Nativity Differentials in Older Age Mortality in Taiwan: Do They Exist and Why?

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ABSTRACT

Comparisons of migrants vs. native populations have become increasingly important as a means of gaining insight into the factors affecting health and mortality levels and the relationship between them. Taiwan underwent a unique migration in 1949-50, as more than a million people, mostly young males, arrived from Mainland China following the Communist civil war victory. The Mainlanders are distinct in several ways: they represented different provinces in China than the original settlers, were better educated, and had distinct occupational profiles. Since 1950, Taiwan has experienced a rapid demographic transition and notable economic development, resulting in mortality decline. In this paper, we generate age- and cause-specific death rates circa 1990 by education and nativity to evaluate the relative importance of each factor. We also use time series data on mortality and survey data to help interpret the differentials in terms of selection, risk factors, and other dynamics of health and mortality.

INTRODUCTION

The health and mortality levels of migrants compared to their host populations can take many forms, depending on their early environments and the socioeconomic characteristics of each group, the reasons for migration and differences in health behaviors, risk factors, health care utilization, and possibly genetic factors. Many major international migration streams in the past have been characterized by disadvantaged groups moving to places of greater opportunity and safety. Insofar as the migrant groups have less education, income, and resources and often poorer living conditions and access to health care, it is not surprising that they have poorer health and higher mortality, given the strong association between socioeconomic status and these outcomes. There have been notable exceptions to this relationship, however, wherein migrants who are socio-economically disadvantaged appear to display lower mortality levels than their host populations. These reversals have received considerable attention, often viewed as "paradoxes" of one type or another. Examples of this paradox include the Hispanic paradox (Palloni and Morenoff 2001) and the Mediterranean paradox (Khlat and Darmon 2003).

Many of these situations are receiving detailed study as a means of further understanding possible artifacts in the analysis of mortality (e.g., selection effects in relation to those who migrate as well as those who return) and, beyond artifacts, in gaining more understanding of how lifestyle, diet, and other cultural traits, as well as psychological dispositions affect mortality. Also of interest is gaining insight into the impact of health on mortality, as in many cases the migrant groups display poorer health despite the apparent mortality advantage. Indeed, Deboosere and Gadeyne (2005, p. 661) assert that "migrant populations create an exceptional situation. They can be seen as a laboratory experiment in 'real life' where populations have a specific set of characteristics and live in the same environmental conditions as a control population." Though this assertion may be overly optimistic in not recognizing the large number of factors that can intervene to cause group differences, it remains true that, where the data permit, carefully constructed comparisons can help illuminate the dynamics of morbidity and mortality.

If the migrant group is large, taking account of possibly distinct mortality or morbidity levels and patterns is also important when tracing trends in the host country, to avoid misinterpreting the sources of change. For example, Manton and Vaupel (1995) suggest that the better health of migrants into the United States was a possible source of this country's higher

survival rates at older ages for cohorts born late in the 19th century, compared to survival rates in several other developed countries.

This paper initiates an examination into the mortality ramifications of a large and unusual migration that took place in Taiwan. Between 1948 and 1951, approximately 1.3 million people of the Nationalist regime, mostly younger males, arrived from mainland China in the wake of the Communist Civil War victory.[1] The migrants represented about 20 percent of the population at that time, and an even higher percentage of certain age-sex groups. The Mainlanders, as they are often called, were distinct from the existing Taiwanese population in a number of ways, although they share a common Chinese cultural heritage. The Mainlanders came largely from different provinces of China than the original Taiwanese settlers, they were better educated on average, and spoke Mandarin rather than Taiwanese. They mainly settled in the northern urban areas of Taiwan and were residentially segregated to some extent insofar as they occupied specially constructed dependents' villages, or neighborhoods and dormitories vacated by the Japanese, who ruled the island between 1895 and 1945. A large number of migrants were in the military (approximately 600,000) and many of the others were officials or administrators in the Republic of China government, as well as technicians and industrialists. The education and occupational advantages of the Mainlanders may not have extended to income and wealth in the early years, as they were mainly salaried and probably lagged behind the rapid gains in income in the private sector and in the business opportunities that began to expand in Taiwan shortly after their arrival (Hermalin et al. 1994). But as will be shown below, when observed in 1989, the Mainlanders display higher incomes than the Taiwanese in the same age groups. Despite some hostilities and tensions between the two groups, there was also considerable interaction at many levels and, given the strong sex imbalance among the Mainlanders, a fair amount of intermarriage.

In studying the mortality of Mainlanders and Taiwanese, therefore, we are not examining a disadvantaged group vis a vis a more advantaged host population, but rather comparing two groups with strong cultural similarities along with several cross-cutting differences. The period covered in the analysis is roughly 40-50 years after the migration, as the Mainlanders enter into the older ages. During this period there was considerable assimilation as younger military retired and entered the civilian world; and as Mainlander administrators retired, and often pursued other careers. (For example, Shih 1997, Table 5.2, shows that as of 1993 almost 50% of Mainlander

men over the age of 64 held two or more jobs after age 50, compared to only 15% of Taiwanese men in the same age group.)

The size and nature of the migration raise several intriguing questions related to mortality trends and differentials, including:

1) Did the Mainlanders differ in mortality and if so what was the effect of the Mainlander population moving through the age structure on the over –all trends in Taiwanese mortality?
2) To what degree can differences between Mainlanders and Taiwanese mortality be accounted for by their educational differentials?
3) Do any observed mortality differences persist into old age, and if so, how well do they accord with Mainlander and Taiwanese differences in health, risk behaviors and indicators of health access, as well as in socio-demographic characteristics?

Due to data limitations we cannot answer these questions fully, but by utilizing a range of data and analyses, we believe that a number of the underlying dynamics can emerge.

THEORETICAL BACKGROUND AND SETTING

Figure 1 sets out in a general timeline a number of the life events and conditions that can affect health and mortality at each age and subsequently. As indicated, our interest centers on the older age mortality of those born before 1930, whom we observe with differing degrees of detail from 1980 to 2003 (with lesser attention to observations between 1964 and 1980). Clearly, many life events have intervened from the time of birth to the later life ages when we learn most about the characteristics and survival probabilities. Many of these cannot be measured on the individual level, though some of the conditions on the group level are known. It should also be noted that, at each point, we are dealing with those that have survived. This means that, as the birth cohorts age, each group is increasingly selective and the challenge is to discern how past events and current characteristics may influence the mortality levels that are observed (Crimmins 2005; Beckett 2000; Noymer 2001). We return to these issues in the Conclusion.

Costa (2005) provides an overview of factors that may be involved in improving health and longevity at older ages, and Costa and Lahey (2005) review the historical US data to assess the role of many of these factors. Almost all the circumstances and events illustrated in Figure 1 come into play in these assessments. These include intrauterine and infant growth, place and

season of birth (the latter likely reflecting birth weight, but perhaps mothers' vitamin sufficiency), exposure to and experience with infectious diseases, environmental factors (air and water quality, congestion), occupational hazards, nutritional intake and diet, medical care and technology, and income and education; the latter two, in turn, obviously relate to the foregoing factors in a number of ways. With respect to migration, Costa and Lahey (2005, Table 2) show that, for the United States, those of foreign birth born from 1870-1899 had higher mortality at older ages, but those born from 1900-1929 experienced lower older age mortality among all whites in the same birth cohorts.

In addition to the usual array of factors that can intervene in comparing the mortality levels across any two groups, possible selection effects in terms of those who are able to, choose to, or are forced to migrate need to be considered. In the case of those who came to Taiwan from China, mainly between 1948 and 1951, a high proportion were young soldiers (perhaps in the range of 45%) and many of the others were officials, administrators, industrialists, and technicians associated with the Nationalist government--two quite different groups in terms of background. Although we have no direct knowledge of the health of those migrating, it is likely that the active soldiers would have been sufficiently healthy to join the army, or be inducted, and be able to migrate; and that the class of administrators and officials would have been advantaged in terms of education, influence, and resources in comparison to their age peers. At the same time, the stresses of the years preceding their migration should be noted. The Nationalists were engaged in warfare against the Japanese from 1937 to 1945 and against the Chinese Communists from 1945 to 1949, and to some extent earlier. The government had to move frequently during this period and it is reported that many of the crack forces of the Nationalist armies were badly decimated in the war against Japan and against the Communist regime thereafter, so that the soldiers who did migrate are likely to be less selective than otherwise.[2] It should also be noted that a number of the units, consisting of more than 150,000 men, were cut from the military payroll in Taiwan in 1950, many of them apparently remnants of the warlord forces loosely affiliated with the Nationalists (Kallgren 1963, p. 40 and footnote 12).

The wartime experiences of the soldiers who migrated, as well as their characteristics are important in considering future survival chances. Indeed, studies of the U.S. Civil War veterans indicate that those who were under higher levels of wartime stress (being wounded, prisoners of

war, etc.) experienced higher rates of certain illnesses and mortality levels than others at older ages, after controlling for other factors (Costa 1993; Lee 1994; Pizzaro et al. 2006).

With regard to civilian Mainlanders, it is worth noting that the city of Chongqing, which was the Nationalist capital for much of the war, was one of the most heavily bombed cities during World War II (Second Sino-Japanese War 2007). There was also substantial bombing of Taiwan by the Allied Forces between 1941 and 1945 and the effect of these bombings was summarized as follows:

> "….in 1945 when Taiwan was retroceded to the Republic of China, about three fourths of industrial productive capacity and two thirds of power generating capacity were destroyed, over one half of the existing rails, bridges, station facilities, and rolling stock were incapacitated, and only one fourth of the highways remained serviceable for motor vehicles, while harbors were largely ruined and blocked by sunken ships. As a result, agricultural output dropped to 45% and industrial output to less than one third of their respective pre-war peaks." (Hsing, 1971 quoted in Hermalin et al. 1994, p. 62.)

In the first few years after the retrocession, there was considerable turmoil in Taiwan due largely to mismanagement on the part of the administrators that were sent by the Nationalists to take over the island. This culminated in the famous disturbance of February 28, 1947, which was marked by violent protests in several cities in Taiwan and contributed toward a distinct sense of Taiwanese identity (Edmonson 2002; Gates 1987).

Considerable detail is known about the demographic, health, and socio-environment of Taiwan between 1900 and 1930, when most of the birth cohorts under analysis were born, because of the Japanese record keeping systems and subsequent research. (For a broad overview of this period, see Hermalin et al. 1994, who also provides references to much of the primary data.) When China ceded Taiwan to Japan in 1895, Taiwan could be characterized as a traditional agricultural economy that was not highly commercialized and with relatively few contacts with the outside world. In 1900, the population was about 3 million, mainly descendents of earlier settlers from Fujian and Kwantung provinces. Expectation of life at birth was about 30 years, as of 1906. The principal objectives of Japan's colonial policy were to promote the production and export of sugar and rice and to keep economic power in Japanese hands. To achieve these goals, they made sizable investments in industrial and agricultural infrastructure, agricultural productivity, public health and basic education. Public health measures controlled the spread of cholera and plague, eliminating major epidemics. Health

services were improved by the gradual substitution of modern medical doctors for the predominant Chinese herb doctors; government expenditures for public health services increased more than eight-fold between 1905 and the early 1930s. As a result of these efforts, expectation of life advanced from about 30 years in 1906 to 48 years in 1941. Death rates declined from 31 to 18 per thousand between 1906 and 1943 although the birthrate remained around 40 per thousand over much of the period. The Japanese gradually extended elementary education to all Taiwanese males, although most were effectively barred from post primary education. In 1905, less than 5% of the Taiwanese school-age population was enrolled in elementary school while by 1944 the percentage was 71% (81% of males and 61% of females). Despite these changes, living standards did not improve greatly, remaining at or near subsistence levels, and most Taiwanese had little opportunity for non-farm employment. Approximately 75% of Taiwan's labor force was in agriculture and fishing in 1895 and the proportion was about 70% in 1940.

The early environment of the Mainlander migrants to Taiwan is harder to capture because they came from many different provinces of China. The Taiwan censuses of 1980 and 1990, which report the province of domicile of the Mainlanders, indicates substantial immigration from 12 different provinces, mainly from central and southeast China, but extending as far west as Sichuan. Fujian and Kwangtung provinces, which were the main source of the original settlers to Taiwan, are also prominent among the later mainlander migrants. (It is possible that the more senior officials and administrators of the Nationalist government would have a somewhat different distribution of province of origin than the younger soldiers. This has not been investigated as yet.) For much of the critical 1900-1930 period, China was not under any central government, and there are few statistics on mortality, morbidity, and health conditions. Campbell's (1997) study of early public health efforts, though focused on Beijing, briefly describes and gives reference to an array of relevant steps. These include: 1) the North Manchurian plague prevention service carried out between 1911 to 1937, to combat plague, cholera, and other infectious diseases; 2) establishment of medical colleges and hospitals; vaccination programs; hygiene regulations and educational campaigns in urban areas; 3) establishment of a Ministry of Health by the Nationalist government in the 1930s and formation of a national health policy focusing on rural areas; and 4) efforts in many large cities before 1935, to provide treated tap water; vaccination campaigns; refuse collection, etc.

In contrast, the demographic estimates for rural China, prepared by Barclay et al. (1976), based on data collected from farmers between 1929-31 in 16 provinces by the Department of Agricultural Economics at Nanking University, point to an expectation of life at birth of less than 25 years at that time. In addition, they note that even for that low expectation, there was very high mortality between the ages of five and twenty, possibly indicating high levels of tuberculosis attributable to infections during childhood. These data point to levels of mortality in rural China, much higher than Taiwan at that period; and the contrasts with the efforts ongoing in urban China suggest that the Chinese migrants from urban areas would have had a more beneficial early health environment than those from rural areas. (As shown below, a high proportion of Mainlanders observed in 1989 report having grown up in urban areas.)

It is worth stressing that early conditions and life chances were probably quite different for the older and younger Mainlanders, as the older groups had higher occupational statuses and were likely to be from more advantaged backgrounds. It is likely that the younger Mainlanders were quite heterogeneous in salient ways. While many were soldiers, from poorer rural areas with no education, others were likely to be children of senior officials, more highly educated, as well as young technicians. At the same time, for the Taiwanese, the social and economic developments in Taiwan from 1900 to 1940 suggest the more usual secular process, whereby younger Taiwanese would be the beneficiaries of increased agricultural productivity, declining death and disease rates, improved sanitation, and more accessible health facilities. These different patterns seem to have consequences for later contrasts in mortality and will be discussed further below.

As is well known, from 1950 on Taiwan experienced a very rapid demographic transition and exceptional socioeconomic development. Its population had doubled from about 3 million in 1900 to 6 million in 1940, and its civilian population was reported as 7.5 million at the end of 1950.[3] Life expectancy at birth increased from 51 years in 1949 to about 75 years in 2000; the total fertility rate declined from 5.9 per woman in 1949 to below replacement level by 1985. Calories per person increased from about 2,000 per day in 1950 to 3,000 by 1988, and public health expenditures and medical facilities have increased markedly (e.g., population per physician declined from close to 1,600 in 1955 to about 750 in 2000). School enrollment and educational attainment for younger men and women has soared. A successful land-to-the-tiller program greatly increased the number of farms and the proportion of cultivators who were full

owners. At the same time the rapid growth of the industry and service sectors has led to many new job opportunities, so that the percentage of the labor force employed in agriculture dipped below 10% by the late 1990s. Per capita GNP in US dollars advanced from under $200 in 1952 to about $14000 in 2000 (Republic of China 2006).

Though both Mainlander migrants and native Taiwanese benefited from the rapid socioeconomic progress in Taiwan, the life courses of each group may have been quite different. A high proportion of the Taiwanese we are studying would have continued to live in rural areas, pursuing largely agricultural pursuits, while most Mainlanders would have been urban dwellers, serving in government related enterprises and, over time, increasingly in the private sector.

The primary objective of this paper is to examine whether the different experiences and conditions of Mainlanders and Taiwanese over their life course give rise to different mortality risks. To the extent that differential mortality risks exist, we aim to identify the underlying causes of those differences.

DATA SOURCES

From one standpoint, Taiwan is a perfect laboratory for studying mortality differentials over time of the two groups. The Japanese initiated a household registration system as part of their control system, which was deemed quite complete by 1905. Under this system, the characteristics of all members of the household were recorded, and changes to the household as result of birth, death, migration, and marital status events had to be registered and incorporated. A detailed analysis of the system by Barclay (1954) concluded that the system was highly complete and accurate. The household system was maintained after Taiwan was returned to China in 1945. So for a developing country, Taiwan has had excellent vital statistics and population data throughout much of the 20th century.

The distinction between Mainlanders and Taiwanese is based on the concept of "domicile". It combines elements of birthplace and ancestry and was intended to show the origin of family groups rather than individuals. Domicile is a relatively fixed characteristic of men, but women who marry a person of a different domicile are expected to adopt their husband's domicile (Speare1974). Indeed, the registration forms for birth, death, and marriage that were in effect for much of the post-World War II period recorded the domicile of those involved in the event--that is parents of the newborn, the decedent, and for marriages, the domiciles before and

after marriage. Given the existence of these data in the household registration system, it would have been possible for Taiwan to generate death rates by domicile on a regular basis, as well as characteristics of Mainlanders and Taiwanese on such items as education and occupation at regular intervals. Although there was a strong focus on relationships between the groups and attention to domicile in a number of arenas, little of this reporting potential embedded in the household and vital registration system was utilized, and much of the analytic potential is thus lost. We use what is available from the household and vital statistics system, but rely to a great extent on census data and a special panel study of the elderly.

We use the censuses to provide information on the number of Mainlanders and some of their characteristics. In the post-war period, population censuses were conducted in 1956, 1966, 1970 (sample census), 1975 (sample census), 1980, 1990, and 2000, and nativity was a standard item through 1990. Published tables by domicile by age and sex are usually shown, and micro data files of the complete 1980 and 1990 censuses enabled us to prepare additional cross tabulations. Table 1 shows the number of Mainlanders by age and sex as published for 1970, 1980, and 1990 for the relevant ages, as well as the proportions in the each age group. As of 1990, Mainlander men constituted about 40% of the total for ages 60-75, a third of those 75-79 and a more then a fifth of those above age 80. Mainlander women are a much smaller percentage of the female total, representing 13 to 15% of those aged 60-75, and less than 10% of those older than age 75.

The first question we posed about the Mainlander migration is its possible impact on the observed trends in Taiwanese mortality. Due to the failure to report deaths and the corresponding denominators by nativity, it is not possible to obtain direct measures of age-specific death rates for the two groups over time, which precludes a clear answer to the question. Instead, we experimented with an indirect approach in which we modeled a quinquennial time series of overall age-sex specific death rates as a function of age, time, and proportion Mainlanders by age and sex (derived from the censuses) to estimate the impact of nativity on mortality levels. In addition, to obtain a more direct measure of the impact of nativity over time, we used the census data files for 1980 and 1990 to compute census survival rates over the period, by age, sex, education, and nativity. These census survival rates also introduce the question of the relative importance of nativity and education on mortality differentials.

The second and third approaches produce direct measures of mortality by nativity and allow control for other factors as well. The second approach makes use of death records for the period from 1989-1991. This is the only period for which nativity is available as part of the death record data, along with age, cause, sex, education, and several other characteristics captured from the household register. Developing this file required matching two death files, one from the Ministry of Health and one from the Ministry of Interior, which maintains the household register. The detailed procedure is described by Kramarow and Yang (1997) who used these data to explore educational differentials in mortality. The complete 1990 census data file was used to develop the denominators by age, nativity, and education for each sex for the corresponding numbers of deaths.[4] This produces cause-specific mortality rates by age, nativity, and education for each sex, and permits a close examination of the relative role of nativity while controlling for education.

The third analysis uses data from the "Survey of Health and Well-being of the Elderly in Taiwan," a panel study that began in 1989 and conducted major follow-up interviews in 1996, 1999, and 2003 (Taiwan Provincial Institute of Family Planning 1989). The death certificates for all survey participants who died between 1989 and 2003 were obtained, providing details as to the dates of death. Information on cause of death was also obtained, but is not used in the present analysis. (For the relatively small number of respondents who were lost to follow-up in the reinterviews, the death registers were searched to determine whether the respondent died and these cases were included.) Though the survey provides only a sample of deaths from 1989-2003, it permits incorporation of all the characteristics measured in 1989 that have been hypothesized to affect mortality. This means that the analysis can go beyond nativity, education, and sex, to include other socioeconomic characteristics, health conditions and behaviors, self-rated health, and health care utilization, which cover many of the adult life experiences enumerated in Figure 1. In addition, we can incorporate some early life experiences, such as type of place of early residence, and month or season of birth, the latter of which some research has pointed to as a critical variable in signaling prenatal development and/or birth weight (Doblhammer and Vaupel 2001).

Many of the early life experiences sketched in Figure 1 cannot be measured on an individual basis, but the survey data directly address the third question posed, and the three interrelated analyses help clarify the picture of the dynamics underlying differences by nativity.

RESULTS

Trends in death rates: 1964-2004

We begin with an overview of trends in mortality at older ages in Taiwan during the latter half of the 20th century. Taiwan experienced substantial improvements in old-age mortality during this period, as depicted in Figure 2, which presents age-specific mortality rates for men (top graph) and women (bottom graph) in Taiwan between 1964 and 2004. Declines in mortality occurred at all ages for both men and women, but they were most pronounced at the older ages (80-84 and 85+). The declines in age-specific death rates were particularly marked between 1974 and 1984. At every age and year shown here, death rates were higher for men than for women. These mortality improvements were also reflected in large increases in life expectancy at age 60 for both men and women. Between 1964 and 2004, expectation of life at age 60 increased from 14.4 to 19.1 years for men, and from 17.2 to 22.6 years for women (Republic of China 1995 and 2005).

Although it is clear that overall mortality at older ages declined steadily and fairly substantially over this period, trends in cause-specific death rates were more variable. Figure 3 presents age-specific death rates for males between 1989 and 2004 for selected causes. The trends in heart disease and cerebrovascular disease (stroke) death rates are consistent with the overall trend, in that death rates drop monotonically over time. In the case of heart disease, the decline is particularly marked between 1994 and 1999. For cancer and diabetes, however, a very different trend is evident. Death rates for cancer actually increased fairly steadily over this period, with the increases being most pronounced at older ages. Diabetes death rates also increased at each age between 1989 and 1999, after which they declined slightly between 1999 and 2004. The trends in cause-specific death rates for women are generally similar to those for men and are not shown here.

The question that we attempt to address in this part of the analysis is what impact the Mainlander migration had on overall mortality trends in Taiwan. As noted in the previous section, in lieu of a direct measure of age specific death rates by nativity (which is not possible with published data), we undertook indirect estimates by modeling the overall death rates and adding a measure of the proportion Mainlander to gauge the nativity impact. The database included a total of 72 observations representing eight age groups 50 years and older (50-54

through 85 and older) for the nine quinquennial years from 1964 through 2004. Although we could capture the shape and level of the mortality rates shown in Figure 2 in regression analyses which produced excellent fits (R-squares exceeding .99 for some models), the estimates of Mainlander effects across models were not very stable, and for this reason we do not report them here. (Further investigation of a more adequate specification that would "back out" Mainlander and Taiwanese estimates more formally is underway.) The models tested did show a negative effect of Mainlanders on death rates that was quite substantial in some cases, especially for males. It should be noted, however, that these estimates may overstate the nativity effect, as other characteristics like education were not incorporated. Attempts to introduce education generated strong collinearity problems.

In order to gain some time perspective, we used the 1980 and 1990 micro-data census files to calculate census survival rates by age, education, and nativity for each sex. In a closed population, census survival rates can produce reasonable estimates of mortality over a 10-year period but are affected by differential census coverage and misreporting of age and the other characteristics involved. In the case of Taiwan, most censuses over this period had been judged quite complete and accurate, but some degree of error does exist which can affect the estimates. It is important to remember that for females, the reporting of nativity may change due to marriage (or after divorce or widowhood), that the proportion of Taiwanese at higher education levels is small, and that Mainlander women are a relatively small proportion of each age group.

Table 2 shows the educational distribution of Taiwanese and Mainlanders by age and sex, as derived from the 1990 census, and reflects clearly the Mainlander educational advantage discussed at the outset. The Mainlander migrants also have much higher educational attainments than those in the same age group who remained in China. For example the 1990 Chinese census (People's Republic of China1993) shows that only 11 percent of men aged 60 or older and less than 2 percent of women have more than a primary education, compared to the 52 percent of men and 38 percent of women among the Mainlander migrants.

Table 3 shows the 1980-90 census survival rates for ages starting at 50-54 years in 1980. For men, total census survival rates indicate that the two groups were very similar for those aged 50 to 70 at the start of the decade. But starting at age 70, Mainlander survival rates were quite a bit higher than Taiwanese. By education, for those with less than primary school, Taiwanese survival exceeded Mainlanders for those younger than 70 years in 1970, it was about the same

for those 70-74, and lower than the Mainlanders for ages 75 and older. For primary grads, there was little difference between the two groups below age 60, but thereafter Mainlander survival exceeded Taiwanese; and for those with more than primary education, Taiwanese survival was higher at ages below 65, about the same for ages 65 to 69, and lower at higher ages.

Female census survival rates tend to resemble males in the sense that the survival advantage for Mainlanders tends to emerge most strongly at older ages, but among the very small number of Taiwanese with more than primary education, there appears to be a survival advantage across nearly all the ages (but it should be recalled from Table 2 that 3% or fewer Taiwanese females at ages 70 and older as of 1990 had more than a primary education, so that even a relatively small number of coverage or reporting errors in 1980 or 1990 can affect the census survival rate substantially). Whether the differentials by nativity and the age patterns observed through the census survival rates are sustained with more direct measures of mortality will become apparent as we turn to these other approaches.

Nativity differentials in overall and cause-specific death rates

The second set of data that we use to examine Mainlander-Taiwanese mortality differentials is the complete file of deaths for the three years 1989-1991, coupled with the 1990 census. Tables 4 and 5 show the annual-average age, nativity, education specific death rates for each sex for 1989-91. The top portion of each table provides the actual rates while the lower portion provides various ratios to highlight the nativity and educational differentials. The top portion of Table 4 shows that the death rates increased steadily by age, that they are higher for the least educated than for the most educated, and that the death rates in total and by educational level are lower for the Mainlanders than for the Taiwanese. The standardized death rates above age 60 for males shown in the last row indicate that the average death rate from 1989-1991 was 2,977 per 100,000 for Mainlanders, or about three-quarters the rate of 3,913 for Taiwanese. The Mainlander advantage holds within each educational level, demonstrating that the lower mortality for Mainlanders does not arise only from their more favorable educational distribution.

The bottom portion of Table 4 quantifies some of the differentials embedded in the top portion. The first four columns present Mainlander to Taiwanese ratios of death rates by educational level and in total. The Mainlander advantage is least pronounced for those with less than primary school education. For ages up to 80, the Mainlander advantage does not exceed

8%, though it increases substantially for the relatively smaller groups above age 80. The largest differential occurs among those with primary education, where the age-standardized Mainlander ratio is only .71 of the Taiwanese, with substantially lower ratios for the two oldest groups. Among those with the highest level of education, the standardized ratio varies rather narrowly between .80 and .94 with again some indication of a growing Mainlander advantage by age.

The last six columns of the bottom portion examine the educational differentials in death rates separately for Mainlanders and Taiwanese. This is done by showing the ratio of each category's death rate to the total death rate for that age group, for each nativity. For Mainlanders there is a clear gradient across educational categories, for each age group, with the least educated showing the highest death rates, the primary graduates substantially lower death rates, and those with more than primary education displaying the lowest death rates up to age 80, after which point they exceed those with only primary school attainment. Overall, as reflected in the standardized rates, primary graduates have 24% lower mortality than the least educated, and the most educated are 13% lower than those with primary schooling.

Among the Taiwanese, the pattern is quite different. For three of the ages, the primary graduates display a higher mortality than those with the least education, and for the standardized total they are about 5% higher. At the same time, at every age, those with more than primary education show the lowest mortality--25 to 28% lower than the other two categories.

Table 5 presents similar data for females and the patterns differ from males in a few respects. As with males, Mainlander females have a clear advantage over their Taiwanese counterparts, in total and within educational categories, as shown by the standardized rates as well as the age-specific rates. The only exception is that for those aged 60-64, Mainlander women with less than primary education have slightly higher mortality than Taiwanese at that age. As the lower portion of the table shows, the Mainlander advantage at each age varies less across educational categories than among men. There is still a tendency for that advantage to increase by age. As shown by the standardized ratios, the death rates among Mainlanders is .80 of Taiwanese for those with less than primary education, and the ratios for primary graduates and those with more than primary education are .73 and .76 respectively.

The last six columns of the lower portion of the table which focus on the educational differentials within each nativity for females also show some differences from the male pattern. Among Mainlanders, the gradients across education are quite clear, and only among the oldest

females does a reversal appear, where those with primary school have slightly lower mortality than those with more education. Similarly for Taiwanese, the gradients across education groups by age are quite pronounced, as distinct from the male pattern, and the only reversal occurs again among those 85 years and older.

The pattern whereby the Mainlander advantage in mortality tends to increase with age is intriguing, but probably should not be over-interpreted. Mainlanders at the oldest ages are of course those who were older when they arrived in Taiwan in 1949-50, and as such may be a more select group -- having weathered the long Japanese-Chinese war, the Chinese civil war, and the harsh conditions of those periods and prewar China as well. In addition, within each educational category they may have had more influential posts and assignments, given the strong role of seniority in the military and civil service. The combination of selection effects and advantages in terms of available resources and health care may help account for their enhanced advantage over their Taiwanese age and educational counterparts, but this conjecture needs to be further tested and will be discussed further below.

For clues, we look to the causes of death available from the detailed death records. Table 6 presents the standardized death rates by cause, nativity, and educational level for males and females. For men, the contrast between Mainlanders and Taiwanese within educational categories is consonant with the overall death rates, with Mainlanders showing lower death rates for almost every cause. The major exception is hypertension, where the death rates for the lowest and highest educational levels are higher among Mainlanders, and about equal for the primary graduates. Also, the diabetes death rate for those with less than primary is higher for Mainlanders than for Taiwanese. The standardized death rates, however, obscure any age related trends and the detailed death rates by cause and age (not shown separately, but available) add further insight. Examination of Mainlander-Taiwanese differentials by cause and age reveals the following observations:

1. Among those with less than primary education, hypertension death rates are higher for Mainlanders than for Taiwanese in every age group. This differential is also observed among those with primary education or higher in several of the age groups.
2. Cancer death rates are generally lower among Mainlanders, but for the least educated, Mainlander rates exceed Taiwanese at ages above 75.
3. The Mainlander advantage for cerebrovascular and heart disease is generally consistent across all the age groups within each educational level.

4. For the least educated, Mainlander death rates from diabetes exceed the Taiwanese in four of the six age groups.

In addition to reviewing the actual and standardized rates, we also summarized the causes of death detail through a regression in which each major cause of death was regressed against the 36 observations available by age, nativity, and education. As our interest was in broad patterns, we adopted a 10% significance level in examining nativity and educational differences. Among males, Mainlanders had significantly lower death rates for cerebrovascular disease, heart disease, diabetes, nephritis, chronic liver diseases, and bronchitis and emphysema, after controlling for age and education. There was no significant difference for hypertension, cancer, or accidents.

The standardized death rates by cause for females, shown in Table 6, reveal advantages for Mainlanders for nearly every cause and educational level. Unlike for men, hypertension rates are lower among Mainlander females than for Taiwanese at each educational level. The most noticeable reversal is for malignant neoplasms, where Mainlanders exceed their Taiwanese counterparts among the least educated and, by a slight amount, among the most educated. The only other reversal is for bronchitis and emphysema among the most educated. A review of the detailed age data for females confirms the patterns observed in Table 6:

1. For malignant neoplasms, the death rates among Mainlanders in the lowest educational category are higher than comparable Taiwanese in every age category; and Mainlanders exceed Taiwanese among the most educated in four of the age groups.
2. The higher rates for bronchitis and emphysema among the most educated Mainlanders are apparent in four of the six age groups.
3. The cerebrovascular and heart disease death rates are lower for Mainlanders than Taiwanese in every age group and at each educational level, and the differentials are quite substantial, as suggested by the standardized rates.

The regression analysis for females reveals that Mainlanders had significantly lower death rates only for cerebrovascular, heart disease, hypertension, and diabetes, out of the nine specific causes shown in Table 6.

The data on causes of death reveal that the Mainlander advantage arises to a considerable extent from their lower death rates from cerebrovascular and heart diseases. For men, the differences from these two causes account for one-third of the overall difference in standardized death rates, and over half of the differential from the nine leading causes shown in Table 6. For females these two causes account for 46% of the overall difference in death rates and 70% of the

difference from the nine leading causes shown in Table 6. Whether these differentials reflect mainly genetics, selection, dietary patterns, healthcare, or health behaviors is difficult to sort out and we postpone any attempts at unraveling these factors until later. In general, we expect that Mainlanders, because of their predominance within the military and administrative sectors, had better health care on average and the physical regimes in the military may have been somewhat advantageous for those in the armed forces. These considerations make it all the more surprising that the Mainlander men generally show a higher death rate from hypertension. Hypertension should have been fairly easy to diagnose from the routine exams military personnel and administrators were likely to receive, and treatments have been available for some time. Also to the extent that Mainlanders, at least those who were in the military, were more exposed to regular physical exercise than the Taiwanese, this should have acted to lower hypertension rates. (On the other hand, it should be recognized that most of the Taiwanese men were farmers and worked long hours in the fields.) Given these possibilities, the higher death rate among Mainlanders suggests that perhaps genetic factors and dietary differences play a significant role, but this requires further investigation.[5]

The higher cancer rates among Mainlander women and among the least educated Mainlander men merit further investigation and analysis. As shown below in the survey results, the prevalence of smoking is slightly higher for Taiwanese than Mainlander men, but for women Mainlanders are much more likely to smoke than are Taiwanese. It is possible that the smoking differential among women helps account for the cancer differential, and an initial review of lung cancer rates tends to support this surmise, but further investigation of this relationship is required.

Nativity differentials in risk factors and their impact on mortality

The third data source we employ to analyze mortality differentials by nativity is the 1989 Survey of Health and Well-being of the Elderly. These data are used to investigate differences between Mainlanders and Taiwanese with respect to health and lifestyle, SES, and access to health care, and the contribution of these factors to explaining the observed mortality differentials.

A few papers based on this survey have touched on nativity differentials in health and mortality. The survey data was used by Tung and Mutran (2005) to explicitly address health

disparities between Mainlanders and native Taiwanese, referred to as "ethnicities" in the paper. Their analysis utilized the 1996 follow-up to the original 1989 sample and was restricted to those 60-70 years of age in 1989. The major focus is on the determinants of health measures in 1989 separately for each group and factors associated with change. But they also address whether nativity affects the development of any ADL's or change in self-reported health between 1989 and 1996. In a second paper, Zimmer and colleagues (2005) examine the determinants of old age mortality in Taiwan between 1989 and 1999. Although not the focus of their paper, their analysis shows that Mainlanders have lower mortality even after controlling for other socioeconomic and health status variables. We use this same data over a longer period with a different modeling approach to look explicitly at nativity differentials in mortality and the factors that influence these differentials.

To do this, we estimated both logistic regression models to predict mortality at any point during the 14-year follow up period, and a parallel set of Cox proportional hazard models predicting time to death (in months) starting from the baseline interview. The models were run separately for men and women. For both sets of models we started with age, nativity and an interaction between age and nativity as the only predictors (Model 1). We then added the following factors in an incremental fashion: education (Model 2), other demographic and socioeconomic factors (Model 3), and health-related factors (Model 4). The purpose of this incremental approach was to first establish whether there is a nativity differential in mortality for men and women and, if so, to investigate what factors explain or otherwise influence that differential. Results from the logistic and proportional hazard models were very similar with respect to the factors that showed significant effects and their influence on the nativity differentials, and for ease of interpretation we present only the logistic regression results in this paper.

Table 7 provides distributions for these factors by nativity, separately for males and females. Mainlanders are somewhat younger on average than their Taiwanese counterparts, particularly among men. Despite this, the proportion currently married is lower for Mainlander versus Taiwanese men (65% vs. 79%, respectively). This is largely due to the higher prevalence of never-marriage among Mainlander men (16% vs. 2% for Taiwanese men; not shown here). In contrast, among women, the proportion currently married is somewhat higher for Mainlanders compared to Taiwanese (58% vs. 51%). The family and household composition of Mainlanders

is also distinctive. Mainlander men and women have fewer children on average than Taiwanese, and they are more likely to live in a nuclear household (i.e., alone, with spouse only, or with unmarried children). Mainlanders are also more likely than Taiwanese to have lived in urban area, both during childhood and in later life (i.e., at the baseline survey wave). The nativity differential is particularly pronounced for women.

Mainlanders and Taiwanese older adults are also characterized by distinctive socioeconomic profiles. Mainlanders are more educated, they are more concentrated at the upper end of the income distribution and, among those who ever worked, are substantially more likely to have worked in a non-agricultural, non-family business for their main occupation compared to Taiwanese. Among women, the proportion who never worked for pay is higher for Mainlanders than Taiwanese (48% vs. 35%); among men the number who never worked is negligible for both groups (percentages not shown).

Given their younger age and higher socioeconomic status, we might expect Mainlanders to have more favorable health profiles than Taiwanese. However, this is generally not the case. The lifetime prevalence of smoking is very high for both Taiwanese and Mainlander men (81% and 75%, respectively). Among women it is much lower, but the differential is much larger between the two nativity groups, with Mainlanders having a higher prevalence than Taiwanese (26% vs. 9%). Mainlander men and women are also slightly more likely to consume alcohol than their Taiwanese counterparts. The percentages rating their health as fair or poor is much higher for women than for men, but within sexes it is remarkably similar by nativity. Nativity differences in disease prevalence are also generally small, and for heart disease the prevalence is slightly higher for Mainlanders compared to Taiwanese. Proxy interviews may also be indicative of health problems. Though the percentage of proxy interviews is low overall, it is higher for Taiwanese than for Mainlanders. With regard to health services utilization and insurance coverage, the percentage that did not use any health services in the past year is low for all groups, however, insurance patterns differ greatly by sex and nativity. A majority (53%) of Mainlander men used health services that were covered by insurance, whereas the majority of Mainlander women (52%) and of Taiwanese men and women (60% and 82%, respectively) used services that were not covered by insurance. Finally, we examine the season or time of year in which the respondent was born, which has been shown in other studies to be an important predictor of mortality. The distribution of births by quarter is very similar for Taiwanese and

Mainlander men and for Taiwanese women. Mainlander women have slightly higher percentages born in the third and fourth quarters than is the case for the other groups.

Table 8 shows the percent of respondents who died at some point during the 14-year follow up period. Overall, mortality was highest for Taiwanese men (61%), followed by Taiwanese women (51%), Mainlander men (47%), and Mainlander women (33%). The percent who died during the follow up period generally increased with age; the only exception is in the very highest age group for Mainlanders, for which the percentages dropped a bit for both men and women. Within each sex group, the percent deceased is higher for Taiwanese than for Mainlanders at all ages. For males, the nativity differential is largest in the oldest age group and for women it is largest in the 70-74 and 80+ age groups. For both men and women, the nativity differential is very small in the 75-79 age group.

Tables 9 and 10 present results from the logistic regression models predicting mortality between 1989 and 2003 as a function of demographic, socioeconomic and health factors, separately for males (Table 9) and females (Table 10). Unless otherwise indicated, the characteristics reflect the respondents' status at the baseline wave of the study (1989). Results are presented in the form of odds-ratios.

As shown under Model 1 in Table 9, Mainlanders have a distinct mortality advantage compared to Taiwanese (OR = 0.64, $p < .001$), controlling for age. This advantage is particularly pronounced among the oldest-old (age 80 or over), as indicated by the significant age*nativity interaction term (OR = 0.31, $p < .05$). This pattern is consistent with the Census results for the 1989-1991 period discussed earlier, and supports the hypothesis that the Mainlanders who were relatively older (40 years or older) at the time of their migration to Taiwan were more advantaged than their younger Mainlander compatriots, and that this advantage carried over into late life health and mortality. The nativity differential (both overall and for the 80+ age group) is reduced slightly when education is added to the model (Model 2), but remains significant. The addition of other demographic and socioeconomic factors (Model 3) and health-related factors (Model 4) has only a small impact on the nativity differential. If anything, the advantage for Mainlanders in the 80+ age group appears to increase slightly with the addition of SES and health factors, while the overall advantage decreases slightly. However, both the main effect of nativity and the age*nativity interaction effect remain significant in the model that includes the full set of controls. We discuss potential reasons for this later in this section.

Although they did not explain the nativity differential in mortality, a number of other factors were found to be significant predictors of mortality. In Model 2, we observe a significant difference between the lowest and highest education groups in the expected direction, but no difference for the intermediate levels. This effect for the low education group is accounted for by other socioeconomic factors added in Model 3. We tested whether there were interaction effects between nativity and education, but these coefficients were not significant.

Turning to Models 3 and 4, men who were married at baseline were significantly less likely to have died during the follow up period than were those who were not married at baseline. This is consistent with other studies that have found a protective effect of marriage on mortality for men (Goldman et al.1995). However, no effects were found for other social support measures (number of living children, household composition) or for urban residence during childhood or in later life. With regard to income, there appears to be a somewhat monotonic effect across the income quartiles, with the lowest income group having the highest mortality risk, the highest income group having the lowest mortality risk, and the other income groups falling in between. The effect for the lowest income group remains significant when controlling for health (OR = 1.66, $p < .01$ in Model 4); the effect for the 3rd quartile remains marginally significant (OR = 1.27, $p < .10$). Type of main occupation was not related to mortality.

Most of the health-related factors examined in this study are important predictors of mortality for men (Model 4). Men who have ever smoked have significantly higher mortality risks than non-smokers, as do those who reported their health as fair or poor (vs. good to excellent), who were interviewed by proxy, and who had diabetes and had ever experienced a stroke. Men with heart and kidney disease had marginally higher mortality risks than those without these diseases. There is also some indication that health service access and use is an important predictor of mortality. Men who used services that were covered by insurance had a significantly lower risk of dying than those who used services that were not covered by insurance. Finally, mortality risks differ for men according to the season or quarter in which they were born. Those who were born in the 3rd and 4th quarters have higher mortality than those born in the 2nd quarter (OR = 1.31, $p < .10$; OR = 1.67, $p < .001$ for 3rd and 4th quarters, respectively). (This pattern is at odds with that observed by Doblhammer and Vaupel (2001) who found that those born in the second quarter had higher mortality. The number of cases under observation here is small compared to their data and the findings should be treated as very

tentative but perhaps deserving of further testing, as a differential pattern for Asia if confirmed would be of considerable interest). Those for whom month of birth was not known also have higher mortality risks; this is likely due to a strong selection effect of those with missing birth month that is not captured in the model.[6]

The findings for women are presented in Table 10. In general, the findings are quite similar to those for men. Mainlander women are significantly advantaged with respect to mortality compared to Taiwanese women (OR = 0.51, $p < .01$). The odds-ratio for the age*nativity effect is very low, suggesting that the advantage is more pronounced at ages 80 and over, as was found for men. However, due to the small number of Mainlander women in this age group, the effect is unstable and should be interpreted with some caution. As with men, the addition of education, demographic, other SES and health factors tends to reduce the overall nativity differential (OR = 0.63, $p < .10$ in Model 4 for main effect of nativity) and to increase the nativity differential for the 80+ age group (OR = 0.17, $p < .10$ in Model 4, compared to OR = 0.26, $p = .17$ in Model 1). Thus, although the main and interaction effects for nativity are only marginally significant in the full model, nativity differentials do remain for women, as was the case for men.

With respect to other predictors of mortality, there are both similarities and differences in the findings for women versus men. The effect of education is similar for women and men, in that those with no formal schooling have higher mortality risks compared to those with the highest level of schooling. However, unlike for men, the education effect for women remains significant after controlling for income and other factors. Marriage is associated with a lower mortality risk for women (OR = 0.73, $p < .05$ in Model 4), as was found for men. In contrast to men, for whom no urban/rural differentials were observed, women who were living in an urban area in 1989 had a significantly lower risk of mortality than their rural counterparts. Also in contrast to men, income level is unrelated to mortality for women. In addition, main occupation shows a marginal effect, such that women who worked in a non-agricultural, family-owned business have higher mortality than those who worked in a non-agricultural, non-family business.

The effects of smoking, fair or poor health, proxy interview, diabetes, and heart disease were all significant for women, as was the case for men. Stroke was also a significant predictor of mortality for women, although the effect was much less pronounced than that for men.

Women who reported at baseline that they drink any alcohol have marginally lower mortality than those who do not drink (OR = 0.62, $p < .10$). This is in contrast to the finding for men, for whom drinking is unrelated to mortality. Kidney disease was not associated with mortality for women, nor was utilization and coverage of health services. Finally, with respect to the timing of birth, there is some evidence that women born in the 3rd quarter have higher mortality compared to those born in the 2nd quarter, but there is no differential for those born in the 4th quarter, as was found for men. As for men, those with missing data on month of birth were more likely to have died during follow up.

In summary, although there are a number of demographic, socioeconomic and health factors that have an important impact on mortality for both men and women, these factors make only small headway in accounting for differentials between Mainlanders and Taiwanese. The lack of differentials in mortality by education are in keeping with observations and conjectures on convergence of socio-economic groups at older ages (Crimmins 2005), but this convergence is not apparent for nativity. Possible reasons for these findings are discussed in the next section.

DISCUSSION

Throughout the paper we have stressed the many life events and circumstances that can affect group differences in mortality and morbidity, ranging from prenatal conditions to the amount and nature of medical care in old age. The goal of research is to assess the relevant importance of these factors, to understand why and how they operate, and to determine how stable they are across groups, place, and time. In the present analyses, we have investigated mortality differences of two culturally related groups -- migrants from mainland China to Taiwan at mid-century and native Taiwanese -- with the thought that this rather unusual migration and the data available might add to our understanding. Though we have clarified a few issues, several intriguing questions remain. The different types of analyses that we have carried out so far point to the following:

1. Mainlanders (especially men) appear to have had lower mortality on average, from the 1960s on, as indicated by a number of times series models (not shown in detail in the paper) and by the overall census survival rates from 1980-1990. Judging by the census survival rates, this differential appears stronger at more advanced ages.
2. The detailed death records for 1989-1991 show quite clearly that Mainlander men and women had lower mortality than their Taiwanese counterparts during this period. This

differential was evident in each age group above age 60, and held within the educational categories, indicating that the mortality advantage did not arise solely from the more favorable educational distribution of the Mainlanders.

3. The panel study of the elderly, which traced deaths from 1989-2003, reveals that there was a significant and substantial mortality advantage among Mainlander men that was not explained by education or other socioeconomic characteristics, nor was it explained by a range of indicators of risk behaviors, access to health care and health status. For females, the mortality differential is as large as for males, but it is only marginally significant (between 5% and 10%) once other factors are controlled. For both men and women, there is also evidence that the Mainlander effect is stronger at the oldest ages, as suggested by the other types of analyses.

Taiwan's recording of the key demographic events entering into this analysis is on the whole very accurate with regard to age and the other characteristics, and the coverage of the household registration system and censuses appear to be virtually complete. Nevertheless, there are some unknowns that might influence results reported under points one and two. For example, the number of people over age 75 reported in the censuses and the household register differ by several percentage points for 1980 and 1990, pointing to possible deficiencies in census coverage for the very old. There may be distortions arising from older Mainlanders returning to live in China for a long period or until death; and there are also Taiwanese businessmen who have taken up residence in China for long periods, while operating their businesses there. Though the numbers do not appear large and there are rules governing how registration is maintained and deaths recorded, which should minimize errors in coverage or rates, it does appear that the data do contain some degree of error. We do not perceive that any of these factors are large or systematic enough to distort the major findings, but they need to be kept in mind and further investigated. It should also be noted because of the emphasis on education throughout the three analyses, that it is possible that the Mainlanders in the highest category of education (more than primary school) had more years of schooling on average than the Taiwanese in this category; and of course, it is possible that the content and the rigor of the two school systems differed.

What do these findings tell us and, perhaps more to the point, what do they fail to tell us? Although we were not able to control for all possible factors implicated in the mortality differentials, in the survey analysis we did incorporate controls for several early life characteristics and a range of later life statuses, behaviors, and conditions. Despite this array of controls, Mainlander-Taiwanese mortality differentials remain substantial. In seeking further

insights it is useful to take stock of factors across the life cycle that may have been omitted. Early life conditions are important, and we have been able to incorporate urban-rural residence of early childhood and season of birth. We do not have individual data on other early life conditions, such as illnesses, health care, and health environment, though on a group basis, we know that overall health conditions in China early in the 20th century were not superior to Taiwan. It is probably fair to surmise that the Mainlanders who attained higher levels of education at that time came from advantaged urban families and retained sufficiently good health to pursue their education. The younger and least educated Mainlanders may have grown up under rather difficult health, nutritional, and material conditions. Both groups of Mainlanders experienced a high degree of wartime stress, as did the Taiwanese during the bombings of 1940-45, though the Mainlander soldiers would have encountered the highest incidence of battle related injuries and traumas.

Unfortunately, we know relatively little detail about Mainlander-Taiwanese contrasts between 1950 and 1990. As described at the outset, the older migrants would have predominated as officials and administrators in the government and presumably had relatively good health care as a result. (Although Taiwan now has a national health program, it was not instituted until 1995.) As they retired, many moved into the private sector. The younger migrants were more heterogeneous, many of the soldiers would have been discharged and taken up civilian pursuits; others would have maintained military careers, and still others would have fashioned technical and other private-sector careers. A tabulation of the 1980 census shows that for men aged 50-54 who were working, the proportions who were teachers, other professional and technical workers, or in clerical occupations were higher for Mainlanders than for Taiwanese. One-sixth of Mainlanders age 50-54 were associated with the military or with public security, while almost half of the Taiwanese at those ages were in agricultural pursuits. The mortality data for 1980-1990 suggest a possible selection process, whereby the younger, less educated Mainlanders had somewhat higher mortality than their Taiwanese age peers, leaving a more robust segment of Mainlanders entering older ages.

It is true that, as of 1989, when we can observe the Mainlander and Taiwanese in some detail through the survey, the two groups appear quite similar on a number of crucial health dimensions, including their self-reported health and prevalence of conditions. However, this may be misleading to some degree. As Crimmins (2005) notes, similarity of prevalence rates for

certain diseases between two groups may mask differentials in incidence and survival rates. The less advantaged group may have experienced both higher incidence and mortality levels leading to similar prevalence rates with the more advantaged group. In addition, there may well be differences in awareness of certain conditions like hypertension and diabetes because of differential access to health care. Support for this idea is found in work by Zimmer and colleagues (2002), in which they found that the prevalence of certain chronic diseases increased with education in Taiwan, as well as Pan and colleagues (2001 and 2003) who report differentials across groups in awareness of hypertension and diabetes in the Nutrition and Health Survey in Taiwan. Taiwan greatly increased the number of sophisticated medical devices in operation during the 1980s and 1990s and it is quite possible that Mainlanders were earlier beneficiaries of these. These advantages in health care utilization may mean that the chronic conditions experienced by Mainlanders were under better control than was the case for the Taiwanese as of 1989. It is plausible that these benefits in health care access would also translate into better survival chances during the crucial 1989–2003 period.

In short, it appears that the story of the Mainlander migration is a tale of two different streams. The first stream includes those who were older at the time of migration, and who were greatly advantaged as youth in China and were robust survivors of difficult times there. They maintained their comparative advantage over similarly educated Taiwanese counterparts after the migration and may have even enhanced their differential health status because of their better access to higher quality health care. The second, younger stream was more heterogeneous; many had low education and poor early environments. These may have had somewhat higher mortality than their Taiwanese counterparts from the 1950s to 1990, leaving behind a more robust and advantaged subgroup which displays lower mortality than the Taiwanese as they move into older ages. These two processes in combination may have given the Mainlanders a distinct mortality advantage during the 1990s and later, and may have also served to mute educational differentials, once nativity is accounted for, though more detailed modeling on this point is warranted.

A few other implications from the analysis of this migration are worth noting. Insofar as the Mainlanders had distinctly lower mortality as they moved through their life cycles, as suggested by our findings, they affected the level and pattern of mortality over those years and this needs to be considered in any long-term analysis of mortality trends. Also, because the

Mainlanders were mostly male, the sex ratio of mortality at those ages would be altered and failure to note this can lead to misinterpretations of sex-ratio trends. Though the migration to Taiwan was unique in some ways, major movements of people and changing boundaries have been very common over the last century, many the result, unfortunately, of wars and their aftermath (see Bogue 1969 for a review of migrations from 1946-54) and the history of the last decade or so is replete with instances of massive movements of people in many areas of the world. Attention to their potential impact on levels of mortality, age patterns, and cause specific analyses need to be kept in mind when studying long-term trends. Similar concerns arise when completeness of mortality coverage changes within a country, either geographically or along some other dimension. The United States provides several examples, through its gradual expansion of the death registration states between 1900 and 1933 (for the effects of the expansion on death rates from stroke see Lanska and Mi 1993; for the effect on maternal mortality, see Wooodbury 1924), and more recently in the way that the measurement of Hispanic mortality in the vital statistics system has evolved (Elo et al. 2004).

It is common to call for more data whenever research results are somewhat ambiguous. In this case study and in many similar studies that have attempted to account for group differentials in late life mortality, it is clear that there are important gaps that need to be addressed in order to sort out the critical factors at work. As with the research presented here, the data that are typically used in these studies provide limited knowledge of early life conditions and focus primarily on observations made in later life, close in time to the assessment of mortality. It is clear that more detail is needed, including knowing what happens to people during their early adult and mid-life ages. In addition, it is important to observe them more closely as they age, with better measurements of their health conditions and the progression of those conditions, the type of medical care they receive, and when they receive it.

Although it is unlikely that any one data base would be available to provide all the needed data, we can become more adept at cross-walking different types of studies to gain more insights. For example, in Taiwan (as cited above) and other places there are a number of health interview studies, including health and nutritional studies similar to the U.S. National Health and Nutrition Examination Survey (NHANES). These studies often contain a good deal of data on prevalence of different conditions, people's awareness of these conditions, dietary and other behaviors, as well as medical measurements of blood pressure, blood sugar, cholesterol, and

other key indicators. Knowing how Mainlanders and Taiwanese compare on some of these indicators would be helpful in unraveling the possible sources of observed mortality differentials. It is hoped that this type of research, which combines more traditional socio-demographic inquiries with the more epidemiological oriented investigations, will be undertaken in the years ahead.

FOOTNOTES

1 Estimates of the number of migrants tend to vary from around one million to two million (see for example Nationalist Party 2006). The 1956 Census of Population in Taiwan recorded the province of origin of the civilian migrants only, but the 1966 Census included both civilians and those still in the military.

2 Hsiung's (1995) book review states that at the start of the war in 1937, the Nationalist army had over 2 million soldiers, including Chiang Kai-shek's own best equipped men, but that early on, at the Battle of Shanghai alone, he lost three-fifths of his crack troops, and continued to suffer heavy losses of his "central" forces in subsequent battles. An alternate source (Second Sino-Japanese War 2007) estimates that one-third of the Nationalist crack divisions were killed or wounded in the Battle of Shanghai, but confirms the heavy toll then and subsequently. It also notes the increasing reliance on the "provincial army" nominally affiliated with the Nationalist army but closely connected to the former warlords. Kallgren (1963, p37) states that "the military force evacuated to Taiwan was made up of a variety of units, many fragmented, under-strength and with low morale."

3 The migration of the Mainlanders did not greatly inflate Taiwan's civilian population in the 1940-50 decade because it was countervailed to some extent by the departure of the Japanese after 1945.

4 The 1990 census of population was conducted in December 1990 and the age, sex, nativity denominators were adjusted to mid-year to represent the midpoint of the deaths from 1989-91.

5 It is also possible that Mainlanders were more often diagnosed with hypertension and that this led to greater attribution of this condition as a cause of death.

6 Additional analyses revealed that, of those with missing birth month who died during follow up (n=103), over half had died in the first four years, compared to one-quarter of decedents for whom birth month was not missing. Those with missing birth month were also substantially more likely to have rated their health as either fair or poor in 1989 and to have had a proxy interview. All of this suggests that the individuals with missing birth month were frailer than those for whom birth month was obtained.

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Figure 1: Schematic Diagram of Factors Affecting Mortality and Periods of Mortality Measurement

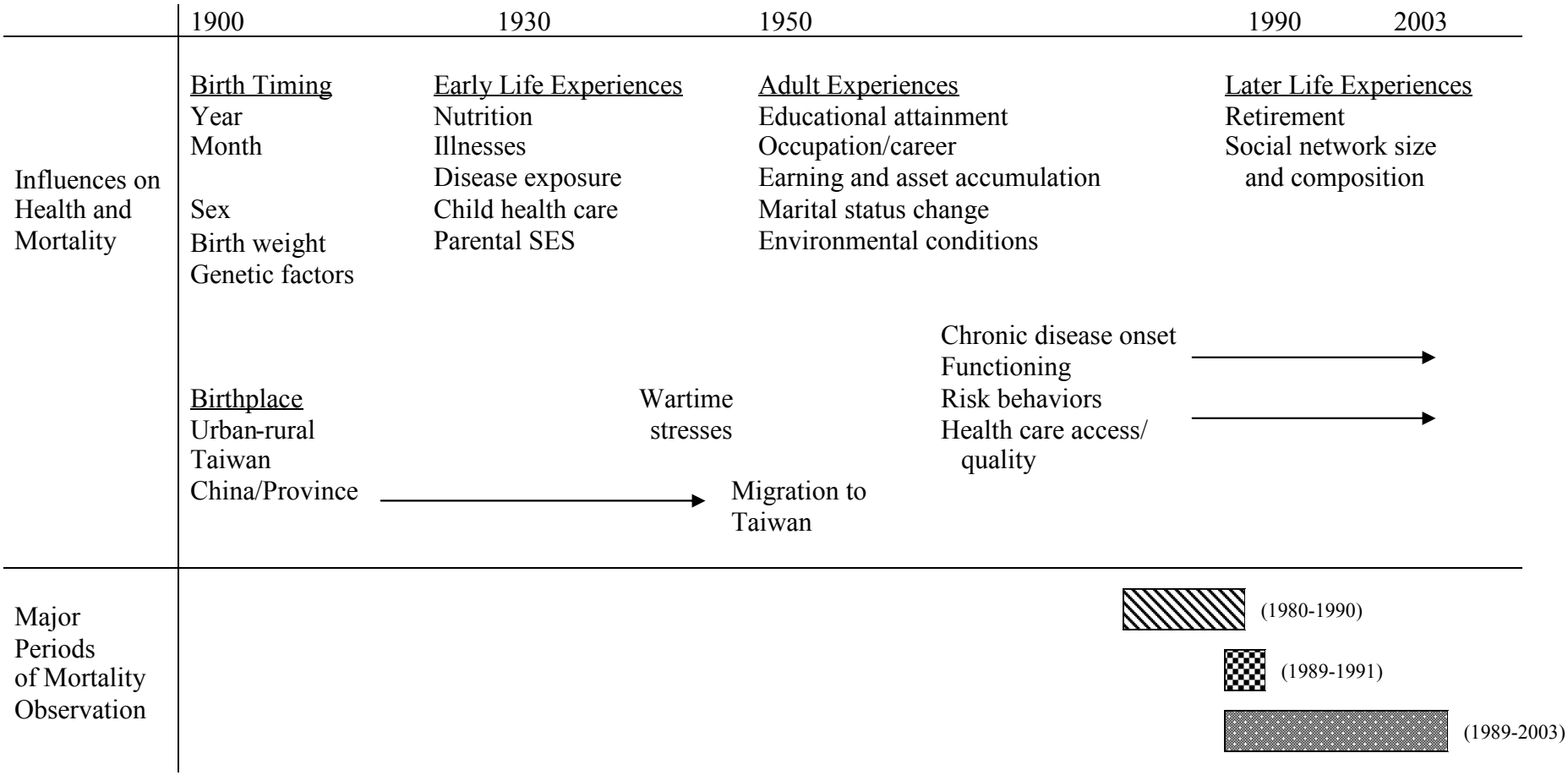

Figure 2. Age-specific death rates by sex: Taiwan: 1964-2004

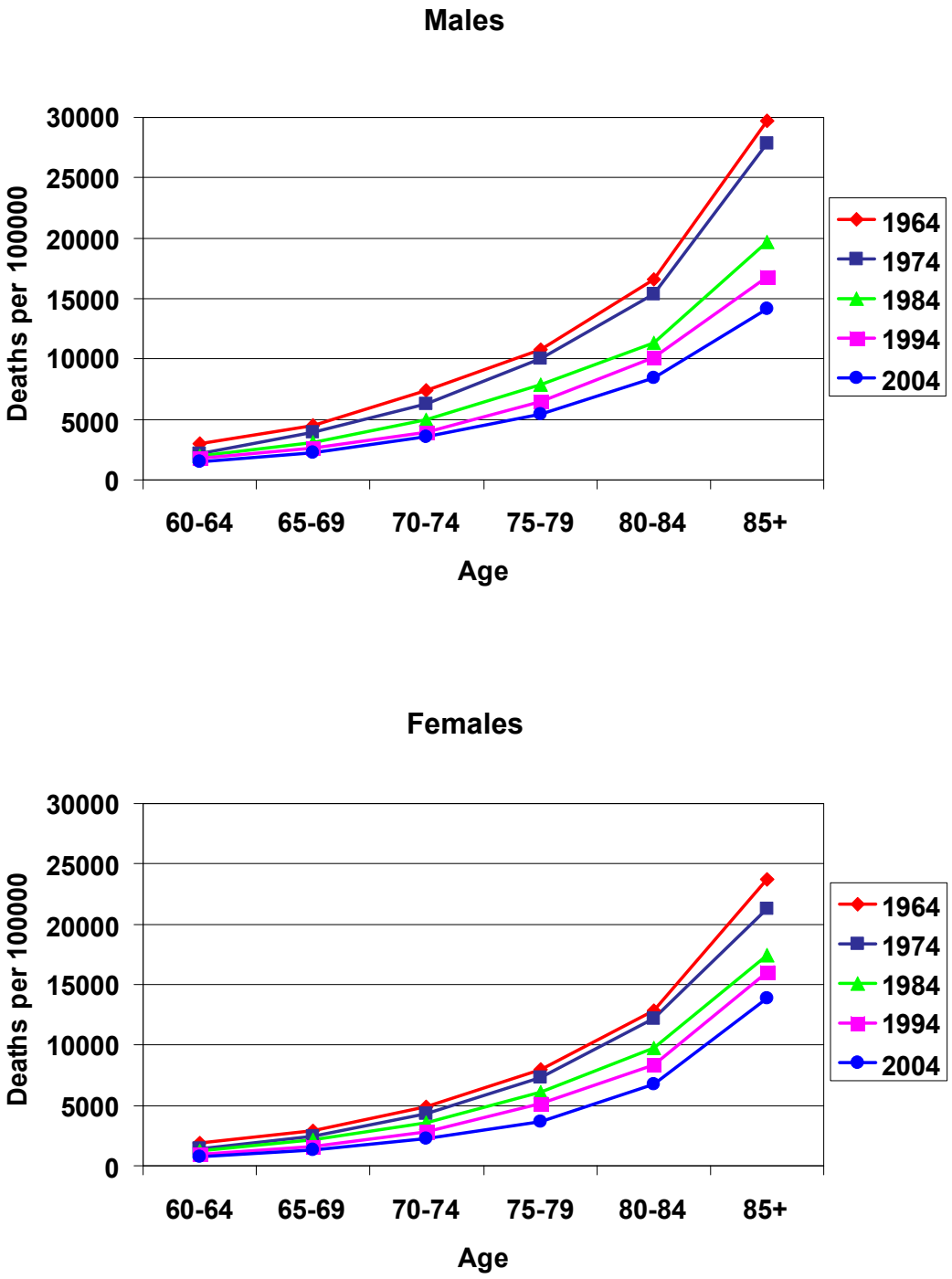

Figure 3. Age-specific death rates for selected causes for males: Taiwan, 1989-2004

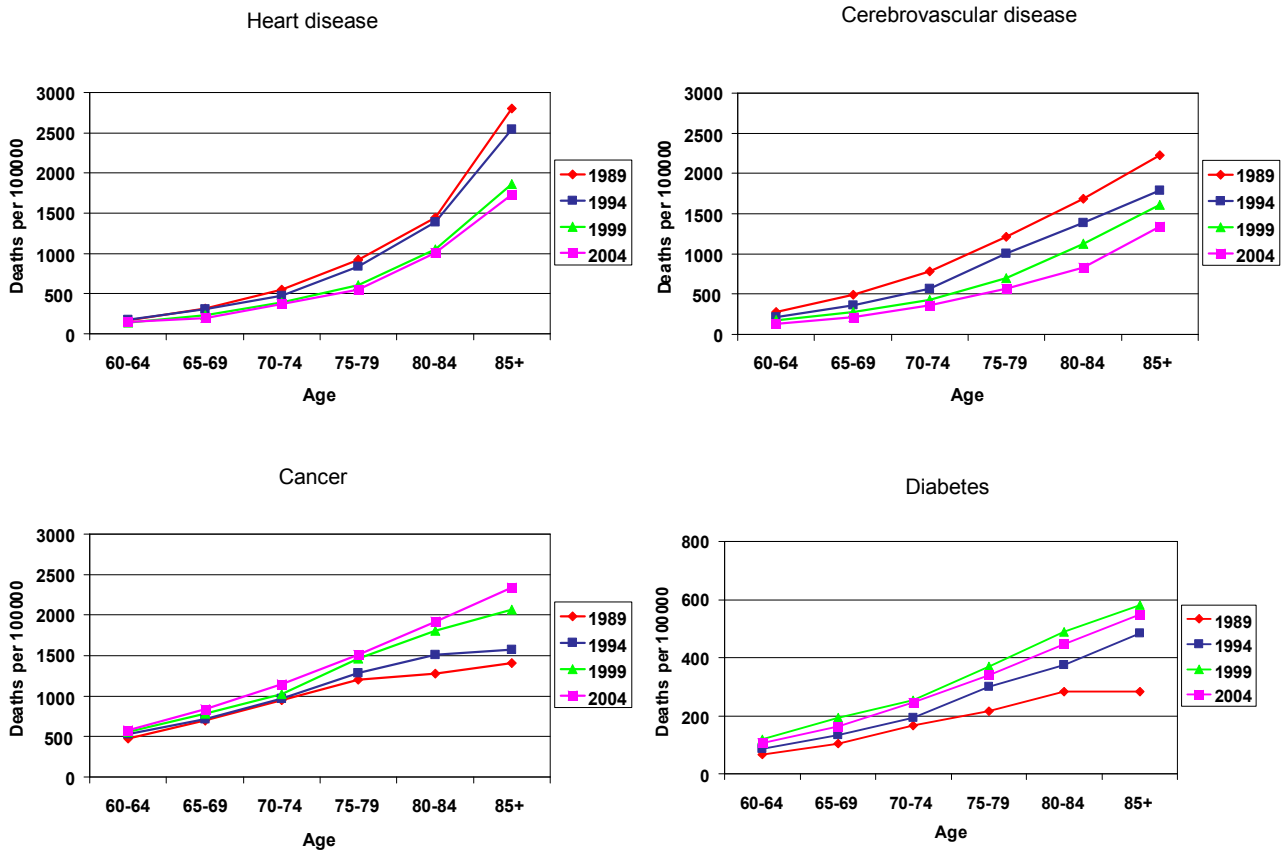

Table 1: Number and Percentage of Mainlanders in Taiwan Area by Age & Sex in 1970, 1980 and 1990

Men

	Number			Percentage		
Age	**1970**	**1980**	**1990**	**1970**	**1980**	**1990**
40-44	196,380	20,721		39.7	4.6	
45-49	182,850	71,826		44.8	16.6	
50-54	112,273	192,195	20,413	38.8	39.9	4.9
55-59	75,643	172,819	65,953	32.9	45.0	16.7
60-64	33,672	104,829	164,849	22.2	39.2	39.6
65-69	16,051	67,027	138,819	17.2	33.2	44.9
70-74	6,575	19,698	74,238	12.6	22.3	39.4
75-79	2,216	7,927	39,357	9.3	17.3	33.2
80-84	840	2,426	8,617	8.2	13.0	24.6
85+	180	797	3,380	5.5	11.5	22.3

Women

	Number			Percentage		
Age	**1970**	**1980**	**1990**	**1970**	**1980**	**1990**
40-44	56,081	63,252		16.4	14.7	
45-49	47,674	48,340		17.0	12.9	
50-54	29,539	48,057	58,608	14.0	14.7	14.1
55-59	17,132	40,757	44,099	9.6	15.4	12.4
60-64	8,337	24,918	43,214	6.1	12.2	14.5
65-69	4,294	15,215	35,162	4.5	9.0	15.4
70-74	3,533	4,936	19,818	5.6	5.2	12.6
75-79	2,216	2,760	11,169	5.8	4.9	9.8
80-84	1,022	1,609	3,141	5.6	5.6	7.2
85+	692	1,307	1,959	6.8	9.1	8.4

Sources: 1970, 1980 and 1990 Census of Population and Housing. (Republic of China, 1972, 1982, 1992a)

Table 2: Mainlander and Taiwanese Educational Distributions by Age and Sex in 1990

Men

	Mainlander			Taiwanese		
Age	**LT Primary**	**Prim Grad**	**MT Primary**	**LT Primary**	**Prim Grad**	**MT Primary**
60-64	16	27	57	27	52	20
65-69	22	27	51	40	44	16
70-74	27	24	49	54	36	11
75-79	35	23	42	62	30	8
80-84	41	19	41	68	25	8
85+	43	17	40	77	17	7
Total 60+	22	26	52	42	43	15

Women

	Mainlander			Taiwanese		
Age	**LT Primary**	**Prim Grad**	**MT Primary**	**LT Primary**	**Prim Grad**	**MT Primary**
60-64	31	29	39	62	30	7
65-69	36	24	41	74	21	5
70-74	42	19	38	84	14	3
75-79	51	17	32	88	9	2
80-84	62	14	25	92	6	2
85+	70	12	18	95	4	1
Total 60+	38	24	38	75	20	5

Source: Tabulations from 1990 Census micro-data file.

Table 3: Census Survival Rates from 1980 to 1990 by Age, Education and Nativity

		Less Than Primary		Prim Grad		More Than Primary		Total	
Sex	Age	Mainlander	Taiwanese	Mainlander	Taiwanese	Mainlander	Taiwanese	Mainlander	Taiwanese
Male	50-54 to 60-64	0.8860	0.9040	0.8251	0.8391	0.8586	0.9218	0.8577	0.8686
	55-59 to 65-69	0.8065	0.8222	0.7809	0.7843	0.8142	0.8451	0.8033	0.8085
	60-64 to 70-74	0.6840	0.7172	0.6910	0.6742	0.7307	0.7441	0.7082	0.7038
	65-69 to 75-79	0.5516	0.6079	0.5866	0.5418	0.6199	0.6180	0.5872	0.5869
	70-74 to 80-84	0.3825	0.3856	0.4865	0.3649	0.4843	0.4478	0.4375	0.3842
	75-79 to 85-89	0.2905	0.2452	0.4164	0.2713	0.4067	0.3152	0.3493	0.2537
	80+ to 90+	0.1541	0.0880	0.3699	0.1496	0.1997	0.1671	0.1896	0.0968
Female	50-54 to 60-64	0.8939	0.9213	0.8872	0.8829	0.9181	0.9938	0.8992	0.9142
	55-59 to 65-69	0.8665	0.8565	0.8670	0.8463	0.8568	0.9568	0.8627	0.8587
	60-64 to 70-74	0.8016	0.7701	0.8194	0.7557	0.7771	0.8786	0.7953	0.7709
	65-69 to 75-79	0.7588	0.6745	0.7413	0.6404	0.6956	0.7721	0.7341	0.6729
	70-74 to 80-84	0.6466	0.4485	0.7329	0.4818	0.5738	0.6127	0.6363	0.4529
	75-79 to 85-89	0.5005	0.3068	0.6667	0.4531	0.5044	0.4415	0.5178	0.3122
	80+ to 90+	0.1693	0.1129	0.3867	0.2865	0.2818	0.2865	0.1818	0.1164

Source: Tabuated from 1980 and 1990 Census micro-data files.

Table 4: Taiwan's Average Annual Death Rates, per 100,000, for Males, 1989-1991 by Age, Nativity, and Education & Relative Mortality Differences

	Mainlanders				Taiwanese				
Age	LT Prim	Prim Grad	MT Prim	Total	LT Prim	Prim Grad	MT Prim	Total	Grand Total
60-64	1,953	1,551	1,231	1,433	2,036	1,935	1,312	1,836	1,672
65-69	2,844	2,254	1,942	2,224	3,102	3,073	2,184	2,939	2,622
70-74	4,545	3,778	3,029	3,620	4,563	5,100	3,463	4,635	4,244
75-79	6,663	5,552	4,710	5,589	6,926	7,888	5,843	7,131	6,630
80-84	12,272	9,246	9,636	10,635	14,490	16,185	12,004	14,723	13,739
85+	16,679	11,941	14,900	15,150	23,118	20,746	18,227	22,389	20,821
Standardized total	3,705	2,964	2,585	2,977	4,005	4,176	3,006	3,913	3,584

Relative Differentials

	Ratios of Mainlander to Taiwanese Death Rates				Ratios of Educational Categories to Total Death Rates by Nativity					
					Mainlanders			Taiwanese		
Age	LT Prim	Prim Grad	MT Prim	Total	LT Prim	Prim Grad	MT Prim	LT Prim	Prim Grad	MT Prim
60-64	0.959	0.802	0.938	0.780	1.36	1.08	0.86	1.11	1.05	0.71
65-69	0.917	0.733	0.889	0.756	1.28	1.01	0.87	1.06	1.05	0.74
70-74	0.996	0.741	0.875	0.853	1.26	1.04	0.84	0.98	1.10	0.75
75-79	0.962	0.704	0.806	0.843	1.19	0.99	0.84	0.97	1.11	0.82
80-84	0.847	0.571	0.803	0.722	1.15	0.87	0.91	0.98	1.10	0.82
85+	0.721	0.576	0.817	0.677	1.10	0.79	0.98	1.03	0.93	0.81
Standardized total	0.925	0.710	0.860	0.760	1.24	1.00	0.87	1.02	1.07	0.77

Note: LT Primary = less than completion of primary (includes illiterate and semi-literate)
Primary Grad = completed primary school (includes those who attended junior high but did not complete
More Than Primary = completed junior high school or higher level of schooling

Source: Tabulated from special mortality file and 1990 Census.

Table 5: Taiwan's Average Annual Death Rates, per 100,000, for Females, 1989-1991 by Age, Nativity, and Education & Relative Mortality Differences

	Mainlanders				Taiwanese				
Age	LT Prim	Prim Grad	MT Prim	Total	LT Prim	Prim Grad	MT Prim	Total	Grand Total
60-64	1,203	895	522	846	1,171	1,050	614	1,094	1,057
65-69	1,935	1,409	1,061	1,455	2,001	1,737	1,070	1,901	1,834
70-74	2,587	2,266	1,559	2,132	3,393	2,982	1,973	3,296	3,154
75-79	4,106	3,824	2,820	3,645	5,696	5,242	3,473	5,604	5,419
80-84	8,347	6,345	5,980	7,491	12,233	10,192	8,829	12,042	11,722
85+	15,553	8,929	9,995	13,788	20,784	13,897	17,001	20,476	19,923
Standardized total	2,785	2,161	1,691	2,300	3,488	2,949	2,223	3,387	3,275

Relative Differentials

	Ratios of Mainlander to Taiwanese Death Rates				Ratios of Educational Categories to Total Death Rates by Nativity					
					Mainlanders			Taiwanese		
Age	LT Prim	Prim Grad	MT Prim	Total	LT Prim	Prim Grad	MT Prim	LT Prim	Prim Grad	MT Prim
60-64	1.027	0.852	0.850	0.773	1.42	1.06	0.62	1.07	0.96	0.56
65-69	0.967	0.811	0.992	0.765	1.33	0.97	0.73	1.05	0.91	0.56
70-74	0.762	0.760	0.790	0.647	1.21	1.06	0.73	1.03	0.90	0.60
75-79	0.721	0.729	0.812	0.650	1.13	1.05	0.77	1.02	0.94	0.62
80-84	0.682	0.622	0.677	0.622	1.11	0.85	0.80	1.02	0.85	0.73
85+	0.748	0.642	0.588	0.673	1.13	0.65	0.72	1.02	0.68	0.83
Standardized total	0.798	0.732	0.761	0.679	1.21	0.94	0.74	1.18	0.87	0.66

Note and Source: See Table 4.

Table 6: Standardized Mortality Rates by Nativity, Education, Sex and Cause for Ages 60+, Taiwan, 1989-1991

Male

		Mainlander				Taiwanese				Total
ICD9CM Code	Cause	LT Prim	Prim Grad	MT Prim	Total	LT Prim	Prim Grad	MT Prim	Total	Total
430-438	Cerebrovascular disease	570	477	380	453	621	701	475	626	565
410-429	Heart diseases	438	347	323	361	503	511	393	498	453
401-405	Hypertension	173	120	93	124	107	123	86	111	116
140-239	Malignant neoplasms	682	662	657	662	722	844	725	754	713
250	Diabetes	132	102	98	106	122	156	128	133	122
580-589	Nephritis	65	52	60	59	91	109	93	97	83
571	Chronic liver	111	90	64	82	123	115	69	111	100
490-493	Bronchitis & emphysema	118	80	65	84	163	142	62	145	125
E800-899	Accidents	249	190	133	176	253	232	141	227	207
Other	Other	1,169	844	712	871	1,299	1,242	832	1,212	1,100
Total	Total	3,705	2,964	2,585	2,977	4,005	4,176	3,006	3,913	3,584

Female

		Mainlander				Taiwanese				Total
ICD9CM Code	Cause	LT Prim	Prim Grad	MT Prim	Total	LT Prim	Prim Grad	MT Prim	Total	Total
430-438	Cerebrovascular disease	467	348	243	369	669	545	359	641	611
410-429	Heart diseases	352	238	212	289	541	372	344	519	497
401-405	Hypertension	99	100	51	84	151	109	63	145	139
140-239	Malignant neoplasms	523	476	461	489	422	533	456	436	441
250	Diabetes	202	189	101	159	239	244	135	231	222
580-589	Nephritis	78	67	36	59	101	100	69	98	94
571	Chronic liver	68	57	35	53	76	71	39	73	70
490-493	Bronchitis & emphysema	72	41	48	59	91	54	36	87	84
E800-899	Accidents in total	100	70	44	73	114	96	54	108	104
Other	Other	825	575	459	667	1,084	825	667	1,048	1,012
Total	Total	2,785	2,161	1,691	2,300	3,488	2,949	2,223	3,387	3,275

Notes: The ICD9 categories are those that match the basic tabulation of causes of death used for Taiwan time series (see Republic of China, 1992b, Table 15)

Source: Calculated from special mortality file and 1990 Census.

Table 7. Sample characteristics at baseline (1989) by sex and nativity

Characteristics	Males			Females		
	Taiwanese	Mainlander	Total	Taiwanese	Mainlander	Total
Demographic						
Age						
60-64	37.2	44.4	39.5	31.1	32.2	31.2
65-69	27.4	32.0	28.9	27.8	33.6	28.2
70-74	18.6	13.2	16.9	20.2	19.6	20.2
75-79	10.3	7.7	9.5	13.1	9.8	12.8
80+	6.5	2.7	5.2	7.8	4.9	7.6
Married	78.5	64.8	74.1	50.5	58.0	51.1
# living children (mean)	5.15	2.48	4.97	5.10	3.52	4.29
Household composition (hierarchical)						
Lives alone	4.86	23.92	11.01	5.90	7.75	6.06
Lives with spouse only	18.02	13.71	15.95	10.24	18.31	10.90
Lives with married child(ren)	54.70	15.73	42.13	64.13	47.18	62.75
Lives with unmarried child(ren)	18.23	39.25	25.01	13.13	16.20	13.38
Lives with other relatives	5.18	7.39	7.39	6.60	10.56	6.92
Urban residence during childhood	20.6	30.4	23.8	19.8	58.7	23.0
Urban residence in 1989	60.7	76.6	65.9	61.8	92.3	64.3
Socioeconomic						
Completed education						
No schooling	35.8	26.1	32.6	75.8	49.0	73.5
Primary or less (1-7 years)	46.2	23.7	38.9	20.1	14.0	19.6
Junior high (7-9 years)	9.2	16.4	11.5	2.4	14.7	3.5
Senior high or more (10+ years)	8.9	33.8	16.9	1.7	22.4	3.4
Income (rough quartiles)						
Lowest quartile	27.4	7.2	20.9	42.7	17.5	40.6
2nd quartile	22.6	20.6	22.0	20.2	20.3	20.2
3rd quartile	27.3	37.7	30.7	22.8	37.8	24.0
Highest quartile	18.3	32.6	22.8	9.0	22.3	10.1
Missing	4.4	1.9	3.6	5.3	2.1	5.1
Main occupation (if ever-worked)						
Family farm	38.0	1.6	26.2	25.6	0.7	23.5
Family, non-farm	19.2	10.6	16.4	9.7	7.7	9.5
Non-family, farm	9.8	0.7	6.8	12.1	2.1	11.2
Non-family, non-farm	33.0	87.1	50.6	52.6	89.5	55.8
Never worked	--	--	--	33.6	48.3	34.8

Table 7 (cont.)

	Males			**Females**		
	Taiwanese	Mainlander	Total	Taiwanese	Mainlander	Total
Health and related						
Current or former smoker	81.0	75.0	79.0	9.4	25.9	10.7
Current drinker	30.4	38.5	33.0	5.3	7.0	5.4
Fair or poor self-rated health	16.7	16.3	16.6	28.8	29.4	28.9
Health conditions						
Diabetes	6.1	6.8	6.4	11.1	11.9	11.1
Stroke	5.4	4.4	5.1	3.6	0.7	3.3
Heart disease	16.4	19.8	17.5	26.9	30.8	27.2
Kidney disease	5.2	5.6	5.3	8.0	2.8	7.6
Interviewed by proxy	3.9	2.0	3.3	3.8	0.7	3.6
Health service utilization and insurance coverage (past year)						
No services used	16.4	15.5	16.1	9.2	14.0	9.6
Services used, covered by insur.	23.2	52.9	32.8	9.1	33.6	11.1
Services used, not covered	60.4	31.6	51.1	81.7	52.4	79.3
Month of birth						
January-March	25.7	25.5	25.6	24.9	18.9	24.4
April-June	20.2	20.7	20.4	20.7	21.0	20.7
July-September	24.0	25.9	24.6	22.5	29.4	23.0
October-December	27.3	26.3	27.0	27.8	30.1	28.0
Missing month of birth	2.8	1.5	2.3	4.2	0.7	3.9
Sample size	1,566	748	2,314	1,592	143	1,735

Table 8. Percentage of respondents who died between 1989 and 2003 by sex, nativity and age at baseline

Age in 1989	Males		Females		Total
	Taiwanese	Mainlander	Taiwanese	Mainlander	
60-64	44.3	31.3	27.4	19.6	34.8
65-69	56.4	49.2	41.3	27.3	48.0
70-74	76.7	68.1	64.5	36.0	68.8
75-79	84.6	83.9	84.3	83.3	84.3
80+	96.0	80.0	92.7	60.0	92.4
Total	61.2	47.2	51.4	32.6	53.8

Table 9. Odds-ratios for the effects of baseline demographic, socioeconomic and health characteristics on male mortality between 1989 and 2003

Characteristic	Model 1	Model 2	Model 3	Model 4
Age	1.16***	1.15***	1.14***	1.15***
Mainlander (vs. Taiwanese)	0.64***	0.69***	0.67**	0.70*
Mainlander age 80+	0.31*	0.33+	0.28*	0.21*
Completed education				
No schooling		1.42*	1.14	1.02
Primary or less (1-7 years)		1.19	1.03	0.91
Junior high (7-9 years)		0.94	0.88	0.78
Senior high or higher (10+ years)		--	--	--
Married			0.71**	0.69**
Lives alone or with spouse only			0.98	0.93
Number of living children			1.00	1.00
Urban residence during childhood			1.04	1.13
Urban residence in 1989			0.95	0.97
Income (rough quartiles)				
Lowest quartile			1.87***	1.66**
2nd quartile			1.43*	1.28
3rd quartile			1.29+	1.27+
Highest quartile			--	--
Missing			4.08***	1.47
Main occupation				
Family farm			0.84	0.94
Family, non-farm			1.15	1.13
Non-family, farm			1.13	1.19
Non-family, non-farm			--	--
Current or former smoker				1.61***
Current drinker				0.86
Fair or poor self-rated health				1.51**
Interviewed by proxy				3.49*
Health conditions				
Diabetes				3.08***
Stroke				5.41***
Heart disease				1.28+
Kidney disease				1.56+
Health service utilization and insurance coverage (past year)				
No services used				0.85
Services used, covered by insurance				0.73*
Services used, not covered				--
Month of birth				
January-March				1.11
April-June				--
July-September				1.31+
October-December				1.67***
Missing month of birth				3.93**
Model Chi-square	342.31	351.88	401.29	566.48
(df)	(3)	(6)	(18)	(32)

+ p < .10 * p < .05 ** p < .01 *** p < .001

Table 10. Odds-ratios for the effects of baseline demographic, socioeconomic and health characteristics on female mortality between 1989 and 2003

Characteristic	Model 1	Model 2	Model 3	Model 4
Age	1.19***	1.19***	1.18***	1.18***
Mainlander (vs. Taiwanese)	0.51**	0.61*	0.67	0.63+
Mainlander age 80+	0.26	0.22	0.19	0.17+
Completed education				
No schooling		1.99**	1.97*	1.67+
Primary or less (1-7 years)		1.40	1.42	1.18
Junior high or higher (7+ years)		--	--	--
Married			0.82	0.76*
Lives alone or with spouse only			1.07	1.16
Number of living children			0.99	1.00
Urban residence during childhood			0.94	0.93
Urban residence in 1989			0.78+	0.73*
Income (rough quartiles)				
Lowest quartile			0.91	0.78
2nd quartile			0.72	0.66
3rd quartile			0.81	0.76
Highest quartile			--	--
Missing			1.85+	1.25
Main occupation				
Family farm			1.07	1.05
Family, non-farm			1.50+	1.52+
Non-family, farm			1.33	1.21
Non-family, non-farm			--	--
Never worked			1.12	1.15
Current or former smoker				1.75**
Current drinker				0.62+
Fair or poor self-rated health				1.65***
Interviewed by proxy				2.86+
Health conditions				
Diabetes				3.36***
Stroke				1.96+
Heart disease				1.30+
Kidney disease				0.88
Health service utilization and insurance coverage (past year)				
No services used				0.92
Services used, covered by insurance				0.72
Services used, not covered				--
Month of birth				
January-March				1.25
April-June				--
July-September				1.36+
October-December				1.02
Missing month of birth				5.05***
Model Chi-square	415.14	427.36	450.30	577.81
(df)	(3)	(5)	(18)	(32)

+ p < .10 * p < .05 ** p < .01 *** p < .001

Comparative Study of the Elderly in Asia

This series of research reports deals with the status of the elderly in several Asian countries. The series was initiated in 1989 under a broad project sponsored by the U.S. National Institute on Aging (Grant No. AG07637) and directed by Albert I. Hermalin. This particular report presents research that was conducted under a parallel R01 grant from the National Institute on Aging, A Comparative Study of Aging and Health in Asia (AG20063-01 and AG20072-01). This is a multi-country collaborative study whose overall goal is to describe and analyze health transitions and health care utilization patterns in four Asian countries undergoing rapid population aging and social and economic change.

The project uses existing longitudinal survey data from five Asian settings: Taiwan, the Philippines, Singapore, Indonesia, and China. Organizations collaborating in this research include the Population Council, New York; the Population Institute, University of the Philippines; the Department of Sociology, National University of Singapore; the Bureau of Health Promotion, Department of Health, Taichung, Taiwan; the Beijing Geriatric Clinical and Research Center, Beijing, China; and the Nihon University Population Research Institute, Tokyo, Japan.

For additional information on this research project, please visit the project website: http://aha.psc.isr.umich.edu or contact the Principal Investigator: Mary Beth Ofstedal, Population Studies Center, University of Michigan, PO Box 1248, Ann Arbor, MI 48106-1248, USA.

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