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ARTICLES

Continental Expansion and the Asia-Pacific:
The Imperial Outposts of Nineteenth Century U.S. Culture
........................................................................................................ Anirudra Thapa

Special Issue On Health

Postwar American Influences on Public Health, Medicine, and
Health Trends in Okinawa
........................................................................................................ Seizo Sakihara

The effects of the establishment of public health centers on
people's health in Okinawa after the Second World War
........................................................................................................ Seisho Higa

Contribution and Influence of U.S. Administration on
the Training of Physicians in Okinawa
........................................................................................................ Masao Maeshiro

The Historical Context of Okinawan Longevity: Influence of
the United States and Mainland Japan
.................................................................................. Makoto Suzuki, Craig Willcox and Bradley Willcox

Caloric Restriction, Energy Balance and Healthy Aging in
Okinawans and Americans: Biomarker Differences in Septuagenarians
................................................................................... Bradley J. Willcox, D. Craig Willcox, Hidemi Todoriki,
Katsuhiko Yano, J. David Curb, Makoto Suzuki

The American Studies Center of the University of the Ryukyus
The Historical Context of Okinawan Longevity: Influence of the United States and Mainland Japan

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Okinawa, the southwestern-most prefecture (state) of Japan, is known for the longevity of its inhabitants (Willcox BJ et al., 2001; Suzuki, 1985; Suzuki 2001). The historical context of this phenomenon and the role of various political factors, such as the American occupation and the influence of mainland Japan are not well known. Therefore, in this paper, we explore the history of Okinawan longevity and hypothesize as to the influence of various political, demographic, epidemiological and other factors on Okinawan longevity, particularly the U.S. presence.

Various demographic tools are used to measure longevity in populations but life expectancy and prevalence rates of long-lived persons are among the more common. Life expectancy at birth is not an ideal measure of longevity since it is most impacted by what happens to younger members of a population since they have the most to contribute in terms of years to population life tables. However, often data are not available, particularly historic data, on life expectancy at older ages, which might better reflect longevity. Prevalence rates of long-lived persons, such as centenarians, may also be influenced by diverse factors, many of which have little to do with longevity (e.g. immigration, emigration, birth cohort size, etc.). Since centenarians have historically appeared only rarely, and in small numbers, the small sample size can strongly affect prevalence rates. Therefore one must be cautious when selecting smaller regions with few centenarians for statistical analysis and not rely too heavily on such data. For this paper, we use regions composed of at least one hundred thousand persons to estimate centenarian prevalence rates.

Despite these limitations, it is naturally expected that there may be some relation between both measures. That is, centenarian prevalence rate should be high in regions with high life expectancy if true population longevity exists, assuming moderate to low infant mortality rates. Therefore, with these caveats in mind, we report life expectancy at birth and the octogenarian and centenarian prevalence rate for Okinawa and various other regions and at various times, including the period of the old Ryukyu (Okinawan) Kingdom, which lasted until 1879, the periods of Japanese jurisdiction (1879-1945; 1972-present) and the period of U.S. jurisdiction (1945-72).

The methodological approach that this paper takes, is mainly an epidemiological and demographic
comparison of life expectancy data and prevalence rates of long-lived persons (octogenarians and centenarians) in Okinawa and other locations. Therefore, we collected population data released by the offices of the Japan national and prefectural governments, report raw data, calculated prevalence rates of octogenarians and centenarians for various time periods, and report trends in such rates over time. We also considered other national datasets and other studies that have reported population data concerning Okinawan longevity, after reviewing how such data were analyzed and which academic congress or other media were used for the reports. Careful consideration of the validity and the accuracy of the data was a priority before including them in this paper.

Subsequently, we compared life expectancy at birth previously reported in Japanese national governmental and Okinawan local governmental data for various years. The *koseki* (family registration) system provided much of the Okinawan and Japanese data. Historically, the *koseki* began in 1872 (known as the year *Meiji 5*) in Japan. The *koseki* reports year of birth as well as other important demographic data for every person in Japan. However, life expectancy data were not calculated or reported at that time. For such data, in the mainland of Japan, the census was begun in 1891 (*Meiji 24*) and life expectancy results were officially released in 1898 (*Meiji 31*) (Nanjo et al., 2004). This report was the first official report for mainland Japan; however, there were no official releases of Okinawan data before 1955 (Showa 35). According to a report by Nagata, the average life expectancy at birth of Okinawans in 1955 was calculated from a demographic survey conducted by the Civilian Government Administration Office (Nagata, 1963).

In order to assess Okinawan longevity in the context of Japan, itself a long-lived country, we can compare the average life expectancy of Okinawans, both male and female in 1955 (Showa 30), to that of mainland Japan (see Table 1). Such a comparison shows that Okinawan life expectancy is clearly higher than that of mainland Japan. No data are available on life expectancy at older ages during this time period. On a global comparative scale, for the mid-1950s, the average life expectancies at birth in Okinawa, when compared to long-lived countries, ranked second in the world, with only Norway exceeding that of Okinawa (see Table 1) (Nanjo et al., 2004; WHO 1955; Okinawa Prefectural Government, 1976).

**Table 1. Average Life Expectancy at Birth for Okinawa and Long-Lived Countries**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Year</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Norway</td>
<td>1946-50</td>
<td>69.3</td>
<td>72.7</td>
</tr>
<tr>
<td>2</td>
<td>Okinawa</td>
<td>1955-57</td>
<td>66.4</td>
<td>72.5</td>
</tr>
<tr>
<td>3</td>
<td>New Zealand</td>
<td>1950-52</td>
<td>68.3</td>
<td>72.4</td>
</tr>
<tr>
<td>4</td>
<td>England/Whales</td>
<td>1952</td>
<td>67.1</td>
<td>72.4</td>
</tr>
<tr>
<td>5</td>
<td>Sweden</td>
<td>1946-50</td>
<td>69</td>
<td>71.6</td>
</tr>
<tr>
<td>6</td>
<td>Holland</td>
<td>1947-49</td>
<td>69.4</td>
<td>71.5</td>
</tr>
<tr>
<td>7</td>
<td>U.S.A.</td>
<td>1949-51</td>
<td>65.5</td>
<td>71</td>
</tr>
<tr>
<td>8</td>
<td>Canada</td>
<td>1950-52</td>
<td>66.3</td>
<td>70.8</td>
</tr>
<tr>
<td>13</td>
<td>France</td>
<td>1950-51</td>
<td>63.6</td>
<td>69.3</td>
</tr>
<tr>
<td>15</td>
<td>Japan</td>
<td>1955</td>
<td>64</td>
<td>68</td>
</tr>
</tbody>
</table>
Since 1972, the year of Okinawa’s reversion to Japanese jurisdiction from U.S. jurisdiction, average life expectancy at birth has been calculated from life tables compiled by the Japan Ministry of Health, Labour and Welfare (Nanjo et al., 2004) and the Department of Health and Welfare of the Okinawan Prefectural Government (see Figure 1).

**Figure 1. Average Life Expectancy at Birth in Japan and Okinawa by Year 1898-2000**

From 1955 (Showa 30) until 1995, the average life expectancy at birth in Okinawa, both for males and females has been higher than that of the mainland of Japan (Figure 1). This is despite rapidly increasing life expectancy in both the mainland and Okinawa year on year. Interestingly, the rate of increase in life expectancy has been steeper in mainland Japan. Consequently, the difference of life expectancy at birth between the mainland and Okinawa has gradually narrowed.

Indeed, the average life expectancy at birth of Okinawan males slipped from first place to fifth place among Japan’s 47 prefectures in 1990 (fourth place in 1995), although the number one position has been maintained at ages 65-plus. In 2000, Okinawa’s prefectural ranking sharply dropped to 26th for male life expectancy at birth (Japan Ministry of Health, Labour and Welfare, 2000). Figure 1 shows the historical transition of average life expectancy at birth in the Japanese mainland and Okinawa. It is clear that Okinawan males have followed a different life expectancy trajectory than females. As for Okinawan females, they have retained first place rank in life expectancy at birth and at all other ages until the latest available rankings (year 2000). However, the average life expectancy of female mainlanders is getting closer to that of Okinawan females, such that there is a possibility of losing the top rank of life expectancy in near future.

As to why Okinawa achieved such impressive life expectancy in the first place there are a number of factors to consider. Political context is one factor. Historically, longevity appears to be a longstanding phenomenon in both the old Okinawa (Ryukyu)
Kingdom and after its annexation by Japan in 1879 (Nagata, 1963; Willcox BJ et al., 2001). However, immediately post-World War Two (WW2), Okinawa was under U.S. occupation (until 1972) and there is much speculation as to the effect that this may have had on Okinawan longevity.

The most obvious immediate effect was beneficial in that diligent public health efforts were undertaken post-WW2 to control infectious disease, particularly with respect to tuberculosis, malaria and parasitic infections, childhood nutrition and maternal health were also major areas of focus (Omine et al., 1995; Sakihara and Abe 1996). Infant mortality was markedly reduced and life expectancy increased rapidly during a short period of time. However, as far as longevity of the elderly is concerned, what we might call "exceptional longevity", the effects are harder to discern. For example, it is impossible to draw a firm conclusion regarding how the U.S. occupation affected exceptional longevity in Okinawa since few statistical data exist on life expectancy in the elderly, such as life expectancy at age 65 or life expectancy at age 85 years, until recently.

Interestingly, despite much adversity, Okinawan life expectancy at birth exceeded that of the Japanese mainlanders, and even Americans, in 1955. Consequently, it is tempting to assume that Okinawans possess genetic factors that enhanced their longevity since they prospered despite a harsh environment until the 1960s (Takata et al., 1987; Wilcox DC et al., 2006). Other hypotheses exist for this longevity including a diet high in nutritional quality but calorically sparse (Wilcox DC et al., 2006; Wilcox BJ et al., 2007). Since the 1950s however, many Okinawans have become overweight and obese, partly linked to a "westernized" lifestyle (Todoriki et al., 2004; Willcox BJ et al., 2007) habituated during the U.S. occupation and coincident with a Japanization, habituated during the subsequent Japanese governance.

Post-WW2 birth cohorts of Okinawans, now in their middle years, were the first generation acculturated in eating a non-traditional diet from childhood during the U.S. occupation years (Willcox BJ et al., 2007). Full-fat milk, white bread, red meat and other foods high in calories appeared in the school lunch program, and in the general population, and had substantial impact upon eating habits. Influence from Japan also occurred with the main result being loss of the low calorie sweet potato as the main carbohydrate and adoption of higher calorie white rice. The result has been a diet higher in calories, mainly due to more calorie-dense food, combined with less physical activity, as society transitioned from farming and fishing to white collar work. The resultant positive energy balance has resulted in a higher prevalence of overweight and obesity, which in turn, has increased the prevalence of "lifestyle-related" diseases influenced by obesity, such as ischemic heart disease, stroke, malignant neoplasms, and Type 2 diabetes mellitus (Todoriki et al., 2004; Wilcox BJ et al., 2007). In this way, there is an association with the American occupation and the subsequent reversion to Japan and dietary acculturation—which may have adversely affected Okinawan longevity by increasing mid-life mortality versus other Japanese. Social problems from high unemployment, loss of traditional culture and identity also challenge the youth of Okinawa where suicide rates and accidents are among the highest in Japan (Naka et al., 1999).

In terms of other, perhaps more robust indicators of longevity within a population, we can measure
In his interesting account of Okinawan longevity, Nagata also cited data from an old document entitled the "Agarie Essay," written by Kishaba Okina (Nagata, 1963). Contained within this text was a list of the elderly people in Ryukyu dynasty period. Fifty of them were listed as older than 90 years old and were given the medals of honor called "Ikai hou shou" by the King of Ryukyu Kingdom. This occurred during a 138 year period, spanning the reigns of King Shou Kei, year 25 (1738) to King Shou Tai, year 29 (1876). Twenty-one of the awardees were listed as over the age of 100 years, including one female, aged 105 years, one female aged 103 years, two males aged 101 years, and seventeen in total aged 100 years (10 males, 7 females). If this record is assumed to be a correct account of centenarianism in Okinawa over that time period (which may or may not be true), approximately one centenarian appeared every 12 to 13 years in Okinawa, a relatively high prevalence given Okinawa’s small population.

If we are to make early centenarian prevalence comparisons with mainland Japan, some interesting insights emerge. These comparisons are somewhat tenuous, given the nature of age validation at in the early years of the 20th century, and the young age of the koseki (it had been in existence less than one hundred years and was therefore less reliable) but these data are of historical interest nonetheless.

In the early 1900s the first such comparison can be made. We can refer to the survey conducted by Tokyo Mann Chou Hou-sha in 1908 (Meiji 41), where it was reported that 388 centenarians existed in the mainland of Japan (Nagata, 1963). However, in 1928 (Showa 3), the year of Gotaiten, the succession of the throne of emperor, a population survey was done for the celebration of long-lived persons in Japan (not including Okinawa). The
number of centenarians was recorded as 287 at that
time (Nagata, 1963). This number was smaller
than that reported in 1908. For convenience, we
can refer to Tokyo for calculation of centenarian
prevalence. At that time, only two centenarians
were recorded in Tokyo. If we calculate
prevalence, we know that the total population of
Tokyo was two million at that time, therefore only
one centenarian appeared per million persons in
Tokyo. At that time in Okinawa, there was one
centenarian in existence in a population of a few
hundred thousand yielding much higher
centenarian prevalence in Okinawa. These
comparisons are obviously prone to a high level of
error but are in line with historical reports of
longevity in Okinawa.

In the 1950s, another survey, this performed in
1958 (Showa 33), counted three centenarians (one
male, two females) in Okinawa. Interestingly, four
people (one male and three females) aged 99 years
old were reported as alive by koseki officials of the
Okinawan Civilian Government under US
sovereignty (Table 2) (Nagata, 1963).

Table 2. Octogenarians and Centenarians in Okinawa and Japan 1870-1975

<table>
<thead>
<tr>
<th>Octogenarian</th>
<th>Centenarians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Okinawa</td>
<td>Japan</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>1872 (M5)</td>
<td>2,005</td>
</tr>
<tr>
<td>1928 (S3)</td>
<td>3,471</td>
</tr>
<tr>
<td>1958 (S33)</td>
<td>5,638</td>
</tr>
<tr>
<td>1963 (S38)</td>
<td>741,000</td>
</tr>
<tr>
<td>1966 (S41)</td>
<td>796,000</td>
</tr>
<tr>
<td>1975 (S50)</td>
<td>14,869</td>
</tr>
</tbody>
</table>

*1 1738-1876 Ikai-houshou (the award given to centenarians from the king)
*2 1908 (M41) Tokyo-manchouho-sha
*3 1928 (S3) Gotaiten
*4 1958 (S33) Okinawa Social Welfare Council
*5 1963 (S38) Japan Health and Welfare Bureau for the Elderly
*6 1975 (S50) Okinawa Prefectural Government

More recent data became available in the 1960s
when Japan began to collate its centenarian data.
The current system of compiling centenarian data
began in 1963 (Showa 38). Since that time, the
number of centenarians has been released every
year based on the data issued by the Ministry of
revealed a total of 153 centenarians in Japan (20
males, 133 females) (Japan Health and Welfare
Bureau for the Elderly, 2000). No particular
demographic report regarding centenarians was
available in Okinawa at that time for comparative
purposes. However, in 1966 the health ministry of
the local civilian government in Okinawa
(koseikyoku) first began to record the numbers of
centenarians (in line with mainland Japan) and
reported 10 centenarians that year, five were
reported to be aged 101 years and another five were
aged 100 years, all were women (Ryukyu Shinpo, 1966).

The 1970s brought better comparative data as the koseki system began to mature and the year 1970 revealed a total of nine centenarians, (two males, seven females) alive in Okinawa; a total of 310 centenarians (62 males, 248 females) were recorded in the mainland at that time (Japan Ministry of Health and Welfare, 1970). Therefore, the centenarian prevalence rate was 14.43 centenarians per hundred thousand persons in Okinawa and 3.80 centenarians per hundred thousand persons in the mainland of Japan. As such, the centenarian prevalence was much higher in Okinawa than mainland in 1970, consistent with previous historical reports of longevity in Okinawa.

Also in the 1970s we began the first medical and sociological surveys on Okinawan centenarians (Sanabe et al., 1977). In 1976 (Showa 51) we began visiting centenarian residences for personal interviews, physical checkups and clinical examinations. At that time, we identified 28 centenarians in Okinawa. Okinawa Prefectural government lists reported that there were 27 centenarians. However, one of the centenarians was not recorded on the family registry (koseki) list and was accidentally discovered in the course of our survey. The centenarian prevalence rate was therefore 2.68 per one hundred thousand in Okinawa (using a total twenty-eight centenarians). Conversely, there were 666 centenarians in the mainland of Japan at that time, corresponding to a centenarian prevalence rate of 0.59 per one hundred thousand persons. Therefore, the centenarian prevalence was significantly higher in Okinawa in 1976 by our calculations, consistent with high life expectancy in Okinawa and other previously reported data.

In order to assess the potential effect of the U.S. occupation on Okinawan longevity using centenarian prevalence we need accurate prevalence data for those years (1945-1972). However, there were likely few centenarians during the U.S. occupation period since the numbers did not grow significantly until after the 1970s. Therefore, it is not possible to assess how the U.S. occupation affected Okinawan longevity using centenarian data. However, public health interventions that reduced infectious disease, common cause of centenarian mortality in Okinawa, suggest that the effect was likely positive. Better medical care may have also helped since it would help ensure the survival of middle aged and young elderly persons in the 1950s and 1960s who later became centenarians in the subsequent decades. The absolute numbers of centenarians in the mainland of Japan and Okinawa from 1970 until 2004 are shown in Table 3. The increase in numbers is impressive over the 1980s until present (see also Fig 2). It is obvious that the higher prevalence rate for Okinawa has been maintained both for males and females relative to other prefectures. According to the most recent annual centenarian report (year 2007), the centenarian prevalence rate in Okinawa ranked the highest among prefectures in Japan at 57.89 per 100,000 population. However, Okinawa may yet lose its dominance since other prefecture’s prevalence rates have come closer to Okinawa in recent years (Kochi prefecture reported 52.98/100,000 in 2007).
Table 3. Number of Centenarians in Okinawa and Japan by Year 1970-2007

<table>
<thead>
<tr>
<th>Year</th>
<th>Okinawa</th>
<th></th>
<th>Japan</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>1970 (S45)</td>
<td>2</td>
<td>7</td>
<td>9</td>
<td>62</td>
<td>248</td>
</tr>
<tr>
<td>1971 (S46)</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>70</td>
<td>269</td>
</tr>
<tr>
<td>1972 (S47)</td>
<td>5</td>
<td>9</td>
<td>14</td>
<td>78</td>
<td>327</td>
</tr>
<tr>
<td>1973 (S48)</td>
<td>7</td>
<td>22</td>
<td>29</td>
<td>91</td>
<td>404</td>
</tr>
<tr>
<td>1974 (S49)</td>
<td>8</td>
<td>18</td>
<td>26</td>
<td>96</td>
<td>431</td>
</tr>
<tr>
<td>1975 (S50)</td>
<td>6</td>
<td>22</td>
<td>28</td>
<td>102</td>
<td>446</td>
</tr>
<tr>
<td>1976 (S51)</td>
<td>5</td>
<td>22</td>
<td>27</td>
<td>113</td>
<td>553</td>
</tr>
<tr>
<td>1977 (S52)</td>
<td>2</td>
<td>29</td>
<td>31</td>
<td>122</td>
<td>575</td>
</tr>
<tr>
<td>1978 (S53)</td>
<td>5</td>
<td>19</td>
<td>24</td>
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<td>1979 (S54)</td>
<td>8</td>
<td>23</td>
<td>31</td>
<td>180</td>
<td>757</td>
</tr>
<tr>
<td>1980 (S55)</td>
<td>6</td>
<td>30</td>
<td>36</td>
<td>174</td>
<td>794</td>
</tr>
<tr>
<td>1981 (S56)</td>
<td>8</td>
<td>32</td>
<td>40</td>
<td>202</td>
<td>870</td>
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<td>1982 (S57)</td>
<td>10</td>
<td>34</td>
<td>44</td>
<td>233</td>
<td>967</td>
</tr>
<tr>
<td>1983 (S58)</td>
<td>12</td>
<td>46</td>
<td>58</td>
<td>269</td>
<td>1,085</td>
</tr>
<tr>
<td>1984 (S59)</td>
<td>11</td>
<td>57</td>
<td>68</td>
<td>347</td>
<td>1,216</td>
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<tr>
<td>1985 (S60)</td>
<td>11</td>
<td>65</td>
<td>76</td>
<td>359</td>
<td>1,381</td>
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<tr>
<td>1986 (S61)</td>
<td>22</td>
<td>68</td>
<td>90</td>
<td>361</td>
<td>1,490</td>
</tr>
<tr>
<td>1987 (S62)</td>
<td>19</td>
<td>78</td>
<td>97</td>
<td>462</td>
<td>1,809</td>
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<tr>
<td>1988 (S63)</td>
<td>18</td>
<td>100</td>
<td>118</td>
<td>562</td>
<td>2,106</td>
</tr>
<tr>
<td>1989 (H1)</td>
<td>21</td>
<td>126</td>
<td>147</td>
<td>630</td>
<td>2,448</td>
</tr>
<tr>
<td>1990 (H2)</td>
<td>19</td>
<td>139</td>
<td>158</td>
<td>680</td>
<td>2,618</td>
</tr>
<tr>
<td>1991 (H3)</td>
<td>25</td>
<td>147</td>
<td>172</td>
<td>479</td>
<td>2,876</td>
</tr>
<tr>
<td>1992 (H4)</td>
<td>30</td>
<td>163</td>
<td>193</td>
<td>822</td>
<td>3,330</td>
</tr>
<tr>
<td>1993 (H5)</td>
<td>34</td>
<td>172</td>
<td>206</td>
<td>943</td>
<td>3,859</td>
</tr>
<tr>
<td>1994 (H6)</td>
<td>40</td>
<td>191</td>
<td>231</td>
<td>1,093</td>
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<tr>
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<td>47</td>
<td>216</td>
<td>263</td>
<td>1,255</td>
<td>5,123</td>
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<tr>
<td>1996 (H8)</td>
<td>50</td>
<td>232</td>
<td>282</td>
<td>1,400</td>
<td>5,973</td>
</tr>
<tr>
<td>1997 (H9)</td>
<td>54</td>
<td>261</td>
<td>315</td>
<td>1,570</td>
<td>6,921</td>
</tr>
<tr>
<td>1998 (H10)</td>
<td>66</td>
<td>297</td>
<td>363</td>
<td>1,812</td>
<td>8,346</td>
</tr>
<tr>
<td>1999 (H11)</td>
<td>61</td>
<td>304</td>
<td>365</td>
<td>1,973</td>
<td>9,373</td>
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<td>2000 (H12)</td>
<td>57</td>
<td>344</td>
<td>401</td>
<td>2,158</td>
<td>10,878</td>
</tr>
<tr>
<td>2001 (H13)</td>
<td>55</td>
<td>402</td>
<td>457</td>
<td>2,541</td>
<td>12,934</td>
</tr>
<tr>
<td>2002 (H14)</td>
<td>58</td>
<td>467</td>
<td>525</td>
<td>2,875</td>
<td>15,059</td>
</tr>
<tr>
<td>2003 (H15)</td>
<td>64</td>
<td>505</td>
<td>569</td>
<td>3,159</td>
<td>17,402</td>
</tr>
<tr>
<td>2004 (H16)</td>
<td>77</td>
<td>558</td>
<td>635</td>
<td>3,523</td>
<td>19,515</td>
</tr>
<tr>
<td>2005 (H17)</td>
<td>84</td>
<td>615</td>
<td>699</td>
<td>3,779</td>
<td>21,775</td>
</tr>
<tr>
<td>2006 (H18)</td>
<td>74</td>
<td>666</td>
<td>740</td>
<td>4,150</td>
<td>24,245</td>
</tr>
<tr>
<td>2007 (H19)</td>
<td>75</td>
<td>717</td>
<td>792</td>
<td>4,613</td>
<td>27,682</td>
</tr>
</tbody>
</table>
Since there is a paucity of historical data on centenarians before the 1970s another method for assessing population longevity in a historical context is assessment of octogenarian prevalence. Such being the case, octogenarian data are available in Okinawa and mainland Japan for the 1870s. These data show that for Okinawa, there were 2,005 octogenarians (552 males, 1,453 females) in 1872 (King Shou Tai year 25) (Nagata, 1963). The corresponding population for mainland Japan in the year 1872 (Meiji 5) is not known but a
demographic survey was performed in 1879 (Meiji 12) at the time of the Hai-han-chi-ken Meiji Restoration. According to this survey, the Okinawan population at that time was 310,545 persons (154,394 males, 156,151 females) (Nagata, 1963). Since there was unlikely to be a large difference for the population between 1872 and 1879, we can use these data for the calculation of octogenarian prevalence rate. These calculations show that there were 354.5 male and 930.5 female octogenarians per one hundred thousand persons.

A half century later, in 1928, (Showa 3), the year of Gotaiten, it is reported that there were 854 males and 2617 female octogenarians in Okinawa (Nagata, 1963). At that time, the Okinawan population was 560,941, composed of 269,290 males and 291,651 females. This results in an octogenarian prevalence rate of 317.1 males and 897.3 females per one hundred thousand persons at that time. Interestingly, this shows that the octogenarian prevalence rate had decreased during 50 years from 1879 to 1928 both for males and females. The reason for this decrease is unclear, although data quality may have improved by the 1920s resulting in a more accurate number of octogenarians or the harsh experience of several famines may have particularly affected elderly survival rates and resulted in this apparent reduction of octogenarians (Kerr, 2000).

In the 1950s, governmental surveys were again conducted. A survey conducted in 1958 (Showa 33) by the Okinawa Social Welfare Council, revealed that there were 1,490 male and 4,418 female octogenarians in Okinawa (Nagata, 1963). The national census in 1960 (Showa 35), revealed that the Okinawan population was 1,042,572 (510,754 males, 531,818 females). Thus, the prevalence rate can be calculated as 877.72 for males and 1952.92 for females, respectively. These data support an increase in octogenarian prevalence rates (see Table 2, Figures 4 and 5).
In summary, historical life expectancy data and centenarian prevalence data lend support to a longevity phenomenon in Okinawa that has lasted for more than a century and perhaps several centuries. However, in the past two decades this longevity phenomenon has begun to change. In 1990, the life expectancy of Okinawan males slipped from the top rank to its current 26th rank among Japan’s 47 prefectures. Average life expectancy at birth for males is now slightly lower than the current average of mainland Japan although Okinawa remains number one for males in life expectancy at age 65 years and females at all ages (Willcox BJ et al., 2006). Higher mortality rates among youth (mainly accidents, suicides) and among middle-aged males (cardiovascular disease, cancer) appear as strong antecedents (Willcox DC, 2007). Future increase in mortality from obesity-related illnesses (mainly cardiovascular diseases, cancer, diabetes) in Okinawan males and similar but delayed tendencies in females suggest that the impact on overall Okinawan longevity may be worse in years to come (Todoriki et al., 2004). Figure 6 illustrates a mortality comparison based on sex, and age between Okinawa and mainland Japan. According to this figure, a cross-over phenomenon is observed between mortality rates in Okinawans and mainlanders at the age of sixty years where younger Okinawans have higher mortality and older Okinawans have lower mortality than mainland Japanese.
Political forces that have influenced public health practices and have influenced cultural practices (including dietary habits) appear to be associated both positively and negatively with Okinawan longevity. Some of the more important factors appear below:

Living standards were devastated and the public health infrastructure was destroyed in Okinawa during WW2. After the war the living standard in Okinawa improved with the help of the U.S., including better food supply, increased public health services, the maintenance of infrastructure, and rapid increases in life expectancy of Okinawans resulted. The single most important factor was the rapid eradication of infectious diseases (e.g. tuberculosis, parasitic diseases) (Willcox BJ et al., 2006). The greatest effect was on younger persons allowing rapid increases in life expectancy at birth.

Regarding longevity, particularly the "oldest-old" population (defined here as ages 80-plus) comparison data on octogenarian and centenarian prevalence rates suggest that there were few differences in prevalence rates of long-lived persons between 1928 and 1963, which suggests that the U.S. occupation did not markedly affect exceptional longevity in Okinawa. However, more recent tends showing a rapid increase in centenarian prevalence indicates survival of large numbers persons who were middle-aged at the beginning of the U.S. occupation in 1945 and are now centenarians. This suggests that some recent positive effects for these cohorts can be seen since more of them are surviving to centenarian years rather than succumbing to mid-life or early late-life diseases, particularly infectious diseases such as tuberculosis. Nevertheless, since "longevity" appeared to exist before the U.S. presence and still
exists today, one might argue that the impact of the U.S. occupation has been minimal thus far.

However, data suggests that the negative effects of the US presence have yet to fully manifest. Future outcome may not be so rosy. Middle-aged and younger Okinawans (particularly those aged 60 or less years) have "high risk" health profiles. Overweight and obesity trends are rising, as is the prevalence of Type 2 diabetes mellitus, a disease linked to increased body fat levels. In two generations the Okinawans have gone from among the leanest to the heaviest of the Japanese (Todoriki et al., 2004). Consequently, the numbers of people who suffer from lifestyle related diseases has increased, especially in the middle-aged. Measures of obesity, such as BMI, indicate that middle-aged and young adults have the highest overweight and obesity in Japan. This trend, when combined with social problems among the youth (leading to higher mortality in younger years vs. mainland Japanese), identifies potential future problems with both life expectancy and prevalence of long-lived persons, since smaller numbers of middle-aged persons will survive until very old ages. This obesity epidemic is partly the result of economic "modernization", which markedly decreases physical activity (low energy-demand white collar jobs are the norm rather than high energy-demand farming) but also due to Westernization and Japanization of dietary habits (Todoriki et al., 2004).

At present, further extensions in longevity appear to be in peril—traditional year on year gains in life expectancy at birth are slowing markedly, particularly in comparison with other prefectures and at some point this will affect measures of exceptional longevity such as centenarian prevalence rates. Currently, two different populations appear to exist in Okinawa—healthy and long-lived elderly (ages 60-plus) and less healthy, potentially short-lived young and middle-aged populations.

In conclusion, modern Okinawa has depended on substantial support from the national budget of Japan, much of which is derived from payments to offset the presence of large U.S. military bases. Regarding "self-generated" prefectural income, Okinawa has little in the way of primary or secondary industry, so must rely upon tertiary industry, mostly related to tourism. This monetary source has seen setbacks since the September 11th terrorist attacks, in 2001, which resulted in fewer visitors from mainland Japan. After several years of very low numbers, the number of tourists coming to Okinawa has gradually increased.

However, each tourist spends less money than before. As a result, the income for tourism has dropped down to the level of 1972 (Showa 47). Therefore, economic health has suffered and this has well known consequences for public health, particularly among the youth. Lack of opportunities for young Okinawans may contribute to social ills which impact Okinawan longevity at present and in the future.

Solutions to the threats to Okinawan longevity appear to be difficult to achieve but potential solutions might be drawn from the increasing emphasis and value placed on health and wellness in many countries. This emphasis extends to growing desire for health food products, other products for healthy lifestyles and wellness tourism. The tourism industry has become increasingly competitive but a niche market exists for aging baby boomers as they search for meaningful tourist experiences. This presents opportunities for Okinawa since its culture of wellness is attractive to tourists. This can also engender increased pride
for Okinawans in their health and longevity and create business opportunities for Okinawa’s youth.

For this purpose, the texts “The Science of Centenarians” (Suzuki, 1985), “Japanese Centenarians” (Tauchi et al., 1999), and “The Okinawa Program” (Willcox BJ et al., 2001) are useful and practical in that they present data on longevity and methods on how to enhance one’s own odds for health and longevity based, in part, on lessons learned from the Okinawan elderly. Development of a new industry cluster—which includes industry, government, and academic research on healthy longevity—may help the goal of enhancing Okinawan longevity. As the youth place higher value on health and wellness and strive to create a health-related industry, this might simultaneously enhance the Okinawan economy.

Many challenges lie ahead including: (1) Elucidation of the factors associated with healthy longevity; (2) Elucidation of the phenotype and genotype for healthy longevity based on clinical, physiological and genetic data; (3) Social-psychological analysis of adaptive mechanisms, coping mechanisms, self-empowerment, and better support networks for active longevity and its enhancement. In this way we may learn how to avoid risk factors and enhance “health promoting” factors. Finally, it is hoped that Okinawa will become a “Mecca” in the world for longevity science and its practical application—from “bench to bedside.” This should be a strategic direction for Okinawa and its new centers of learning, particularly the World class Okinawa Institute of Science and Technology (OIST).
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