

Review Article

**Diets for Healthy Longevity Proven by Global Studies
-Lessons from Australian Aboriginals-**

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Abstract

Cardiovascular Diseases (CVD) and Alimentary Comparison Study was a WHO-coordinated multi-center epidemiological survey on diets and CVD risks and mortalities in 61 populations. Twenty-four-hour urinary (24U) taurine (T) was inversely related significantly with coronary heart disease mortality. Higher 24U-T excreters over the mean had significantly lower body mass index (BMI), diastolic and systolic BP (SBP, DBP), and total cholesterol (T-Cho), than lower T excreters below the mean. Higher 24-U-magnesium (M) excreters over the mean had significantly lower BMI, SBP, DBP, and T-Cho. Therefore, higher T and M excreters over the means had significantly lower BMI, SBP, DBP and T-Cho than lower T and M excreters below the means.

Australian aboriginals before the mid-18th century lived hunters' and food gatherers' life, eating seafood and nuts rich in T and M so that they were supposed to be free from metabolic syndrome (MS).

However, aboriginals living in urban Melbourne had nearly the highest prevalence of MS in 61 populations and therefore, aboriginals were invited to an intervention study to take 25g of soy protein daily from breads for 8 weeks.

Their CVD risks were significantly decreased, indicating traditional oriental soy diets containing soy protein, isoflavones and M could prevent CDV.

Since the evolutionary origin of human life was traced back to in the sea containing abundant M and food gatherers lived on seafood and bush food rich in T and M, T and M are assumed to be essential for cardiovascular health thus for healthy longevity.

KEY WORDS: Taurine, Magnesium, 24-houre urine, metabolic syndrome, Aboriginals

Introduction

Through a proposal to the World Health Organization (WHO), the author has conducted the Cardiovascular Disease and Alimentary Comparison (CARDIAC) Study, an international joint study on cardiovascular diseases and alimentation, in 61 regions worldwide since 1985¹⁻⁴. Based on an investigation conducted in people in their early 50s (randomly selected 100 males and 100 females aged 48 to 56), it was found that people living in regions of low longevity had very high risk for cardiovascular diseases, whereas people living in regions of higher longevity had low risk for these diseases and enjoyed longevity while maintaining a healthy cardiovascular system. However, over the 20 years of the study, we have found that originally healthy food cultures have gradually deteriorated and the risk for cardiovascular diseases has increased in some of these regions of higher longevity⁵.

Today, there are many regions all over the world that have lost their traditional foods and experienced urbanization, industrialization, and Westernization of eating habits: Asian countries have experienced very strong influences. Therefore, based on the question of "what are essentially good food choices for health of humans?" we have conducted an additional epidemiological study called HEART (Healthy Eating Asian Remain Together) since 2004.

Human beings originated in Africa and migrated all over the Earth. Those who finally reached Japan after overcoming difficulties thanks to their "thrifty genes" became ancestors of the modern Japanese, and those who could migrate farther to Australia thanks to their even healthier thrifty genes became the native aboriginals of Australia. Because people who are considered to have these thrifty genes belong to populations in which lifestyle-related diseases occur quite frequently, here we will discuss based on the information gleaned through our study how we should improve our eating habits, tracking the path of the great migrations of humans backwards.

Australian aboriginals have thrifty genes and a short average life expectancy

Through medical examinations of aboriginal people, the following findings were obtained:⁶ there were many obese people in their 20s with high prevalence of hypertension (blood pressure \geq 140/90 mmHg) especially in men in their 50s was 69.2%; the peak prevalence of hypercholesterolemia (total cholesterol \geq 220 mg/dL)

in men in their 50s was observed to be 77.8%, and that in women, with slightly better longevity, was 100% in their 60s; the rate of diabetes (fasting blood glucose ≥ 126 mg/dL) was also high, and 75.0% (*i.e.*, 3/4) of men over 60 suffered from diabetes. The average life expectancy in this population was as short as 51-52 years, shorter than that in the Japanese population and Australian Caucasian populations by approximately 30 years. Risks for cardiovascular diseases were found to emerge no less than 30 years earlier in the aboriginal population.

However, there were smaller numbers of obese aboriginals and greater numbers of elderly aboriginals in regions with seafood-eating habits where eel has been a part of the diet for 8000 years. In the ancient past, shell mounds were built in areas inhabited by aboriginal people, and people had continued to live by gathering food from the fertile land until around the period of the Meiji Restoration in Japan.

In our study, seeking links between nutrition and longevity, among nutritional constituents in seafood we focused on taurine. Although also found in organ meats, large amounts of taurine is contained in seafoods, especially in oysters, squid, octopus, and shrimp, which are frequently consumed by Japanese people in very large amounts⁷⁾.

Importance of taurine

Before starting this international joint study, the author reported an experiment using spontaneously hypertensive rats (SHR)^{8,9)} and stroke-prone spontaneously hypertensive rats (SHRSP)^{10,11)}, which demonstrated that oral administration of taurine dissolved in drinking water suppressed an increase in blood pressure and decreased incidence of stroke (1978)¹²⁾. In addition, Fujita *et al.* reported in 1986 a study using DOCA-salt hypertensive rats that demonstrated taurine administration suppressed increase in blood pressure as well as increases in blood levels of markers of

sympathetic nervous system activity such as norepinephrine and epinephrine¹³⁾. These reports indicate that eating seafoods that contain large amounts of taurine should be good for health.

Based on our investigation, taurine consumption is high in areas with eating habits with high seafood consumption such as Japan and the Mediterranean areas. Taurine consumption in Japanese people was above 2,000 μ Eq/day and by far the highest level when seen from a global perspective^{14,15)}. On the other hand, people in Lhasa, Tibet, whose taurine consumption was the lowest (below 300 μ Eq/day), never eat seafood, considering it as the seat of the soul of their ancestors (associated with their “water burial” tradition) and obtain taurine from organ meat sources. In addition, taurine consumption is generally low in inland China, while the consumption is high in Guangzhou, known for the Chinese saying “Food is in Guangzhou.” Our worldwide comparison also found that regions with higher taurine consumption, *i.e.*, with higher seafood consumption, showed lower mortality due to ischemic heart disease (*Figure 1*)^{4,14,15,16)}. In Japan, the mortality due to heart disease is the lowest among advanced countries, which contributes to its high average longevity. This is directly attributed to the seafood-eating habits of the Japanese. From the above discussion, it appears that people with higher seafood consumption should live longer.

Importance of magnesium

In addition to seafood, nuts including macadamia nut were another food that was indispensable to the lives of ancient Australian aboriginals. Because a lot of high quality nuts were produced in Australia, they were consumed as the main food. Nuts contain a large amount of antioxidative substances, and commonly contain a large amount of magnesium⁷⁾. Foods with large magnesium content include nuts/seeds such as almonds, beans sesame, pulses and whole grains; vegetables, algae such as

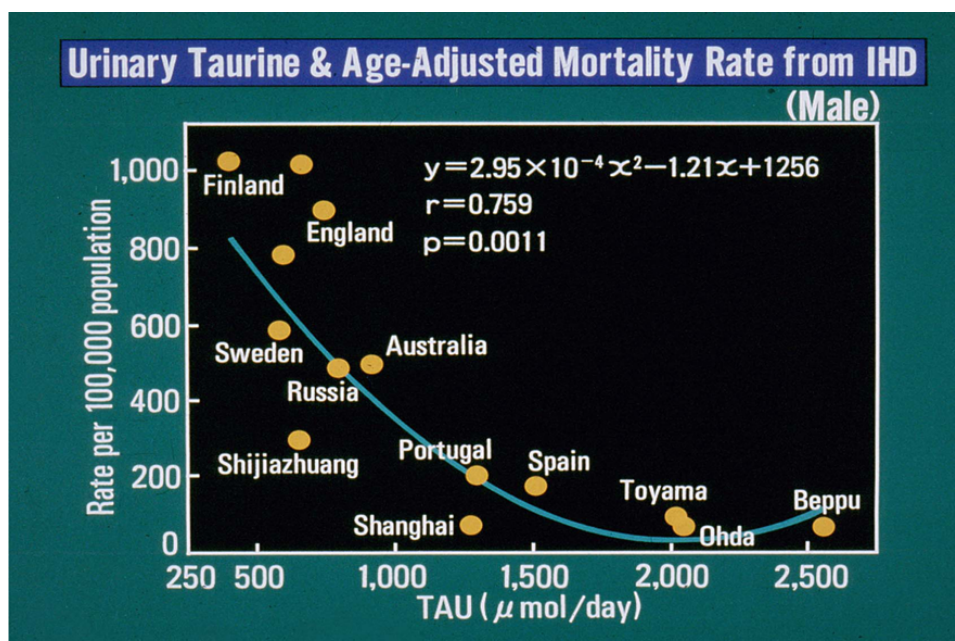


Fig. 1. 24-Hour Urinary Taurine (TAU) vs. Age-Adjusted Mortality Rate from Ischemic Heart Disease (IHD) in males

seaweeds and green lavers, and dried seafoods such as shrimp and cuttlefish. However, the magnesium content of rice and wheat is decreased to 1/6 after they are polished.

The fact that magnesium is contained in seaweeds in quite large amounts and can be consumed in large quantities by taking a small amount of dry food is advantageous to Japanese people. Japanese people enjoy such privileged eating habits all over the country. While there are many regions in the world where salt is used to preserve food, people with good techniques for preserving food in the form of dry foods such as Uighur people living along the Silk Road are also enjoying longevity as seen from a global perspective. Longevity in these regions might be attributable to these dry foods.

As mentioned above, we had demonstrated a relationship between magnesium and blood pressure in an animal study¹⁷. In SHRSP, blood pressure increases with growth, and stroke is observed from approximately 17 weeks of age. Results of investigation into the associated intracellular occurrences showed that the concentrations of free magnesium in lymphocytes decreased in animals with severe hypertension¹⁸. In addition, it was confirmed that supplementation of magnesium in diet prevented stroke via increases in the concentrations of free magnesium in lymphocytes and also decreased the intracellular concentrations of free calcium¹⁹.

About 20 years after that report, a study on effects of magnesium on human erythrocytes was published in 2009²⁰. The study compared a group taking a magnesium supplement (600 mg of pindolate Mg^{2+} orally twice a day) and on a lifestyle improvement program for 12 weeks with a group on lifestyle improvement alone, and the magnesium supplemented group showed a decrease in free sodium and calcium concentrations in erythrocytes and an increase in free magnesium and potassium concentrations as well as a significant decrease in blood pressure for 24 hours, findings similar to those observed in our animal study. The results indicated that magnesium helps pump intracellular sodium ions out of the cells and has a favorable effect on hypertension also in humans by contributing to ATPase function to activate the sodium pump.

In multiple regions worldwide, we investigated the relationships

between urinary magnesium and mean values of both systolic and diastolic blood pressures, and found inverse correlations for both; an increase in urinary magnesium was associated with significant decrease in diastolic blood pressure (Figure 2)²¹. Data obtained in Shijiazhuang (China) showed blood pressure values that were not very low despite high urinary magnesium values, probably because people there consume quite salty foods as well as very large amounts of coarse cereals (reflected by the high urinary magnesium values).

Taurine and magnesium reduce risk of stroke and myocardial infarction

By summarizing the previously available epidemiological data, the following have been derived: a covariance structure analysis for a numerical evaluation by sex of stroke mortality and 5 dietary factors (cholesterol, obesity, salt content, magnesium, and taurine) revealed that salt content contributes to an increase in stroke mortality in both men and women²¹. In contrast, cholesterol contributes to reduction of the mortality^{4,22}. These results indicate that populations with relatively higher cholesterol levels and that consume proper amounts of protein have a lower stroke incidence, because stroke as defined here includes small vessel diseases that could also cause vascular dementia, a frequently encountered disease in Asian countries including Japan. The results also confirm in humans the experimental results that protein intake could prevent stroke in SHRSP rats¹¹. Also in global studies, sulfur-containing amino acids contained in taurine which is the metabolite of proteins as well as free amino acids found abundantly in seafood, have been found to help reduce stroke incidence by suppressing blood pressure.

For ischemic heart disease (*i.e.*, myocardial infarction), we also conducted a similar covariance structure analysis of these 5 dietary factors^{7,15,21}. The results demonstrated that cholesterol and obesity increased the myocardial infarction mortality, while

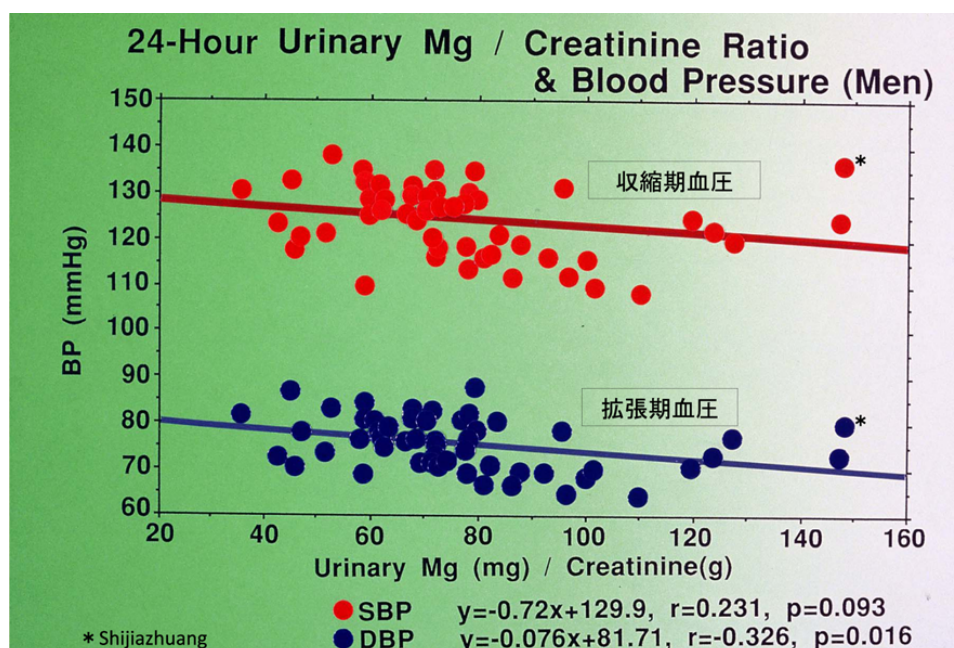


Fig. 2. 24-Hour Urinary Mg / Creatinine Ratio & Blood Pressure (Males)

magnesium and taurine helped reduce the incidence of myocardial infarction. In summary of these data, approximately 60% of the risk of myocardial infarction can be accounted for by these 5 factors in both men and women.

Thus, we performed a study to investigate the effect of taurine and magnesium on cardiovascular risk by comparing body mass index (BMI), systolic and diastolic blood pressure and total cholesterol, between 2 groups, established by dividing all the health examination participants worldwide into 2 groups according to whether their 24-hour urinary taurine/creatinine and magnesium/creatinine ratios were above or below the mean of the CARDIAC study populations (excluding Japanese people, who consume quite a large amount of taurine)^{7,22}.

People who consumed a large amount of taurine from seafood lifelong, *i.e.*, people whose taurine intake was above the average, showed significantly lower risk in every parameter of cardiovascular diseases than those whose intake was below the average.

In addition, for magnesium, which are consumed via nuts, vegetables and seaweeds, people whose intake was above the average showed significantly lower risk in every parameter than those whose intake was below the average. Furthermore, people whose levels of both taurine and magnesium were above the averages also showed significantly lower risk in every parameter than those with the levels below the averages. In fact, the statistical significance for BMI, systolic blood pressure, diastolic

blood pressure, and total cholesterol, reached the levels of $p < 10^{-29}$, $p < 10^{-5}$, $p < 10^{-17}$, and $p < 10^{-5}$, respectively, showing a clear difference in the risk. From the above results, we can conclude that eating foods that contain large amounts of taurine and magnesium is beneficial for reducing the risk of cardiovascular diseases.

People in Guiyang, China, have eating habits leading to longevity

Guiyang (Guizhou, China), where the ethnic minority Miao People (**Figure 3**) account for a large percentage of the population, represents a region where adequate amounts of both taurine and magnesium are consumed compared to the population average of the CARDIAC study. In this region there are limestone lakes in calcareous caves (**Figure 4**), and people in Guiyang actively collect freshwater fishes in the lakes. Because the rice yield in that region is low, soybean is consumed as the main food (**Figure 5**). Tofu is produced by clabbering soy protein in this case using lime from the calcareous caves, which contains a large amount of magnesium, in place of bittern (**Figure 6**). BMI, blood pressure, and total cholesterol are also quite low in people in Guiyang



Fig. 3. Miao People in Guiyang



Fig. 4. Scenic Karst Topography in Guiyang



Fig. 5. Various Soybeans on Market in Guiyang



Fig. 6. Baked Bean Curd Clabbered using High-Mg-containing Water Running from Rocks

compared to the mean value of the whole populations of the CARDIAC study. The risk of cardiovascular diseases is reduced by such a food environment. Until today, the reason for longevity of people in Guiyang had been unknown, but our investigation demonstrated that it is supported by a food environment and eating habits enabling daily consumption of both magnesium and taurine.

In contrast, Newfoundland Island (Canada) was identified in the CARDIAC study as a region with a high cardiovascular risk. Because people mainly in Ireland migrated to this island in its early history, the local people have their traditional eating habits such as spreading pasturelands all over the island and eating large amounts of meat. Although the confluence of ocean currents near the island allows people to catch a lot of fish and build good fishing ports, the people generally salt the fish that they gather and export them in barrels to Canada and America. The local people normally eat fish prepared as "Fish & Chips," made by frying the salted fish in a great amount of fat (known as the most atherogenic recipe). Due to such eating habits, Newfoundland Island is the region with the highest morbidity of myocardial infarction in Canada. We also confirmed 24-hour urinary taurine and magnesium were low in Newfoundlanders who participated in CARDIAC health survey.

We compared the population of St. John in Newfoundland Island to that of Guiyang with regard to incidences of obesity, hypertension, and hypercholesterolemia, and found that all of these were significantly lower in Guiyang than in St. John⁷⁾. The risk of metabolic syndrome in a region where adequate amounts of taurine and magnesium were consumed was found to be considerably different from that in a region where the consumption was inadequate.

Achieving healthy longevity is possible by eating seafoods and soybeans despite the presence of thrifty genes

Recently, near Lake Biwa in Shiga prefecture of Japan, a small clay doll made of stone was unearthed, and found to have been made 13,000 years ago in the Jomon period. It is imagined that people in that period lived mainly on boiled shijimi clams collected in Lake Biwa, brown rice, and soybeans. I was born in 1937 and spent my boyhood in Kyoto, not far from Lake Biwa in Kyoto. In the last century prior to World War II, people used to have miso soup with shijimi clams gathered from Lake Biwa at Seta, as well as rice with traditional vegetables sea weeds and soy products principally every morning. These people continued such eating habits as those in the era of shell mounds 13,000 years earlier. In Kyoto, not only salt but also dashi the extract from dried bonito, mushroom and sea weed is used as a flavoring in everyday meals. It is speculated that this fact resulted in the culture of mild taste food in Kyoto, contributing to the lower incidence of stroke in comparison with other Japanese regions.

Considering that adequate magnesium intake is possible from soybeans even when rice is consumed after polishing, we are focusing on soy diets. In our study, we persuaded a group of Australian aboriginals to eat bread that contained 25 g/day of soy protein in place of wheat bread for 8 weeks, explaining to them that their life was shortened because they had stopped eating nuts, so that they should eat soybeans as a substitute for nuts, like Japanese. A total of 70-75 g of dried soybeans contains 25 g of protein, which is equivalent to the daily recommended consumption of soy

protein by the U.S. Food and Drug Administration (FDA). The 8-week results of this randomized placebo-controlled intervention study showed significant improvements in diastolic blood pressure and atherogenic index in the soy bread group as compared to the wheat bread group⁶⁾. A demonstrable increase in HDL was observed, in part due to the effect of soy isoflavones.

In addition, an aboriginal man whose BMI value before our health examination had been considerably high began to improve his lifestyle through his participation in this interventional study. He began to eat soybeans as a substitute for nuts and started bicycle riding as a substitute for the everyday physical activities of ancient aboriginals for food gathering and hunting, and as a result, he appeared at health examination 1 year later showing a slender body looking like another man.

Thus, even people who are certainly prone to metabolic syndrome due to their thrifty genes can acquire healthy longevity depending on success of dietary improvement. Soybeans containing also magnesium and seafood containing taurine are representative foods indispensable in the diet, and so are rice and vegetables. Rice is all the more favorable in the form of brown rice, which contains 6 times more magnesium than white rice, and chlorophylls in vegetables also contain magnesium. However, it is important to make it a habit to consume low-salt food for us Japanese people because we tend to consume still too much salty food as indicated by the world-wide 24-hour urinary sodium excretion data of CARDIAC study⁴⁾.

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