Longevity Disparities in Multiethnic Hawaii: An Analysis of 2000 Life Tables

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SYNOPSIS

Objective. We examined differences among seven major ethnic groups in Hawaii in life expectancy at birth ($e(0)$) and mortality at broad age groups.

Methods. We constructed life tables for 2000 for Caucasian, Chinese, Filipino, Hawaiian, Japanese, Korean, and Samoan ethnic groups in Hawaii. We partitioned overall mortality into broad age groups: <15 (representing premature mortality), 15–65 (representing working age), and 66–84 and ≥ 85 (representing senescent mortality).

Results. The overall $e(0)$ in Hawaii was 80.5 years, but the difference between the longest-living group (Chinese) and the shortest-living group (Samoan) was 13 years. Chinese had the lowest mortality rates in each age group except the ≥ 85 category. In this last age group, we observed anomalously low rates for some new immigrant groups (especially Samoan males) suggesting, as a cause, that elders in these immigrant groups may return to natal countries in their old age and die there. In the <15 age group, mortality rates for Samoans and Koreans were highest, especially for Korean girls, suggesting some continuance in the U.S. of a preference for boy children. Outside of these anomalies, ethnic differences in $e(0)$ were likely explained by socioeconomic and behavioral variables known to affect mortality levels, which are closely associated with ethnicity in Hawaii.

Conclusions. These findings confirm the need to disaggregate Asian and Pacific Islander data, to conduct ethnic-specific research, and to address socioeconomic disparities.

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Hawaii is home to many Pacific, Asian, and European ethnic groups, all sharing the same physical environment and living side-by-side with little discrimination in comparison with other states. In 2000, the state's ethnic distribution was estimated to be about 24% Hawaiian, 24% Caucasian, 18% Japanese, 16% Filipino, 7% Chinese, 2% Korean, 2% Samoan, and 7% other (Unpublished data: Cancer Research Center of Hawaii. Population estimates 2000. Honolulu: Hawaii Tumor Registry; 2007). Hawaii has the longest life expectancy at birth ($e(0)$) in the nation, but not all ethnic groups live equally long.¹⁻⁵ Since 1950, Japanese and Chinese residents have had the longest $e(0)$ and Hawaiians the shortest (Table 1).^{3,5}

In this article, we compared $e(0)$ for the seven major ethnic groups in Hawaii based on life tables constructed for 2000. To help explain potential ethnic differences in $e(0)$, we partitioned overall mortality into broad age groups: <15, 15–65, 66–84, and ≥ 85 . Although $e(0)$ is widely used as an index of overall health and social conditions in different populations and is independent of a population's age structure, the estimation of $e(0)$ is affected by age patterns of mortality through the lifespan. Thus, examining mortality within broad age groups may shed light on the sources of ethnic disparities in $e(0)$.

DATA AND METHODS

The Hawaii Department of Health provided death record data. To smooth annual fluctuations in mortality, we used a mean of 3.5 years of death data by ethnic group centering on April 1, 2000, to construct 2000 Hawaii life tables. We based population estimates on the 2000 U.S. Census, adjusted by ethnicity estimates obtained through the Hawaii Health Survey (HHS), a random-sample telephone survey patterned after the National Health Interview Survey.⁶

The ethnic categorization schema of the HHS differs from that of the U.S. Census. It essentially is based on paternal ethnicity for mixed offspring, with exceptions for Caucasians and Hawaiians. When only one parent is Caucasian, the child takes the ethnicity of the non-Caucasian parent, and when one parent is Hawaiian or part-Hawaiian, the child is classified part-Hawaiian regardless of the other parent's ethnicity.⁶ For this study, we combined pure Hawaiian and part Hawaiian (simply called "Hawaiian"), as the number of full-blood Hawaiians is small.⁷ Because the HHS classification system is used for death records, HHS population estimates are a better match than U.S. Census estimates in constructing life tables. As with the 1980 and 1990 life tables, we constructed the 2000 life tables following the method proposed by Chiang,⁸ with minor adjustments. We constructed 24 tables (available upon request) for total residents and seven ethnic groups: Caucasian, Chinese, Filipino, Hawaiian, Japanese, Korean, and Samoan. Small sizes of other ethnic groups precluded the construction of meaningful life tables.

In this study, we analyzed the death rates derived from the 2000 Hawaii life table for each ethnic group and gender. The reciprocal of life expectancy at birth, $[1/e(0)]$, is the overall death rate for the stationary population (life table population) formed by the set of observed mortality schedule. This life table death rate (LTDR) is not affected by the age distribution of the original population. The reciprocal of the life expectancy at age x , $[1/e(x)]$, is the death rate of the stationary population for age x and after. Extending the concept of these measurements, we introduced the LTDR between age x and $x+n$, $LTDR(x, x+n)$, which is defined as the following:

$$LTDR(x, x+n) = [l(x) - l(x+n)] / [T(x) - T(x+n)]$$

where $l(x)$ is the number of survivors at age x and $T(x)$ is the life table population at age x and after. The

Table 1. Life expectancy at birth by ethnicity, 1950–2000, Hawaii

Year	Caucasian	Chinese	Filipino	Hawaiian	Japanese	Korean	Samoan	Total
1950	69.2	69.7	69.1	62.5	72.6	NA	NA	69.5
1960	72.8	74.1	71.5	64.6	75.7	NA	NA	72.4
1970	73.2	76.1	72.6	67.6	77.4	NA	NA	74.2
1980	75.8	81.7	79.3	71.8	80.9	NA	NA	77.9
1990	75.5	82.9	78.9	74.3	82.1	NA	NA	78.9
2000	79.0	86.1	80.9	74.3	82.8	81.4	72.8	80.5
Male	76.7	83.5	78.0	71.5	79.7	78.3	71.1	77.5
Female	81.7	88.7	85.9	77.1	88.7	83.6	74.6	83.6

NA = not available

numerator is the number of deaths between age x and $x+n$, and the denominator is the stationary population between age x and $x+n$, justifying that the measure is the LTDR for age group x to $x+n$. We considered that LTDR(0, 15) represents premature mortality, LTDR(15, 65) that of working age, and LTDR(65~) senescent mortality. We also further divided the death rate for ≥ 65 years of age, LTDR(65~), into two parts, LTDR(65, 85) and LTDR(85~), to examine the mortality of the very elderly, as there are suggestions that in some ethnic groups, the elderly repatriate to their home country for health care, eventually dying there.⁵

RESULTS

Between 1950 and 2000, overall $e(0)$ in Hawaii increased by 11.0 years, from 69.5 to 80.5 (Table 1). In comparison, $e(0)$ in the U.S. overall in 2000 was 77.4 years for white residents and 76.9 for all races.⁹ Examining five major ethnic groups (life tables for Koreans and Samoans in Hawaii were not constructed before 2000 due to small numbers in these groups), $e(0)$ increased for all groups between 1950 and 2000, and Chinese residents showed the highest gain (16.4 years). In each decade, Hawaiians had the lowest $e(0)$, which was 10–12 years lower than the highest $e(0)$ group (Japanese in 1950–1970 and Chinese thereafter). With the addition of Korean and Samoan estimates in 2000, the difference between the $e(0)$ for Chinese (highest) and Samoan (lowest) exceeded 13 years. The Samoan $e(0)$ was even shorter than for Hawaiians, while the Korean $e(0)$ was comparable with fellow East Asians (Japanese and Chinese).

The overall gender difference in $e(0)$ was about six years, but there was wide variation by ethnicity. Japanese and Filipino had the largest gender gap, which was nine and eight years, respectively. Samoans had the smallest gender gap of 3.5 years; the gap for other ethnicities was about five years. It was difficult to detect any definitive trend in the gender gap within each ethnic group. For the entire population, however, the gender gap initially presented a widening trend, but in recent decades represented a narrowing trend. This is in general agreement with the global experience in developed nations.^{10,11}

The LTDRs per 1,000 population by ethnicity and gender for the broad age groups are shown in Table 2. Looking at genders combined, generally the ranking in all the age groups was in agreement with that of $e(0)$. However, there were some exceptions. Samoans showed the lowest rate at the oldest age group, despite the fact that they had the highest rates in all other age groups. Caucasians also presented some departure at

the oldest age when the rate became very high, matching that of Hawaiians. Koreans also presented some anomalies; they had a very high LTDR (0, 15), almost on par with Samoans, but their rates at other ages were more similar to the other Asian groups.

Within a given age group, there were wide differences among ethnic groups. Prior to age 85, Chinese consistently presented the lowest rate and Samoans the highest. Until age 65, there was a fourfold difference between Chinese and Samoans and a threefold difference between Chinese and Hawaiians, in large part because of the exceptionally low rates of Chinese. Compared with the next lowest group, Japanese, the Chinese mortality was only about half. In the 65–84 age group, the relative gap narrowed; Samoans were 2.5 times higher and Hawaiians were 2.2 times higher than Chinese. As indicated, in the ≥ 85 age group, the Samoan rate became the lowest among all the ethnic groups—as much as 50% lower than the highest rates.

Looking at death rates for males, the general trend and pattern by ethnic group were similar to (although higher than) those observed in the gender-combined population up to age 85. Chinese males, followed by Japanese, showed the lowest mortality rates and Samoan males the highest. But, as in the gender-combined case, the picture abruptly changed at the ≥ 85 age category. While Samoans presented an exceptionally low rate of 7 per 1,000, all others were ≥ 12 . Actually, other than the low rate for Chinese, all other groups were in a narrow range between 14 and 16 per 1,000. Within a given age group, between the lowest (Chinese) and highest (Samoan) rates, there was nearly a fourfold difference prior to age 65, and in the age group 65–84, the difference between those two ethnicities was a little more than twofold.

In females, we observed some anomalies at the oldest age group. Samoan females had the highest mortality rates in adult ages, and then their rate became lower than Hawaiian and Caucasian females and similar to Japanese and Korean females. Filipino female rates were generally the highest among the Asian groups in those aged < 85 ; however, at age ≥ 85 , they presented the lowest rate among the groups. For Korean females, LTDR (0, 15) was exceptionally high—five times higher than for Chinese females and nearly two times higher than for Samoan females. For those aged 84 and younger, the ethnic gaps within a given age group were somewhat wider in females than in males.

As expected, male mortality was higher than female mortality for most age groups (and especially for Samoan males aged 0–14). But there were two important exceptions. In the youngest age group, the Korean

Table 2. Life table death rates per 1,000 population by ethnicity for broad age groups, Hawaii, 2000

Ethnicity	Combined				Male				Female			
	0–14	15–64	65–84	≥85	0–14	15–64	65–84	≥85	0–14	15–64	65–84	≥85
Caucasian	0.06	0.29	3.27	14.42	0.07	0.37	3.80	15.87	0.05	0.20	2.76	13.58
Chinese	0.02	0.14	2.01	10.31	0.03	0.18	2.53	11.91	0.02	0.10	1.58	9.29
Filipino	0.07	0.24	2.66	13.65	0.08	0.31	3.25	16.58	0.05	0.17	2.12	8.46
Hawaiian	0.06	0.50	4.45	14.47	0.07	0.61	5.34	14.13	0.05	0.39	3.78	14.63
Japanese	0.05	0.21	2.40	11.52	0.05	0.27	3.16	13.49	0.05	0.16	1.83	10.32
Korean	0.08	0.23	2.68	12.00	0.05	0.29	3.53	16.23	0.10	0.19	2.07	10.47
Samoaan	0.09	0.60	5.05	9.47	0.11	0.70	5.78	7.36	0.06	0.50	4.56	10.81

female rate was twice the male rate. Demographers in Korea have also found higher female infant mortality than male infant mortality.^{12,13} For those ≥85 years of age, Samoan female mortality was much higher than male mortality (almost 50%), while Hawaiian females had a slightly higher rate than males.

DISCUSSION

A scrutiny of ethnic life tables in Hawaii during the last half-century clearly showed that ethnic disparity in $e(0)$ was persistent and consistent. While overall $e(0)$ increased by a mean of 2.2 years per decade between 1950 and 2000, the gap between the longest and shortest $e(0)$ has remained, with East Asians (Chinese, Japanese, and Koreans) presenting the best $e(0)$, and Pacific Islanders (Hawaiians and Samoans) the poorest $e(0)$.^{2–5} Although it has been noted that disparities in $e(0)$ in the developed countries narrow as life expectancy increases over time,¹⁴ this does not seem to be the case in Hawaii ethnic groups.

Why do such mortality discrepancies exist in Hawaii? Biological factors are important, but likely account for little of the variation. As intermarriage is increasing, the ethnicity-assigning algorithm may become an increasingly invalid mechanism for representing the ethnicity of mixed-heritage offspring. Yet, disparities in mortality and life expectancy exist. In fact, the relative inter-ethnic mortality difference in young age (0–14), which likely had the biggest proportion of mixed-ethnic members, was as large as those of a later age (Table 2). If we excluded the ≥85 age group, the age-specific mortality curves by ethnicity paralleled each other, maintaining the ranking in $e(0)$. Hawaii-based research has found relatively little ethnic differences in neonatal infant mortality in comparison with the differentials in postneonatal mortality.¹⁵ We contend that neonatal infant mortality is more attributable to biological factors compared with postneonatal infant mortality.

Thus, in large part, the explanation of ethnic disparity in mortality in Hawaii likely rests in behavioral and social factors, and this supposition is supported by national and local data sources. Per the U.S. Census, which presents data for racial (rather than ethnic) categories in Hawaii, median household income in 1999 for Asians was \$54,232 compared with \$49,426 for Caucasians and \$41,779 for Native Hawaiians and Pacific Islanders (NHPI), while homeownership among Asians in Hawaii was 70% compared with 48% for Caucasians and 46% of NHPI. Only 39% of NHPI in Hawaii reported post-high school education vs. 53% of Asians and 71% of Caucasians.¹⁶ Hawaiians were also more likely than Caucasians and Asians to participate in government assistance programs.¹⁷

Behavioral health data suggest that Hawaiians are most likely to smoke (26% vs. 14%–17% of others), be overweight (60% vs. 41%–48% of others), and report themselves in fair or poor health (19% vs. 8%–15% of others).¹⁸ Only 2% of Japanese reported that they could not see a doctor due to cost, compared with 8% of Caucasians and 11% of Hawaiians.¹⁹ Studies on causes of death may shed additional light on the origin of ethnic disparities.

Historical relationships with the U.S. may also help explain some of the disparities. Native Hawaiians are the indigenous people of the islands who lost land, language, and culture following colonization by the West.²⁰ Residents of American Samoa, a U.S. territory, can freely migrate to the U.S., and do so for jobs, education, and medical care.²¹ For both Pacific Islander groups, substitution of their traditional high-fiber, low-fat diet with western foods has led to a dramatically increasing prevalence of obesity, diabetes, and heart disease.^{22,23}

Filipinos and Koreans both participated in migration for labor, coming to Hawaii in the early 1900s to work on sugar plantations.^{23,24} As both countries have been occupied by the U.S. military, some Filipinos and

Koreans came to Hawaii as spouses of U.S. soldiers, and in-migration from these countries continues under family reunification rules.²⁴ Although Chinese and Japanese also were brought to Hawaii for plantation work starting in the 1850s, a series of exclusionary agreements and laws restricted immigration from these countries between the turn of the 20th century and the 1950s.^{23,24} Thus, the vast majority of the state's Chinese and Japanese residents are Hawaii-born, and many hold important positions in government, business, and other professions. Caucasian immigration peaked in the 1920s and 1930s, with most coming as members of the military, and after statehood in 1959.²³

Although Hawaii's people may live together relatively harmoniously and adopt lifestyles of other ethnic groups with little resistance, many also adhere to traditional cultural values and practices. According to practitioners in Hawaii's community health centers, which serve many of the state's new immigrant group, it is not uncommon for older Filipinos and Samoans to return to their home countries when they are sick and near death, taking advantage of strong family support systems and low medical costs in their natal homes (Personal communication, Ritabelle Fernandes, Kokua Kalihi Valley Community Health Center, April 2008). This phenomenon may explain the unreasonably low death rates for these groups. Of course, the low rate for Samoan males at the oldest age group could be due to sampling variability. But their sudden departure from the mortality trend and pattern in this particular age group seems to indicate something more. Had the Samoan male LTDR (≥ 85) equaled that of Caucasian males, their $e(0)$ would be 69.9, rather than 71.1.

Although Korean working age and senescent mortality were at reasonable levels, their premature mortality LTDR (0, 15) was very high, especially among young females. The higher female infant mortality also has been noted in Korea proper¹² and in other societies with widespread son preference, but this figure may be declining.²⁵ Further research is needed to determine if son preference is prevalent among Koreans in Hawaii and to identify factors related to high mortality among Korean girls.

Limitations

The ethnic life table analysis in Hawaii faced several limitations. First, Hawaii is a small state with a population of about 1.2 million people. We adjusted U.S. Census counts to reflect the ethnic distribution found in our local health interview survey. Given our large number of ethnic groups of interest, some of the age-gender-ethnic groups were very small and subject to

considerable sampling error. The number of deaths observed in each age group may have had a large annual fluctuation; thus, we calculated the mean number of deaths from the 3.5 years around 2000. However, our age- and gender-specific mortality curve for each ethnicity revealed reasonable patterns of mortality, with some exceptions.

For both population and death data, we applied the established Hawaii state algorithm for classifying ethnicity. The arbitrary yet rigid classification schema has been used in Hawaii since before statehood (1959), when mixed-ethnic marriages were less common. A mixed-race offspring is labeled Hawaiian if either parent has Hawaiian blood, labeled the dominant non-Caucasian ethnic group if no parents are Hawaiian but one is Caucasian, or otherwise assigned paternal ethnicity. As such, two children assigned as Hawaiian can have very different ethnic compositions, while two children with essentially identical ethnic compositions could be assigned different ethnicities. Although there are fewer mixed-blood individuals in the older age groups and among the newer immigrants to Hawaii, marriage between people of different ethnicities has become very common in Hawaii. In fact, 57% of the children born in 2006 were of mixed ethnicity (Unpublished data: Hawaii Department of Health. 2006 resident live births by ethnicity of mother and father. Special tabulation, October 2007). This trend will further obfuscate and perhaps render meaningless the established ethnic classification system at some point in the future.

In examining $e(0)$ in Hawaii from 1950 to 2000, we noted some methodological changes in life table construction over time. Specifically, in 1980 we changed the way we estimated life expectancy of the terminal age. In comparing old and new methods, however, these methodological variations resulted in only minimal, if any, changes in $e(0)$. Finally, our inability to add social factors to our death record database restricted us from testing for predictors of $e(0)$ disparities.

CONCLUSION

Overall, our findings confirm the need to disaggregate Asian and Pacific Islander data and to conduct ethnic-specific research to help reduce ethnic disparities.²⁶ Given that the East Asian groups are generally living longer than Caucasians, research on these groups may provide useful information about increasing $e(0)$ in non-East Asian ethnic groups.

There is an urgent need to improve the health of Hawaiian and Pacific Islander groups, whose $e(0)$ lags far behind other ethnic groups in the state. Socio-economic and behavioral variables known to affect

mortality levels are closely associated with ethnicity in Hawaii. It is possible that programs to reduce socioeconomic disparities and improve healthy behaviors could reduce disparities in death rates.

REFERENCES

1. Island residents live longest. Honolulu Advertiser; 2007 Jul 12.
2. Park CB, Gardner RW, Nordyke EC. Life tables by ethnic groups for Hawaii. R & S Report. Honolulu: Hawaii Department of Health, Office of Health Status Monitoring; 1979.
3. Gardner RW. Ethnic differentials in mortality in Hawaii, 1920–1970. *Hawaii Med J* 1980;39:221-6.
4. Yang H, Braun K, Onaka A, Horiuchi B. Life expectancy in the state of Hawaii; 1980 and 1990. R & S Report. Honolulu: Hawaii Department of Health, Office of Health Status Monitoring; 1996.
5. Braun KL, Yang H, Onaka AT, Horiuchi BY. Life and death in Hawaii: ethnic variations in life expectancy and mortality: 1980 and 1990. *Hawaii Med J* 1996;55:278-83, 302.
6. Hawaii Department of Health. Hawaii health survey. Honolulu: Hawaii Department of Health; 2006.
7. Look MA, Braun KL. A mortality study of the Hawaiian people: 1910–1990. Honolulu: The Queen's Health System; 1995.
8. Chiang CL. The life table and its applications. Malabar (FL): R.E. Krieger Publishing Co.; 1984.
9. Arias E. United States life tables, 2000. *Natl Vital Stat Rep* 2002 Dec 19;51:1-39.
10. Gorman BK, Read JG. Why men die younger than women. *Geriatrics Aging* 2007;10:182-91.
11. Gleit DA, Horiuchi S. The narrowing sex differential in life expectancy in high-income populations: effects of differences in the age pattern of mortality. *Popul Stud (Camb)* 2007;61:141-59.
12. Choe MK. Sex differentials in infant and child mortality in Korea. *Soc Biol* 1987;34:12-25.
13. Bongaarts J. How long will we live? *Population Development Rev* 2006;32:605-28.
14. Park CB, Cho NH. Consequences of son preference in a low-fertility society: imbalance of the sex ratio at birth in Korea. *Population Development Rev* 1995;21:59-84.
15. Census Bureau (US). Census 2000 summary file 3—sample data. Washington: Census Bureau (US); 2007.
16. Hawaii Department of Human Services. Report on fiscal year 2006. Honolulu: Hawaii Department of Human Services; 2007. Also available from: URL: <http://hawaii.gov/dhs/main/reports> [cited 2008 May 12].
17. Hayashi A. Native Hawaiian data book. Honolulu: Office of Hawaiian Affairs; 2006.
18. Hawaii Department of Health. 2006 state of Hawaii Behavioral Risk Factor Surveillance System [cited 2008 May 12]. Available from: URL: <http://hawaii.gov/health/statistics/brfss/index.html>
19. The apology resolution. U.S. Public Law 103-150 [cited 2008 Feb 11]. Available from: URL: http://www.alohaquest.com/pdf/US_Public_Law_103-150.pdf
20. Aitaoto N, Braun KL, Dang KL, So'a T. Cultural considerations in developing church-based programs to reduce cancer health disparities among Samoans. *Ethn Health* 2007;12:381-400.
21. Keighley ED, McGarvey ST, Quested C, McCuddin C, Viali S, Maga U. Nutrition and health in modernizing Samoans: temporal trends and adaptive perspectives. In: Ohtsuka R, Ulijaszek SJ, editors. *Health change in the Asia-Pacific region*. New York: Cambridge University Press; 2007. p. 147-91.
22. McDermott JF, Tseng WS, Maretsky TW, editors. *People and cultures of Hawaii: a psychocultural profile*. Honolulu: University of Hawaii Press; 1980.
23. Min PG. *Asian Americans: contemporary trends and issues*. Thousand Oaks (CA): Sage Publications; 1994.
24. Chung W, Das Gupta M. The decline of son preference in South Korea: the role of development and public policy. *Population Development Rev* 2007;33:757-83.
25. Tanjasiri SP, Wallace SP, Shibata K. Picture imperfect: hidden problems among Asian Pacific islander elderly. *Gerontologist* 1995;25:753-60.
26. Ghosh C. Healthy People 2010 and Asian Americans/Pacific Islanders: defining a baseline of information. *Am J Public Health* 2003;93:2093-8.