteritis were consistently among the leading causes of death, accounting for approximately 12-15% of total deaths for both sexes, 1924-1941. Death rates attributed to diarrhea and enteritis were regularly at their lowest in Hsinchu followed by Taipei, and at their highest in Tainan, 1924-41. Hsinchu (47-57% of the all island average) and Taipei (63-80%) rates are substantially lower than the all Taiwan average, which is pushed up by very

Table 8. **Cause Specific Crude Death Rates by Sex and Prefecture, *Diarrhea and Enteritis*, 1924-1941. Deaths per *100,000*.**

Year			*Prefectures**				*Indexed Crude Death Rates by Cause, All Taiwan =100*				
Diarrhea Enteritis	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*
Males											
24-26	330	207	172	334	457	344	62.7	52.1	101.2	138.5	104.2
29-31	340	215	161	352	461	420	63.2	47.4	103.5	135.6	123.5
34-36	271	198	154	282	341	320	73.1	56.8	104.1	125.8	118.1
39-41	244	152	125	283	322	272	62.3	51.2	116.0	132.0	111.5
Females											
24-26	330	223	173	342	432	345	67.6	52.4	103.6	130.9	104.5
29-31	351	246	165	366	469	421	70.1	47.0	104.3	133.6	119.9
34-36	277	221	154	282	346	322	79.8	55.6	101.8	124.9	116.2
39-41	244	161	130	275	312	277	66.0	53.3	112.7	127.9	113.5

* Figures for Kaohsiung in 1924-26 have been adjusted to exclude Penghu.

high rates in the south. Tainan's rates (25-39% higher than the average) are more than twice as high as Hsinchu's. The diarrhea rates thus show a sharp divide between the northern and the southern prefectures (including Taichung), similar to that we found for malaria and respiratory tuberculosis, though not as extreme as in the case of malaria. Diarrheal disease rates by sex show a slight female excess in all prefectures and periods; sex ratios of mortality for these diseases generally range from 95 to 100. It is interesting that the sex ratio of mortality remains largely constant across sharp regional variations. Why should women, who have such a large advantage over men in respiratory tuberculosis and respiratory diseases, have a slight disadvantage in the diarrheas, when all three categories of disease are considered nutritionally sensitive?

What can explain such a sharp regional difference? Differential exposure (perhaps resulting from climatic factors favoring bacterial growth) and resistance are likely possibilities. The cooler northern climate likely benefits Hsinchu and Taipei in reducing the amount of food and drink contaminated by bacteria. Could differences in food and drink sanitation practices between north and south also play a role in the regional contrasts? It is important to note that diarrheas, because they interfere with the absorption of nutrients can be important causes of the worsening of concurrent diseases. Higher rates of diarrhea and enteritis thus likely play an important role in raising the rates of death from other diseases.

Table 9. **Cause and *Age* Specific Crude Death Rates by Sex and Prefecture, *Diarrhea and Enteritis*, 1934-1941. Deaths per *100,000*.**

Year			Prefectures*				Indexed Crude Death Rates by Cause, All Taiwan =100				
Diarrhea Enteritis	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*
Males<2											
34-36	2470	2142	1633	2573	2758	2882	86.7	66.1	104.2	111.7	116.7
39-41	2055	1526	1194	2288	2517	2234	74.3	58.1	111.3	122.5	108.7
Females<2											
34-36	2478	2276	1577	2616	2771	2799	91.8	63.6	105.6	111.8	113.0
39-41	2047	1599	1257	2298	2396	2207	78.1	61.4	112.3	117.0	107.8
Males>2											
34-36	83	49	32	81	119	94	59.0	38.6	97.6	143.4	113.3
39-41	90	47	33	100	132	103	52.2	36.7	111.1	146.7	114.4
Females>2											
34-36	88	62	37	78	124	104	70.0	42.0	88.6	140.9	118.2
39-41	92	47	37	96	135	110	51.1	40.2	104.3	146.7	119.6

Table 10. **Sex Ratios of Cause, Age and Sex Specific Death Rates of Taiwanese, *Diarrhea and Enteritis*, 1934-1941. Male Death Rate/Female Death Rate.**

Year		*Prefectures*				
Diarrhea Enteritis	*All Taiwan*	*Taipei*	*Hsinchu*	*Taichung*	*Tainan*	*Kaohsiung*
Age <2						
1934-36	1.00	0.94	1.04	0.98	1.00	1.03
1939-41	1.00	0.95	0.95	1.00	1.05	1.01
Age >2						
1934-36	0.94	0.79	0.86	1.04	0.96	0.90
1939-41	0.98	1.00	0.89	1.04	0.98	0.94

Diarrheal diseases are an important cause of infant mortality and a large proportion of deaths due to diarrhea occur in infancy (42% and 37% for males and females in 1939-41), early childhood (35% and 42% for males and females ages 1-4, 1939-41), and in the older age groups age 55 and above (10% 1939-41).

The fourth international classification of causes of death separates deaths due to diarrhea below age 2 from deaths above age 2. Thus for the years 1934-36 and 1939-41 we are able to report age and cause specific death rates for diarrhea across the prefectures. The very high diarrhea death rates below age 2 reflect the concentration of diarrhea deaths in infancy and early childhood. In 1939-41 65% and 66% of all male and female diarrhea deaths occurred below age 2. Both age groupings show sharp regional difference between low northern and high southern diarrhea death rates; the regional contrast is even greater above age two. The high diarrhea death rates below age 2 provide insight into a leading cause of infant mortality and a major contributor to regional differences in infant death rates. In 1939-41 diarrhea and enteritis deaths accounted for 19% and 21% of all male and female deaths below age 2 and 16% and 17% below age 1.

These findings have relevance for our understanding of the impact of adoption on infant and early childhood death rates, especially for females. We have strong evidence that adoption at early ages is associated with elevated rates of female mortality (Wolf 1995: 302ff., Yu Kuang-hong et al. this volume). A likely causal pathway raising the death rates of adopted girls is one that links early weaning and consumption of contaminated food and drink to diarrheal diseases. If our assumption that rates of adoption of girls at young ages are much higher in Taipei and Hsinchu than in the south is correct, and that adoption is an important determinant of infant and early childhood mortality patterns overall, we would expect to find higher rates of diarrheal mortality among girls compared to boys in the northern prefectures, and among girls in the north compared to girls in the south. Diarrheal causes of death are concentrated in the postneonatal period (see Shepherd "Trends", infra), so the strong disadvantage of boys in the neonatal period compared to girls should not affect our comparison. We find that girls below age 2 suffer from higher rates than boys in Taipei in both years and Hsinchu in one year, while in the other prefectures there is little difference between the sexes. This gives some support to the hypothesis that female adoption elevates diarrheal death rates in the north, rather than a general son preference - daughter neglect pattern that would raise female rates (both adopted and non-adopted) in all prefectures. However, the regional comparison casts doubt on the overall significance of the adoption hypothesis. Southern rates of female diarrheal mortality below age 2 are much higher than northern rates, despite the presumed low rates of female adoption. That diarrheal death rates are much higher in the south for both sexes both below age 2 and above shows that environmental and epidemiological factors are much more important than adoption patterns as determinants of levels of diarrheal disease mortality in all the prefectures.

Certain Diseases of Infancy. 'Certain diseases of infancy' is a cause category restricted to deaths occurring in infancy, and which includes causes occurring

Table 11. **Cause Specific Crude Death Rates by Sex and Prefecture,** ***Certain Diseases of Infancy*****, 1924-1941. Deaths per** ***100,000.***

Year	*Prefectures**						*Indexed Crude Death Rates by Cause, All Taiwan =100*				
Dis. of Infancy	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*
Males											
24-26	142	135	136	143	159	122	*95.1*	*95.8*	*100.7*	*112.0*	*85.9*
29-31	132	132	114	127	147	133	*100.0*	*86.4*	*96.2*	*111.4*	*100.8*
34-36	144	159	135	130	152	135	*110.4*	*93.8*	*90.3*	*105.6*	*93.8*
39-41	129	135	96	123	157	119	*104.7*	*74.4*	*95.3*	*121.7*	*92.2*
Females											
24-26	109	112	102	109	119	88	*102.8*	*93.6*	*100.0*	*109.2*	*80.7*
29-31	100	107	82	96	107	99	*107.0*	*82.0*	*96.0*	*107.0*	*99.0*
34-36	109	124	96	97	116	107	*113.8*	*88.1*	*89.0*	*106.4*	*98.2*
39-41	102	108	77	98	122	95	*105.9*	*75.5*	*96.1*	*119.6*	*93.1*

* Figures for Kaohsiung in 1924-26 have been adjusted to exclude Penghu.

overwhelmingly in the first month of life, such as congenital malformation, debility, prematurity, and birth trauma. Hsinchu regularly reports the lowest or next lowest rates (excepting males 1924-26 when Hsinchu ranks third), and Tainan regularly reports the highest or next highest rates. Both the Hsinchu advantage over the all Taiwan average and the Tainan excess are the smallest of the disease groups discussed. Because the certain diseases of infancy category reports primarily endogenous and neonatal deaths, rather than exogenous causes related to environmental exposures, a smaller degree of variation among the prefectures is to be expected.

Note that while the death rates reported in this category are the smallest of the disease groups reported so far, they exceed the rates reported for malaria in 1931-41 for all prefectures (excepting Kaohsiung females) and for the northern prefectures from 1924. Thus certain diseases of infancy though restricted to the first year of life nevertheless ranks high as a leading cause of death for all prefectures. But note also that these rates are reported as a crude death rate where the entire population forms the denominator when in fact the population at risk is restricted to newborns.

To get a more precise picture of variation across the prefectures with respect to infant causes of death we can refine these measures by limiting the denominator to the exposed population of live births. The ‘certain diseases of

Table 12 Infant Death Rates and certain neonatal causes of death by prefecture, 1924-41. Deaths per thousand.

Year			*Prefectures*				*Indexed Crude Death Rates by Cause, All Taiwan =100*				
IDR	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*
Males											
InfDeathRate											
1924-26**	181.7	170.2	154.6	179.7	194.8	207.6	93.7	85.1	98.9	107.2	114.3
1929-31	170.3	168.1	143.9	169.5	176.6	190.6	98.7	84.5	99.5	103.7	111.9
1934-36	162.0	163.9	153.9	161.0	164.4	165.5	101.2	95.0	99.4	101.5	102.2
1939-41	144.0	133.0	123.8	143.9	159.5	145.5	92.4	86.0	99.9	110.8	101.0
NN death rate											
1924-26	90.9	80.6	73.6	91.0	101.3	111.5	88.7	81.0	100.1	111.4	122.7
1929-31	81.9	81.3	69.8	84.3	84.0	91.2	99.3	85.2	102.9	102.6	111.4
1934-36	74.8	74.1	74.2	74.1	76.4	76.3	99.1	99.2	99.1	102.1	102.0
1939-41	67.7	-	-	-	-	-					
PNN death rate*											
1924-26	99.9	97.5	87.5	97.6	104.0	108.1	97.6	87.6	97.7	104.1	108.2
1929-31	96.3	94.6	79.7	93.0	101.0	109.4	98.2	82.8	96.6	104.9	113.6
1934-36	94.3	97.0	86.0	93.9	95.2	96.6	102.9	91.2	99.6	101.0	102.4
1939-41	81.8	-	-	-	-	-					
NN%											
1924-26	50.0	47.4	47.6	50.6	52.0	53.7	94.8	95.2	101.2	104.0	107.4
1929-31	48.1	48.3	48.5	49.8	47.6	47.8	100.4	100.8	103.5	99.0	99.4
1934-36	46.1	45.2	48.2	46.0	46.5	46.1	98.0	104.6	99.8	100.9	100.0
1939-41	47.0	-	-	-	-	-					
Cert.Dis.Infancy											
1924-26	32.4	33.9	31.3	31.3	35.9	29.2	104.6	96.6	96.6	110.8	90.1
1929-31	28.4	31.6	25.7	26.1	29.1	28.7	111.3	90.5	91.9	102.5	101.1
1934-36	31.0	38.3	30.6	26.8	30.5	28.9	123.5	98.7	86.5	98.4	93.2
1939-41	28.4	32.8	21.3	25.6	32.3	27.5	115.5	75.0	90.1	113.7	96.8
Tetanus***											
1934-36	25.6	20.5	28.4	26.4	25.9	27.7	80.1	110.9	103.1	101.2	108.2
1939-41	23.1	18.6	27.6	22.2	24.1	23.9	80.5	119.5	96.1	104.3	103.5
Females											
InfDeathRate											
1924-26**	151.5	143.4	123.7	146.7	163.8	173.2	94.7	81.7	96.8	108.1	114.3
1929-31	141.8	144.8	115.0	136.5	144.0	166.9	102.1	81.1	96.3	101.6	117.7

1934-36	135.6	143.6	123.5	129.2	137.2	143.7	*105.9*	*91.1*	*95.3*	*101.2*	*106.0*
1939-41	120.8	111.3	101.4	117.8	134.6	127.1	*92.1*	*83.9*	*97.5*	*111.4*	*105.2*
NN death rate											
1924-26	67.3	60.1	52.8	66.5	75.5	81.1	*89.3*	*78.5*	*98.8*	*112.2*	*120.5*
1929-31	60.1	61.6	48.5	60.4	59.7	71.1	*102.5*	*80.7*	*100.5*	*99.3*	*118.3*
1934-36	55.4	57.0	51.8	53.5	56.4	59.8	*102.9*	*93.5*	*96.6*	*101.8*	*107.9*
1939-41	52.0	-	-	-	-	-					
PNN death rate*											
1924-26	90.3	88.7	74.8	85.9	95.5	100.3	*98.2*	*82.8*	*95.1*	*105.8*	*111.1*
1929-31	86.9	88.7	69.9	81.0	89.7	103.1	*102.1*	*80.4*	*93.2*	*103.2*	*118.6*
1934-36	84.9	91.8	75.6	80.0	85.6	89.1	*108.1*	*89.0*	*94.2*	*100.8*	*104.9*
1939-41	72.6	-	-	-	-	-					
NN%											
1924-26	44.4	41.9	42.7	45.3	46.1	46.8	*94.4*	*96.2*	*102.0*	*103.8*	*105.4*
1929-31	42.4	42.6	42.1	44.3	41.4	42.6	*100.5*	*99.3*	*104.5*	*97.6*	*100.5*
1934-36	40.9	39.7	41.9	41.4	41.1	41.7	*97.1*	*102.4*	*101.2*	*100.5*	*102.0*
1939-41	43.1	-	-	-	-	-					
Cert.Dis.Infancy											
1924-26	25.1	27.5	24.1	24.2	27.1	21.8	*109.6*	*96.0*	*96.4*	*108.0*	*86.9*
1929-31	21.9	25.5	19.1	20.1	21.8	21.7	*116.4*	*87.2*	*91.8*	*99.5*	*99.1*
1934-36	24.3	29.9	22.6	20.6	24.3	23.4	*123.0*	*93.0*	*84.8*	*100.0*	*96.3*
1939-41	23.5	26.3	18.1	21.4	26.7	22.5	*111.9*	*77.0*	*91.1*	*113.6*	*95.7*
Tetanus***											
1934-36	18.7	15.7	19.3	18.6	19.8	21.1	*84.0*	*103.2*	*99.5*	*105.9*	*112.8*
1939-41	17.3	13.8	18.9	15.8	19.2	19.6	*79.8*	*109.2*	*91.3*	*111.0*	*113.3*
Total Fertility Rate, 1941**	6.24	5.77	6.43	6.5	6.66	5.96	*92.5*	*103.0*	*104.2*	*106.7*	*95.5*
Total Marital Fertility Rate, 1941**	7.62	6.85	7.8	8.01	8.13	7.34	*89.9*	*102.4*	*105.1*	*106.7*	*96.3*

* PNN death rate calculated as deaths per survivors of the first month of life.

**infant death rate reported here diverges from the life table infant mortality rate in 1924-26 where the life table is based on birth cohorts and uses only two full years of infant deaths and births spread across the 1924-26 period.

*** Infantile Tetanus for prefectures is estimated as 82% of reported deaths due to "other infectious and parasitic" causes, except in 1934-36 when it is 83% for males.

**** Fertility rates calculated from *Fubo no nenreibetsu shussei oyobi shisan tōkei*, 1941 (Statistics of live births and stillbirths by age of parents). Taiwan Sōtokufu Sōmukyoku. Taihoku 1943.

infancy' category reports only deaths in the first year of life, which enables us to report such deaths per thousand live births. The table above presents several additional measures of infant mortality. First is a direct computation of the infant death rate, the neonatal and postneonatal death rates, and the percentage of infant deaths neonatal by prefecture and sex. Second is the rate of infantile tetanus, 1934-41 (estimated for the prefectures as 82% of reported deaths due to "other infectious and parasitic" causes, based on the detailed list used in the reports of deaths by age for all Taiwan in those years). Infantile tetanus is a cause of death occurring overwhelmingly in the first month of life. However, there is some reason to believe that infantile tetanus was 'overreported', as neonatal deaths from other causes were carelessly reported as infantile tetanus; this does not however affect our assessment that this category reports overwhelmingly neonatal deaths (see Shepherd "Trends", infra). Third are reports of the total and marital fertility rates by prefecture for 1941.

Despite having lower than average infant death rates and lower than average neonatal death rates, Hsinchu has higher than average rates of deaths due to 'tetanus', and Taipei higher than average rates of deaths due to certain diseases of infancy.

Hsinchu's neonatal death rate is low despite having above average fertility rates while Kaohsiung's neonatal death rate is high despite having below average fertility rates. This suggests that explanations relying on excess fertility and crowded spacing to explain high neonatal death rates are less important than factors related to the disease environment in the various prefectures. This contradicts the usual assumption that neonatal deaths are relatively immune to environmental influences. Perhaps environmental influences on neonatal death rates are operating via effects on maternal health, independent of fertility, which in turn result in higher proportions of low birth weight babies?

Certain diseases of infancy and tetanus combined account for at least 70% of total neonatal deaths in 1934 (see Shepherd "Trends", infra). From 1924 to 1941, the PBI category accounts for 27-32% of total infant deaths, the diarrhea category accounts for 16-21%, certain diseases of infancy accounts for 16-20%, the tetanus category accounts for 13-17%, and malaria accounts for 1-3%. While certain diseases of infancy and tetanus account for the bulk of neonatal deaths, respiratory diseases and diarrheas account for the bulk of postneonatal diseases (Shepherd "Trends", infra). Of the causes of death reviewed here, malaria and respiratory tuberculosis are of little significance in infant mortality.

The patterns of difference between the prefectures with regard to the infant death rates and neonatal and postneonatal death rates confirm our impression that Hsinchu is the healthiest prefecture and Tainan and Kaohsiung are the least healthy. Overall the degree of variation among the prefectures in infant death rates is more moderate than for many of the causes we have reviewed;

Table 13. **Infant Death Rates, by Prefecture*, Selected Years, 1906-1941.**

Year	*Prefectures**						*Indexed Infant Death Rate, All Taiwan =100*				
IDR	*All Taiwan*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*	*Taipei*	*Hsinchu*	*Tai-chung*	*Tainan*	*Kao-hsiung*
Males											
06-08*	194.0	184.5	159.4	200.1	201.6	199.3	*95.1*	*82.2*	*103.1*	*103.9*	*102.7*
14-16*	196.6	192.0	178.2	202.1	207.9	205.7	*97.7*	*90.6*	*102.8*	*105.7*	*104.6*
20-22	176.5	174.0	156.3	186.2	173.0	190.7	*98.6*	*88.6*	*105.5*	*98.0*	*108.0*
24-26	181.7	170.2	154.6	179.7	194.8	207.6	*93.7*	*85.1*	*98.9*	*107.2*	*114.3*
29-31	170.3	168.1	143.9	169.5	176.6	190.6	*98.7*	*84.5*	*99.5*	*103.7*	*111.9*
34-36	162.0	163.9	153.9	161.0	164.4	165.5	*101.2*	*95.0*	*99.4*	*101.5*	*102.2*
39-41	144.0	133.0	123.8	143.9	159.5	145.5	*92.4*	*86.0*	*99.9*	*110.8*	*101.0*
Females											
06-08*	193.0	157.1	122.3	211.3	191.1	200.8	*81.4*	*63.4*	*109.5*	*99.0*	*104.0*
14-16*	172.2	180.0	137.0	181.8	180.9	181.3	*104.5*	*79.6*	*105.6*	*105.1*	*105.3*
20-22	148.3	151.8	130.7	149.5	145.6	162.5	*102.4*	*88.1*	*100.8*	*98.2*	*109.6*
24-26	151.5	143.4	123.7	146.7	163.8	173.2	*94.7*	*81.7*	*96.8*	*108.1*	*114.3*
29-31	141.8	144.8	115.0	136.5	144.0	166.9	*102.1*	*81.1*	*96.3*	*101.6*	*117.7*
34-36	135.6	143.6	123.5	129.2	137.2	143.7	*105.9*	*91.1*	*95.3*	*101.2*	*106.0*
39-41	120.8	111.3	101.4	117.8	134.6	127.1	*92.1*	*83.9*	*97.5*	*111.4*	*105.2*

* Pre-1920 boundaries enclosed only parts of the areas defined by the boundaries set in 1920. Figures for Kaohsiung in 1920-26 include Penghu.

Hsinchu's advantage and Kaohsiung and Tainan's excess above the all Taiwan average are relatively small. It is interesting that Kaohsiung's infant death rates in these periods are regularly higher than those in Tainan, which modifies our impression from the other causes of death that Tainan was more often the worse off. There is little variation among the prefectures in the percentage of infant deaths neonatal, which is higher for males than females. The sex ratio of mortality is highest for the neonatal death rates (generally ranging 130-140) and falls in the postneonatal period (generally ranging 107-117), as is expected.

Conclusion to Regional Differences

One of the most striking features of these tables taken as a whole is that the advantage enjoyed by Hsinchu and the disadvantages suffered by Tainan and Kaohsiung are consistent across all causes, rather than concentrated in one or two. Moreover the advantages and disadvantages are constant across all periods

Table 14. **Crude Death Rates by Sex, *Urban vs. Rural, All Causes*, 1929-1941. Deaths per *100,000*.**

		Death Rates Inside and Outside Cities			*Ratio of Urban to Rural*	
Year	*Urban Taipei & Keelung*	*Rural Taipei Pref.*	*Urban Tainan*	*Rural Tainan Pref.*	*Taipei*	*Tainan*
Males						
29-31	2483	2124	2361	2462	*1.17*	*0.96*
34-36	2405	2241	1933	2254	*1.07*	*0.86*
39-41	2021	1857	1801	2380	*1.09*	*0.76*
Females						
29-31	2254	2048	2109	2169	*1.10*	*0.97*
34-36	2107	2136	1778	1981	*0.99*	*0.90*
39-41	1779	1660	1684	2050	*1.07*	*0.82*

despite fluctuations in rates. This pattern of division between "healthy districts" and "unhealthy districts" suggests that disease comorbidity is an important contributor to overall death rates. High rates of diseases like malaria and diarrheas in the warmer southern districts lower the population's immune resistance and increase rates of secondary and opportunistic diseases like respiratory tuberculosis and pneumonias. But when a district like Hsinchu is relatively free of malaria and the diarrheas, the local population's immune responses remain relatively unimpaired, the population is better able to resist opportunistic infections, and the result is lower death rates overall.

A separate comparison of the large cities of Taipei-Keelung and Tainan for each of the cause categories (not shown here) shows that in comparison to the rural areas of their respective prefectures both cities have lower death rates for malaria, diarrheas, and respiratory diseases. But this urban advantage is offset by communicable diseases such as respiratory tuberculosis, measles and whooping cough, which spread easily in dense populations and whose severity is greatest among the poorly nourished. The table above showing the urban-rural comparison for all causes summarizes the results.

The overall balance of factors finds urban Tainan enjoying a growing advantage over its countryside. But the disadvantage in respiratory tuberculosis and infectious diseases leaves urban Taipei-Keelung with net death rates higher than its countryside. Thus we find regional climatic and epidemiological factors, rather than urban-centered public health measures (contra Barclay) to be the most important determinants of northern Taiwan's regional advantage in mortality in colonial period Taiwan.

Ethnic Differences in Colonial Taiwan

In the balance of this paper we turn to discuss variation in mortality levels among the major ethnic groups in Taiwan (not considered here are the resident Japanese nationals). Among the questions we address are: Is there evidence that mortality varied by ethnicity in colonial Taiwan? Is such variation a consequence of regional variation in mortality or is it itself a determinant of regional variation? We begin with a brief introduction to Taiwan's ethnic groups.

A substantial majority of the colonial Taiwanese population were descendants of Han Chinese migrants from China's southern Fujian province and were speakers of the southern Min ("Minnan") language. These Minnan speakers are known as "Hoklo" (also "Hokkien") and their provenance/nationality was classified as "Fujianese" in the household registers and the censuses and vital statistics based on them. [Readers interested in a more detailed introduction to the definition of ethnic groups in Taiwan may refer to a previous essay by Shepherd et al., 2006 "Group identity and fertility."] An important minority of Taiwanese descended from Han migrants from the province of Guangdong who spoke a Chinese language known as Kejia. These Kejia speakers are known as "Hakka" and were entered into the household registers as "Guangdongese."

The household registers assigned individuals to provenance groupings (Fujianese and Guangdongese) based on ancestral origin and descent (through the presumed biological father or mother if father was unknown) rather than ethnicity or language. For the great majority provenance and ethnolinguistic affiliation coincided unproblematically. The 1915 census reports that more than 99% of those registered as Fujianese were also Min speakers. However, approximately 15% of Guangdongese (from Chaochou prefecture) were speakers of a language more closely related to Minnan than Kejia. This is the most important exception to our practice of equating the provenance categories of Fujianese and Guangdongese to Hoklo and Hakka, respectively. Additional exceptions may result from marriages and adoptions across these categories.

A third ethnolinguistic grouping considered here is the Plains Aborigines, descendants of the indigenous Austronesian inhabitants of the island. The provenance/ nationality category used to enter the Plains Aborigines (also known as *pingpuzu* or "*Pepo*") into the household registers was "*shu*," meaning "*shufan*" or "civilized aborigine." Taiwan's Plains Aborigines descend from as many as ten separate ethnolinguistic groups dispersed across the lowland areas of the island, where they were early brought under Chinese influence and domination. A small minority in numbers, most Plains Aborigines by 1915 were speakers of the southern Min language, and had adopted many Han customs.

During the 18th and 19th centuries Taiwan was a frontier of Chinese agricultural settlement. The often times turbulent process of frontier settlement resulted in the creation of mutually antagonistic residentially segregated communities based on provenance and speech group. Conflicts between Hoklo and Hakka, and Hoklo or Hakka and Plains Aborigines were frequent, and reinforced the cultural identity of separate ethnic communities.

The two Han groups, Hoklo and Hakka, shared many Han customs, including patrilineal ancestor worship, strong parental authority, equal property inheritance among brothers, and folk religious practices. Hoklo and Hakka practiced similar forms of marriage and adoption, including little daughter in law marriage ('minor' marriage), and had similar levels of marital fertility (Shepherd et al. 2006). But there were also differences, most notably mutually unintelligible languages, different patron deities, and the Hakka refusal to bind the feet of daughters. This latter distinction meant that female Hakka were able to perform field labor and contribute economically to their families in ways denied to adult Hoklo women, over ninety percent of whom were bound-footed (up to 1915 when the Japanese banned the practice, Shepherd 2001 ms).

By the beginning of the twentieth century, Plains Aborigines had adopted many Hoklo customs and the great majority were native speakers of the southern Min language. Most Plains Aborigines practiced forms of family organization, property inheritance, marriage (excepting minor marriage), and folk religion similar to those of neighboring Han. Important markers of ethnic difference were the lack of footbinding among the Plains Aborigines, worship of distinctive deities on special festival days, and in some cases membership in Presbyterian and Catholic churches.

Despite the many similar customs shared among all three groups, the remaining differences, whether in language, footbinding or historical experience became the focus of separate ethnic identities that perdured into the twentieth century. Whether these cultural distinctions had important consequences for differential mortality among these groups is explored below.

Changing Boundaries and the Regional Distribution of the Population by Ethnic Group

In our discussion of demographic differences we need to keep in mind that the three groups, and especially the two minority ethnic groups (Hakka and Plains Aborigine), were not evenly distributed among all the localities of the island, but rather showed marked regional concentrations in certain prefectures. [Changes in prefectural boundaries in the Japanese period have been reviewed above.]

We look at the regional distribution of the ethnic groups in two ways; first we examine the ethnic composition of each prefecture's population. Among Taiwanese overall in 1915, the Hoklo population clearly dominated demographically (82.8% of Taiwanese were Hoklo), and was spread widely throughout the island. The Hoklo were the majority ethnic group in every prefecture except Hsinchu, Taichung, and Hualien (in the latter two prefectures, mountain aborig-

Table 15. **Ethnic composition of prefectural populations, by percent of Taiwanese, 1915**

Prefecture	*Fukien*	*Kwangtung*	*Plains Aborigine*	*Total % of Taiwanese**	*Number of Taiwanese*
Taipei	99.5%	0.3%	0.2%	100.0%	459353
Ilan	96.8	1.6	1.6	100.0	140103
Taoyuan	54.3	**45.5**	0.2	100.0	228688
Hsinchu	30.8	**68.5**	0.6	100.0	321020
Taichung	89.7	10.2	0.1	100.0	579726
Nantou	87.3	8.2	4.3	99.9	122810
Chiayi	99.0	0.6	0.3	100.0	552605
Tainan	98.8	0.1	1.1	100.0	545609
Ahou	62.3	**29.0**	8.6	99.9	252067
Taitung	10.6	3.4	6.7	20.7	34824
Hualien	21.0	10.2	13.8	45.1	33114
Penghu	100.0	0	0	100.0	55836
Taiwan	82.8%	14.4%	1.4%	98.6%	3325755

Census of 1915, kekka hyō. P. 8-9.

* Not included here are the additional Taiwanese subcategories ‘other Han’ and ‘raw aborigines’.

Table 16. **Ethnic composition of prefectural populations, by percent of Taiwanese, 1920**

Prefecture	*Fukien*	*Kwangtung*	*Plains Aborigine*	*Total % of Taiwanese**	*Number of Taiwanese*
Taipei	98.7%	0.8%	0.5%	100.0%	658184
Hsinchu	37.4	**62.1**	0.5	100.0	549401
Taichung	88.3	10.9	0.8	100.0	754466
Tainan	98.5	0.7	0.8	100.0	922337
Kaohsiung	80.3	**15.3**	4.4	99.9	509270
Taitung	11.8	3.9	7.4	23.1	35260
Hualien	23.7	14.1	12.1	49.9	37589
Taiwan	82.3%	15.0%	1.4%	98.7%	3466507

Census of 1920, daiikkai Taiwan kokusei chōsa yōran hyō, table 1, pp. 2-7.

* Not included here are the additional Taiwanese subcategories ‘other Han’ and ‘raw aborigines’.

ines dominated). The Hakka (14.4% of the Taiwanese population) were the majority population in Hsinchu, and constituted large pluralities in Taoyuan and Ahou. Plains Aborigines (only 1.4% of the Taiwanese population) were always small minorities in the prefectures, but had significant presences in Hualien, Ahou, Taitung and Nantou. In the consolidation of prefectures in 1920 Hsinchu maintained its sizeable Hakka majority when it absorbed most of Taoyuan, and concentrations of Hakka in Kaohsiung, Hualien, and Taichung remained significant pluralities. The 1920 consolidation meant that the Plains Aborigine concentrations in Nantou and Ahou were absorbed into Taichung and Kaohsiung, diluting their percentages of these larger units.

A slightly different perspective emerges when we examine the distribution among the prefectures of the three ethnic groupings. In 1915 the bulk of the large Hoklo population was concentrated in two adjacent southern prefectures of Chiayi and Tainan, the mid-island prefecture of Taichung, and the northern prefecture of Taipei. In all, these four prefectures account for 75% of the total Hoklo population. The same pattern continued after 1920 when Tainan absorbed Chiayi. In 1915 the Hakka population was concentrated in the northern prefectures of Hsinchu and Taoyuan, followed by Ahou in the south, and Taichung. These four prefectures account for 95% of the total Hakka population. After 1920 more than 65% of the Hakka population was concentrated in the single prefecture of Hsinchu, and smaller concentrations remained in Taichung (16%) and Kaohsiung (15%). In 1915 more than half the plains aborigine population was concentrated in Ahou and Tainan in the south, and smaller concentrations were located in Nantou in the mid-island foothills, and Hualien on the east coast. These four prefectures account for 79% of the total plains aborigine population. The same pattern continued after 1920 when Kaohsiung absorbed Ahou and Taichung absorbed Nantou; leaving Kaohsiung and Tainan with more than half the Plains Aborigine population and Taichung and Hualien with significant concentrations.

It is also worth pointing out that Taiwan's small urban population was overwhelmingly Hoklo. Five cities (Taipei, Keelung, Taichung, Tainan, and Kaohsiung) were recognized in the 1925 census and the 1926 ethnic survey, and they accounted for approximately eight percent of the total Taiwanese population (cf. Barclay 1954: 116). Living in these five cities in 1926 were 9.8% of the Hoklo population and only 0.9% of the Hakka population. The Hakka and plains aborigine populations were thus overwhelmingly rural, while a small percent of the Hoklo population lived in the small major cities. It is also likely that the larger and more urban Hoklo population was stratified internally to a greater degree than the other populations.

Because of the marked regional concentrations, especially of the minority Hakka and plains aborigine populations, generalizations based on all-island data about the separate ethnic groups must raise an immediate question: is the select-

Table 17. **Distribution of the ethnic groups among the prefectures, 1915.**

Prefecture	***Fukien***	***Kwangtung***	***Plains Aborigine***
Taipei	16.6%	0.3%	1.9%
Ilan	4.9	0.5	4.7
Taoyuan	4.5	21.7	0.9
Hsinchu	3.6	46.0	4.1
Taichung	18.9	12.3	1.2
Nantou	3.9	2.1	11.2
Chiayi	19.9	0.7	3.6
Tainan	19.6	0.1	12.4
Ahou	5.7	15.3	45.5
Taitung	0.1	0.2	4.9
Hualien	0.2	0.7	9.6
Penghu	2.0	0	0
Taiwan	100.0%	100.0%	100.0%
Total Number	2,753,212	478,557	47,676

Census of 1915, kekka hyō.p. 8-9

Table 18. **Distribution of the ethnic groups among the prefectures, 1920.**

Prefecture	***Fukien***	***Kwangtung***	***Plains Aborigine***
Taipei	22.8%	1.1%	6.2%
Hsinchu	7.2	65.7	5.2
Taichung	23.4	15.8	12.9
Tainan	31.9	1.2	15.3
Kaohsiung	14.3	15.0	45.7
Taitung	0.1	0.3	5.4
Hualien	0.3	1.3	9.3
Taiwan	100%	100%	100%
Total Number	2,851,353	519,770	48,894

Census of 1920, daiikkai Taiwan kokusei chōsa yōran hyō, table 1, pp. 2-7.

Table 19. **Age Structure by Ethnic Group and Sex, 1920**

Sui Age	***Fukien***		***Kwangtung***		***Plains Aborigines***	
*by cohort**	*Male %*	*Female %*	*Male %*	*Female %*	*Male %*	*Female %*
1-5	14.1	14.4	14.7	15.0	13.5	13.0
6-15	25.9	25.4	25.8	25.4	25.2	23.8
16-30	27.5	25.1	27.5	25.9	26.0	24.8
31-45	20.1	18.4	18.4	17.6	21.2	20.7
46-60	9.4	10.9	9.5	10.3	10.7	12.2
61 & over	3.0	5.8	4.0	5.8	3.4	5.6

Census of 1920, Dai-ikkai Taiwan kokusei chōsa shukei gempyō zentō no bu, table 2, pp. 2-43.

* 'Sui Age by cohort': the census reports 'age' by year of birth, beginning with those born in the year of the census, 1915, who are listed as sui age 1. Thus there is no age '0' by this reckoning. Note that this reckoning is by birth year cohort and does not correspond either to traditional Chinese lunar year 'sui' or to Western measures of age at last birth.

ed characteristic the result of cultural differences or the result of differences linked to regional ecology, such as climate, epidemiology, agrarian economy, wealth, access to ports, administrative influence, etc.? Throughout the following discussion of differences and similarities among the three ethnic groups, we must not lose sight of the possibility that these regional concentrations are likely to have an important influence on the patterns we observe.

Age Structure among the Ethnic Groups

The Taiwan vital statistics (J: *Taiwan jinkō dōtai tōkei*) annual volumes contain reports of stillbirths, births, and deaths by ethnic group and sex for each year from 1906 to 1935, and deaths by cause, sex, and ethnic group for each year from 1906 to 1931. When combined with reports of the population by ethnic group from the censuses, these tables provide the information needed to compute crude rates of death and death by cause for each ethnic group by sex over more than twenty years. As crude rates, these measures give us a convenient summary measure of the impact of mortality on each group. Crude rates, however, because they combine age groups whose death rates vary widely, are less reliable when comparing groups whose age structures also vary widely (unfortunately the absence of death data by age and ethnicity makes it impossible to calculate age specific death rates by ethnic group from the vital statistics)(Barclay 1958: 135). Fortunately, the censuses for 1915 and 1920 (but not 1925 and 1930) published tables that enable us to check for divergent age structures among our groups.

Examination of the age composition of the ethnic groups (shown here only for

Table 20. **Cause Specific Crude Death Rates by Ethnicity, *All Causes*, 1906-1931. Deaths per 100,000.**

	Cause Specific Crude Death Rates by Ethnicity, Deaths per 100,000						*Indexed Crude Death Rates, Hoklo = 100*			
Year	*Hoklo*		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
All Causes	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
06-8*	3617	3548	2454	2365	3163	2956	*68*	*67*	*87*	*83*
14-6*	3305	3075	2289	2165	3272	2919	*69*	*70*	*99*	*95*
19-21	3038	2823	2586	2384	2909	2987	*85*	*84*	*96*	*106*
24-26	2681	2406	2151	1968	2760	2664	*80*	*82*	*103*	*111*
29-31	2356	2123	1856	1719	2453	2396	*79*	*81*	*104*	*113*

* No correction for unregistered nonsurvivors has been possible for the deaths by ethnic groups.

Vital statistics from the *Taiwan jinkō dōtai tōkei,* and populations at risk from the Taiwan censuses for the relevant years.

1920) reveals no major differences in age structure among our groups that would affect our ability to interpret differences in death rates as reflecting differences in the incidence and severity of disease rather than differences in age composition.

Crude Death Rates by Ethnic Group

Given their similar age distributions, we can discount the danger that any differences we observe in crude death rates among the ethnic groups are merely the products of differences in age structure. What differences do we observe? We begin with the table above which is drawn from the reports of deaths by cause by ethnic group and sex for the years 1906-1931. Three year averages have been computed and related to the population totals by ethnic group reported in the censuses of 1905 (adjusted to a midyear population 1907), 1915, 1920, 1925 and 1930. The table reports the crude death rates for all causes, and to facilitate comparison among the groups, the right most columns index the death rates by sex in each period on the Hoklo rates, which represent more than 80% of Taiwanese.

The crude death rates by sex for each cultural group presented in the table above reveal strikingly lower death rates among the Hakka compared to the Hoklo and plains aborigine groups. The Hakka and Plains Aborigines (in the early years) regularly report death rates which are only a fraction of the Hoklo rates. The large divergence in the death rates of the Hakka in contrast to the other groups is consistently maintained from 1906 to 1931. Compared to the Hoklo the

Table 21. **Cause Specific Crude Death Rates by Leading Causes and by Ethnicity and Sex, 1906-1931. Deaths per 100,000. (IDR as deaths per thousand live births).**

	Cause Specific Crude Death Rates by Ethnicity, Deaths per 100,000						*Indexed Crude Death Rates, Hoklo = 100*			
Year	*Hoklo*		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
Malaria	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1906-8	365	392	290	308	754	806	*79.5*	*78.6*	*206.6*	*205.6*
1914-16	340	351	221	221	492	814	*65.0*	*63.0*	*144.7*	*231.9*
1919-21	214	212	198	179	306	325	*92.5*	*84.4*	*143.0*	*153.3*
1924-26	177	172	145	146	341	345	*81.9*	*84.9*	*192.7*	*200.6*
1929-31	71	68	75	73	165	224	*105.6*	*107.4*	*232.4*	*329.4*
Resp. TB										
1906-8	191	104	84	51	111	64	*44.0*	*49.0*	*58.1*	*61.5*
1914-16	189	109	75	38	134	61	*39.7*	*34.9*	*70.9*	*56.0*
1919-21	237	150	96	44	113	82	*40.5*	*29.3*	*47.7*	*54.7*
1924-26	227	137	108	53	129	85	*47.6*	*38.7*	*56.8*	*62.0*
1929-31	195	124	95	48	120	120	*48.7*	*38.7*	*61.5*	*96.8*
Resp. Dis.										
1924-26	848	700	639	535	894	878	*75.4*	*76.4*	*105.4*	*125.4*
1929-31	733	611	590	510	798	716	*80.5*	*83.5*	*108.9*	*117.2*
Diarrhea,E										
1924-26	352	353	190	192	342	349	*54.0*	*54.4*	*97.2*	*98.9*
1929-31	369	384	195	202	367	343	*52.8*	*52.6*	*99.5*	*89.3*
Cert.Dis.Inf.										
1924-26	145	112	139	106	125	76	*95.9*	*94.6*	*86.2*	*67.9*
1929-31	138	106	115	79	186	130	*83.3*	*74.5*	*134.8*	*122.6*
Cert.Dis.Inf as IDR*										
1924-26	32.9	25.5	32.3	24.7	31.1	19.8	*98.2*	*96.9*	*94.5*	*77.6*
1929-31	28.7	22.4	25.9	18.0	45.1	31.4	*90.2*	*80.4*	*157.1*	*140.2*

* IDR as deaths per thousand live births. Vital statistics from the *Taiwan jinko dotai tokei*, and populations at risk from the Taiwan censuses for the relevant years.

Plains Aborigines reported lower rates when Hoklo rates were highest in the first two periods, but higher rates in the final two periods when Hoklo rates dropped.

We turn now to an exploration of the causes of death among the different cultural groupings to see which causes account for most of the ethnic variation in death rates. Cause of death data is reported in the Vital Statistics by subcultural grouping by sex but not by age, so we can report only 'crude' cause specific rates for each group (which are vulnerable to differences in age structure, as discussed above). Also as noted above the quality of cause of death reporting in the early periods was not as high as it would be in later years.

The table above reports the death rates by cause for the leading causes of death. The right most panel indexes the death rates by sex in each period on the Hoklo rates.

Malaria was consistently a leading cause of death in nineteenth and early twentieth century Taiwan and as such early became a target of Japanese colonial public health efforts. Although declines in malaria death rates are noticeable in all the groups from 1919 to 1931, differences among the subcultural groups remain substantial in all periods. The Plains Aborigines show much higher rates for both sexes, and the Hakka show much lower rates, compared to the Hoklo, for all years except 1929-31 when rates were at their lowest. Within each group the sex differential in malarial death rates is small, qualified somewhat by the excess for plains aborigine females. The sharp differences among the cultural groups in malarial death rates is surely accounted for by their regional distribution. Malarial death rates are highest in climates most favorable to the propagation of anopheline mosquitoes and the malaria plasmodium. It appears that the plains aborigine population is concentrated in areas with such an unfavorable climate: the subtropical foothills. The Hakka population, on the other hand, appears to have had the good fortune to be concentrated in areas least favorable to malaria-bearing mosquitoes (especially Hsinchu and Taoyuan). The key factor in malaria death rates is most likely to have been differential rates of exposure, as differences in other factors, disease resistance or methods of prevention, are unlikely to have been significant.

Respiratory tuberculosis shows strikingly higher rates among the Hoklo than the Hakka and the Plains Aborigines. Hypotheses accounting for differentials in the incidence of respiratory tuberculosis variously emphasize diet, exposure to active cases, crowded living spaces, poor ventilation, and polluted cities, and reduced immune response due to co-morbidity. One or many of these factors may underlie the high Hoklo rates. The Hoklo dominance in urban areas, where respiratory tuberculosis rates were highest (see above), contributes to these high rates for Hoklo.

"Respiratory diseases" is a broad category including pneumonia, bronchitis, influenza, and other respiratory diseases, that weighed heavily on the health of Taiwanese in this period. When combined they are the leading cause of death in all periods, and all three groups suffered from high rates of these diseases. In all three groups, pneumonia death rates were the highest of the three named diseases; cases of pneumonia often bring on death after a person has been stricken by some other disease. The same Hakka advantage appears in the respiratory death rates, as the Plains Aborigine and Hoklo groups suffered from significantly higher respiratory death rates. The Hoklo disadvantage, however, is lower than in the case of respiratory tuberculosis. What can account for the higher Plains Aborigine and Hoklo rates – diet (pneumonia is nutritionally sensitive), environmental conditions, lowered resistance due to a heavier incidence of concurrent diseases, or higher exposure rates?

Diarrhea and enteritis is our next disease category. The disdvantage of the Hoklo and the Plains Aborigines when compared to the Hakka in diarrhea and enteritis death rates is the second greatest, after respiratory tuberculosis, of the leading causes. What can explain such a sharp difference? Differential exposure (perhaps resulting from climatic factors favoring bacterial growth?) and resistance are possibilities, but differences in food and drink sanitation practices may also play an important role. Do we have evidence here supporting the reputation of the Hakka for better sanitation? It is important to note that diarrheas, because they interfere with the absorption of nutrients when the immune system is most in need of them, can be important causes of the worsening of concurrent diseases. Higher rates of diarrhea and enteritis could play an important role in raising the rates of death from other diseases among the Hoklo and Plains Aborigines.

Certain diseases of infancy is a cause category restricted to deaths occurring overwhelmingly in the first month of life. The Hakka advantage in this category over the Hoklo is small compared to the other leading causes. The Plains Aborigine rate in this category fluctuates greatly between 1924-26 and 1929-31 for some unknown reason, and may reflect inconsistent cause reporting. To get a more precise picture, we can measure this category of deaths as a proportion of live births. Reporting certain diseases of infancy as an infant death rate does not change our impression of the relative rates of death among the ethnic groups.

The most striking feature of these tables is that the Hakka advantage is consistent across all causes, rather than concentrated in one or two, and that the advantage is continuous across all periods despite fluctuations in rates. This could suggest that some factor related to Hakkaness is beneficial to health and longevity? But before we leap to conclusions, astute readers will remember that the Hakka, and the Plains Aborigines are not dispersed as widely as the Hoklo, but are heavily concentrated in certain localities. Is the Hakka advantage a product of Hakkaness, or of the environments in which Hakka are fortunate to live?

Crude Death Rates by Ethnicity and Prefecture

The vital statistics reports births and deaths by both prefecture and ethnicity; this enables us to test whether the Hakka advantage so visible in the data aggregated by ethnic group is enjoyed by Hakka regardless of where they live. The same data enable us to see whether some Hoklo and Plains Aborigines also benefit from living in healthy districts dominated by Hakka.

The tables below present the crude death rates by prefecture and ethnic group in 1906-08, 1914-16, 1920-22, 1924-26, and 1929-31. Rates for Hakka and Plains Aborigines are only shown for prefectures where each sex of each group numbered greater than 1000. We will focus our discussion on the highlighted prefectures which have the more significant concentrations of Hakka and Plains Aborigine populations.

Do Hakka uniformly have the lowest rates of death regardless of prefecture? Or if regionally specific factors are more important than ethnicity, do Hoklo living in prefectures where Hakka have low rates of death also enjoy lower rates than Hoklo elsewhere? Let us begin our discussion with the Taoyuan- Hsinchu –Miaoli prefectures where 65% of Taiwan's Hakka population is concentrated. The Hakka in these prefectures ('Hsinchu' after 1920) have a clear advantage over their Hoklo neighbors in all periods shown in the tables, although for all periods after 1914 it is interesting that the advantage is smaller than the average Hakka advantage for all Taiwan. This is because Hoklo have their lowest death rates in Taoyuan 1906-1916, and in Hsinchu 1920-1931 (shown in **bold** in the tables). Thus Hoklo also benefited from living in these prefectures and the healthier environment they provided, even if they did not benefit from any possible health benefits of Hakkaness?

Any assumption that Hakkaness everywhere confers health advantages is contradicted when we look beyond Hsinchu. The advantage of being Hakka disappears when we move to the southern prefectures. In Fanshuliao and Ahou in 1906-16, and in Kaohsiung 1920-1931 (where 15% of Hakka reside), the Hakka death rate is very close to that of the Hoklo and sometimes worse (as in Fanshuliao in 1906-08, and Kaohsiung 1924-26). So it appears that if some aspect of Hakkaness confers a health benefit in the northern climate of Hsinchu, this factor is not effective when confronted with the southern environment of Kaohsiung. And when we compare the death rates of Hakka in Kaohsiung to those of Hoklo in northern districts, and for Taiwan as a whole (which because Hoklo are 80% of the total population their rates are very close to the average for all Taiwanese), the southern Hakka death rates exceed these averages. Clearly the southern Hakka, concentrated in the eastern parts of Kaohsiung (today's Pingtung) lack the health advantage enjoyed by their northern cousins.

The hypothesis that some aspect of Hakkaness confers a health advantage is considerably weakened by the high death rates of the southern Hakka. Nevertheless, it is still the case that the Hsinchu Hakka appear to do better than their Hoklo neighbors, suggesting that environment alone is not the full explanation (we explore this further below).

Hoklo death rates also varied significantly by prefecture. The highest rates regularly occurred in the southern districts of Chiayi, Tainan, and Ahou (1906-16), and Tainan and Kaohsiung (1920-31) (putting aside the very high rates occur-

Table 22. **Crude Death Rates by Ethnicity and Prefecture, 1906-08.**

	Crude Death Rates by Ethnicity, Deaths per 1000						***Indexed Crude Death Rates, Hoklo = 100***			
Year	*Hoklo*		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
Prefecture	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Taipei	29.7	27.5								
Keelung	27.9	26.1								
Ilan	28.4	26.9			22.6	19.7			*79.8*	*73.2*
Shenkeng	27.1	25.2								
Taoyuan	**25.0**	**23.5**	19.1	19.4			*76.7*	*82.3*		
Hsinchu	30.8	28.6	19.9	18.2			*64.4*	*63.5*		
Miaoli	34.5	31.7	21.6	20.9	23.4	18.9	*62.6*	*65.8*	*67.9*	*59.5*
Taichung	35.1	31.2	24.4	22.4			*69.4*	*71.6*		
Changhua	38.2	36.8	25.3	25.5			*66.2*	*69.3*		
Nantou	34.8	33.9	33.2	37.1	31.2	27.0	*95.5*	*109.5*	*89.8*	*79.5*
Douliu	37.7	38.1								
Chiayi	46.7	49.1								
Yanshuigang	38.4	40.6			31.2	33.9			*81.1*	*83.5*
Tainan	37.7	36.3			24.8	24.3			*65.7*	*66.9*
Fanshuliao	38.4	34.1	40.3	37.6	42.4	39.1	***104.9***	***110.3***	*110.3*	*114.7*
Fengshan	41.4	40.7								
Ahou	44.5	43.3	41.0	38.3	32.1	31.2	*92.1*	*88.5*	*72.1*	*72.0*
Hengchun	31.8	31.9	27.7	25.4	29.0	24.5	*87.0*	*79.8*	*91.3*	*76.8*
Taitung	54.4	44.4			37.0	34.3			*68.0*	*77.2*
Penghu	32.1	36.3								
All Taiwan	36.0	35.2	23.9	22.8	31.4	29.3	*66.4*	*64.8*	*87.2*	*83.2*

ring in the east coast prefectures of Taitung and Hualien 1906-1922 suffered by small populations of Hoklo [most likely malaria related]). And the lowest Hoklo rates regularly occurred in the northern prefectures that would form Taipei and Hsinchu after 1920. The strong regional differentiation that persists throughout the period represented in the tables is particularly marked in the early years but declines somewhat as rates overall moderate in the later years.

Death rates for the Plains Aborigine minority also demonstrate a strong north- south regional differentiation. We noted above that Plains Aborigines overall did better than Hoklo 1906-16 and worse 1924-31, but the regional data enable us to qualify that generalization. Plains Aborigines did worse than Hoklo in southern Fanshuliao 1906-08 and better than Hoklo in Taichung and Tainan

Table 23. **Crude Death Rates by Ethnicity and Prefecture, 1914-16.**

	Crude Death Rates by Ethnicity, Deaths per 1000						*Indexed Crude Death Rates, Hoklo = 100*			
Year	*Hoklo*		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
Prefecture	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Taipei	26.2	25.8								
Ilan	23.9	23.2			25.1	16.9			*105.1*	*72.6*
Taoyuan	**21.5**	**21.4**	18.3	18.3			*85.1*	*85.4*		
Hsinchu	26.7	23.9	20.1	19.1			*75.4*	*79.9*		
Taichung	33.2	30.2	24.4	20.7			*73.5*	*68.3*		
Nantou	32.8	28.7	22.5	23.5	30.3	26.2	*68.7*	*82.1*	*92.2*	*91.5*
Chiayi	38.7	36.5	19.5	23.5			*50.3*	*64.4*		
Tainan	38.0	33.9			38.9	27.6			*102.4*	*81.5*
Ahou	36.8	35.8	37.3	34.9	35.8	33.3	***101.2***	***97.3***	*97.2*	*92.9*
Taitung	25.4	21.4			36.9	26.6			*145.4*	*124.2*
Hualien	43.0	30.2	26.4	21.7	31.2	29.6	*61.3*	*71.8*	*72.4*	*98.0*
Penghu	32.0	31.7								
All Taiwan	33.0	30.8	22.9	21.7	32.7	29.2	*69.2*	*70.4*	*99.0*	*94.9*

Table 24. **Crude Death Rates by Ethnicity and Prefecture, 1920-22.**

	Crude Death Rates by Ethnicity, Deaths per 1000						*Indexed Crude Death Rates, Hoklo = 100*			
Year	*Hoklo*		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
Prefecture	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Taipei	26.7	24.9	17.6	18.7	22.7	15.7	*65.8*	*75.1*	*85.2*	*63.2*
Hsinchu	**25.1**	**22.5**	23.4	22.0	20.5	22.7	*93.4*	*97.8*	*81.7*	*100.6*
Taichung	30.8	27.5	28.6	23.6	25.6	26.9	*92.9*	*85.8*	*83.3*	*97.6*
Tainan	31.7	29.9	25.4	27.7	25.1	24.1	*80.0*	*92.7*	*79.1*	*80.5*
Kaohsiung	30.8	29.2	31.3	28.8	30.1	31.1	***101.4***	***98.6***	*97.7*	*106.8*
Taitung	31.0	26.2			34.3	34.8			*110.9*	*133.0*
Hualien	42.4	35.2	31.0	28.8	33.6	29.1	*73.1*	*82.0*	*79.2*	*82.6*
All Taiwan	29.8	27.6	25.5	23.4	28.3	28.2	*85.7*	*84.9*	*95.1*	*102.1*

Table 25. **Crude Death Rates by Ethnicity and Prefecture, 1924-26.**

		Crude Death Rates by Ethnicity, Deaths per 1000					*Indexed Crude Death Rates, Hoklo = 100*			
Year	*Hoklo*		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
Prefecture	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Taipei	23.6	21.8	11.9	16.1	17.0	17.4	*50.3*	*73.9*	*71.8*	*79.6*
Hsinchu	**21.1**	**19.2**	18.8	17.5	24.3	23.3	*88.8*	*91.4*	*115.0*	*121.8*
Taichung	25.8	22.4	20.0	17.9	22.1	21.0	*77.4*	*80.2*	*85.6*	*93.8*
Tainan	30.5	26.9	19.6	19.8	23.1	22.4	*64.4*	*73.6*	*76.0*	*83.4*
Kaohsiung	28.3	26.5	36.1	30.8	32.3	30.5	***127.6***	***116.3***	*114.0*	*115.3*
Taitung	25.9	26.1	24.6	25.8	30.2	35.0	*95.3*	*99.2*	*116.6*	*134.3*
Hualien	26.7	25.9	25.0	23.2	26.6	24.1	*93.6*	*89.4*	*99.9*	*93.1*
All Taiwan	26.8	24.1	21.5	19.7	27.6	26.6	*80.2*	*81.8*	*103.0*	*110.7*

Table 26. **Crude Death Rates by Ethnicity and Prefecture, 1929-31.**

		Crude Death Rates by Ethnicity, Deaths per 1000					*Indexed Crude Death Rates, Hoklo = 100*			
Year	*Hoklo*		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
Prefecture	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Taipei	22.5	21.3	11.0	12.0	12.0	12.6	*48.9*	*56.1*	*53.6*	*59.0*
Hsinchu	**19.9**	**18.1**	17.3	16.2	23.2	23.1	*86.9*	*89.3*	*116.5*	*127.4*
Taichung	22.8	20.1	17.8	15.9	20.7	17.7	*78.0*	*79.1*	*90.6*	*87.9*
Tainan	24.8	21.8	14.7	14.5	20.9	20.2	*59.3*	*66.5*	*84.5*	*92.9*
Kaohsiung	25.8	23.8	26.0	23.3	27.2	26.8	***100.6***	***98.2***	*105.2*	*112.8*
Taitung	24.1	20.1	27.0	20.0	32.3	29.6	*112.0*	*99.5*	*134.0*	*147.3*
Hualien	22.4	21.0	19.0	20.0	25.5	26.9	*84.9*	*95.4*	*114.0*	
*128.3*Penghu	24.5	19.9	-	-	-	-	-	-	-	-
All Taiwan	23.6	21.2	18.6	17.2	24.5	24.0	*78.8*	*81.0*	*104.1*	*112.9*

1920-31. The 45% of Plains Aborigines living in Kaohsiung (1920-31) regularly suffered from higher death rates than those living outside the southern prefectures. It is particularly interesting to note in Kaohsiung that while Plains Aborigine men sometimes did slightly better than their Hakka neighbors (though worse than Hoklo), Plains Aborigine women fared much worse than both Hakka and Hoklo.

Refining the Test of Ethnicity vs. Locality: District Level and Household Register Data

District Level Data. The crude death rates by prefecture and ethnicity have enabled us to refine generalizations about the health advantages and disadvantages of ethnic group membership based on data by cause aggregated by ethnic group alone. We have identified several localities where the apparent health consequences of ethnicity contradict the pattern found for all Taiwan, and found that strong regional differences affect all the ethnic groups. But so far our tests of the role of ethnicity vs. locality have been applied only at the level of the prefecture, leaving open the possibility that health disadvantages and advantages (such as that of the Hakka in Hsinchu) are the product not of ethnicity within a regional context but of environmental differences among much smaller districts. Because ethnic groups are segregated by residence within prefectures, it is conceivable that the environments of subdistricts occupied by particular ethnic groups have an important effect on their death rates which is hidden when data are aggregated at the prefectural level. Is the impression that ethnicity plays a significant role within prefectural units an effect of over-aggregation of data?

We can refine our assessment of the role of ethnicity vs. locality somewhat by focusing on subprefectural districts (J: *gun*, C: *jun*, 郡) that contain substantial populations of **both** ethnic groups. In Hsinchu, five of eight districts contain large populations of both Hoklo and Hakka: Hsinchu, Chungli, Tachi, Chunan, and Miaoli. In Taichung prefecture, two districts containing large populations of both Hoklo and Hakka are Fengyuan and Nenggao (Puli); the latter also contains a large Plains Aborigine population. In Kaohsiung prefecture, three districts contain large populations of Hoklo, Hakka and Plains Aborigines: Chishan, Pingdong, and Chaochou. Do the districts simply replicate the prefectural level patterns of ethnic differences in mortality, or do they reveal local influences that complicate the prefectural ethnic patterns?

In four of the five districts in Hsinchu, Hakka consistently have death rates for both males and females lower than Hoklo (the single exception is females in Hsinchu *jun* in 1920-22) in agreement with the prefectural pattern. But in the fifth district of Chungli, where both the Hoklo minority and the Hakka consistently have death rates below the Hakka prefectural average, Hakka death rates are nevertheless consistently higher than Hoklo. Thus within Hsinchu, the Hakka advantage does not hold in every case. Whether Hakka crude death rates are higher or lower than Hoklo, it is interesting that the Hakka males always did better (index is lower) compared to their Hoklo counterparts than the Hakka females, with the single exception of Miaoli in 1929-31.

In Taichung, Hakka death rates are consistently lower than Hoklo rates in Fengyuan, but more often higher in Nenggao. In Kaohsiung's Chishan and Pingdong death rates for both Hoklo and Hakka are lower than or very close to the

Table 27. **Crude Death Rates by Ethnicity and District, 1920-22.**

Year										
	Crude Death Rates by Ethnicity, Deaths per 1000						***Indexed Crude Death Rates, Hoklo = 100***			
	Hoklo		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
District	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Hsinchu Pref.	**25.1**	**22.5**	**23.4**	**22.0**	**20.5**	**22.7**	***93.4***	***97.8***	***81.7***	***100.6***
Hsinchu Jun	26.2	22.3	23.9	23.4			*91.2*	*104.9*		
Chungli	22.1	20.1	23.0	22.5			*104.1*	*111.9*		
Tachi	28.2	27.2	24.2	25.2			*85.8*	*92.6*		
Chunan	23.5	20.0	23.0	20.1			*97.9*	*100.5*		
Miaoli	25.3	21.0	23.4	20.4			*92.5*	*97.1*		
Taichung Pref.	**30.8**	**27.5**	**28.6**	**23.6**	**25.6**	**26.9**	***92.9***	***85.8***	***83.3***	***97.6***
Fengyuan	25.8	24.7	23.5	18.9			*91.1*	*76.5*		
Nenggao	34.1	27.2	38.0	29.0	24.7	25.7	*111.4*	*106.6*	*72.4*	*94.5*
Kaohsiung Pref.	**30.8**	**29.2**	**31.3**	**28.8**	**30.1**	**31.1**	***101.4***	***98.6***	***97.7***	***106.8***
Chishan	29.5	28.3	32.1	29.1	36.5	36.5	*108.8*	*102.8*	*123.7*	*129.0*
Pingdong	30.7	28.1	26.9	25.8	24.4	26.4	*87.6*	*91.8*	*79.5*	*94.0*
Chaochou	37.6	34.1	33.5	30.3	30.1	30.3	*89.1*	*88.9*	*80.1*	*88.9*

prefectural averages; Hakka death rates are consistently higher than Hoklo in Chishan (single exception of females in 1924-26), but are more often lower (especially for females) in Pingdong. In Chaochou death rates for both Hoklo and Hakka are substantially higher than the prefectural averages for both groups, but Hakka death rates are lower than Hoklo in two out of the three periods. In the Kaohsiung districts Hakka females consistently did better than males compared to their Hoklo counterparts (single exception of Pingdong in 1920-22), the opposite of the Hsinchu pattern. These multiple differences among districts within prefectures reveal internal variations which suggest that local environmental conditions were more important than ethnicity in determining levels of mortality between Hoklo and Hakka.

Plains aborigine death rates also show the important influence of local environments. Plains aborigine death rates in Kaohsiung compared to Hoklo are consistently higher in Chishan and Pingdong (with the exception of 1920-22) but lower in Chaochou, and often lower than Hakka. Plains aborigine death rates in Taichung's Nenggao are more often lower than Hoklo rates.

The sex ratio of mortality among the selected districts in Hsinchu is con-

Table 28. **Crude Death Rates by Ethnicity and District, 1924-26.**

Year	*Crude Death Rates by Ethnicity, Deaths per 1000*						*Indexed Crude Death Rates, Hoklo = 100*			
	Hoklo		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
District	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Hsinchu Pref.	**21.1**	**19.2**	**18.8**	**17.5**	**24.3**	**23.3**	***88.8***	***91.4***	***115.0***	***121.8***
Hsinchu Jun	22.4	20.2	18.7	17.3			*83.4*	*85.3*		
Chungli	16.9	14.7	17.0	16.4			*100.9*	*111.1*		
Tachi	20.1	17.9	16.9	17.2			*83.7*	*96.3*		
Chunan	22.1	20.8	19.7	19.2			*89.1*	*92.2*		
Miaoli	24.3	19.2	20.5	18.9			*84.5*	*98.4*		
Taichung Pref.	**25.8**	**22.4**	**20.0**	**17.9**	**22.1**	**21.0**	***77.4***	***80.2***	***85.6***	***93.8***
Fengyuan	23.0	18.5	21.1	18.4			*92.0*	*99.2*		
Nenggao	25.4	19.3	21.1	20.5	23.6	20.4	*83.1*	*106.1*	*92.8*	*105.8*
Kaohsiung Pref.	**28.3**	**26.5**	**36.1**	**30.8**	**32.3**	**30.5**	***127.6***	***116.3***	***114.0***	***115.3***
Chishan	26.3	26.7	33.6	25.6	31.8	30.6	*128.0*	*95.7*	*121.1*	*114.3*
Pingdong	30.7	30.5	32.3	30.1	35.3	32.9	*105.2*	*98.6*	*115.1*	*108.0*
Chaochou	34.1	34.0	43.3	36.5	32.2	28.1	*126.8*	*107.2*	*94.2*	*82.5*

sistently lower among the Hakka than among the Hoklo (even in Chungli), with the single exception of Miaoli in 1929-31. But even this aspect of Hakka population cannot be generalized beyond Hsinchu; the sex ratio of mortality among Hakka in the Taichung districts is as often higher as it is lower than Hoklo, and in the Kaohsiung districts is consistently higher compared to Hoklo with the single exception of Pingdong in 1920-22. There is a slight tendency for the lower mortality group to have a lower sex ratio of mortality; high mortality appears to accentuate the differences between the sexes regardless of ethnicity.

The sex ratio of mortality among the Plains Aborigines in Taichung's Nenggao is lower than that of the Hoklo in two out of three periods, and lower than the Hakka in only one period. Among the Plains Aborigines in Kaohsiung the sex ratio of mortality is lower in all three districts than the Hakka sex ratio in all three periods, and lower than the Hoklo in two periods out of three. This points to plains aborigine female death rates which are frequently higher than among Hoklo and Hakka. District level differences also point to the important effect of environmental conditions on mortality among the plains aborigines.

Table 29. **Crude Death Rates by Ethnicity and District, 1929-31.**

Year			*Crude Death Rates by Ethnicity, Deaths per 1000*				*Indexed Crude Death Rates, Hoklo = 100*			
	Hoklo		*Hakka*		*Plains Aborigine*		*Hakka*		*Plains Aborigine*	
District	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Hsinchu Pref.	**19.9**	**18.1**	**17.3**	**16.2**	**23.2**	**23.1**	***86.9***	***89.3***	***116.5***	***127.4***
Hsinchu Jun	20.8	19.1	18.0	16.7			*86.4*	*87.8*		
Chungli	15.5	14.7	16.2	15.9			*104.4*	*108.5*		
Tachi	19.9	19.6	17.9	18.7			*89.7*	*95.2*		
Chunan	21.3	17.9	17.7	16.4			*83.0*	*91.5*		
Miaoli	20.9	18.4	17.7	15.3			*84.7*	*82.9*		
Taichung Pref.	**22.8**	**20.1**	**17.8**	**15.9**	**20.7**	**17.7**	***78.0***	***79.1***	***90.6***	***87.9***
Fengyuan	20.4	17.1	18.8	15.5			*92.5*	*90.8*		
Nenggao	21.1	18.0	20.5	18.7	21.2	17.6	*97.2*	*103.8*	*100.4*	*97.4*
Kaohsiung Pref.	**25.8**	**23.8**	**26.0**	**23.3**	**27.2**	**26.8**	***100.6***	***98.2***	***105.2***	***112.8***
Chishan	22.8	21.1	25.2	22.2	24.8	25.9	*110.5*	*105.3*	*108.8*	*122.9*
Pingdong	23.7	21.9	23.8	21.2	30.5	28.6	*100.4*	*96.9*	*128.7*	*130.3*
Chaochou	30.7	28.4	28.9	26.2	28.6	27.5	*94.3*	*92.4*	*93.2*	*97.0*

Household Register Data. We can refine our tests of ethnicity vs. locality even further by using the household register databases for two localities, thanks to the Program for Historical Demography at the Academia Sinica. The first site is that of Chupei, located in the northwestern county of Hsinchu, whose population is divided between a Hoklo area (Jiugang) and a Hakka area (Liujia)(the registers come from the villages of Maoerding in Jiugang and the village of Liujia in Liujia). The second site is that of Tanei, located in the southwestern county of Tainan, and having a majority Hoklo population but also a significant Plains Aborigine minority. The two sites, because they combine two ethnic groups within a small area, give us the opportunity to see if ethnic differences in mortality persist even when two groups occupy much the same environment.

To create samples as ethnically homogeneous as possible, I have excluded from the sample individuals who had a birth mother or adopted mother whose registered provenance/ethnicity differed from their own (which almost always followed the registered provenance of the father) because they came from the comparison group. However, women adopted by a plains aborigine

Table 30. **Sex Ratios of Mortality by Ethnicity and District, 1920-1931. Male CDR/Female CDR.**

	1920-22			1924-26			1929-31		
District	Hoklo	Hakka	P.A.	Hoklo	Hakka	P.A.	Hoklo	Hakka	P.A.
Hsinchu Pref.	111.6	106.4	90.3	109.9	107.4	104.3	110.0	107.0	100.4
Hsinchu Jun	117.5	102.1		110.6	108.2		109.3	107.6	
Chungli	110.0	102.2		114.3	103.7		106.0	102.0	
Tachi	103.7	96.0		112.5	97.8		101.6	95.7	
Chunan	117.5	114.4		106.2	102.7		118.9	107.9	
Miaoli	120.5	114.7		126.6	108.7		113.2	115.7	
Taichung Pref.	112.0	121.2	95.2	115.2	111.7	105.2	113.4	111.9	116.9
Fengyuan	104.5	124.3		124.0	115.0		119.2	121.4	
Nenggao	125.4	131.0	96.1	131.6	103.1	115.5	117.1	109.7	120.6
Kaohsiung Pref.	105.5	108.7	96.8	106.8	117.2	105.9	108.4	111.6	101.5
Chishan	104.2	110.3	100.0	98.2	131.4	104.1	108.3	113.6	95.9
Pingdong	109.3	104.3	92.4	100.8	107.5	107.4	108.1	112.0	106.8
Chaochou	110.3	110.6	99.3	100.3	118.7	114.6	108.1	110.4	103.9

foster parent were included in the Plains Aborigine group. Comparing samples of people raised by fathers and mothers having the same ethnicity provides the clearest test of the effect of ethnic group membership.

Chupei: Hakka and Hoklo. The next three tables below present various measures of mortality comparing the Hakka and Hoklo of Hsinchu's Chupei. Despite living in villages in close proximity to one another, these data show that the Chupei Hakka enjoyed lower levels of mortality and higher levels of life expectancy than their Hoklo neighbors. The table below presents childhood mortality rates. In infancy (*1q0*) and early childhood (*4q1*) both the Hakka males and females fared better than the Hoklo. A higher percentage of infant deaths occurring in the first month of life (neonatal percentage), combined with a lower infant morality rate over all, suggests that Hakka infants suffered less from post-neonatal causes of death, primarily exogenous factors related to environmental conditions and exposure to communicable diseases. This advantage grew even greater in the next four years of life. Differences in breast-feeding patterns might be invoked to explain such differences in European populations, but we have no evidence that Hakka and Hoklo differed in this regard in Taiwan. Wolf has shown that adoption at young ages had an adverse mortality consequence (perhaps connected to premature weaning) particularly

Table 31. **Probablility of Death, Infant and Early childhood mortality, Hakka and Hoklo, Chupei., 1906-1945.**

	Probability of death, per thousand person yrs.				*Indexed Probability of Death, Hoklo = 100*		*Sex Ratio of Mortality*	
	Hoklo		*Hakka*		*Hakka*		*Male/Female*	
	Male	Female	Male	Female	Male	Female	Hoklo	Hakka
1q0	173.5	141.0	149.6	123.2	*86.2*	*87.4*	123.0	121.4
4q1	114.7	164.8	72.1	95.5	*62.9*	*57.9*	69.6	75.5
5q0	268.3	282.6	210.9	206.9	*78.6*	*73.2*	94.9	101.9
5q5	31.0	24.6	26.5	29.1	*85.5*	*118.3*	126.0	91.1
10q0	291.0	300.3	231.9	230.0	*79.7*	*76.6*	96.9	100.8
NN%	41.0%	24.2%	57.4%	54.7%	*140.0*	*227.9*	170.8	104.9
Total person yrs.	52264	46438	59902	54472				

on young girls (1995: 303). Lower rates of adoption (affecting primarily females) compared to Hoklo might also be invoked to explain the Hakka female advantage in ages 1-4, but in Chupei, both Hakka and Hoklo adopted females and practiced little daughter in law marriage at high rates (Wolf 1995: 50-51, 54, 177 (mean age at adoption of 4, slightly lower for Hoklo)). The Hakka male death probability (4q1) shows almost the same advantage over Hoklo as the female in these years, which suggests factors other than female adoption create the Hakka advantage in early childhood. It is worth noting that the sex ratio of mortality is quite low among both groups at ages 1-4 and especially among the Hoklo; this indicates high excess female mortality that could be the result of high rates of adoptions in both groups. There is a big divergence in the sex ratios of mortality at ages 5-10 (*5q5*); the Hakka ratio shows a female excess when the Hoklo sex ratio shows a substantial male excess.

The Hakka advantage in life expectancy persists for males throughout the life cycle, but diminishes rapidly for Hakka females to levels much closer to those of the Hoklo and even falls below the Hoklo life expectancy at age 30; this is related to the higher probabilities of death at ages 30-45 for Hakka females. Differences in fertility might be suspected to contribute to higher death rates at these ages among a higher fertility group, but previous work shows no significant differences in fertility levels and patterns between the Chupei Hakka and Hoklo (Shepherd et al. 2006:143). Note that the sex ratios for probabilities of death after age 20 almost always show much higher male disadvantages among the Hoklo than among the Hakka. Similarly, the sex ratios of life expectancies are much closer for the Hakka

Table 32. **Life Expectancy at Different Ages, Hakka and Hoklo, Chupei., 1906-1945.**

	Life Expectancy at Dfferent Ages, in Years				*Indexed Life Expectancy, Hoklo = 100*		*Sex Ratio of Life Expectancy*	
	Hoklo		*Hakka*		*Hakka*		*Male/Female*	
Chupei 1906-1945	Male	Female	Male	Female	Male	Female	Hoklo	Hakka
0	38.0	41.8	44.7	46.3	*117.6*	*110.8*	90.9	96.5
1	44.9	47.6	51.5	51.8	*114.7*	*108.8*	94.3	99.4
5	46.6	52.8	51.4	53.1	*110.3*	*100.6*	88.3	96.8
10	43.0	49.0	47.8	49.6	*111.2*	*101.2*	87.8	96.4
30	27.8	33.5	31.8	33.1	*114.4*	*98.8*	83.0	96.1
50	15.9	17.9	18.0	18.5	*113.2*	*103.4*	88.8	97.3

Table 33. **Age Specific Death Rates, Hakka and Hoklo, Chupei. Deaths per 1000 person years.**

	Age Specific Death Rates, per thousand				*Indexed Probability of Death, Hoklo = 100*		*Sex Ratio of Mortality*	
Chupei	*Hoklo*		*Hakka*		*Hakka*		*Male/Female*	
Age at begin. of interval	Male	Female	Male	Female	Male	Female	Hoklo	Hakka
0	197.4	156.4	167.1	134.8	*84.7*	*86.2*	126.2	124.0
1	30.8	46.0	18.8	25.4	*61.0*	*55.2*	67.0	74.0
5	6.3	5.0	5.4	5.9	*85.7*	*118.0*	126.0	91.5
10	3.9	3.3	3.5	2.3	*89.7*	*69.7*	118.2	152.2
15	4.2	5.0	4.3	3.8	*102.4*	*76.0*	84.0	113.2
20	9.1	6.7	5.9	4.6	*64.8*	*68.7*	135.8	128.3
25	11.9	7.1	7.2	6.7	*60.5*	*94.4*	167.6	107.5
30	16.4	5.8	8.6	6.9	*52.4*	*119.0*	282.8	124.6
35	14.0	10.4	11.4	13.2	*81.4*	*126.9*	134.6	86.4
40	22.2	7.1	13.8	10.0	*62.2*	*140.8*	312.7	138.0
45	23.3	12.7	18.6	12.7	*79.8*	*100.0*	183.5	146.5
50	31.1	18.0	21.9	15.2	*70.4*	*84.4*	172.8	144.1
55	40.0	37.0	28.0	29.3	*70.0*	*79.2*	108.1	95.6
60	53.6	42.8	48.2	49.7	*89.9*	*116.1*	125.2	97.0
65	79.9	60.2	49.0	61.4	*61.3*	*102.0*	132.7	79.8
70	114.5	93.9	102.9	77.6	*89.9*	*82.6*	121.9	132.6

than the Hoklo indicating a much larger gap in the life expectancies of Hoklo males compared to Hoklo females, a factor to be discussed below.

Comparison with rates for other parts of the island show that both the Hoklo and the Hakka benefited from the healthier environment of Hsinchu, but as these data show even in the circumscribed area of Chupei, a Hakka advantage persists. Both the Hakka advantage and the advantage conferred by the Hsinchu environment demand explanation. The regional differences in causes of death discussed above provides clues to the general Hsinchu advantage. Within the township of Chupei, microecological differences between Jiugang's Maoerding and Liujia likely made a difference. Jiugang is a coastal area of large nucleated villages with some full-time fishermen among a majority of farmers, while Liujia is an agricultural area with a dispersed settlement pattern (Chuang Ying-chang 1994: 15, 19, 23). It may have been easier for communicable diseases to spread among the concentrated population in Maoerding compared to the more dispersed farmsteads of Liujia. Because fish waste attracts flies, which can transport bacteria to human food, it may also have been easier for gastrointestinal diseases to spread in Maoerding compared to Liujia. Both areas are reputed to rely on relatively clean well water and not surface sources of water, but well water near the coast may have been salty and less pure. Windiness in coastal areas may cause greater respiratory illness, and also eye problems (I am indebted to Shih Tianfu for these comments).

There remains the possibility that cultural differences mattered, but which aspects of Hakkaness contributed to higher survival in the Hsinchu environment remain a mystery. Is it greater resistance to disease or less exposure that explains the Hakka advantage? There are many popular notions about Hakka – Hoklo differences that could provide clues. Could the reputation for the greater orderliness and cleanliness of Hakka villages (Kleinman 1980: 338n, Chuang Ying-chang personal communication) reflect a generally higher level of sanitation that had a positive impact on their health? Could the reputation of Hakka for strong group solidarity (Pasternak 1972: 128, Kleinman 1980: 338n) imply a community that provided support for the sick and disadvantaged in ways that reduced death rates? Are there dietary and food preparation practices among Hakka that led to lower levels of diarrhea and enteritis? Or did lower levels of malaria in Hsinchu somehow differentially benefit the Hakka and lead to lower disease levels overall due to reduced negative impacts of comorbidity? Did the Hakka reputation for bodily cleanliness associated with regular afternoon bathing (Myron Cohen, personal communication), have positive health consequences, or reflect sanitary practices that carried over into food and drink preparation? Why are respiratory tuberculosis rates so low among the Hakka? What does this reflect about the situation of Hakka in Hsinchu - is it an advantage of having so little of its population living in urban centers (note such an argument could not explain the Chupei differences)? Were there more scholars and medical professionals per capita among the Hakka than among the Hoklo (Kleinman 1980: 338n)? Was the Hakka population (or the Hsinchu population generally compared to all Taiwan) better educated (higher rates of school attendance?) and thus more familiar with germ theory and sanitary principles based on it?

Did Hakka women benefit compared to their bound-footed Hoklo counterparts from having natural feet and freedom of movement, or suffer from heavy labor as Hoklo critics alleged? A health benefit from natural feet fails to explain why Plains Aborigine women, similarly free of binding, benefited so much less, and why Hakka men shared the same health advantages as Hakka women over Hoklo counterparts. But perhaps the health of both male and female Hakka benefited from women's natural feet? Note that adult men are much more vulnerable than adult women to respiratory diseases; perhaps the increased share of farm field labor borne by Hakka women reduced the exposure of vulnerable Hakka men to the elements and to the risk of death due to respiratory diseases, without jeapordizing the similar advantage of Hakka women over Hoklo in respiratory diseases? If Hakka men and women more freely switched off in otherwise gendered tasks when an opposite sex family member was sick, the sick person could be left to recover and over the long run both sexes would enjoy a health advantage. (Note that even after the demise of the footbinding practice from 1915, the Hoklo gender division of labor likely continued to contrast with that of the Hakka.) This implies a lower sex ratio of mortality at adult ages for Hakka compared to Hoklo, which is supported by our data for Chupei and Hsinchu (but not for the south). This gives a different meaning to the Hoklo critique of lazy Hakka men benefiting from the heavy labor of Hakka women and suggests that it was Hoklo men as much as Hoklo women who paid the price of footbinding in poorer health.

Overall it is striking how many potentially viable hypotheses there are that could explain a Hakka mortality advantage. Yet we must remember that the actual advantage of Hakka over Hoklo within Hsinchu is moderate, and that the advantage disappears in the context of Kaohsiung. If a Hakkaness hypothesis survives further testing, it will be in a conditional form that acknowledges the importance of environmental factors. Unfortunately we have no reports of causes of death by both ethnic group and prefecture with which to pursue these questions. The reports of causes of death by prefecture reviewed above showed a pattern of low rates for all leading causes for Hsinchu that are consistent with those shown for the Hakka when compared to the Hoklo at the all-Taiwan level. But because of the extensive presence of both Hakka and Hoklo, the prefectural cause of death data can shed no light on ethnic differences within Hsinchu.

Tanei: Hoklo and Plains Aborigines. The next three tables compare the various measures of mortality for the Plains Aborigines and Hoklo of Tanei. Not surprisingly, given Tanei's southern location within Tainan prefecture, the life expectancies of both Tanei groups are considerably lower than those in Hsinchu's Chupei. The first table below presents childhood mortality rates. There is little difference in the probabilities of death between Plains Aborigine and Hoklo men and women in the first five years of life (*5q0*) but Plains Aborigine women have a surprisingly higher probability of death at ages 5-10 (*5q5*) than Hoklo women. This contradicts our notion that a higher value placed on female children would result in a survival benefit for Plains Aborigine daughters compared to the Hoklo. The much lower sex ratio of mortality among Plains Aborigines than Hoklo at ages 1-4 (*4q1*) and 5-9, indicating high rates of excess female mortality compared to male, is further evidence of adverse conditions for Plains Aborigine girls. Rates of little daughter in law marriage and female adoption are low in Tanei among the Hoklo, so the adverse consequences of adoption are not operating to raise the Hoklo rates of deaths. The Plains Aborigine pattern of adopting Hoklo girls (though not for little daughter in law marriages) probably raises the Plains Aborigine rates. Overall the probabilities of death 0-9 (*10q0*) for Plains Aborigine and Hoklo children in Tanei show only minor differences, but the degree of excess female mortality shown by the Plains Aborigine sex ratio of mortality for ages 0-9 is surprising.

The differences between the two Tanei groups in life expectancy are generally less than between the Hakka and Hoklo of Chupei, with an interesting discrepancy between the sexes that changes with age. The life expectancy of Plains Aborigine women is lower than that of Hoklo women up to age 30 but is essentially the same thereafter, while Plains Aborigine men do somewhat better than Hoklo men up to age 50 when they fall slightly behind. Plains Aborigine women have higher probabilities of death at ages 20-40, which coincides with the childbearing years. Differences in fertility might be suspected to contribute to higher death rates at these ages among a higher fertility group, but previous work shows no significant differences in fertility patterns between the Tanei Plains Aborigines and Hoklo (Shepherd et al. 2006: 143). The sex ratios of life expectancies show a greater sexual difference among the Hoklo than the Plains Aborigines up to age 50. The sex ratio of mortality for Hoklo consistently shows a male excess from age 20, while the Plains Aborigines show a female excess ages 20-35, and a male excess thereafter up to age 70.

The Tanei Plains Aborigines are reputed to be poorer than their Hoklo neighbors, but this does not seem to have translated into a significant difference in probabilities of survival. Both Tanei groups suffered from levels of mortality much higher than the Hsinchu groups, reflecting the adverse consequences of their southern environment. But neither Tanei group demonstrates a peculiar ethnic advantage or disadvantage via a vis one another in their mortality patterns.

Table 34. **Probability of Death, Infant and Early childhood mortality, Plains Aborigine and Hoklo, Tanei, 1906-1945.**

	Probability of death, per thousand person yrs. *Hoklo*		*Plains Aborigine*		***Indexed Probability of Death, Hoklo = 100*** *Plains Aborigine*		***Sex Ratio of Mortality*** *Male/Female*	
	Male	Female	Male	Female	Male	Female	Hoklo	P.A.
1q0	160.3	147.1	177.6	143.3	*110.8*	*97.4*	109.0	123.9
4q1	139.2	153.2	118.4	156.1	*85.1*	*101.9*	90.9	75.8
5q0	277.2	277.7	275.0	277.0	*99.2*	*99.7*	99.8	99.3
5q5	40.1	46.5	25.3	**67.0**	*63.1*	*144.1*	86.2	37.8
10q0	306.2	311.3	293.3	325.5	*95.8*	*104.6*	98.4	90.1
NN%	47.9%	41.7%	54.8%	41.7%	*114.4*	*100.0*	114.9	131.4
Total person yrs.	124880	116215	16944	19395				

Table 35. **Life Expectancy at Different Ages, Plains Aborigines and Hoklo, Tanei, 1906-1945.**

	Life Expectancy at Different Ages, in Years. *Hoklo*		*Plains Aborigine*		***Indexed Life Expectancy, Hoklo = 100*** *Plains Aborigine*		***Sex Ratio of Life Expectancy*** *Male/Female*	
1906-1945	Male	Female	Male	Female	Male	Female	Hoklo	P.A.
0	33.8	37.0	36.0	35.7	*106.5*	*96.5*	91.4	100.8
1	39.2	42.4	42.8	40.6	*109.2*	*95.8*	92.5	105.4
5	41.4	45.8	44.3	43.9	*107.0*	*95.9*	90.4	100.9
10	38.0	42.9	40.4	41.9	*106.3*	*97.7*	88.6	96.4
30	24.0	29.5	24.5	29.6	*102.1*	*100.3*	81.4	82.8
50	13.6	17.7	13.3	17.7	*97.8*	*100.0*	76.8	75.1

Overall, the mortality of the Hoklo groups, whether located in Tanei or in Hsinchu, more resemble those of their close neighbors than they do those of other Hoklo.

Conclusion

We have documented in this paper the persistence of strong regional differences in the levels of mortality and the underlying causes of death throughout the

Table 36. **Age Specific Death Rates, Plains Aborigine and Hoklo, Tanei. Deaths per 1000 person years.**

	Age Specific Death Rates, per thousand				*Indexed Probability of Death, Hoklo = 100*		*Sex Ratio of Mortality*	
	Hoklo		*Plains Aborgine*		*Plains Aborgine*		*Male/Female*	
Age at begin. of interval	Male	Female	Male	Female	Male	Female	Hoklo	P.A.
0	180.6	164.0	202.9	159.3	*112.3*	*97.1*	110.1	127.4
1	38.0	42.4	31.7	43.0	*83.4*	*101.4*	89.6	73.7
5	8.2	9.6	5.2	13.9	*63.4*	*144.8*	85.4	37.4
10	6.1	5.0	2.0	5.5	*32.8*	*110.0*	122.0	36.4
15	7.1	7.7	7.7	7.3	*108.5*	*94.8*	92.2	105.5
20	13.3	12.5	8.5	15.1	*63.9*	*120.8*	106.4	56.3
25	14.4	12.7	8.4	18.1	*58.3*	*142.5*	113.4	46.4
30	19.0	13.9	10.0	17.9	*52.6*	*128.8*	136.7	55.9
35	25.0	14.2	19.9	18.1	*79.6*	*127.5*	176.1	109.9
40	28.4	22.4	33.1	17.5	*116.5*	*78.1*	126.8	189.1
45	34.1	21.2	41.6	11.9	*122.0*	*56.1*	160.8	349.6
50	43.1	22.8	39.4	24.2	*91.4*	*106.1*	189.0	162.8
55	50.7	31.8	64.0	27.1	*126.2*	*85.2*	159.4	236.2
60	73.2	42.3	68.7	37.9	*93.9*	*89.6*	173.0	181.3
65	119.9	68.9	152.7	52.3	*127.4*	*75.9*	174.0	292.0
70	116.9	88.4	111.8	148.7	*95.6*	*168.2*	132.2	75.2

Japanese period in Taiwan. These differences show up strongly from the earliest date and persist to the end of the period despite public health interventions and overall declines in mortality. It is likely that the environmental and epidemiological factors giving rise to these patterns long predated the accession of Japanese rule.

We have also documented striking ethnic differences, especially in the case of the Hakka minority. The best explanation for the Hakka advantage overall is the Hakka population's good fortune to be heavily concentrated in the area of lowest mortality. But within Hsinchu we also find a moderate Hakka advantage over Hoklo persists even within small districts that keeps alive the possibility of a cultural advantage for Hsinchu Hakka. But this advantage disappears in the southern context of Kaohisung.