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## The Effects of Post-War Dietary Change on Longevity and Health in Okinawa

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### Abstract

Life expectancy for men in Okinawa has fallen sharply relative to other prefectures of Japan and although at present women still retain their lead in Okinawa, if present trends continue, they too will fall. The nutrition transition in Okinawa with regards to increased fat intake and increased bodyweight (i.e. schoolchildren population), may be related to socio-political, socio-economic and socio-cultural changes that were set in motion either directly or indirectly during U.S. administration beginning in 1945.

**Keywords:** Okinawa, Nutrition transition, Life Expectancy, Longevity, Obesity

### Current Longevity in Okinawa

Okinawa has among the world's longest-lived population<sup>1)</sup>. Recently, this has begun to change. The life expectancy of men in Okinawa Prefecture fell to 26<sup>th</sup> from 4<sup>th</sup> among the 47 prefectures of Japan, according to the most recent Ministry of Health, Labor and Welfare statistics (2000)<sup>2)</sup>. Although life expectancy gains in Okinawa, particularly for men, had been slowing relative to other prefectures for around 17 years, the fall was none the less precipitous. Evidence of longevity in Okinawa has generally come from two indices, that of average life expectancy, and that of the centenarian ratio (number of centenarians per one hundred thousand population)<sup>3)</sup>.

As for growth in life expectancy, rates for both men and women in Okinawa have been slowing relative to other prefectures since 1985, and the growth between 1995 and 2000 was only 0.42 years for men (the lowest rate among the 47 prefectures of Japan) and 0.93 years

for women (46<sup>th</sup> among the 47 prefectures of Japan). (Table 1 and Figure 1). All-cause mortality for younger, post-war generations is higher than the national average while all-cause mortality for older people in Okinawa is lower, with the cross-over taking place at about 55 years of age (Figure 2). Although women in Okinawa currently remain the longest-lived in Japan, at current slow growth rates in life expectancy it is predicted that they too will relinquish their number one position in the not too distant future. As far as the other often used index of longevity, that is, the ratio of centenarians, for Okinawa the ratio for the year 2002 stood at 39.50 (per 100,000) vs. 35.06 for Kochi prefecture, and 14.09 for Japan as a whole thus it appears that although Okinawa still retains the lead in this area, other prefectures have been catching up here as well. The relative drop for younger generations seems to be due to multiple causes with increased risk

Table1. The Growth Rate of Life Expectancy in Japan, Okinawa, and selected Prefectures.

Male			Female		
Ranking	City	Growth rate (1995-2000)	Ranking	City	Growth rate (1995-2000)
1	Hyogo	2.03	1	Hyogo	2.51
2	Tottori	1.31	2	Nara	1.84
3	Nara	1.22	3	Fukui	1.76
4	Chiba	1.16	4	Shiga	1.72
23	Aomori	0.96	20	Nagano	1.42
35	Nagano	0.83	43	Aomori	1.18
44	Yamaguchi	0.67	44	Oita	1.09
45	Kochi	0.67	45	Yamaguchi	1.04
46	Shimane	0.64	46	Okinawa	0.93
47	Okinawa	0.42	47	Kumamoto	0.91
	Japan	1.01		Japan	1.40

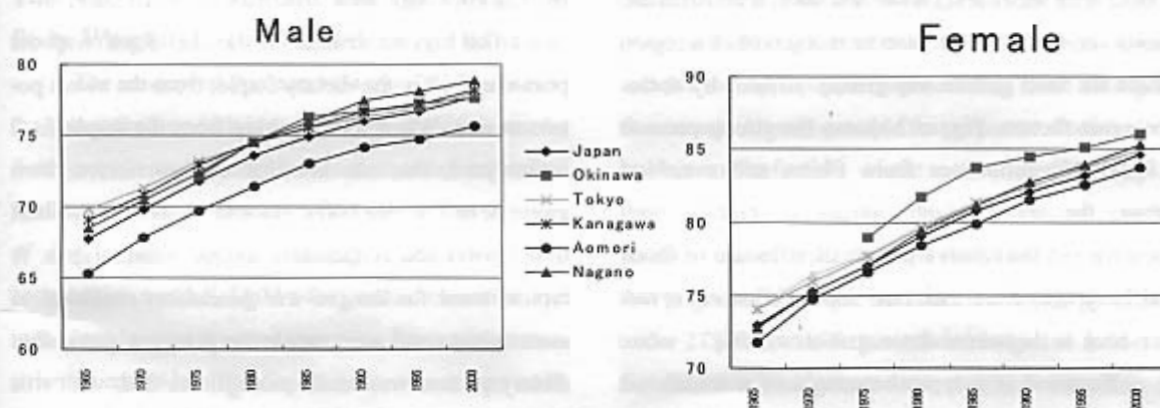


Fig.1. Yearly Trend of Life Expectancy

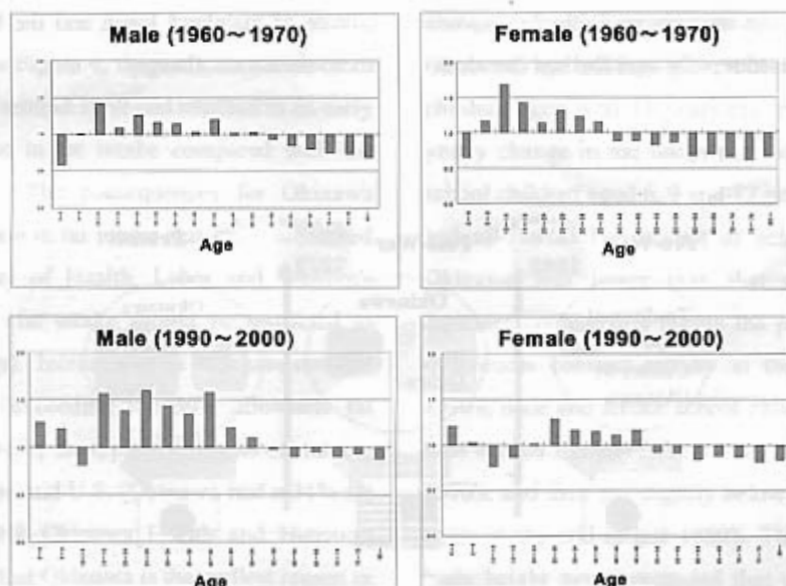


Fig.2 Age Adjusted Mortality Ratio for Men and Women in Okinawa vs. in Japan 1960-1970(upper), 1990-2000 (lower)

for mortality from certain lifestyle related diseases figuring prominently<sup>9</sup>.

### Changing Eating Habits in Okinawa

Okinawa is thought to be a region of Japan where the food culture was formed through unique and intense cross-cultural contacts throughout the ages. Early influences (14<sup>th</sup> ~19<sup>th</sup> century) came as an independent kingdom (Ryukyu Kingdom) participating in the spice trade, with trading relationships with other kingdoms and city-states in S.E. Asia, Korea, China and Japan. Recent (late 19<sup>th</sup> ~20<sup>th</sup> century) influences came from contact with Japan and China, and later, with America. Moreover, Okinawa can also be thought of as a region where the food culture was greatly affected by socio-economic factors. Figure 3 shows the strong pre-war (1879-1945) influences from China and mainland Japan, the sudden large impact of contact with America and the relative growth of influence of foods and beverages from mainland Japan following reversion back to Japanese administration in 1972.

Seaweed is a typical example of a traditional food of Okinawa. Seaweed consumption in Okinawa's capital city of Naha was the highest in Japan until 1988, however, as can be seen in Table 2, seaweed consumption decreased rapidly over the last decade so

that by 1999, Naha had dropped to 19<sup>th</sup> place, with 1/3 the consumption of that seen in previous years<sup>9</sup>. Younger generations in Okinawa seem to prefer a more westernized dietary pattern although certain caveats apply. For example, although the increase in the consumption of flavorings (such as "Aji-no-moto") seems to have taken up or replaced some of the reduced consumption of seaweed, the change in the overall "taste preference" seems to be small. Furthermore, the traditional cooking styles of Okinawa (such as "stir-fry" and "boiling") seem to have been maintained despite the relatively larger changes seen in raw materials used in cooking.

The biggest change in the diet itself was the post-war shift in the dietary staple, from the sweet potato to rice. When the transition from the staple food is analyzed, one can see that the conversion from sweet potato to rice takes place in an extremely short time period and is therefore unique within Japan. A typical meal for the pre-war generation consisted of sweet potato and soup, while the post-war generation dietary pattern was much more diversified, with rice as the staple. The rapid post-war shift in dietary habits was due mainly to strong influences from the food culture of mainland Japan and the United States and socio-economic change.

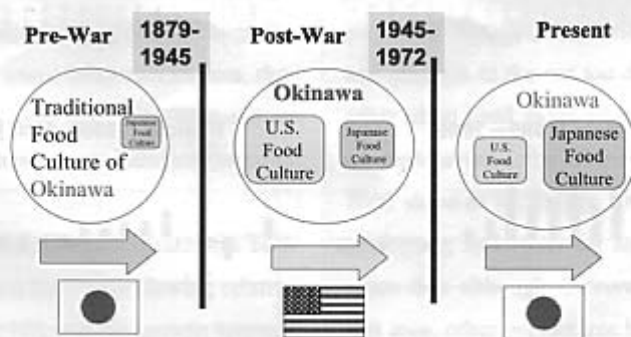


Fig3. Socio-cultural Influences on Traditional Okinawan Diet under Differing Political Administrations

Table2. Yearly Trend of Amount of Seaweed Consumption in Prefectural Capitals of Japan

ranking	City (consumption amount per household: gram)				
	1982	1988	1993	1998	1999
1	<b>Naha(1405)</b> →	<b>Naha(1103)</b>	Toyama(1138)	Toyama(1044)	Toyama(1126)
2	Toyama(1281)	Toyama(1087)	Morioka(1053)	Morioka(1021)	Aomori(891)
3	Morioka(1023)	Aomori(918)	<b>Naha(969)</b>	Yamagata(977)	Yamagata(848)
4	Aomori(949)	Yamagata(869)	Yamagata(927)	Aomori(784)	Morioka(798)
5	Nagasaki(908)	Morioka(864)	Aomori(904)	Fukushima(752)	Sendai(764)
6	Yamagata(815)	Sendai(821)	Kochi(817)	Sendai(752)	Utsunomiya(706)
7	Fukuoka(787)	Matsue(749)	Sendai(800)	<b>Naha(662)</b>	Nigata(705)
19					<b>Naha(511)</b>
	Japan(596)	Japan(601)	Japan(585)	Japan(511)	Japan(470)

### The Nutrition Transition and the Change in Body Weight of School Children in Okinawa

The concept of the "nutrition transition" relates to the idea that underlying shifts in socio-economic, demographic and related forces that affect mortality, fertility and disease patterns reflect changes in structure of diet, physical activity, average stature and body composition trends<sup>6)</sup>. Unlike the gradual transition that took place in most Western countries, the nutrition transition in many less developed nations has been swift and unsettling, leading to large differences in dietary patterns between generations and between rural and urban areas.

As shown in Figure 4, the nutrition transition in Okinawa took off around 1960 and resulted in an early and rapid increase in fat intake compared with the whole of Japan<sup>7)</sup>. The consequences for Okinawa included an increase in fat intake that came to exceed the Japan Ministry of Health, Labor and Welfare's recommendations (fat intake should be restricted to 25% of total energy). Increases since then have resulted in Okinawa now exceeding the 30% allowable fat intake recommended by the typically high fat consuming countries of Europe and U.S. (Okinawa had a 31% fat intake for the 1998 Okinawa Health and Nutrition Survey). It seems that Okinawa is the earliest region in the rice culture regions of East and S.E. Asia where

the nutrition transition (with regards to fat intake) took place and although underway in South Korea, China and the rest of Japan, it is proceeding more slowly in these areas. A good example for purposes of comparison is Nagano Prefecture, where male life expectancy is the longest in Japan, and fat intake shows similar levels to that of Japan as a whole. It may be important that political, economic and social changes generated under 27 years of U.S. governance helped to influence the direction and pace of the nutrition transition in Okinawa.

Other aspects of the nutrition transition, such as changes in body weight and height, can also be seen in Okinawa by looking at school health statistics of children aged 6 to 15 years old. Figure 5 shows the yearly change in the bodyweight of male and female school children aged 6, 9 and 12 years old in Okinawa and all-Japan. The weight of school children from Okinawa was lower than that of their mainland Japanese counterparts during the post-war period but differences contract rapidly in the first half of the 1970's, male and female school children from Okinawa then exceed the level of all-Japan in the latter half of 1970's, and then fall slightly below all-Japan averages again in the mid to late 1980's. The yearly change in body height never exceeded that of all-Japan in the way that body weight did although similar trends can

be witnessed. Figure 6 shows the various facets of the nutrition transition along with the body weight of school children.

The second curve shows the body weight gap in which the body weight of the mainland Japanese is subtracted from that of their counterparts in Okinawa (as an example we use 9 year old girls). The curve begins to rise sharply around 1972 and then peaks around 1984 so as to bring about a decrease in the differences in weights between Japanese young girls as a whole and their Okinawan counterparts. The weight gap then decreases gradually from 1984.

The third curve shows the yearly trends of fat intake which were obtained from the National Nutrition Survey for all-Japan and Okinawa. Daily fat intake in Okinawa rose higher about five years earlier than in all-Japan. The fourth curve shows the gap of the fat intake. The peak appears to begin its ascent in around 1966 and peak in 1970 and then gradually levels out after that.

The fifth curve represents the growth in the amount of imported meat coming into Okinawa. As can be seen, this curve rises rapidly after 1961 following the change from controlled trade to free trade by the United States Civil Administration of the Ryukyu Islands (USCAR) in around 1960. Although the effect of the free trade policy on overall purchasing power of consumers is not yet clear it can be seen as representative of the amount of influence that USCAR had on food culture through indirect means, such as that of controlling the food supply during the period from 1945 to 1960. In 1945 Okinawa went from a devastated economy where people were almost totally dependent on rations and controlled imports and exports in foodstuffs such as rice, flour, meats, sugars and oils to one where gradually economic rebuilding and restructuring took place along with lifting of controls. And later, strong economic growth led to large increases in real purchasing power by the average consumer. With

prices remaining stable and real income growing many times over the 1950's, these factors began to converge in the early 1960's and led to large increases in the amount of the imported foodstuffs, such as processed foods (e.g. pork luncheon meat). As for the meat production in Okinawa at that time, after 1960, meat intake accelerated in that the increased import of processed meat joins local production to increase overall intake (Figure 7).

What accounts for the rapid post-war rise in fat intake in Okinawa? Obviously, as with any complex phenomenon that involves socio-cultural change, there is no one simple answer to this question. Rationing and controls on imports/exports and price policy under USCAR may certainly have helped to keep fat intake under control during the 1945-1960 post-war period. Gradual lifting of restrictions on rations, imports and exports along with real economic growth and large increases in consumer purchasing power in the 1960's and 1970's may have been large contributing factors to increases in fat intake. Other factors that relate more directly to increased fat intake among school children include the food aid and school lunch policy of bread and milk introduced by USCAR to supplement calorie-poor diets of school children in Okinawa beginning in 1955 and lasting until 1960. Increasing numbers of private cars, purchases of TV's and labor saving devices in Okinawa also came about in the 1970's following further rises in income levels following reversion to Japan in 1972. Figure 8 shows body weight gaps between Okinawan children aged 6-12 and their Japanese counterparts. These gaps began to narrow rapidly around 1972 with Okinawan children surpassing their Japanese counterparts in the late 1970's. We suspect that increased fat intakes among the Okinawan population that began a few years earlier may be partly responsible for this phenomenon since this likely contributed to increased caloric intake.

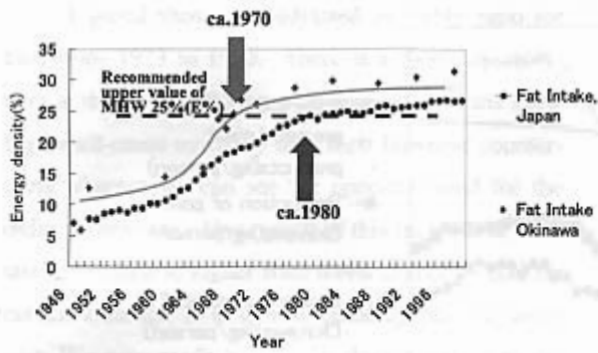


Fig4. Yearly Trends of Fat Intake of Total Population in Okinawa and Japan

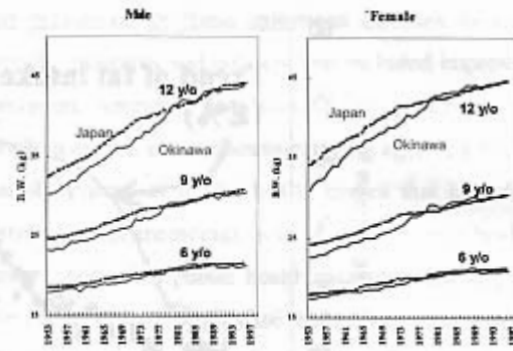
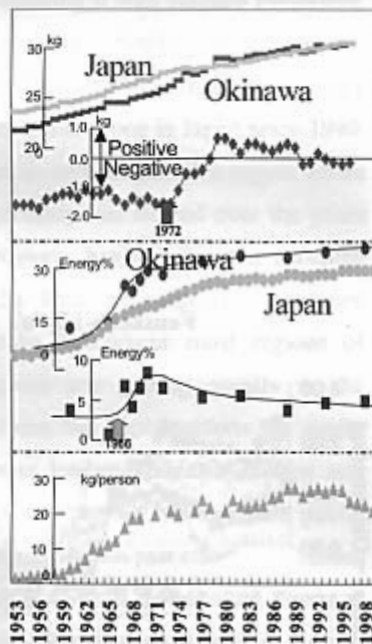


Fig5. Yearly Trends of Body Weight



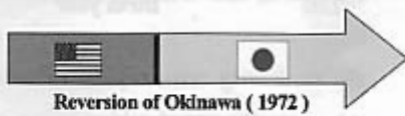
Body Weight (kg) of females, 9 y/o

B.W. gap (kg) of females, 9 y/o

Fat Intake between Okinawa and Japan

Fat Intake gap of between Okinawa and Japan

Amount of imported meat products of Okinawa



Political administration

Fig6. Nutrition Transition and Effects on Body Weight

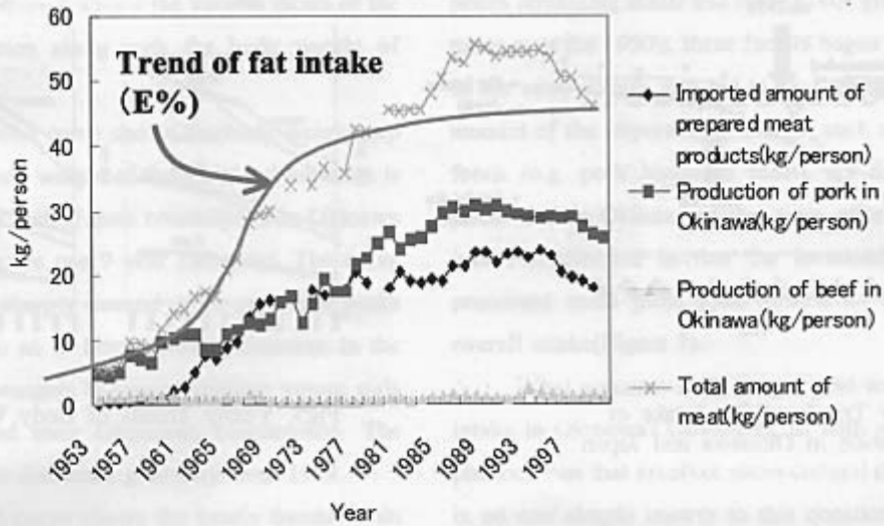


Fig7. Yearly Trend of Amount of Imported Prepared Meat Products and Local Production of Meat in Okinawa

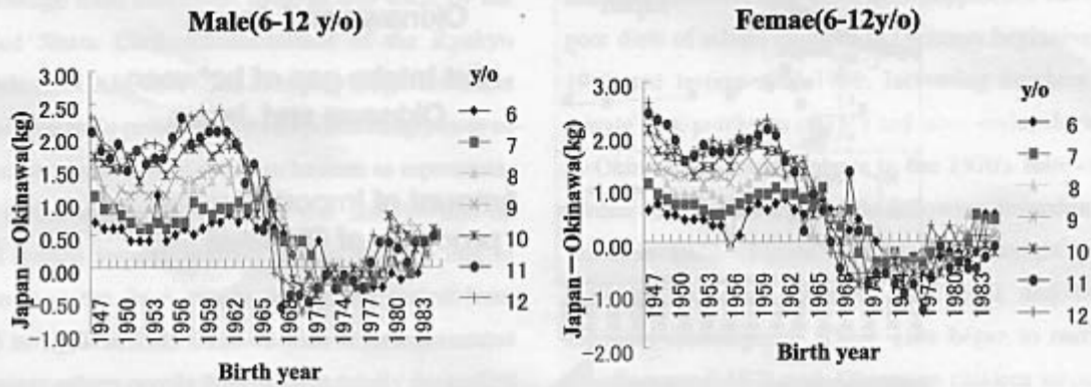


Fig8. Yearly Trends of Body Weight Gap (6-12 y/o) between Birth Cohorts of Okinawa and Japan

Figure 2 shows age-adjusted mortality ratio for men from 1973 to 1992. There is a mortality cross-over at the age of 50 where younger Okinawans show higher all-cause mortality than their Japanese counterparts whereas we can see the opposite trend for the older generations. How much of this increase in mortality is related to higher BMI levels cannot be said for certain although it is almost certainly playing some part. We may profit by paying close attention to the cohort where BMI has risen in future studies of health, longevity and the effects of the nutrition transition in Okinawa.

#### Factors Involved in the Fall of Life Expectancy in Okinawa

It may be worthwhile to consider Okinawan longevity while comparing it with Nagano Prefecture, where life expectancy has shown gradual increases over the years, particularly for men, whose life expectancy has been number one in Japan since 1990. Tokyo is also given as an example of a region where growth in life expectancy has slowed over the years relative to other regions, having once too occupied first place (Table 3). Thus, although life expectancy continues to improve throughout most regions of Japan, not all regions are sharing equally in the phenomenon. Nor can the top positions be easily maintained as former leaders Okinawa, Tokyo and others can attest to, but rather a considerable public health effort is required. Nor can past efforts and lessons learned be necessarily counted upon in the future as the case of Okinawa seems to show and as will be pointed out below.

Factors responsible for post-war growth in life expectancy include major public health efforts under USCAR to eliminate infectious diseases that were responsible for the major causes of death at the time (i.e. tuberculosis, gastroenteritis, malaria, etc.). Infant death rates decreased sharply through the elimination

and prevention of these infectious diseases through specific programs and policies that included improved sanitation, spraying and elimination of habitats of mosquitoes and other disease-carrying agents, a home visiting system of public health nurses that included distribution of medicines, setting up of public health centers, and other public health measures that largely eliminated infectious disease endemic to the region. These actions were directly or indirectly responsible for bringing about large gains in average life expectancy in the 1950's and 1960's.

On the other hand, long-term influences of American high-fat, fast-food culture may be exerting negative influences on the health of younger and middle-aged generations. Lifestyle related diseases brought about by risk factors such as obesity will usually begin to make themselves felt in the form of increased death from circulatory diseases, diabetes and other chronic diseases in middle-aged persons and older. Indeed, we can see higher death rates from circulatory diseases in middle-aged persons in Okinawa compared to other areas of Japan. Large-scale epidemiological cohort studies are needed to further clarify these preliminary findings. Lifestyle risk factors such as obesity and high blood cholesterol need to be closely followed in the future.

That being said, other lifestyle factors not related to food culture are also playing a role in slowing life expectancy gains in Okinawa. For example, the age adjusted mortality rate for suicide and lung cancer for men in Okinawa were the main causes of death for males in the mid-1990's (Japan Ministry of Health, Labor and Welfare, 1995). As for women, deaths from lung cancer are also high compared to other prefectures. Suicide and accidents are, of course, major causes of death for younger persons, and this will negatively affect overall or average life expectancy for the population as a whole<sup>9)</sup>.

Perhaps Okinawa prefecture can learn from the

Table 3. Life expectancy of males in Okinawa, Nagano and selected Prefectures.

	1975		1980		1985		1990		1995		2000								
	LE	Rank	LE	Rank	LE	Rank	LE	Rank	LE	Rank	LE	Rank							
Tokyo	73.19	1	Okinawa	74.52	1	Okinawa	76.34	1	Nagano	77.44	1	Nagano	78.08	1	Nagano	78.90	1		
Kanagawa	72.95	2	Kanagawa	74.52	1	Nagano	75.91	2	Fukui	76.84	2	Fukui	77.51	2	Fukui	78.55	2		
Kyoto	72.63	3	Nagano	74.50	3	Fukui	75.64	3	Gifu	76.72	3	Kumamoto	77.31	3	Nara	78.36	3		
Nagano	72.40	4	Tokyo	74.46	4	Kagawa	75.61	4	Kanagawa	76.70	4	Okinawa	77.22	4	Kumamoto	78.29	4		
					Tokyo	75.60	5	Okinawa	76.67	5									
Okinawa	72.15	10																	
								Tokyo	76.35	14					Tokyo	77.98	15		
														Tokyo	76.91	20			
																	Okinawa	77.64	26

public health measures taken in Nagano over the past couple of decades which has seen stroke rates plummet and life expectancy increase, in part, due to public health campaigns aimed at bringing about lower salt intakes, a major risk factor for stroke. Although Nagano cannot necessarily be said to be home to a large number of centenarians (20<sup>th</sup> overall among the 47 prefectures) some indices concerning independence of the elderly (more reflective of qualitative levels of health) are reportedly better in Nagano as well.

### Summary

The nutrition transition in Okinawa, particularly with regards to increased fat intake and increased bodyweight, may be related to socio-political, socio-economic and socio-cultural changes that were set in motion either directly or indirectly during U.S. administration beginning in 1945 and although still being felt, were particularly strong up until reversion to Japan in 1972.

Life expectancy for men in Okinawa has fallen sharply relative to other prefectures and although at present women still retain their lead in Okinawa, if present trends continue, they too will fall. To put things in perspective, life expectancy rankings do not have a huge meaning anymore because differences between regions in the whole of Japan have been

gradually decreasing. However, life expectancy is an intuitively comprehensible index that represents the concept of "longevity" and therefore has great appeal to the average person, after all, who doesn't want to live a long and healthy life? In particular it is thought that the decrease in life expectancy rankings will exert a negative influence for Okinawa for the "longevity brands" of health food and the tourism industry. The "longevity crisis" that Okinawa has been dealing with since the latest life expectancy figures came out in 2000, was actually already pointed out as far back as ten years ago (or longer) by some investigators who have been following these health trends. Although public policy has been slow to respond and the meaning of "ten lost years" may be large for Okinawa. Public health authorities may also be limited in the extent to which they can counteract current lifestyle habits that are promoted by large multinational corporations (i.e. high-fat fast foods)<sup>9)</sup>. On the other hand, the large life expectancy gains that took place in Nagano over the past few decades should not be overlooked, especially with regards to the beneficial effects that public health policy exerted in bringing about positive changes in health-promoting behavior.

In that sense, it is necessary to look at things from a long-term perspective and plan ahead using the latest scientific knowledge and tools at our disposal. An

epidemiological study with a large population is necessary, as is priority given to a population strategy of health education beginning with school children and aiming at life-long health promotion for the average person<sup>10)</sup>.

### Acknowledgements

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