Male-Female Mortality Differences in the Netherlands and Taiwan

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Today, in Western societies, common sense has it that the longer life expectancy enjoyed by modern women has firm roots in history. Women, as members of the biologically stronger sex, have always lived to reach higher ages than men, except perhaps in faraway places such as East Asia where outright discrimination of females may have led to female infanticide and other ‘exotic horrors’. However, there is ample scholarly evidence to argue that such a perspective does not cover the entire historical truth.

A number of historical studies have successfully demonstrated the existence of gendered patterns of mortality in Europe from the 18th- through the mid-20th century. As early as 1978, Dominique Tabutin argued that, prior to 1940, European societies were characterised by patterns of female excess mortality at some ages, in particular for young adult women but also at younger ages in childhood and adolescence.[1] Tabutin later showed that, in Western societies, adolescent girls between ages 5 and 19 had a 29 percent higher death risk than boys of the same age.[2] Isabelle Devos uncovered the higher mortality risks for adolescent girls in 19th century Belgium, and Stefan Klasen demonstrated the occurrence of high mortality rates among 18th-century adult women in Germany.[3] Female mortality disadvantages in these studies seemed strongly related to rural areas and backgrounds.

By contrast, Chinese female mortality disadvantages have long been thought related to infanticide and adoption. Adele Fielde reported astounding figures on infant mortality for 40 Chinese Christian converts over age 50 in the 19th-century port of Shantou (Swatow), Guangdong Province: 31 percent of their sons and 70 percent of their daughters died by age 10, with 45 percent of their daughters dead by infanticide.[4] Only 45 percent of the daughters excluded from infanticide survived. Arthur Wolf and Chieh-Shan Huang found that in early 20th-century Haishan in Taiwan, adopted daughters had between a 4 and 10 percent higher probability of death by age fifteen than daughters, while daughters had a 4 percent higher risk than sons for the cohort born 1906-1915.[5] Wolf’s and Huang’s data for the cohorts born 1916-1925 and 1926-1935, however, pose a challenge to the common assumption that the mortality impact of infanticide and adoption follows directly from son preferences: sons in those cohorts had a 2 percent higher risk of death than daughters. Why would sons in later cohorts have higher mortality rates than daughters raised in their natal home? It could be that, for children raised in their natal homes, birth order was as important as gender in determining mortality: older boys being favored over younger boys.

Male mortality disadvantages existed in European historical populations as well but appear to have been restricted to the first year of life due to the greater genetic frailty of male babies. But what caused the excess mortality of European adolescent girls? One of the major causes of death for adolescent girls were infectious diseases such as tuberculosis. The onset of menarche, with its changes in the biological household of the female body, is considered as an important factor for the increased susceptibility of girls for these respiratory diseases. However, mortality patterns do not merely reflect biology. Mortality patterns also reflect increases or decreases in the availability of crucial life resources. And as Sheila Johansson has

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1 Dominique Tabutin, ‘La surmortalité féminine en Europe avant 1940’, *Population* 33 (1978) 121-148.

2 Dominique Tabutin, Michel Willems, ‘Differential mortality by sex from birth to adolescence: the historical experience of the West (1750-1930), in: United Nations, *Too young to die: genes or gender?*, New York, 1998, 17-52.

3 Isabelle Devos, ‘Te jong om te sterven. De levenskansen van meisjes in België omstreeks 1900’, *Tijdschrift voor Sociale Geschiedenis* 26 (2000) 55-75; Stephan Klasen, ‘Marriage, bargaining, and intrahousehold resource allocation: excess female mortality among adults during early German development (1740-1860)’, *Journal of Economic History* 58 (1998) 432-67.

4 A. M. Fielde, *Pagoda Shadows: Studies from Life in China* (Boston: Corthell 1884), pp. 23-25.

5 A.P. Wolf and Huang, C-S. *Marriage and Adoption in China, 1845-1945* (Stanford, CA: Stanford University Press 1980), pp. 237-238. See also, A.P. Wolf, *Sexual Attraction and Childhood Association: A Chinese Brief for Edward Westermarck* (Stanford, CA: Stanford University Press 1995), pp. 302-305.

argued, in particular diseases such as tuberculosis are highly sensitive to differences in living standards and general levels of wellbeing.[6] If young girls were exposed to this disease to a similar extent as were boys, their relative mortality risks increased when they were worse fed than the boys. Differential mortality patterns – whether by age, social group, or gender – may therefore reflect structural inequalities in the access to a society's resources.

In this paper we focus on differential mortality patterns by gender for infants, older children, and young adults up to age 20 based on Taiwanese and Dutch population register data. This comparison allows various hypotheses on gender differentials in mortality to be analyzed. First of all, we compare levels and patterning by age group between the two societies. To what extent do levels of mortality diverge and to what extent do gendered patterns differ at various stages between age 0 and age 20? Second, we test the assumption that East Asian societies were strongly discriminatory in their treatment of female babies and young children. Comparing mortality levels for Taiwanese and Dutch male and female babies should give us an indication of the extent to which Taiwanese parents with their strong preferences for sons were trying and indeed succeeding to counteract the male biological disadvantage at age 0. And to what extent were female babies the ones paying for the increased parental investment in their little brothers? The rich Taiwanese data further enable examination of the preferential treatment of a household's 'own' children versus children adopted into the household. Third, we focus on the fates of Taiwanese and Dutch girls between age 10 and 19 to discover whether this group did indeed experience excess mortality when compared to boys. (In Taiwan, where marriages were commonly arranged between ages 15 and 20, this age range begins the adult category.) Female excess mortality for this age group appear to have existed, and to a similar extent, in some 18th- and 19th-century Chinese and Japanese communities.[7] The question is to what extent the strong son preference of Taiwanese society had similarly negative consequences for females at adolescent ages.

The Comparison Case Materials

Lonneker: A Dutch rural-industrial village, 1860-1890

Lonneker is a rural village located in the very eastern part of the Netherlands, in the close vicinity of Enschede. In the second half of the 19th century, it was one of the fast growing and expanding textile towns in the country.

Table 1. Population development, Lonneker

Year	N=	% growth
1859	8611	-
1869	10503	22
1879	12794	22
1889	7491	-42
1899	10951	46

Population increase was considerable and is no doubt related to the close vicinity of Enschede and its advancing factories. Also geographically, Lonneker was being 'conquered' by Enschede as the village lost a sizeable proportion of its inhabitants to the town of Enschede in 1884, which explains the negative growth rate for that decade. Growth was however not

[6] Sheila Ryan Johansson, 'Welfare, mortality and gender. Continuity and change in explanations for male/female mortality differences over three centuries', *Continuity and Change* 6 (1991) pages ?

[7] George Alter, Matteo Manfredini, Paul Nystedt, 'Gender Differences in Mortality', in Tommy Bengtsson, Cameron Campbell, James Z. Lee, et al. (eds.), *Life under Pressure. Mortality and Living Standards in Europe and Asia, 1700-1900*, Cambridge, Mass.: The MIT Press, 2004, 327-358.

realised through migration: in almost all of the above census years about 70% of the Lonneker inhabitants were born inside the village.

Inhabitants were either small farmers (arable farming) or factory workers in textile employed in the Enschede factories. Farming is under pressure though – certainly from the 1860s onwards – because of competitive disadvantages. The proportion of the population employed in agriculture is thus falling from 65% in 1795 to 39% in 1899. Industry is rising: from 38% in 1889 to 55% in 1899. The occupational distribution in the sample used in this paper reflects the local economic structure of the 1860s: families were primarily engaged in agriculture (63,8%), in factory work (22,7%) or in a variety of artisinal occupations (13,5%). We should however not view these economic sectors as strictly divided compartments. Even at the end of the 19th century Lonneker, as was the case in most parts of the eastern Netherlands, was a society still very much focused on the ideal of an agrarian existence. In as far as fathers in our sample families were changing occupations over time, this change very much tended in the direction of farming rather than in the direction of industrial occupations.

Households were relatively large between 5,6 or 5,9 persons per household (as opposed to 5,3 and 5,5 for Enschede) which is not unusual for rural households in the east of the country. Certainly for farming families, household size was augmented by the presence of one or two grandparents. This can be demonstrated through the sample population used in this study in which 24% of farming families had a coresiding grandfather at least once in their history against only 13% for other labouring families.

It is likely that these farming families may have had a slight preference for sons who were needed to ensure continuation of the family farm. Continuation of the family farm was also likely to ensure parents a better old age: they could stay on at the farm after the son took over the property which option would greatly increase elderly parents' general level of wellbeing.[8] Daughters may however have been valued for other reasons, such as help in the household as well as the farm, practical assistance of elderly parents even after the daughter's marriage. For factory workers's families such a gendered preference seems highly unlikely. The Enschede textile factories were offering ample employment for male and female children alike. Admittedly, boys' wage rates were higher which may have made them rather more interesting to parents than girls.

The Lonneker Data

In this paper we make use of individual level data extracted from the Population Registers (PR) for a sample of 163 families containing 733 children in total. The construction of the sample was made to fit the research interests of a project focusing on mortality between the ages of 10 and 20 and proceeded in the following way. From the 1860-1865 Marriage Registers we selected all first marriages and followed these couples through the PR up to the year 1890. Families were admitted to the research sample only if *at least* one of the parents could be located in *at least* the PR's of 1870 *and* 1880 so as to limit loss of data through early parental death or the couple's migration. This means that the sample not only contains couples that stayed on in the village but is also biased towards couples of which at least one of the partners was strong enough to survive until 1880. For the resulting sample of 163 families all children were recorded when born before the year 1876 so as to limit the number of children that could only be observed for brief periods of time (as observation closed at the end of the 1880-1890 register). When different registers yielded different dates of birth, these dates were checked against the Birth Registers. For all children that died within the period of observation the dates of death were checked against the Death Registers. Furthermore, for birth intervals of three years or more, both Birth and Death Registers were checked to gather information for

[8] Elles Bulder, *The social economics of old age. Strategies to maintain income in later life in the Netherlands, 1880-1940*, Amsterdam: Thesis Publishers, 1993.

so-called ‘missing children’: children who had died at relatively young ages and through lack of administrative punctuality were left out in the PR.[9] Additional information was gathered from the municipal taxation registers which yearly provide lists with occupation and level of taxation for all household heads. In this way families could be classified according to the occupational status of the father and the economic sector in which he was employed as well as the level of financial resources a family could potentially deploy to take care of its children.

Thirteen Sites in Japanese Colonial Taiwan, 1906-1945

Japanese colonial administration transformed Taiwan from a rural Chinese province, which could provide much-needed rice to and absorb excess male labor from nearby Fujian Province. Taiwan became a model colony, exporting rice to Japan, and camphor, sugar, tea, and sulphur (among other products) to the world market. Between 1895 (when Japan annexed Taiwan) and 1930, Japan invested heavily in developing Taiwan’s infrastructure, production, and population.[10] The Japanese administration built the railroad system, bridges and roads islandwide, hospitals, sewage systems, public wells, and dams for water reservoirs and irrigation systems. They also introduced new agricultural varieties (such as Hawaiian sugarcane) and new processing techniques (e.g., for camphor), and built modern sugar mills. They regulated the tea industry and provided armed guards to protect camphor workers against mountain Aborigine raids. The colonial government began a public school system, expanded the availability of medical services, reduced infectious diseases, and instituted a criminal justice system largely free from corruption.

There are thirteen sites in Taiwan included in this study (Table 2), ranging from upland rural villages (in Emei and Danei) to market towns to a neighbourhood in the urban capital of Taibei. Most rural people were farmers – either tenants or owning their own small holdings – engaged in commercial agricultural production of wet paddy rice (where conditions allowed) or sugarcane, regardless of ethnic identity. Occupations in urban areas were much more varied, ranging from street vendors to seamstresses to soy-sauce factory workers to port and railroad employees. Dajia was famous for tatami mats, baskets and Panama hats, woven by women. Lukang and Dongkang were ports. The Dadao Cheng neighbourhood in the capital city of Taibei was a tea packing and processing area. It was one of the most commercialized places in Taiwan at the beginning of the colonial era. Huxi in the Penghu (also called the Pescadores) Islands was a rural area, where women did most of the agriculture and men were primarily involved in fishing and long-distance sailing.

[map of Taiwan sites]

Table 2. Taiwanese Sites

name	region	urban-rural	ethnic groups
Taibei City (Dadao Cheng)	north	urban	Hoklo (some Chinese migrant workers)
Beipu	north	rural	Hakka (a few Hoklo)
Zhubei	north	rural	Hakka, Hoklo

[9] This procedure yielded another 16 births on a total of 733 live births. This is a relatively high number, 2,2% compared to the rate found for the Tilburg registers in the period 1849-1920 where 0,7% of live births went unrecorded.

[10] C-M. Ka, *Japanese Colonialism in Taiwan: Land Tenure, Development, and Dependency, 1895-1945* (Boulder, CO: Westview Press 1995). M. Brown, *Is Taiwan Chinese? The Impact of Culture, Power, and Migration on Changing Identities* (Berkeley, CA: University of California Press 2004), pp. 53-56. P.R. Katz and Chiu, C-L. ‘Quantifying the colonized: The history and significance of demographic sources from colonial Taiwan’, in Engelen and Wolf, *Positive or Preventative?*, pp. 19-38.

Emei	north	rural	Hakka (a few Hoklo)
Wujie (Yilan)	north(east)	rural	Hoklo, Plains Aborigines
Dajia	central	town	Hoklo (a few Hakka)
Lukang	central	town	Hoklo
Zhushan	central	rural	Hoklo (a few Hakka)
Jibei	south	rural	Plains Aborigine, Hoklo
Jiuru	south	rural	Hoklo (a few Hakka and Plains Aborigines)
Danei	south	rural	Hoklo, Plains Aborigines
Dongkang	south	town	Hoklo
Penghu (Huxi)	island	rural	Hoklo

The sites include Taiwan's three major ethnic groups: Hoklo (also called Hokkien) and Hakka, which are both Han Chinese groups, and Plains Aborigines, which included several of Taiwan's indigenous Austronesian groups. The Han are those whom most Westerners think of as ethnic Chinese, but this category includes seven mutually unintelligible "dialects" as well as documented regional variation in marriage practices and political economy.[11] Hoklo were the clear majority on Taiwan, they spoke the Southern Min dialect of Chinese, and most of their ancestors came from Fujian Province in southeastern China. Hakka spoke the Kejia dialect, and most of their ancestors came from Guangdong Province. The plains Aborigines were sinicized indigenous peoples, who had undergone much intermarriage with Han, even adopting Southern Min language.[12] There were several more ethnolinguistically distinct indigenous peoples in the central mountains – mountain Aborigines – but most of the mountain peoples did not come directly under Japanese authority until the 1930s and so are not represented in the sites.

There were important cultural similiarities among Hoklo, Hakka, and plains Aborigines. Hoklo and Hakka, in particular, 'shared fundamental Han practices and beliefs, including patrilineal ancestor worship, Confucian-justified parental authority, equal property inheritance among brothers, and folk religion.'[13] By 1900, most plains Aborigines were not visibly culturally distinct from Hoklo. For example, they used Hoklo marriage forms, funerary and adoption practices, and generally linked inheritance of property to surnames. Moreover, ethnic identity in colonial-era Taiwan did not result in distinctive fertility outcomes.[14]

There were cultural differences between Hoklo, Hakka, and plains Aborigines, however, and these affected the gender division of labor. Most notably, Hakka and plains Aborigines did not practice the custom of footbinding, which was common (but not ubiquitous) among the Han throughout late imperial China.[15] Until the Japanese colonial

[11] R.S. Ramsey. *The Languages of China* (Princeton, NJ: Princeton University Pres 1987). Y-C. Chuang and Wolf, A.P., 'Marriage in Taiwan, 1881-1905, An example of regional diversity.' *Journal of Asian Studies* 54 (1995) 781-95. H. Gates, *China's Motor: A Thousand Years of Petty Capitalism* (Ithaca, NY: Cornell University Press 1996). For further introduction to Taiwan's ethnic groups as they appear in the colonial-era household registers, see also J. Shepherd, I. Pan, J. Kok, C. Engel, T. Engelen, and M. Brown, 'Group identity and fertility: An evaluation of the role of religion and ethnicity in the Netherlands and Taiwan' in Engelen and Wolf, *Positive or Preventative?* 127-131.

[12] Brown, *Is Taiwan Chinese?*, J.R. Shepherd, *Statecraft and Political Economy on the Taiwan Frontier, 1600-1800* (Stanford, CA: Stanford University Press 1993).

[13] Shepherd et al, 'Group identity and fertility', 129-130.

[14] Shepherd et al, 'Group identity and fertility.'

[15] H. Gates, 'Footloose in Fujian: economic correlates of footbinding.' *Comparative Studies in Society and History* 43 (2001) 130-48. H. Gates, *Hand and Foot: Footbinding and Women's Labor* (book manuscript in progress). L. Bossen, *Chinese Women and Rural Development: Sixty Years of Change in Lu Village, Yunnan* (Lanhan, MD: Rowman & Littlefield 2002).

government banned footbinding in 1915, most Hoklo practiced footbinding. According to census reports, over 90 percent of all Hoklo women in Taiwan had bound feet.[16] However, there is variation in Hoklo footbinding across these sites.[17] Where women had bound feet, they did not work in the paddy fields (binding cloth was relatively expensive and would be ruined by the mud of the fields). The footbinding ban prohibited families from binding their daughters' feet and directed women whose feet could be unbound to do so.[18] People interviewed in Danei Township reported that Japanese police who oversaw the unbinding of women's feet explicitly stated the purpose was to have women work in the fields.[19]

We expect the Taiwanese data on mortality to show evidence of son preference because Han Chinese son preferences are ubiquitous. The Han patriarchal, patrilineal kinship ideology claims that the system operates on the principle that sons are family and daughters are other people's ancestors. Sons inherit the family name and property; they provide old-age support and ancestral worship. Daughters marry out, perhaps creating useful affinal ties but not providing daily support or descendants. Customs related to son preferences therefore may differentially affect female mortality. Such customs include: infanticide, earlier weaning of girls, giving males higher quality foods, seeking medical care for males, and possibly assignment of heavier work loads to girls due to schooling for boys.[20] Before addressing these customs, however, it is important to understand that, as practiced in Taiwan, the Han kinship system has been more flexible than this ideology suggests.

Most importantly, in Taiwan as in southern China, daughters could and often did stand in for sons, providing labor and even descendants by means of an uxorilocal marriage.[21] The negotiated arrangements by which a couple brought in a son-in-law to marry their daughter ranged widely, but the most common form brought the man into his father-in-law's house for a period of years (often 10 or more) and required the son-in-law to name one or more of his sons to his father-in-law's surname. Once an heir or heirs were provided and raised to safe age, the daughter and son-in-law could depart to set up an independent house (if they had the money), leaving the boy(s) with the maternal grandfather's surname in the grandfather's house to support and inherit accordingly. (Any boys with their in-married father's surname would not inherit their grandfather's property.) Because (as we have seen) infant and childhood mortality was high in Taiwan, families could not assume that daughters born early in a sibling set – especially first-born daughters – were going to be other people's ancestors. Clearly, while sons were preferred, daughters who had no brothers were too valuable to treat poorly.

The Taiwan Data

During Japan's colonial administration of Taiwan (1895-1945), the government put together meticulous demographic records: published censuses and vital statistics registers showed aggregated data, and unpublished household registers showed individual demographic data

[16] Shepherd et. al, 'Group identity and fertility' 130.

[17] Yeon Jung Yu, 'Regional variation in footbinding in Taiwan (1895-1945)' Master's thesis, Department of Anthropological Sciences, Stanford University (2005).

[18] There were degrees of footbinding. The smaller 'lotus' form required breaking the arch and could not be unbound. It was painful to unbind the larger 'cucumber' form, but women reported that after a month or so, their feet were functionally like natural feet (Brown, *Is Taiwan Chinese?* 177).

[19] Brown, *Is Taiwan Chinese?* 265n45.

[20] For example, G.W. Barclay, *Colonial Development and Population in Taiwan* (Princeton: Princeton University Press 1954); M. Wolf, *Women and the Family in Rural Taiwan* (Stanford: Stanford University Press 1972); Wolf and Huang, *Marriage and Adoption in China*; A. Wolf, *Sexual Attraction and Childhood Association*.

[21] E.g., Wolf and Huang, *Marriage and Adoption in China*; A. Wolf, *Sexual Attraction and Childhood Association*.

organized by Taiwanese-defined households.[22] In this paper, we use individual-level, household register data from a sample of 13 sites spread throughout Taiwan to examine male-female differences in mortality for individuals up to their 20th birthday, giving us partial data on 143,764 individuals alive between 1906 and 1945, including 22,556 deaths of individuals under 20.[23] Because, at that time, most Taiwanese women married between 15 and 20 years old, taking the data through age 19 gives us a glimpse of the transition to adult mortality rates.

The 13 sites range in size from individual rural villages (Jibei) to entire rural townships (Danei). The household register database includes constant personal information such as birth and death dates, sex, ethnic identity, relationship to the head of the household, as well as event-based information, such as marriage form and dates, divorce dates, adoption dates, and dates of entering and leaving observation in the site. By linking such information, we are able to identify not only individuals who die and their age of death but also the amount of time that living individuals were at risk of death, which allows us to generate age-specific mortality rates.

Calculating the Mortality Rates

Age-specific mortality rates are calculated in terms of the number of people at risk of dying – the number of deaths for a given age group in a specific time period divided by the total number of person-years lived in that age group during that period. Age-specific mortality rate (ASMR) is

$$ {}_nM_x[0,T] = \frac{\text{Number of deaths in the age range x to x + n between time 0 and T}}{\text{Number of person - years lived in the age range x to x + n between time 0 and T}} $$

where *x* refers to the age at the beginning of the time period under consideration and *n* the length of the time period.[24] Both *x* and *n* refer to the elapsed time since an individual's birth in exact years (i.e., fractional years), neither age at last birthday as is common in the Europe nor *sui*, age at the last lunar new year (where one is age 1 upon birth) as is common in Taiwan. This technique's accuracy derived from its use of each individual's actual birthday to weight data from the observed sample. It also allows us to include data from all individuals observed – that is, even individuals for whom we only have partial data, not just individuals whose entire lives were observed. Once individuals leave observation – whether through death or migration – they no longer contribute to the mortality rate.

Most demographic data does not allow calculation of mortality rates in this fashion, so we also provide some data on infant mortality rates (IMR), using the standard calculation of deaths per live births in a time period for a particular site:

$$ IMR = \frac{\text{Number of deaths} < \text{age 1 during years } t_0 \text{ to } t_1}{\text{Number of live births during years } t_0 \text{ to } t_1}. $$

[22] For more complete descriptions of these materials, see: Barclay, *Colonial Development and Population in Taiwan*; C-H. Tuan, "Reproductive histories of Chinese women in rural Taiwan," *Population Studies* 12 (1958) p.40-50; Wolf and Huang, *Marriage and Adoption in China*; Katz and Chiu, 'Quantifying the colonized.'

[23] This is a version of the same database used by W-S. Yang and Y-H. Hsieh, 'Infant Mortality in Colonial Taiwan, 1905-1945: Evidence of the Historical Household Registration Data of Taiwan', Paper presented at the International Conference on Ideas, Organization, and Practice of Hygiene in Han Society from Traditional to the Modern Periods', November 22-23, 2004, RCHSS, Academia Sinica, Taiwan.

[24] From S.H. Preston, P. Heuveline, and M. Guillot, *Demography: Measuring and Modeling Population Processes* (Oxford: Blackwell Publishing 2001), p. 21. This equation is the same as the woman-years method used by Wolf, *Sexual Attraction and Childhood Association*, 105-106.

We reduce the difference between IMR and ASMR by calculating the IMR for subportions of the first year of life (0-1 month, 2-3 month, 4-12 month intervals). For each subportion, the denominator is calculated by subtracting the deaths in the earlier subportions from the total number of live births. Nevertheless, this counts method yields a different rate than the person-years method above, as can be seen by comparing the mortality rates for infants from birth to the first birthday for all 13 sites in Taiwan (Table 3).

Table 3. Comparing Mortality Rates (all 13 Taiwanese sites)		
	IMR	ASMR
males, 1906-1925	0.17	0.193
females, 1906-1925	0.15	0.164
males, 1926-1945	0.158	0.182
females, 1926-1945	0.136	0.153

Males in 1906-25 have an ASMR of 0.193 for the first year of life calculated by the person-years, but the same group has an IMR of 0.17 calculated by the traditional method of number deaths over live births (without adjusting IMR through use of subportions, IMR for males in 1906-25 was even further off at 0.134). The advantage of the person-years method (ASMR) is that it weights the data.

Sex differences in infant and child mortality in the Netherlands and in Lonneker

For the Netherlands as a whole, 19th-century female mortality rates were higher between the ages of 5 and 19, while boys had higher mortality risks in the first year of life and between age 1 and 5.[25] Female excess mortality between the ages of 5 and 19 disappeared after approximately 1930.

Regional variation in sex differences in mortality was considerable, but only for the age group between 5 and 19. In as far as infant mortality is concerned, all provinces in the Netherlands were characterised by excess mortality of boys: boys' mortality was everywhere 15-55 percent higher than that of girls. Between the ages of 5 and 19, clear female mortality disadvantages – 5-20 percent lower mortality risks for boys – existed in the southern and the eastern provinces of the country (see maps below). In economic and social respects, these provinces belonged to the periphery of the country. In some of the few industrial centres of the Netherlands, life chances for boys were unfavourable. It is therefore tempting to relate the lesser life chances for young girls to 19th-century agrarian regimes under pressure with reduced economic opportunities for girls and women, as was suggested for the English case.[26]

[Here Van Poppel maps]

For all children in the Lonneker sample, age-specific mortality rates were calculated (see Figure 1 below). The graph shows that infant mortality for boys in Lonneker was higher than for girls, but that it was also higher in the age groups 2-4 and 5-9 years. After that age up to age 20, the ASMR is clearly unfavourable for girls. For infant mortality, a warning is called for, as the data may perhaps underestimate male mortality. Given the unlikely sex ratio for the

[25] F. van Poppel, *De 'statistieke ontleding van de dooden': een spraakzame bron?*, Nijmegen: Nijmegen University Press, 1999.

[26] Kirsty McNay, Jane Humphries, Stephan Klasen, 'Excess Female Mortality in Nineteenth-Century England and Wales. A regional analysis', *Social Science History* 29 (2005) 649-681.

entire group of children (92 boys for every 100 girls) it may still be that further children are missing from the PR data despite the check on three-year-birth intervals (see above). The distorted sex balance in the sample seems to have been created in only a few registration years. For these years an additional check of the Birth and Death registers will be necessary.

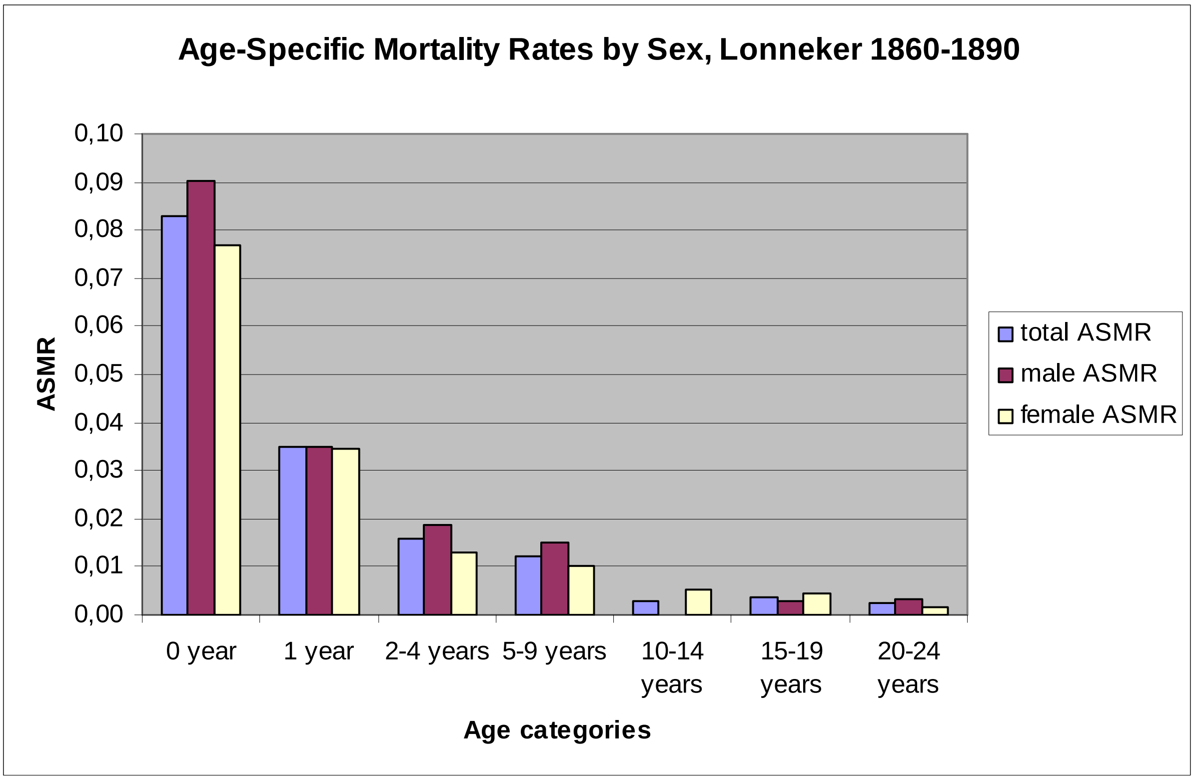

Figure 1. ASMR, Lonneker 1860-1890

Compared to the Taiwan figures, it seems as if Dutch mortality overall is a little lower in the first few years of life[27], but that from age 5 onwards Dutch mortality is higher and above all, that the Dutch data do suggest male female differences between ages 5 to 20 which are not there in the Taiwan data. Females seem to have been worse off in Taiwan at age 1 to 4 but after that age life chances were certainly not worse compared to Taiwanese boys. In the Dutch village of Lonneker, we have a mirror image in some ways: boys were certainly worse off compared to girls in their first year of life – very much like their Taiwanese counterparts – but their comparative disadvantage existed as well in the age group of 2 to 9 years.

Hazard analysis

The results discussed in this paper have been derived from event history analysis which for specific age groups calculates the risk of the event of death occurring for each individual present at the start of that particular period of observation. In a general sense, event history may be described as a method whereby the duration is examined between the beginning of exposure to the 'risk' of a certain event, until the actual occurrence of the event. In event history analysis it is possible to include all individuals, also those we lose from our population because they migrate or disappear in some other way before the end of the observation period. This phenomenon of individuals who exit from observation is called 'censoring' in event history terminology. Finally, event history analysis also comprises complex techniques, the

[27] This however may also be the result of the bias in the sample towards surviving parents which may have reduced health risks for their children.

so-called 'hazard models', which facilitate multivariate analysis of these time-based phenomena. Essentially, these hazard models produce results very much like regression analysis, so that it becomes possible to determine which factors are more influential than others in explaining the patterns that were found. The hazard models indicate the variables that most strongly and significantly determine the rate with which children are undergoing the event under study. Moreover, these models are especially suitable for complex analysis of relatively small datasets.

I have constructed separate models for each age group to look at causality and statistical significance. Variables that were included into the various hazard models comprise the following. The first variable refers to the sex of the child.

Second, I constructed two dummy variables indicating the father's occupation. The information on the family head's occupation was taken from the Population Registers at - or a date as closely as possible to - each child's tenth birthday.[28] As the entire Lonneker population was nearly exclusively employed in agriculture or in factory work two dummy's may suffice here whereby the few heads employed in other occupations are included in the group of factory workers. (Other occupations are mainly artisinal workers of modest means.) It should also be noted that over the course of time very few switches occurred between occupations but that in case occupational switches occurred these tended primarily in the direction of farming.

The third group of variables refers to the family's income position with 4 dummy's based on the taxation classification of the household in the community's yearly taxation listings. Again, this information was taken at or around the child's tenth birthday. The next variable may help to complete the picture of the social circumstances into which each child was born, namely the fact whether parents could read and write. This information on the parents' literacy was taken from the marriage registers and refer to parents' ability to sign their own marriage certificate.

Further variables refer to the child's demographic circumstances. First of all there is the information on the child's birth rank. It is likely that first born children were better taken care of and that with increasing birth rank mother's health was being depleted. This latter fact is important when considering infant mortality.

Further information relates to whether any of the child's siblings died at any point in time. This variabel refers to siblings dying at whatever point in time, both before and after the death of the child concerned. This gives us some idea to what extent children's mortality was a phenomenon which was concentrating in some families but not in others. The database also contains information on the death of the parents. As was explained above the sample is biased towards surviving parents which means that unusual effects may occur when using this information. Maybe it is better to leave it out of the models.

Finally, we have information on whether or not any of the grandparents were present in the household. Having a grandfather or a grandmother present in the household may have positively contributed to a child's life chances in those cases where grandparents helped increase a family's resources, either financially or in terms of household and child care. On the other hand, coresiding grandparents may also have exercised further pressures on already scarce household resources. Presence of grandparents was measured at or around the child's tenth birthday; no distinction is made between paternal or maternal grandparents.

What is seriously missing at this moment, is information on the age of the mother at the time of the child's birth. Whilst the age of the mother may be less influential at ages 10 to

[28] This perhaps somewhat unusual choice resulted from the fact that initially the focus of the project was exclusively centred on mortality differentials between ages 10 and 20. Rather than problematic, this choice may yield a better indication of a family's social and economic setting than occupation's from marriage certificates or other entries from the beginning of a family's history (see Delger).

20, when looking at infant mortality this variable cannot be missed. This omission will be dealt with at a later stage of this project.

Results for Lonneker

Below are the results of an event history analysis for three different age groups: from birth until age 1, from 2-9 years of age, and from age 10 up to and including age 9. Results may be read as in classical regressions: positive coefficients indicate increased risks for the event of death to occur whereas negative coefficients indicate a decrease in the risk for that variable. For the various dummy variables (occupation, tax class and birth order) the results should always be interpreted in contrast to the omitted category: e.g. the result for tax classes 2, 3 and 4 indicates the increase or decrease of the risk as compared to tax class 1.

Sex differences are clearly important. In the first year of life girls have an advantage over boys (negative coefficient) though the result is not significant. Other factors are clearly more important in determining the chance that a child dies before its first birthday.[29] However, from the ASMR's we have already seen that boys are again at a clear disadvantage in the age group 2-9 and this is confirmed by the hazard model. Female children have a statistically significant lesser chance to die between age 2 and 9 than do boys. Regardless of other factors that may negatively influence children's life chances, the sex of the child is a prominent effect of its own. The third and final model looks at the age group 10-19 years of age. Chances at long life and good health have now turned around. In this age group female childen are at a clear disdvantage: there is a strong positive effect with the required significance. Whatever their circumstances or their backgrounds, girls have a higher risk at an untimely death in this age group than do boys. Here results are entirely in line with the broad picture regarding sex differentials as painted by van Poppel.

From a large number of studies we know that social class, mostly measured by the occupation of the head, is decisive for an infant to survive the first year of life. It is therefore remarkable that in Lonneker social factors are largely irrelevant for the survival of infants: neither the father's occupation, nor the family's tax class or the parents' literacy plays a significant role. From other studies on urban areas in the Netherlands clear social inequalities appeared between various occupational and prosperity groups.[30] However, in regression analysis social factors do not always remain in place as was demonstrated for an extensive study on infant mortality for the textile town of Tilburg.[31] Swedish research confirms that social class does not always neatly explain the risk of young infants dying. In fact, the significance of social class in one of the rural areas of northern Sweden was wholly absent. Survival chances for infants born to peasant families did not differ all that much from those born to labourers or middle class families.[32]

For these Lonneker families the only 'social' factor which has the required significance is the presence of a grandfather, with a negative impact on an infant's survival chances. Co-residing grandfathers were usually found in farmer's families, as already noted above. An explanation remains difficult. Perhaps the grandfather is an indication of the economic pressure surrounding these families with a larger number of household members competing for the parents' resources, time and attention. On the other hand, co-residing grandfathers may also be an indication of the traditional patrilineal orientation of families in

[29] This result may yet change when some 'missing' early deaths can be included after further consultation of the death registers.
[30] F. van Poppel, 'Differential Mortality in the Past. The relationship between socio-economic position and infant and child mortality in the Netherlands in the period 1850-1940', NIDI Working paper no. 23, NIDI, 1981.
[31] C.G.W.P. van der Heijden, *Het heeft niet willen groeien. Zuigelingen- en kindersterfte in Tilburg, 1820-1930. Omvang, oorzaken en maatschappelijke context*, Tilburg: Stichting Zuidelijk Historisch Contact, 1995.
[32] Sören Edvinsson, Anders Brändstrom, John Rogers, Göran Broström, 'High-risk families: The unequal distribution of infant mortality in nineteenth-century Sweden', *Population Studies* 59 (2005) 321-337.

which older generations are dominant over younger generations and men over women. New-born babies may suffer from a lack of attention and proper resources in such a climate.

For the two older age groups, social class and taxation come out as irrelevant for the death hazard. This ties in with evidence on The Hague where social class disappeared from the scene more or less when explaining mortality levels at ages 1-4, and disappeared completely when regarding mortality between ages 5-9.[33]

Social factors only show up in the parents' literacy for the age group 10-19, but this time the effect is strong. Ignorant parents are clearly a danger to children's health at these ages. This might suggest that 'life style' factors such as easy access to and implementation of medical care – which I assume are more difficult for illiterate parents to manage – may have played an important role here.

Children's survival chances at the various stages between birth and age 20 seem to have been determined to a large part by demography. To begin with, increasing birth orders have their impact on children's survival chances but the direction of influence differs by age group. For infants it is clear that higher parities increase the death risks. This effect is well-known from the literature and is usually explained through increased competition for parents' and particularly the mother's time, health and resources. However, for children between the ages of 2-9 the higher birth ranks now turn on a negative sign indicating that younger children have better prospects in this age group. We might explain this as the result of elder children being more burdened with hard and early work in or outside the house than their younger siblings. But this effect does not return in the age group 10-19 (although here signs are again negative), at least not in any significant way. Nevertheless, these results clearly suggest that this variables works differently for different age groups.

Other demographic events which may completely alter a child's fate is the untimely death of its parents. It is clear that to an infant its mother's death makes for a vulnerable life situation, which effect comes out clearly in model 1. It should be noted though that the variable mother's death in this study does not necessarily indicate the mother's death *before* the potential death of the child. It just means that the mother dies at some stage between 1860 and 1890. Attempts to turn this variable around into a proper time-varying variable to be switched on at the advent of the mother's death before a child's specific birthday – which would give us an ideal measure of causation – have failed. The amount of data unfortunately proved too small to deal with such a detailed analysis. In this case we can only assume that the variable 'mother dies' indicates a relationship between a child's death hazard and the mother's poor health and life chances in general. But this relationship disappears for the age groups above age 1. Results further indicate that a father's survival chances are not at all linked to his children's life chances, for none of the three age groups.

The results for the three age groups suggest that infant and child mortality is a phenomenon strongly related to what can be termed as 'death clustering', the phenomenon of *multiple child loss*. For all age groups children stood an increased chance of dying themselves when one of their older or younger siblings had already died or would die at some later stage: in all cases effects are strong and highly significant. Even at age 10-19, children are more vulnerable when other siblings have died. The shape death clustering took at young ages can be made clear by looking at the distribution of infant deaths in our sample of Lonneker families. Most families in the sample never experienced the death of one of their infants; only in 25,8% of all families did one or more infants die. But even in this latter group death cases were not evenly distributed: of all families experiencing at least one infant death, the majority of death cases (48,3%) was concentrated in a minority group of families (28,6%). These

[33] Evelien Walhout, Frans van Poppel, Jona Schellekens, 'Gender differences in child mortality in the Netherlands, 1860-1920', paper presented to the European Social Science History Conference, Amsterdam, 2006.

figures are telling but they do need further refinement as number of infant deaths should be related to number of live births per family. This will be done at a later stage.

Death clustering was put on the research agenda by Monica Das Gupta through her study of 20th century rural Punjab in which she demonstrated that families who had already experienced the loss of other children stood an increased chance of losing further children.[34] It should be noted that this relationship applied to a child's survival chances at all stages of childhood. Furthermore, the impact of 'death clustering' in the case of these Punjabi families remained in place after controlling for several biological and social factors, such as the level of the mother's education. Obviously, the explanation of the phenomenon of death clustering is difficult. Death clustering may be seen as an indirect indicator of parental competence in ensuring children's health and survival. But it may equally well indicate the influence of biological factors, such as genetically determined frailty. However, on the basis of her qualitative evidence Das Gupta suggests that parental incompetence plays an important role in the phenomenon of death clustering.

For 19th century European societies similar evidence on the importance of 'death clustering' is available. The Swedish study cited earlier clearly outlines the enormous influence of death clustering for infants.[35] Families in this study – in geographically, socially and economically very different areas of Sweden – could be divided in high-risk and low-risk families. Infant deaths were strongly clustered in these high risk families so that relatively few families accounted for a disproportionate number of infant deaths. Factors influencing a family's chances of becoming such a high-risk family were partly biological and partly social. High-risk families were also families which had more often experienced stillbirths. Furthermore, women in high-risk families remarried one or more times, indicating – according to the authors - a certain degree of family instability. It should be underlined that social class and father's occupation were irrelevant factors for families' risk levels. Not surprisingly the authors argue that infant mortality should be studied within the family as the unit of analysis. Clearly, the family is the theatre in which a child's life chances are determined. In this process family characteristics which go beyond the obvious measurable socio-economic indicators such as occupation, social class or income, play an important role. A family's adverse attitude to health and health risks where children are concerned may play an important role here as well as gendered perspectives on the value of male and female children.

[34] Monica Das Gupta, 'Death Clustering, Mother's Education and the Determinants of Child Mortality in Rural Punjab, India', *Population Studies* 44 (1990) 489-505.
[35] Sören Edvinsson, Anders Brändstrom, John Rogers, Göran Broström, 'High-risk families: The unequal distribution of infant mortality in nineteenth-century Sweden', *Population Studies* 59 (2005) 321-337.

The hazard of the probability of death for different age groups, Lonneker 1860-1890

	Model 1 Age 0	**Model 2 Age 2-9**	**Model 3 Age 10-19**
Female	-0.1644	-0.5213**	1.2945**
(Farming omitted)			
Factory work	0.3062	-0.0953	-0.1568
(Tax class 1 omitted)			
Tax class 2	0.4407	-0.1045	0.1413
Tax class 3	-0.1100	-0.4983 }	
Tax class 4	0.8958	0.4551 }	-0.9883
(Birth order 1 omitted)			
Birth order two	0.5893	0.2613	-1.1502
Birth order three	0.7630	-0.3683	-0.0247
Birth order four	1.0098**	-0.1732	-0.0371
Birth order fiveandmore	0.8119*	-1.0125**	-1.6691
Other children dead	1.6949***	1.6632***	1.5799***
Father dies	-0.6539	0.3139	0.8915
Mother dies	0.7924**	0.2621	0.3138
Grandfather present	0.8284**	-0.4591	0.7246
Grandmother present	-0.2825	0.4437	-0.8715
Parents illiterate	-0.0101	0.0150	1.4044**

Note: *=significant at 10%; **=significant at 5%; ***=significant at 1%.

None of the above models included religion. Religious differences can certainly create differential patterns in mortality. For instance we do know that infant mortality in the city of The Hague towards the closing decades of the nineteenth century was higher amongst Catholics than amongst Protestants. Infant mortality amongst Catholic families was even 23 percent higher than for Protestant families which result may have been caused by differences in breastfeeding patterns.[36] However, religious differences after age 1 diminished and became unimportant, in particular those between Protestants and Catholics. In the rural setting of Lonneker no religious differences could be found. For none of the different age-groups distinguished here did religion produce any significant result. Apparently Protestant and Catholic parents treated their children in quite similar ways.[37] Religious differences in the treatment of (male and female) children above the age of 1 was also absent in The Hague: it was only for post-neonatal mortality that female mortality rates amongst Catholics were significantly worse than amongst Protestants.[38]

What is also missing from the above tables are sex-specific models. It proved difficult, in particular for the higher age-groups, to test similar extended models for each of the sexes separately as a result of low numbers. However, more reduced models showed that in none of

[36] F. van Poppel, J. Schellekens, A.C. Liefbroer, 'Religious differentials in infant and child mortality in Holland, 1855-1912', *Population Studies* 56 (2002) 277-289.

[37] Catholic families constituted a social minority in Lonneker as well as in most of the eastern parts of the country: 20,1 % of all children in this sample were Catholic whilst all of the remaining children belonged to the Dutch-Reformed church.

[38] Evelien Walhout, Frans van Poppel, Jona Schellekens, 'Gender differences in child mortality in the Netherlands, 1860-1920', paper presented to the European Social Science History Conference, Amsterdam, 2006.

the age groups the father's occupation had any significant effect. We may therefore conclude that neither male excess mortality between age 2-9 nor female excess mortality between ages 10-19 were phenomena exclusively related to the economic organisation of the household they grew up in. Female excess mortality in adolescence may be related to rural areas but it is certainly not exclusively related to peasant households.

Sex differences in infant, child and young adult mortality in Taiwan

George Barclay assessed male-female mortality differences using the published, aggregated data for all of Taiwan and concluded,

> Regardless of the year of observation, young girls consistently suffered greater risks than boys. In the first year of life, as is usually the case, males invariably had inferior average chances of surviving to their first birthday. For the next nine or more years they more than made up for this initial disadvantage. Without fail, there were more male than female survivors to age ten from an equal number of each who managed to enter the second cohort of life. This was the case for all cohorts of which the record is available from the first birthday to the tenth—26 cohorts in all.[39]

Working with individual-level, household register data from a sample of 14 localities spread throughout Taiwan, Yang Wen-Shan and Hsieh Ying-hui also find significant male-female differences in infant mortality (up to the first birthday), with females having better survivorship.[40] Both Barclay and Yang and Hsieh note the decline in mortality levels for both males and females throughout the Japanese period as well as the colonial government's efforts to improve public health, effectively reducing plague, malaria, and cholera, which had been the principle causes of death upon Japanese acquisition of Taiwan.

For our initial view of male-female differences in Taiwanese mortality rates, we combine data from all 13 sites, splitting them into two equal time periods – 1906-1925 and 1926-1945 – to see some time differentiation (see Figures 2 and 3).

[39] Barclay, *Colonial Development and Population in Taiwan*, 157; see also pp. 150, 152, 153-63, 172.
[40] Yang and Hsieh, 'Infant Mortality in Colonial Taiwan'.

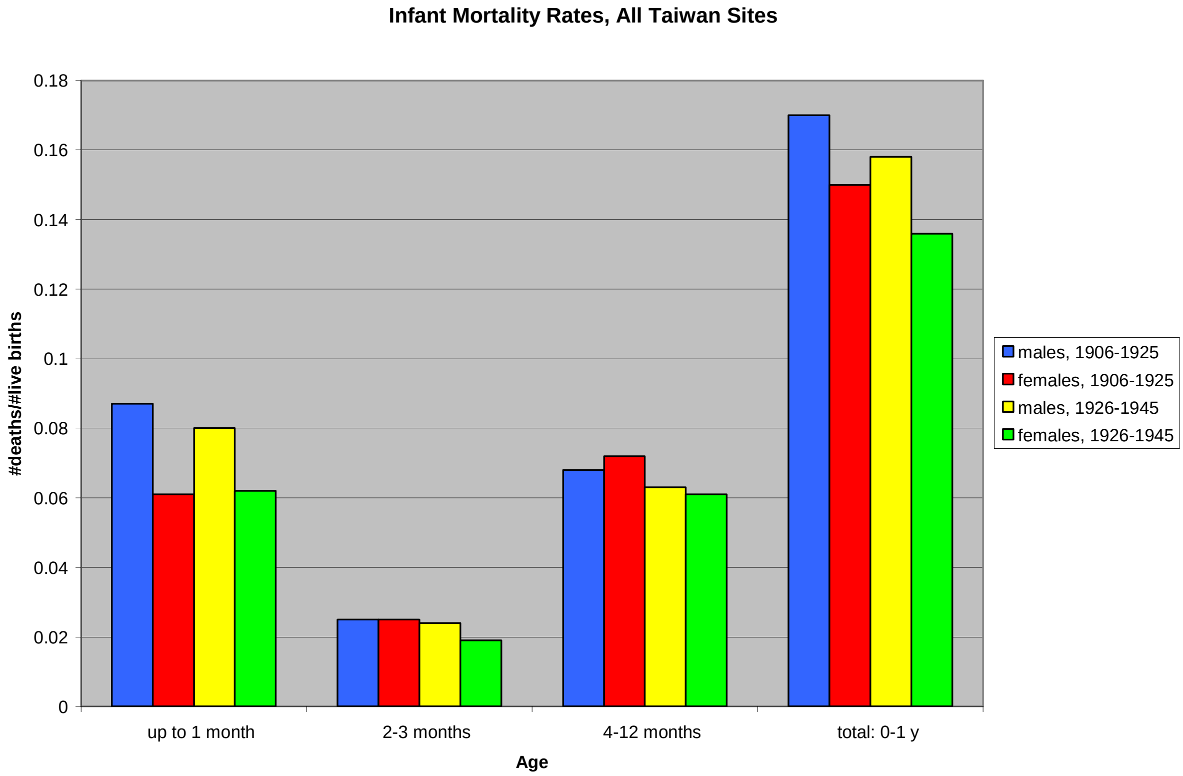

Figure 2. IMR, Taiwan

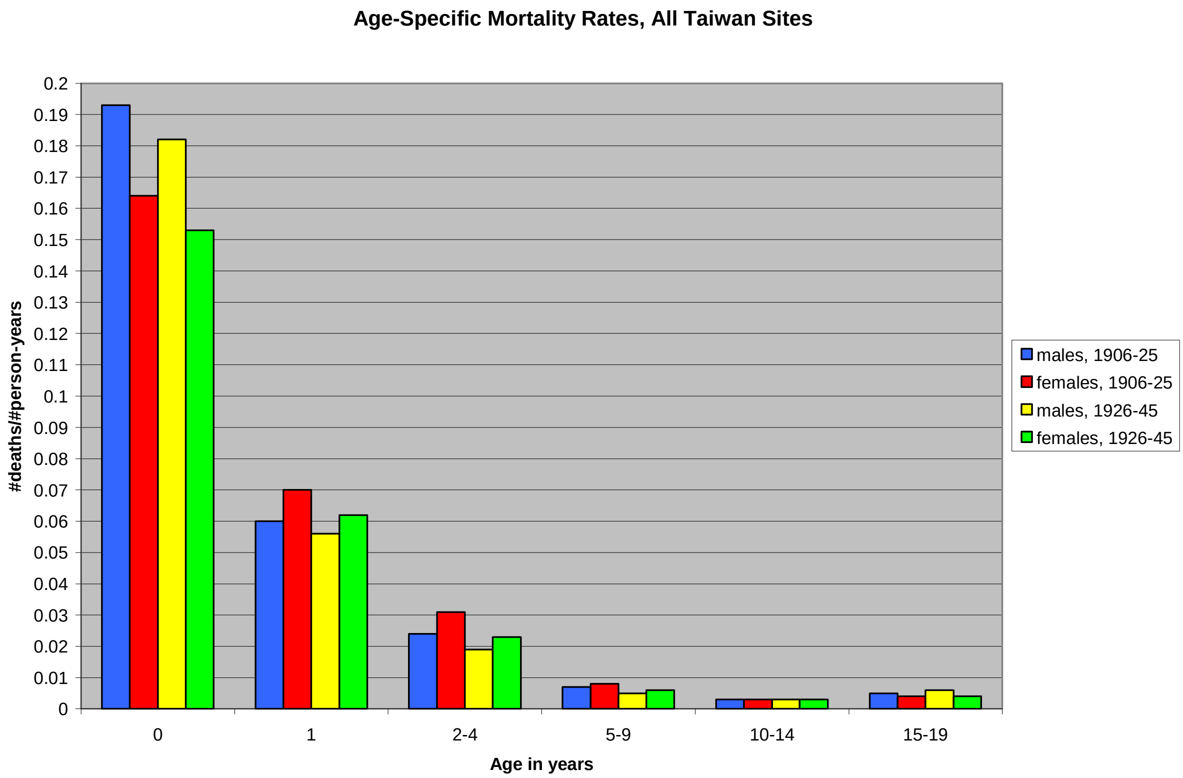

Figure 3. ASMR, Taiwan

As expected, both methods of calculation indicate high infant mortality, declining mortality for later birth cohorts, and male-female differences. In agreement with Barclay as well as

Yang and Hsieh, we find that females survive better up to the first birthday in both cohorts (red: 1906-1925, green: 1926-1945), while males in both cohorts (blue: 1906-25, yellow: 1926-45) do better from the second year of life through age 4 and slightly better through age 9. No male-female differences appear in the low rates of ages 10 through 14, and then male deaths begin to edge up in the 15-19 category.

Compared to the Dutch figures, Taiwanese mortality is significantly higher for the first two years of life (ages 0-1, in years). For ages 2 through 4, Taiwanese female mortality is still notably higher than Dutch female mortality, and even Taiwanese boys have slightly higher mortality rates than Dutch boys. [NOTE: For the final publication, we should break age 2 out of the 2-4 category.] Given the demographic understanding that females across societies have a biological survival advantage over males, [41] explanations for improved Taiwanese male survivorship for ages 1-9 emphasize culture, specifically son preferences manifested through the sex-differentiated practices in infanticide, adoption and weaning.

Infanticide and the sex ratio at birth (SRB)

Although known to Han as a culturally accepted option, the frequency of infanticide in Han populations is not reliably known, either in Taiwan or on the Chinese mainland. Missionaries and Western travelers often mentioned female infanticide but did not attempt to calculate frequencies. Adele Fielde, however, reported astounding figures on infant mortality for 40 Chinese Christian converts over age 50 in the 19th-century port of Shantou (Swatow) in Guangdong Province on the Chinese mainland: 31 percent of their sons and 70 percent of their daughters died by age 10, with 45 percent of their daughters dead by infanticide.[42] Only 45 percent of the daughters excluded from infanticide survived. Such reports have led Western scholars to assume that high rates of infanticide were the rule for Han during the late imperial period (1368-1911). However, evidence of the great economic contributions (via handcraft production, especially of textiles) prior to industrialization made by unmarried daughters as young as 8 years old suggests that the high rates of infanticide reported by Fielde may have been a tragic consequence of industrialization and *not* indicative of pre-industrial frequencies of infanticide.[43]

Barclay argued that infanticide was not a factor at all in Japanese-period Taiwan:

> Japanese officials took a strongly hostile attitude toward this disposal of infants, and apparently succeeded after a few years in stamping it out. By 1906, when the vital statistics records can be relied upon in most matters [and when the household registers begin], there was scarcely any trace of infanticide among the Taiwanese.
>
> To set limits on the extent of the practice, we may assume that all male births were registered, that infanticide occurred only to females, and that the true sex ratio of live births was 105. Then (the sex ratio of registered births in the early years being 109), in the first five years not more than 2 percent of female babies could have been disposed of in this way. In any case, the sex ratio of registered babies soon fell to 105, and stayed between 105 and 106 thereafter.[44]

[41] See, for example, A.J. Coale, 'Excess female mortality and the balance of the sexes in the population: An estimate of the number of "missing females".' *Population and Development Review* 17 (September 1991), p 518.
[42] A. M. Fielde, *Pagoda Shadows: Studies from Life in China* (Boston: Corthell 1884), pp. 23-25.
[43] Gates, 'Footloose in Fujian'. Gates, *Hand and Foot*.
[44] Barclay, *Colonial Development and Population in Taiwan*, 159-160n36.

However, Barclay provides no evidence for his claims of effective prevention of infanticide.

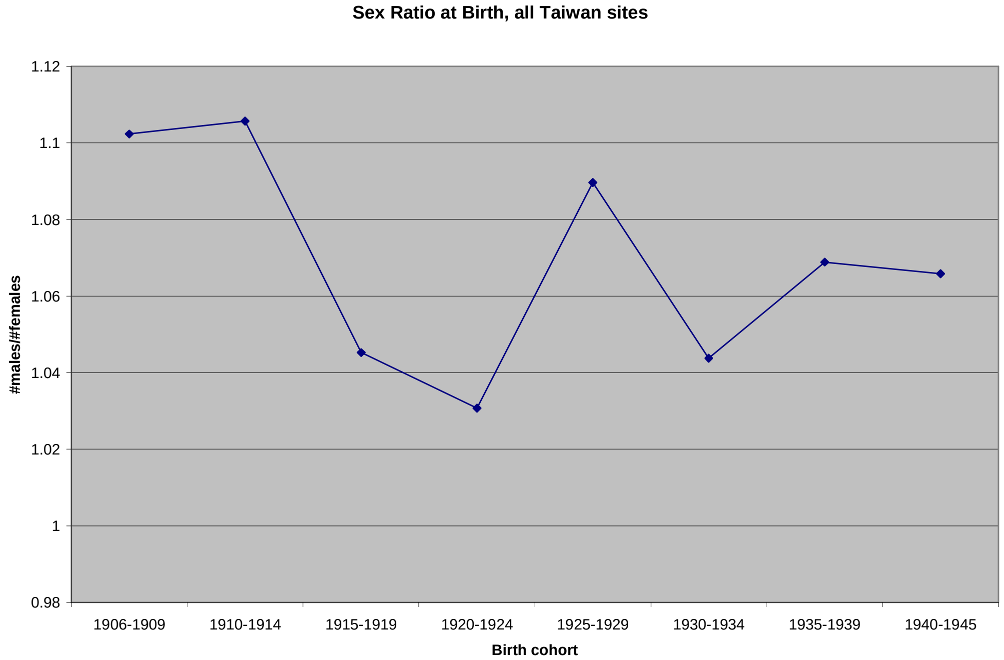

Figure 4. SRB, Taiwan

We calculated the SRB for all 13 Taiwanese sites combined, using the ratio of the number of live male births over the number of live female births (Figure 4). Looking at roughly five-year birth cohorts, we see an SRB somewhat at variance with what Barclay reports. For the two cohorts through 1914, the SRB is over 110, indicating a longer phase of male-bias than Barclay admits. Moreover, that bias may have gone on continuously through 1929, due to the large impacts of a malaria outbreak in 1915 and the worldwide influenza outbreaks in 1918 and 1920.[45] Boys' infant mortality rates were pushed higher by these waves of fatal illness and took longer to return to previous levels than girls' infant mortality rates.[46] We are uncertain, however, what may account for the slight female bias of 104 in the 1930-1934 birth cohort.

It is possible that female infanticide may be a factor in the Taiwanese SRBs. Barclay's estimate of a 2 percent rate of female infanticide relies largely on evidence of underrecording of infants from the early period of the household registers. However, there may have been cultural reasons – related to son preferences – for a sex bias in the underreporting of infants. The general underreporting of infants in the early period of the household registers reported by both Barclay and Tuan may have been more pronounced for females than males, which could also affect SRBs.

Weaning

Theo Engelen and Hsieh Ying-hui find little evidence of female infanticide in their comparison of infant mortality in Dutch Nijmegen and Taiwanese Lukang. Instead, they

[45] Barclay, *Colonial Development and Population in Taiwan*, 146, 147
[46] Barclay, *Colonial Development and Population in Taiwan*, 161.

emphasize the importance of breastfeeding practices in explaining differences in Dutch and Taiwanese infant mortality. They argue that “preferential treatment of sons probably did not influence infant mortality” for neo-natal mortality (that is, mortality in the first month of life), though it could account for sex differences in post-neonatal mortality. [47] We agree that the IMR suggests no son preference influences neo-natal mortality. Given generally high child mortality rates in Taiwan, healthy infants were not without value. The reduction in biological female advantage for post-neonatal infants could be related to an earlier weaning of girls than boys or to post-neonatal female adoptions.[48]

Adoption

Families in Taiwan and much of southern China had an option other than infanticide for daughters they considered excess: adoption.[49] Adoption rates in Taiwan were quite high in comparison to Europe. The Lonneker data contain *no* adoptions, but we find 17,943 first-time adoptions among 143,764 individuals across all 13 sites and the entire 1906-45 time of observation (see Table 4).

Adoption rates in Taiwan were also strongly gender differentiated. We find 15,507 female adoptions but only 2,436 male adoptions in the entire database.

Table 4. Cumulative Probability of Adoption in Taiwan[50]

site	first year of life (age 0)		birth – age 4		birth – age 9		birth – age 14	
	f	m	f	m	f	m	f	m
northern Taiwan								
Taibei City	0.156	0.026	0.246	0.043	0.292	0.049	0.314	0.051
Beipu	0.249	0.033	0.443	0.069	0.508	0.075	0.543	0.081
Zhubei	0.174	0.027	0.366	0.055	0.432	0.063	0.462	0.066
Emei	0.244	0.028	0.391	0.048	0.437	0.055	0.462	0.059
Wujie	0.063	0.018	0.265	0.032	0.380	0.042	0.424	0.047
central Taiwan								
Dajia	0.061	0.010	0.101	0.029	0.137	0.041	0.159	0.043
Lukang	0.109	0.019	0.177	0.042	0.220	0.042	0.251	0.057
Zhushan	0.075	0.019	0.138	0.039	0.195	0.047	0.245	0.052
southern Taiwan								
Jibei	0.015	0.010	0.036	0.028	0.051	0.034	0.068	0.038
Jiuru	0.022	0.019	0.045	0.036	0.068	0.044	0.077	0.047
Danei	0.037	0.010	0.069	0.027	0.092	0.038	0.108	0.045
Dongkang	0.028	0.012	0.071	0.024	0.101	0.034	0.120	0.036
islands								
Penghu	0.435	0.036	0.464	0.051	0.476	0.057	0.487	0.060
TOTAL, all sites	0.122	0.021	0.222	0.040	0.027	0.049	0.297	0.053

Whereas Europeans without an heir might try to adopt an heir, males in Taiwan were rarely given up in adoption. In Han areas with strong lineages, male adoptions outside the lineage

[47] T. Engelen and Y-H. Hsieh, ‘The massacre of the innocent: Infant mortality in Lu-kang (Taiwan) and Nijmegen (The Netherlands)’. Paper presented at the Pre-Conference on Mortality, Academia Sinica, Taipei, Taiwan, January 15 and 16, 2007, pp. 15, 10-11.
[48] Wolf and Huang, *Marriage and Adoption in China*, 232. A. Wolf, *Sexual Attraction and Childhood Association*, 306.
[49] Wolf and Huang, *Marriage and Adoption in China*, 233, 301.
[50] We appreciate the use of data from Arthur Wolf and Hsieh Ying-Hui to produce this table.

were largely prohibited.[51] In the Haishan area of northern Taiwan where male adoptions were not tightly controlled, Wolf and Huang found that males (born to married women between 1906 and 1935) had about a 5 percent probability of being given up in adoption by the time they reached age 15.[52] By contrast, Han girls were readily given up in adoption. In that same Haishan area, Wolf and Huang document that, by the time they reached 15, girls had a probability of being given up for adoption that dropped throughout the colonial period that ranged from a high of over 70 percent (for girls born 1906-1910) to a "low" of 47 percent (for girls born 1931-35).[53]

Female adoption was also unevenly spread throughout Taiwan (see Table 4). Adoption rates were highest in northern Taiwan and Penghu (islands off the coast of Taiwan) and lowest in southern Taiwan. This variation also corresponds to different rates of the "minor" form of marriage, where a family would adopt a little girl to raise to be their son's bride. Minor marriages were very common – indeed, preferred – in northern Taiwan, notably Haishan, Zhubei, and Emei, but rare in central and southern Taiwan, notably Dajia, Danei, Lukang, and Zhushan.[54] This regional difference in minor marriages has been attributed to a greater cultural substrate influence of plains Aborigines in southern Taiwan.[55]

Consequently, adoption had different purposes and meanings in northern and southern Taiwan. Wolf has argued extensively that adoptions in northern Taiwan, for both Hoklo and Hakka, were subject to marriage market pressures.[56] By contrast, it appears that southern adoptions were often related to infant mortality rates, serving to assuage grief, replace a lost child, or spiritually protect other children.[57]

Most of the factors of neglect said of daughters have been shown to apply even more so to adopted daughters in northern Taiwan, where they were usually adopted as daughters-in-law rather than as daughters. For example, in the northern area of Haishan, not only were daughters generally weaned younger than sons, but adopted daughters were weaned younger than daughters.[58] They were also subject to harsh treatment, such as beatings, longer and hard work, and made to go without medicine and religious charms when sick and even get reduced amounts of food, if it was scarce.[59] There was cultural awareness of the more difficult (*ku*, literally "bitter") life of an adopted daughter: exasperated mothers would scold wayward daughters with the threat of giving them up for adoption.

Arthur Wolf's work is very important in establishing the relationship between female adoption and female childhood mortality. Wolf and Huang show that, from the first to the fifteenth birthday, males have a lower probability of death than daughters (girls alive and living in their natal household at age 1) and that daughters have a lower probability of death than adopted daughters (girls adopted before age 1 and still alive at age 1).[60]

Table 5. Probability of Mortality for Sons, Daughters, and Adopted Daughters

[51] J.L. Watson, 1975, "Agnates and Outsiders: Adoption in a Chinese Lineage," *Man* 10 (1975) p.305. Wolf and Huang, *Marriage and Adoption in China*, 208-211.
[52] Wolf and Huang, *Marriage and Adoption in China*, 207.
[53] Wolf and Huang, *Marriage and Adoption in China*, 233.
[54] Chuang and Wolf, 'Marriage in Taiwan', 785-787.
[55] A. Wolf, *Sexual Attraction and Childhood Association*, 54-55. Brown, *Is Taiwan Chinese?*, 155-60.
[56] Wolf and Huang, *Marriage and Adoption in China*. A. Wolf, *Sexual Attraction and Childhood Association*.
[57] B. Pasternak, 'Causes and demographic consequences of uxorilocal marriage in China' in S.B. Hanley and A.P. Wolf (ed.s) *Family and Population in East Asian History* (Stanford, CA: Stanford University Press 1985), p. 122. Brown, *Is Taiwan Chinese?*, 84-88.
[58] Wolf and Huang, *Marriage and Adoption in China*, 232, 234-5. A. Wolf, *Sexual Attraction and Childhood Association*, 265.
[59] Wolf and Huang, *Marriage and Adoption in China*, ch. 17. A. Wolf, *Sexual Attraction and Childhood Association*, 265-67.
[60] Wolf and Huang, *Marriage and Adoption in China*, 238.

(All children born 1906-1935 who survived to age one)

Year of birth	Sons	Daughters	Adopted daughters
Probability of mortality by age fifteen			
1906-1915	.163	.203	.240
1916-1925	.140	.120	.220
1926-1935	.139	.122	.174

(Wolf and Huang 1980:238, Table 17.6)

Wolf further documents that adopted daughters had a higher probability of death than daughters at most ages between one to fifteen. For age 1 through 4, an adopted daughter's "chances of dying were almost double the chances of a daughter dying."[61]

This evidence of the correlation between adoption and mortality for girls raises two major questions about male-female differences in mortality. First, is girls' higher mortality than boys' primarily a consequence of the high mortality of adopted daughters? Li Dengyue and Arthur Wolf suggest that it is.[62] Second, does the mortality rate of adopted sons look more like the rate of sons or the rate of adopted daughters?

Our data indicate that the mortality of adopted daughters do skew the female mortality rate, especially for age 1 (the second year of life), though not as much in these data aggregated across 13 sites as Wolf's data from the single northern site of Haishan suggests (see Figure 5). While adopted girls have higher mortality at age 1 and ages 2-4, we can see that the mortality of females raised in their natal households more closely resembles that of males raised in their natal household than adopted females, for age 1 in particular, but also for ages 2-4, as Wolf and Li predicted.

[61] A. Wolf, *Sexual Attraction and Childhood Association*, 305, see also pp 302-305.

[62] D. Li, '*Sim-pua* to *iong-lu*' (Adopted daughters in law and adopted daughters), *Minzoku Taiwan* 3 (1943) pp. 16-17. A. Wolf, *Sexual Attraction and Childhood Association*, 298-99, 305.

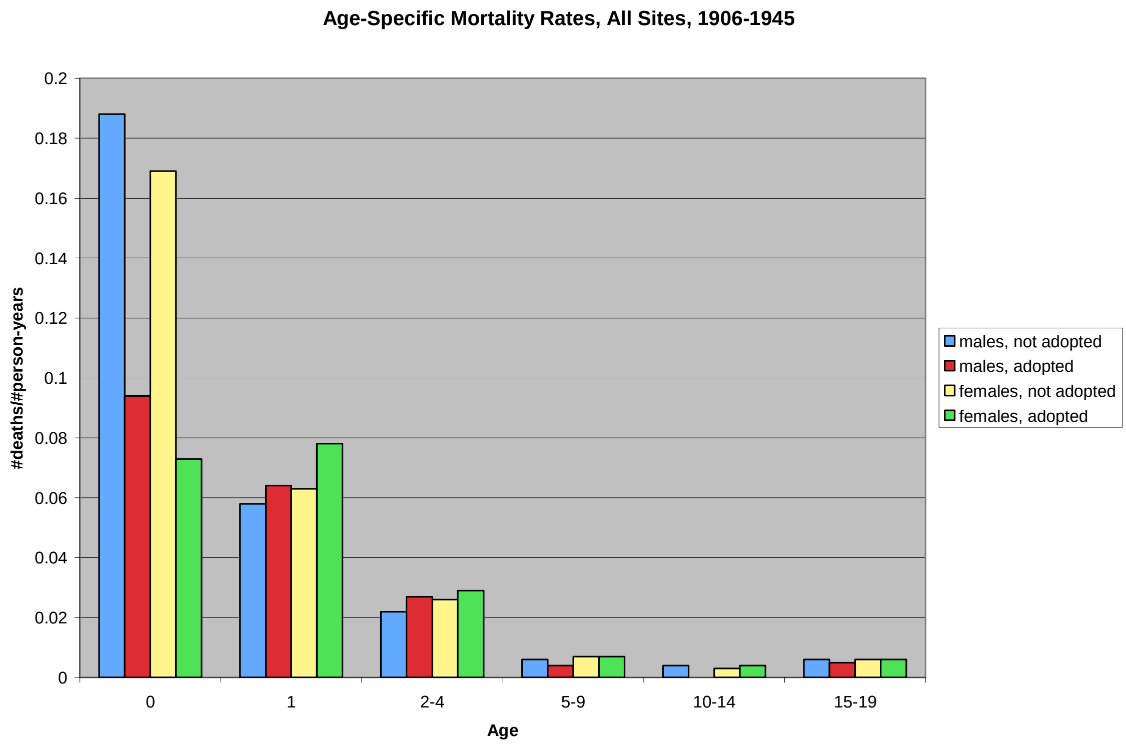

Figure 5. ASMR by adoption, Taiwan

However, unexpectedly, our data also suggest that the mortality of adopted males more closely resembles the mortality of females (raised by their natal families) than that of males raised in their natal households. Given the low numbers of male adoptions and thus the low counts of adopted male deaths by age group (see Table 6), the evidence is not definitive, but this incrementally higher rate of mortality seems to bear out Wolf's suggestion, "adoption killed people," referring to the evidence he finds of adoption trauma.[63]

Contrary to appearances in Figure 5, adopted children did *not* have a much better survival rate in the first year of life. The mortality rate for adopted children in the first year of life is skewed because adopted children are, on average, older than children raised in their natal homes. More first-year adoptions occurred after the child turned 3 months old than in the first three months of life.[64] Since mortality declines over the first year of life and children do not come under observation as adopted until they are older, therefore the calculated mortality rate for adopted children is lower than for children raised by their natal families.[65]

[63] A. Wolf, *Sexual Attraction and Childhood Association*, 307, 306.
[64] Wolf and Huang, *Marriage and Adoption in China*, 235. A. Wolf, *Sexual Attraction and Childhood Association*, 170, 174, 177.
[65] See also A. Wolf, *Sexual Attraction and Childhood Association*, 305.

Table 6. Age-Specific Mortality Rates by Adoption, All Sites, 1906-1945

Age in years	0	1	2-4	5-9	10-14	15-19
Males, Not Adopted						
counts	6238	1740	1728	718	371	508
person-years	33194.005	29922.847	80169.546	115609.509	99226.913	86061.741
ASMR	0.188	0.058	0.022	0.006	0.004	0.006
Males, Adopted						
counts	79	71	101	29	0	29
person-years	837.525	1109.617	3755.255	6483.859	6043.215	5301.869
ASMR	0.094	0.064	0.027	0.004	0	0.005
Females, Not Adopted						
counts	4844	1545	1633	609	205	319
person-years	28661.18	24494.773	61757.17	81223.928	63875.973	55840.117
ASMR	0.169	0.063	0.026	0.007	0.003	0.006
Females, Adopted						
counts	292	417	523	249	141	167
person-years	4020.915	5349.855	18195.686	34791.584	36217.894	29875.951
ASMR	0.073	0.078	0.029	0.007	0.004	0.006

Regional Variation in the Affect of Adoption

Rates of adoption as well as mortality varied regionally in Taiwan, so the degree to which overall male-female mortality rates are affected by adoption also varies. To give some idea of this variation, we look at ASMR in four sites which had counts of adopted female deaths over 25 for ages 1 to 4. Because the counts of adopted male deaths are so low, these rates will not be considered, though they are present in the data.

In Dadao Cheng, a Hoklo Han district in Taibei City, the major Taiwanese city in the north, we see very little difference for each age group across the time periods (see Figures 6 and 7). For age 1, all females taken together have about a 3 percent higher mortality rate than all males, and for ages 2-4, there is less than a percentage point (0.01) difference in the male and female mortality rates. When we take adoption into account, however, we see something rather different. Females raised in their natal family (not adopted) had mortality rates within a single percentage point of males raised in their natal family for age 1 in both 1906-1925 and 1926-45. By contrast, adopted daughters had a mortality rate almost twice as high as children raised in their natal homes, across both time periods. Children aged 2-4 show virtually no male-female differences or affect of adoption.

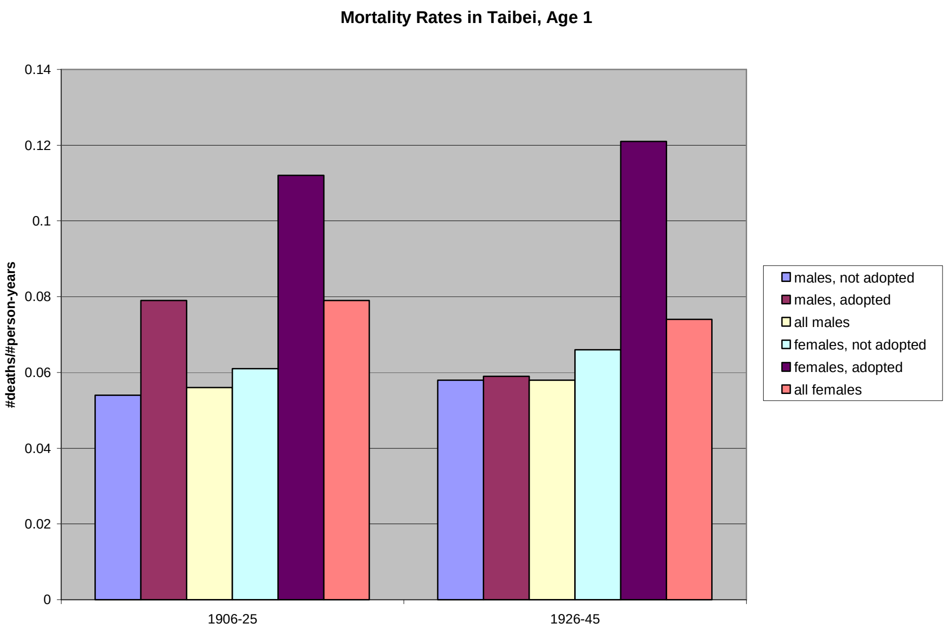

Figure 6. ASMR, Taibei City, Age 1

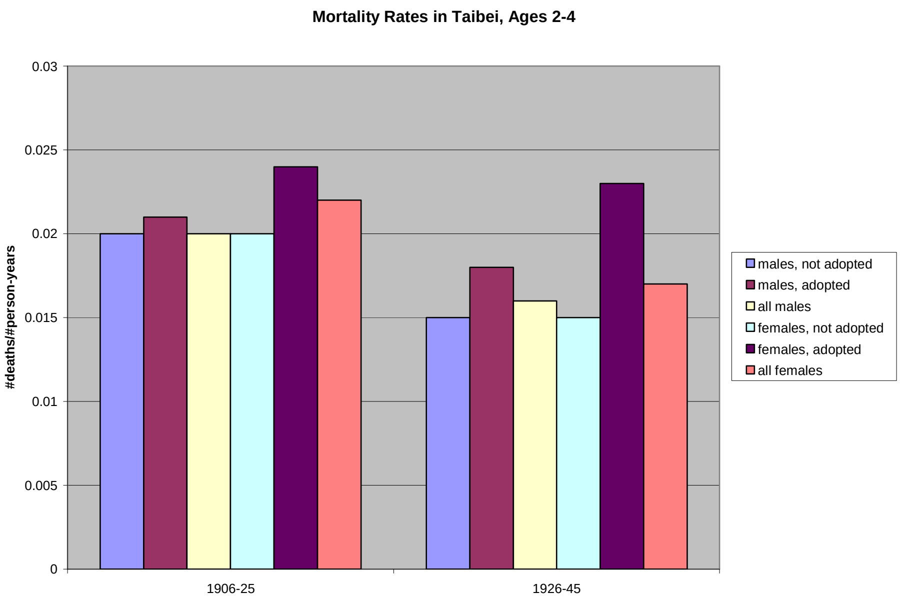

Figure 7. ASMR, Taibei City, Ages 2-4

In Zhubei, a northern rural township with a Hakka Han majority, shows the morality rates for not-adopted females more like adopted females than like not-adopted males for both age groups (1, 2-4) in the 1906-25 period, but more like not-adopted males than adopted females in both age groups in the 1926-45 period, when mortality rates are lower overall (see Figures 8 and 9). Still, all of this variation occurs within 4 percentage points (0.04), and much of it within one point, so the mortality differences for males and females are not pronounced.

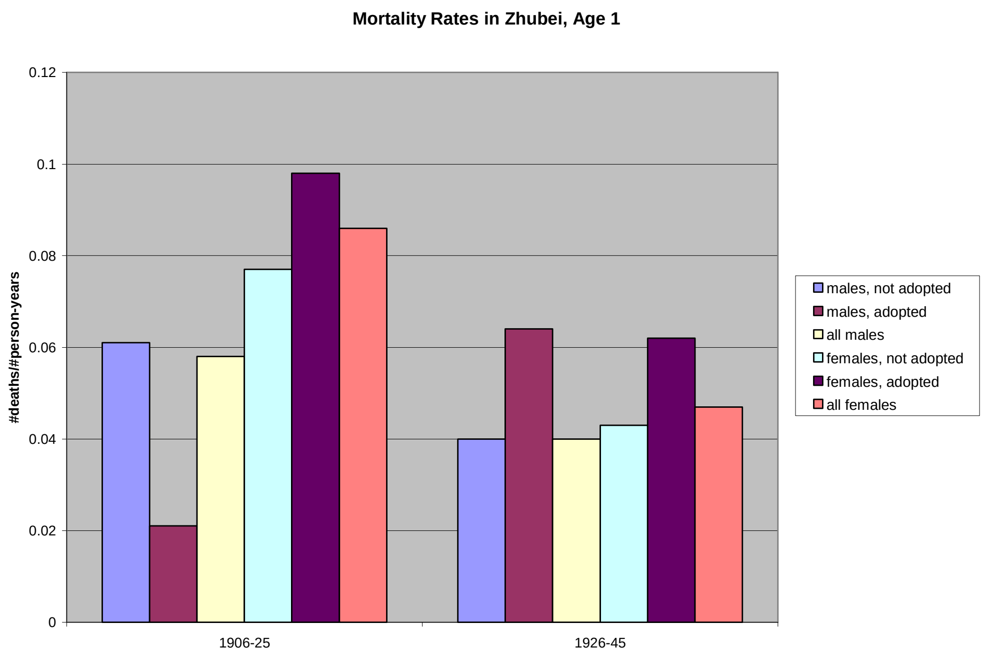

Figure 8. ASMR, Zhubei, Age 1

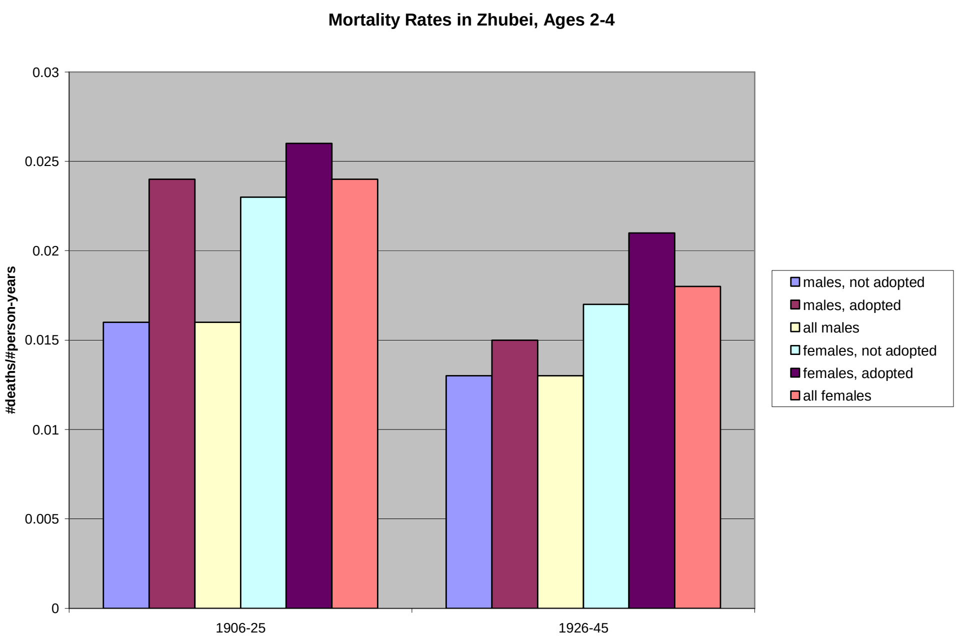

Figure 9. ASMR, Zhubei, Ages 2-4

In Danei, a southern rural township with a large plains Aborigine minority in the majority Hoklo population, the mortality differences for all male and all females are small, for both ages in both time periods, usually less than a percentage point (see Figures 10 and 11). However, when adoptions are considered, we see that adopted females in 1906-45 had twice as high a mortality rate as children raised in their own homes.

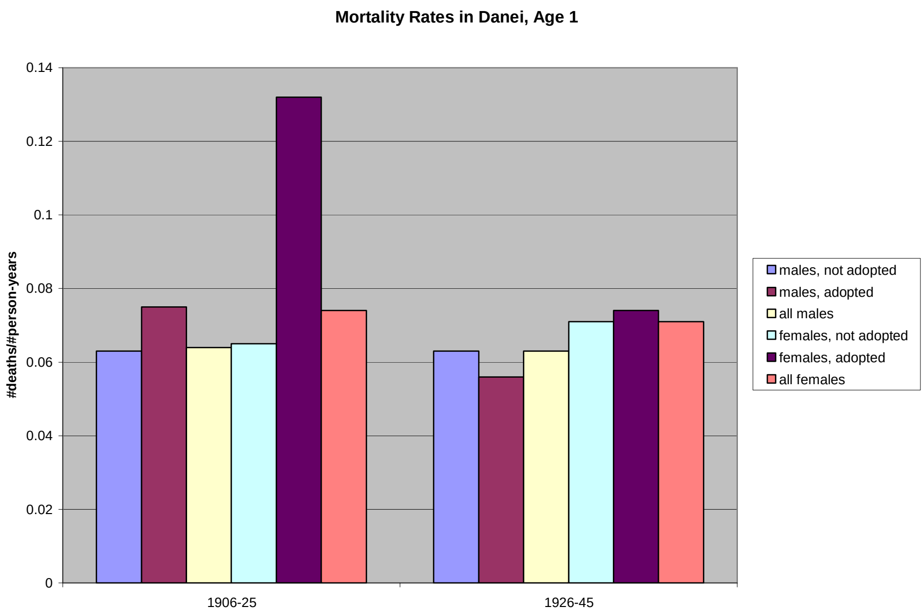

Figure 10. ASMR, Danei, Age 1

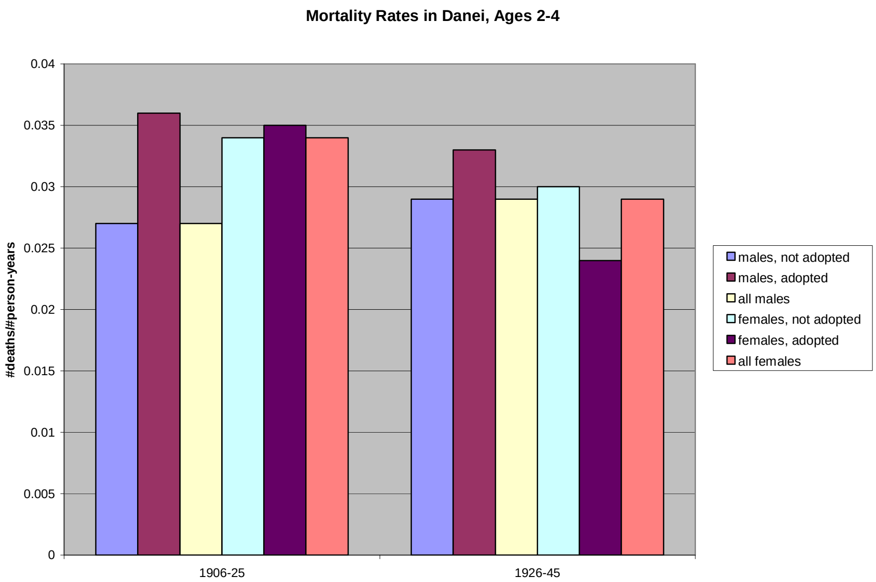

Figure 11. ASMR, Danei, Ages 2-4

This high mortality rate results in so low an affect on overall male-female mortality differences only because the rate of female adoption – 0.069 by age 4 – was much lower than other sites (see Table 4). In Danei, adopted females (age 1 in the 1906-25 time period) are only 24 percent of all female deaths (in that time period), whereas they are 50 percent in Taibei, 46 percent in Zhubei, and 53 percent in Penghu. In the later time period (1926-45), the counts of adopted female deaths drop to 10, so their impact on the overall female mortality rate is negligible.

Mortality rates for adopted girls in Danei may be so high because of their different purpose than northern adoptions. Since adopted daughters were often replacing children who had died, it may be that they were entering households where the risk of death was higher than in other households, possibly due to poverty or to locale-specific endemic disease.

In Penghu, the Hoklo Han populated-islands in the Taiwan Strait, there are more male-female differences in both age groups in 1906-25, though the patterns reverse. For age 1, both categories of female cluster together (within a percentage point), higher than not-adopted males (see Figure 12). For ages 2-4, children raised in their natal families cluster together, lower than adopted females (see Figure 13). In 1926-45, the count of adopted female deaths drops below 20 for both age groups. Nevertheless, a slight advantage for males remains in the age 2-4 group, despite an overall reduction in the mortality rates.

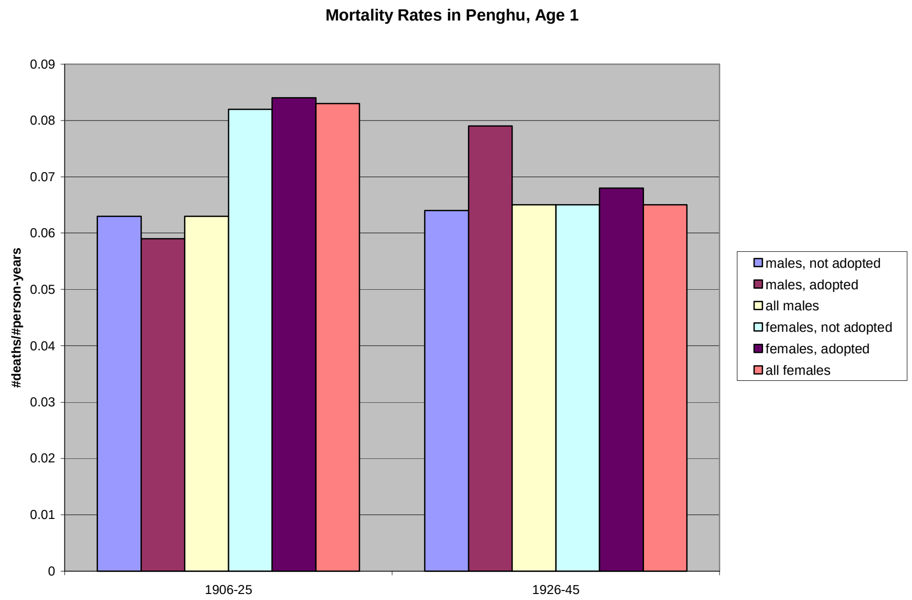

Figure 12. ASMR by adoption, Penghu, Age 1

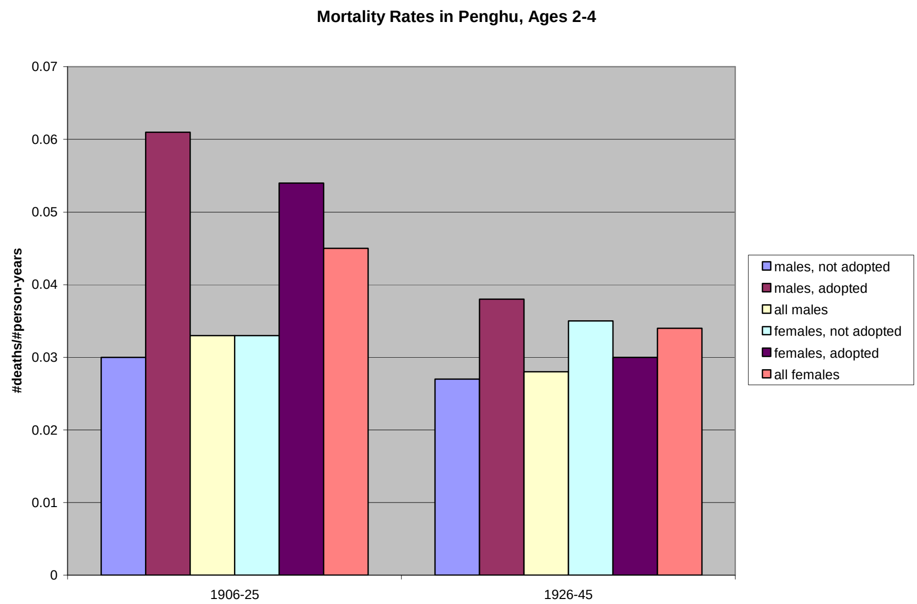

Figure 13. ASMR by adoption, Penghu, Ages 2-4

These data suggest some regional variation in the treatment of daughters as well as rates of adoption. In some times and areas, daughters have similar mortality rates as sons, while in others, they have higher mortality. Adopted daughters, however, had consistently higher mortality rates for all sites and time periods where the counts of adopted female deaths are over 20 (and thus less subject to random variation).

Effective Birth Order

Given the link between adoption and mortality rates, Wolf and Huang's work showing that effective birth order is the best predictor of the probability of adoption has implications for mortality rates.[66] We calculate effective birth order as the number of older siblings present in the household at the time of the birth of the individual (see Figures 14-17). We use this calculation instead of absolute birth order – that is, the order born to the parents – because of the high Taiwanese mortality rates. In order to see the impact of siblings, rather than the effect of an older mother, we need to look at how many siblings are actually present in the household at the time of birth. A child might be her mother's four child, but if all her older siblings are gone (whether due to death or adoption out), then she is effectively a first-born child.

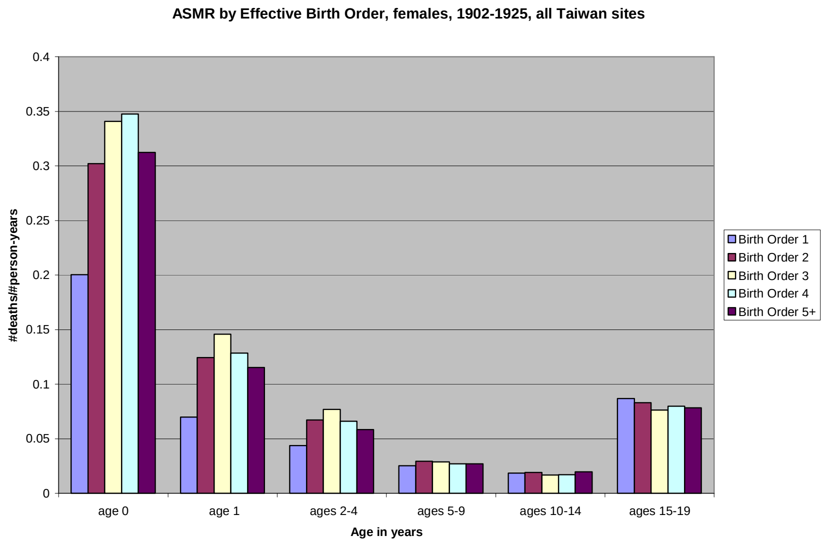

Figure 14. Birth Order, Taiwanese females born 1906-1925

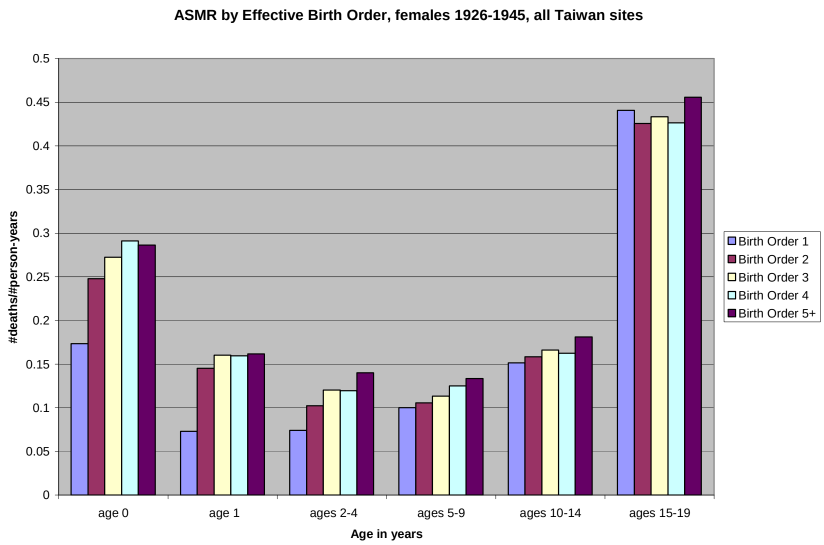

Figure 15. Birth Order, Taiwanese females born 1926-1945

[66] Wolf and Huang, *Marriage and Adoption in China*, 213-14, 252-255.

For females, the effects of being a first-born child strongly reduces mortality risk, from birth through age 4 (see Figures 14-15). This result meets our expectation that, due to a higher risk of adoption, later effective birth orders will have higher ASMR. [NOTE: The cause of the higher AMSR for both females and males aged 15-19 in the 1926-45 cohort is not clear. We'll need to investigate before publication.]

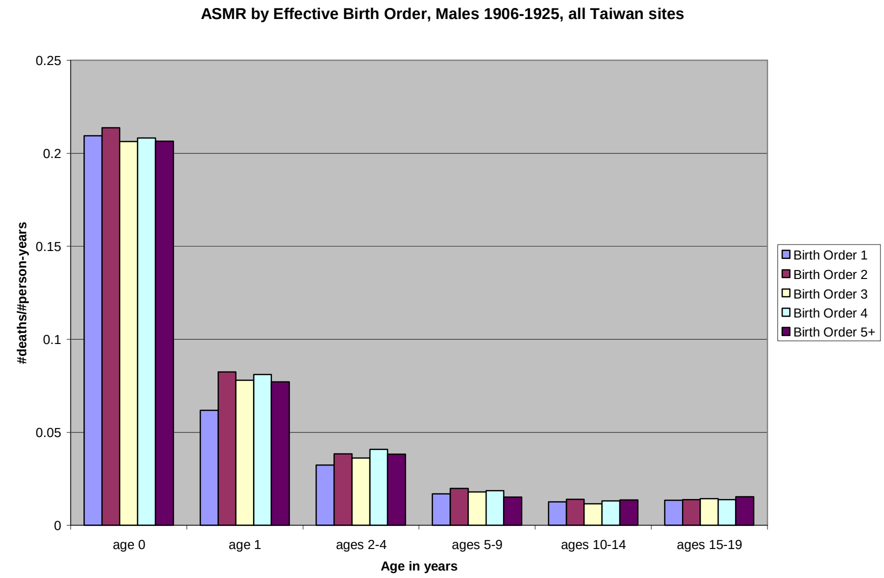

Figure 16. Birth Order, Taiwanese males born 1906-1925

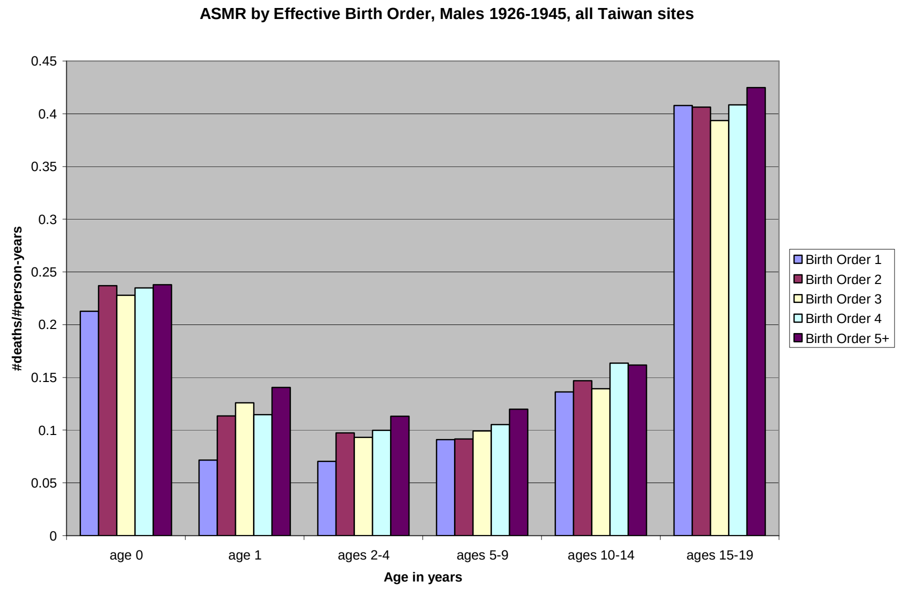

Figure 17. Birth Order, Taiwanese females born 1926-1945

For males, the impact of birth order on mortality is less clear, especially in the first year of life (age 0, see Figures 16-17). There does appear to be a small improvement in mortality risk for first-born males in the second year of life (age 1). However, such minimal birth order effects bear out the relationship between adoption and ASMR. Because adoption rates overall for males are low (around 5 percent), adoption has relatively little impact on male ASMR.

Conclusions

Sex differences in mortality are clearly important. In the Dutch rural community of Lonneker, male children clearly have negative health chances at younger ages, up to age 9. For infant mortality, however, boys' lesser life chances are not statistically significant. Is it possible that in rural societies with a more careless treatment of infants even female babies had relatively high death risks? The greater death risks for young boys up to age 10 is usually explained through the greater risks male children experienced because of their economic and social activities outside the house. While girls were kept inside to assist their mothers at home, boys were sent on errands and other small jobs around the house or in the village. Beyond age 9 girls' health clearly begins to suffer. In Lonneker, life for adolescent girls was certainly more dangerous than for boys.

Death risks for boys and girls in the various age groups did not seem to have been related to their father's occupation. Babies and older children suffered similar fates in industrial and in peasant households. Likewise, gender differentials in mortality were also not the result of the father's occupation. This is remarkable. Even in the industrial households adolescent girls had higher death risks than did boys. The ample employment opportunities for girls in the Enschede textile factories were apparently insufficient incentives for parents to increase their investments in these girls. Given the fact that level of taxation, and thereby, the level of the household's financial resources did not seriously improve children's life chances, strongly underscores the lesser weight of social factors in this rural community. This supports an image of a community with a strong measure of social integration in which children's life courses, including their inherent dangers, were rather uniformly shaped.

This should however not mean to say that death was randomly distributed over these Lonneker families and their children. Far from it: death risks were concentrated in some families but not in others. This phenomenon of death clustering was of great importance to the fates of children of all ages. The question is though to what extent this has a genetic background or rather a more cultural one. After all, when parents are ignorant and careless regarding their children's health, it is likely that more than one child, whatever its age, runs severe health risks. The suggestion of cultural factors is also supported by the important role of parents' literacy for the age group 10-19. Ignorant parents were a danger to the health of their children.

In contrast to Dutch Lonneker, it is Taiwanese girls who have negative survival chances for ages 1 through 9. The higher mortality rates for girls suggest strong social and cultural factors – usually attributed to Han Chinese son preferences – countering the female biological advantage in survivability. In particular, female adoption appears to be an important factor for male-female differences in mortality rates in Taiwan for children aged 1 through 4. Again, in contrast to Dutch Lonneker, ages 10-14 show further reductions in female risks, so that male and female ASMR is the same. Taking into account the biological female advantage, this purported equality of rates nevertheless suggests that there are other factors elevating female mortality rates. It is not until we reach ages 15-19 that we see male mortality rates edging up above female rates. This result seems particularly surprizing given that, in early 20th-century Taiwan, most women began child-bearing during these ages, with all the attendant mortality risks. Moreover, the relationship between mortality risk and adoption is further supported by examination of effective birth order. For girls, the number of older siblings present in the household at the time of birth – that is, effective birth order – has a clear impact on survival chances.

The impact of gender on mortality in the Netherlands and Taiwan does appear to be different. In Taiwan, girls did face cultural factors which increased their risk of death as compared to Dutch girls. However, contrary to popular expectations regarding the role of female infanticide, the primary underlying factor for elevated female mortality in Taiwan appears to have been high rates of female adoption. Arthur Wolf's conclusion that, in Taiwan, adoption killed girls, appears to be correct.