Dietary Changes, Nutrition, and Health in Australian Aborigines and Other Transitional Societies

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Today there are more deaths from cardiovascular diseases in the developing world than in the developed countries. After the age of 5, there are as many deaths from cardiovascular diseases as from infectious and parasitic diseases put together (1).

Before the emergence of agriculture about 10,000 years ago, humans obtained their food by hunting and gathering. Australian Aborigines were one of the world’s largest and most successful hunter-gathering societies and in some remote regions, particularly in northern and central Australia where traditional customs have endured, these original methods of obtaining and preparing food are still used, although to a small extent in most places (2,3). Worldwide, hunter-gatherers now constitute less than 0.001% of the world population (4); these were groups in which obesity, non-insulin-dependent diabetes mellitus (NIDDM), cardiovascular disease, and other degenerative disorders were rare or nonexistent in their traditional state of living. This situation has changed dramatically in many previously traditional societies, including Australian Aborigines, because of the socioeconomic and lifestyle impacts of westernization and so-called modernization.

There have been marked environmental changes in most parts of the world since modern humankind emerged 40,000–50,000 years ago; despite these important changes, humans have altered little genetically over that time, which has seen the development of peasant agriculture through to modern farming and food processing, distribution, marketing, and consumption (5). Staple foods exist in the world’s major regions: rice in eastern and southern Asia; maize in Central America, Mexico, parts of South America, and South Africa; millets in dry parts of Africa and in parts of Asia and South America; and wheat in Europe, North America, Australia, New Zealand, parts of Russia, at high altitudes in the tropics, and in northern India; in some parts of Africa the staple food is not a cereal but a root (cassava or manioc) or a fruit such as a cooking plantain or banana (6). Fermented foods and beverages compose a major part of the people’s diet in Africa (7) and have the advantage of
TABLE 1. Comparison of diets of traditional hunter-gatherers, early agriculturalists and westernized humans

<table>
<thead>
<tr>
<th>Dietary component</th>
<th>Hunter-gatherer</th>
<th>Early agriculturalist</th>
<th>Westernized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal/d)</td>
<td>1800</td>
<td>2000</td>
<td>2400</td>
</tr>
<tr>
<td>Carbohydrate (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>complex</td>
<td>50–70</td>
<td>60–75</td>
<td>25–30</td>
</tr>
<tr>
<td>refined</td>
<td>0</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>15–20</td>
<td>10–15</td>
<td>40</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>15–20</td>
<td>10–15</td>
<td>12</td>
</tr>
<tr>
<td>Fiber (g/d)</td>
<td>40</td>
<td>60–120</td>
<td>20</td>
</tr>
<tr>
<td>Sodium (g/d)</td>
<td>1</td>
<td>5–10</td>
<td>10–15</td>
</tr>
</tbody>
</table>


extended shelf life because of organic acids produced during fermentation. For example, the infant weaning food “ogi” can be kept for 10 days or more by changing the water every 48 hours; lactic acid, acetic acids, and other acids formed during fermentation lower the pH and thus inhibit microorganisms that would otherwise spoil the product. Fermentation also reduces or eliminates toxic components in some products such as cassava tuber (8).

Staple foods alone are not adequate for human well-being, particularly for infants and children who have requirements for growth as well as maintenance. However, contemporary human diets are probably as diverse now as they have been in human history (6), so that balancing staples with other nutrients should not be a problem except where food shortages exist or if the preparation of staple foods is nutritionally detrimental (e.g., with some cereal milling processes). The abundance of food in many parts of the world nowadays, particularly in the West, has brought its own set of nutritional problems because of the relatively rapid and very significant changes in dietary habits and nutrient consumption patterns from hunter-gatherer through early agriculturalist to contemporary styles of living (Table 1).

In many parts of the world, initially in the industrialized and affluent countries, and increasingly now in many developing nations and particularly among their higher social classes, attention is turning from nutritional disorders associated with undernutrition and nutrient deficiencies to those disorders that are associated with overnutrition and with dietary patterns linked to risks of degenerative diseases after childhood (9). In this chapter, I shall discuss some of these issues and illustrate them by using examples of different populations among which this has happened and is continuing, especially among Australian Aborigines.

SOME EXAMPLES FROM THE PACIFIC

The rapid change from traditional to westernized lifestyle has occurred in many of the small and scattered islands of the Pacific region over the past 50 years. This
has been accompanied by an epidemic of noncommunicable diseases in many Pacific populations, e.g., in Nauru, Fiji, Tuvalu, and Kiribati (10). Diabetes mellitus (non-insulin-dependent or type 2) is a disease-related outcome of particular importance in this context and which the 1980 WHO Expert Committee on Diabetes Mellitus concluded was most closely related to obesity as a risk factor (11), although this is not universally agreed (10,12). Other factors in the pathogenesis of non-insulin-dependent diabetes mellitus (NIDDM) include a genetic proneness (13,14) that is unmasked by environmental changes such as alterations to dietary patterns and reduced physical activity; and hyperinsulinemia and insulin resistance, which are detectable before the disease itself is evident (15).

A wide range of prevalence rates of NIDDM has been found in different Pacific populations (see Table 2) from nil among highlanders of Papua New Guinea to 8–12% in western Samoa and Kiribati, and much higher (15–33%) among Nauruans and migrant Asians in Fiji (10). There are large differences in prevalence rates between ethnic groups within countries (e.g., in Fiji) and diabetes prevalence is much lower in communities maintaining traditional lifestyles compared with recently urbanized communities from the same ethnic group (Table 2).

| TABLE 2. Age standardized prevalence rates of non-insulin-dependent diabetes mellitus (persons aged >20 years) in some Pacific Island populations |
|---------------------------------|--------|---------|
| Population                      | Males  | Females |
| Micronesians                    |        |         |
| Nauru                           | 33.4%  | 32.1%   |
| Kiribati                        |        |         |
| rural                           | 3.7%   | 3.9%    |
| urban                           | 11.7%  | 11.1%   |
| Polynesians                     |        |         |
| Western Samoa                   |        |         |
| rural                           | 1.7%   | 4.2%    |
| urban                           | 8.2%   | 8.5%    |
| Wallis Islanders                |        |         |
| Wallis Is., rural               | 2.0%   | 4.1%    |
| Noumea, urban                   | 10.0%  | 14.0%   |
| Melanesians                     |        |         |
| Papua New Guinea                |        |         |
| highlands                       | nil    | nil     |
| Fiji                            |        |         |
| rural                           | 2.1%   | 2.1%    |
| urban                           | 5.9%   | 10.3%   |
| Asians (Indians)                |        |         |
| Fiji                            |        |         |
| rural                           | 15.1%  | 13.6%   |
| urban                           | 17.5%  | 16.3%   |

A study of Micronesians reported in 1970 (16) shows some important dietary and nutritional correlates with rapid sociocultural change. That investigation involved three groups of Chamorro natives from the Mariana Islands and one group from the Caroline Islands; the subjects lived in three different geographic areas. On one of the Mariana Islands, Rota, there was little westernization and the traditional lifestyle was largely unchanged; there was a subsistence economy and most of their food was obtained from small farms and from the surrounding ocean. In sharp contrast, another group of Chamorros had migrated to the United States and had quickly adopted the urban Californian lifestyle. In between these groups were inhabitants of Guam where there had been rapid cultural change since the mid-1940s with the substantial American presence. At the time of the study, a cash economy had become established and little farming or fishing was done. The study also involved a group of Carolinians from an isolated island in the Palau district.

There was a stepwise decrease in total fat consumption from California, to Guam, to Rota, and to Palau for both sexes. The difference was due almost entirely to saturated rather than to polyunsaturated fat; total fat intakes were greater among males than females. Meat, poultry, and dairy products were seldom available to the isolated, subsistence villagers of Palau, whereas taro, cassava, and lean fish were plentiful. Consequently, their diet was relatively low in fat and high in carbohydrate. The inhabitants of Rota raised poultry and some cattle; their dietary fat intakes were slightly greater than for the Palauans. On the other hand, most Guamanians used processed foods, such as canned goods, meat, and milk, and their intakes were more like those of Californians than those of the other islanders; the California Chamorros obtained 40% of their dietary energy from fat, similar to the pattern of other Californians (17). There was also a stepwise increase in the intakes of total dietary energy and carbohydrate from California, to Guam, to Rota. Although there was no clear relationship between disease generally and the intakes of total energy and protein, there were strong associations between the geographic distribution of dietary patterns linking increased fat intakes with serum lipids and measures of illness related to coronary artery disease, including a history of myocardial infarction and electrocardiogram (ECG) abnormalities (16).

The small Pacific island of Nauru provides one of the most remarkable examples of rapid change from traditional diet and lifestyle to westernization. The island is just 37 miles (59 km) south of the Equator, 2500 miles (4000 km) from Sydney, and is only 12 miles (19 km) in circumference. The traditional diet of fish, fresh meats, coconuts, and breadfruit has been largely displaced by foods purchased from the island’s store following changes in the food habits of Nauruans that occurred after the Second World War because of the very high incomes that were generated by the phosphate (guano) mining industry and the social changes that it brought to the native Nauruans (18).

By 1957, the Nauruans were consuming mostly store foods: white rice, canned meats, canned fish, and white sugar (which was used almost exclusively for sweetening beverages); the people had become inactive, most of the physical work in the phosphate industry was done by imported laborers, and any fishing done by Nauruans
was, by the 1970s, from speedboats rather than from traditional canoes (19). By then, they had a diabetes prevalence rate of 34.4%, one of the highest rates reported (20) and similar to that of the American Pima Indians (21). Their lifestyle had become almost totally westernized; nearly all of the food consumed by the islanders was imported from Australia and the main dietary energy intakes of males and females were at least twice those recommended for Western or developing Pacific populations; obesity is a pronounced feature of the population, which is consistent with their excessive energy intakes and reduced exercise.

The problems found on Nauru have been reported from many other parts of the Pacific including the Cook Islands, among the Maoris of New Zealand, the Tokelau Islands, Hawaii, Guam, Tahiti, Tonga, and Tuvalu (see 19 for references).

The Tokelau Island migrant study is a particularly valuable source of information about the impact of migration (mainly to New Zealand) and westernization on the health of a small population of Pacific Ocean atoll dwellers. This multidisciplinary study was undertaken longitudinally over many years and has recently been gathered together in a single volume (22) which provides comprehensive original data and extensive references to other relevant historical, ethnographic, anthropological, demographic, sociological, epidemiological, biological, and environmental data about populations when they migrate and adopt Western diets and lifestyles.

AFRICA

Africa is a vast and diverse continent that contains many different ethnic groups living in very different circumstances and having their own traditions, cultures, and dietary practices. The !Kung Bushmen of Dobe (in Botswana) are an outstanding example of contemporary hunter-gatherers (23); they were found to eat 85 species of plants and more than 50 species of animals, although only 9 of the plant species were eaten in large amounts and only 17 of the animals were consistently hunted (24). Only a little over one third of their dietary energy was provided by hunting, which was done by men, whereas collecting plant foods was done mostly by the women. A similar pattern of food gathering occurs in traditional Australian-aboriginal society. The !Kung Bushmen are thin and may be undernourished (by international criteria) in some seasons; they have little or no obesity, hypertension, coronary heart disease, or dental caries (23), although a secular change in their anthropometric measurements has been observed (25) and some individuals living with sedentary Tswana agriculturalists have been noted to be heavier (23). Despite the fact that the diet of the !Kung Bushmen seems sparse, Truswell (23) found no qualitative deficiency of particular nutrients; animal foods are shared among groups, plant foods only to a lesser extent. The mongongo nut, which contains a high proportion of α-linoleic acid, is their major source of dietary energy. Their diet is rich in vitamin C from baobab and morula fruits and salt is unavailable in their environment (23).

In many parts of Africa, traditional farming practices have been severely disrupted by the impact of cash cropping, which has a complex political and sociological history.
and which affects the health and nutrition of local populations (26). Cash cropping developed to satisfy trade with European merchants and colonizers, and local food crops gradually lost their prominent local cultural and economic roles. Cash cropping led to extensive monetarization which had positive and negative effects on the diet; it also allowed the imposition of systematic tax collection. Cash cropping has had an extensive and serious impact on the fertility of soils and their capacity to produce traditional grains like millet and sorghum. It has also led to mass importation of products such as wheat, rice, sugar and alcohol that have become components in the changing dietary patterns in many places, particularly in towns, larger market places, regional centers, and in cities. These changes and the upsurge of the cash society and consumerism have become driving forces toward westernization and urbanization. This is bound to have an increasingly important impact on the health of African populations in future, particularly with regard to so-called lifestyle diseases.

The availability of basic and reliable data on cardiovascular disorders in Africa is limited but there is strong suggestive evidence from ad hoc reports, some epidemiological studies, clinical observations, and from other sources that the spectrum of these disorders on the African continent is rapidly becoming indistinguishable from that observed in developed countries (27). This is partly due to changes in the environment, altered lifestyles, and rapidly altered economic and socioeconomic circumstances (28-30). The classic risk factors including dietary patterns, obesity, smoking, dyslipidemias, hypertension, and perhaps diabetes apply and appear to be on the rise, and smoking may reach levels equal to or greater than those in many developed countries (27).

Tobacco cultivation occupies up to 72% of the arable land in some developing countries (31,32) which, apart from supplying a major risk factor for cardiovascular diseases, has a serious impact on the capacity of those countries to produce nutritious foodstuffs for their own populations or use the produce for foreign exchange. Zimbabwe relies so heavily on tobacco cultivation that most of its foreign earnings are derived from this source (33).

Cigarette consumption has increased by more than 40% in Africa over the past two decades; this trend has been attributed to urbanization and its strong influences such as advertising; loss of traditional cultural beliefs, attitudes, and practices; adoption of westernized so-called modern lifestyles; and the dumping of tobacco products in developing countries (34,35).

Hypertension has been shown consistently to be the commonest cardiovascular disorder in Africa (36). Obesity is a significant risk factor and, in Africans, is generally commoner in women than in men (27,37); rates of 8.3% for men and 35.7% for women have been reported in Nigeria and rates of about 50% for females have been found among some Bantu populations in South Africa (38,39). Diabetes is now an important problem in African countries and prevalence rates of impaired glucose tolerance in some sub-Saharan populations have been reported to be as high as 9% in males and 10–16% in females (40).
BAHRAIN

To the early 1960s, Bahrainis were heavily dependent on rice and fish as the main traditional foods eaten at lunch and supper, and sometimes at breakfast; dates were the main sweets, consumed either with lunch or between meals with Arabic coffee; buttermilk ("laban") was the main dairy product, consumed with fresh fruit, and vegetables were eaten widely (41–45). Similar patterns existed in other Arabian Gulf countries, such as Oman, where the diet consisted mainly of rice, bread, fish, and dates (46).

There have been many marked changes in food consumption patterns in Bahrain since the early 1970s, in the wake of the financial impact of the Middle East oil boom and the newly found affluence and the socioeconomic changes that brought to the region (44). From 1970 to 1984, the per capita consumption of rice declined by more than 12% (see Table 3) and there were large increases in consumption of red meat, poultry, fish, and vegetable oils. In general, there was an increase in consumption of all food items (except wheat and rice), and the daily consumption of energy increased by 36% (2080 to 2829 kcal) during the period 1970–1980 (44). Soft drinks and carbonated beverages have replaced traditional drinks, like "laban," in many parts of the Middle East (43).

The main trends have been toward Bahrainis eating more expensive, processed, and convenience foods including frozen vegetables and poultry; the country has become very dependent on imported foods, which represent 90% of the total food consumed (44). These trends have seen the consumption of much more high-protein foods such as meat, poultry, eggs, and fish; the daily per capita intake of animal

| TABLE 3. Changes in annual per capita consumption of food products in Bahrain between the early 1970s and early 1980s (from refs 44 and 47) |
|------------------------|------------------------|------------------------|
| Food               | Consumption (kg) in 1970–1972 | Consumption (kg) in 1982–1984 | Percent change |
| Cereals (total)     | 148.8                  | 161.9                  | + 8.8          |
| Wheat               | 68.2                   | 63.1                   | - 7.5          |
| Rice                | 72.7                   | 63.7                   | -12.4          |
| Potatoes            | 18.4                   | 25.7                   | + 39.7         |
| Pulses              | 4.8                    | 7.1                    | + 47.9         |
| Vegetables          | 42.7                   | 108.5                  | +154.1         |
| Fruit               | 111.2                  | 115.1                  | + 3.5          |
| Sugar               | 26.4                   | 31.0                   | + 4.5          |
| Vegetable oils      | 1.6                    | 18.9                   | +1081.3        |
| Red meat            | 22.6                   | 39.8                   | + 76.1         |
| Chicken             | 7.7                    | 29.4                   | +281.8         |
| Fish                | 3.2                    | 18.2                   | +468.8         |
| Eggs                | 7.1                    | 13.2                   | + 85.9         |
| Milk                | 43.3                   | 186.9                  | +331.6         |

From Musaiger AO (44), and the Arab Organization for Agricultural Development (47).
DIETARY CHANGES IN TRANSITIONAL SOCIETIES

protein almost doubled from 1970 to 1980 whereas dietary fiber intake has declined and the average intakes of fat and oil almost doubled in the 1980s (44). The mass media, particularly television advertising, have had a major impact on food habits, particularly with housewives. Disease patterns have changed dramatically; infectious diseases and severe malnutrition have declined sharply in Bahrain over recent decades; the main public health problems now are those that are characteristic of developed countries: cardiovascular disorders, diabetes, obesity, and cancer (44). Similar changes have occurred in other countries in the Arabian Gulf region and other parts of the Middle East that have experienced rapid socioeconomic changes over recent years, particularly in cities and towns and among the wealthier parts of their populations (43).

PIMA (AMERICAN) INDIANS

The Pima Indians lived in the Sonoran Desert of Arizona for at least 500–1000 years as farmers, hunters, and food gatherers; they had a canal system of irrigation that allowed them to grow wheat, maize, beans, and squash (48,49). They hunted for deer, rabbits, and birds, fished from the Gila River, and gathered desert foods like cactus buds and fruit, mesquite beans, wild berries, and wild greens (49). The area became more settled in the 1880s and diversion of the upper reaches of the Gila River disrupted their farming; they became reliant on trading posts and government food programs and, eventually, very little of their food came from subsistence farming, hunting, or gathering (50,51). The carbohydrate content of the Pima diet declined from 70–80% in traditional times to approximately 44% in recent times, whereas the proportion of fat in the diet has increased markedly from 8–12% to about 40% (49, and see Table 4). As already mentioned, NIDDM is very prevalent among these people (14,21).

INUUVIALUIT PEOPLE OF NORTHWEST TERRITORIES, CANADA

The economy of these traditional people who live in the MacKenzie River Delta near the Arctic Coast (at 68° North, 135° West) at the edge of the treeline is based

<table>
<thead>
<tr>
<th>Period</th>
<th>Carbohydrate</th>
<th>Fat</th>
<th>Protein</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>70–80%</td>
<td>8–12%</td>
<td>12–18%</td>
<td>48</td>
</tr>
<tr>
<td>Early 1950s</td>
<td>61%</td>
<td>24%</td>
<td>15%</td>
<td>49</td>
</tr>
<tr>
<td>Early 1970s</td>
<td>44%</td>
<td>44%</td>
<td>12%</td>
<td>50</td>
</tr>
<tr>
<td>1989</td>
<td>47%</td>
<td>35%</td>
<td>15%</td>
<td>C. Smith, unpublished data, cited in ref. 49</td>
</tr>
</tbody>
</table>
on hunting, trapping, fishing, some handicrafts, transportation, oil and gas exploration, and tourism (52). These people still depend heavily on traditional food resources, which include caribou, beluga whale, muskrat, hares, whitefish, other fish, birds (including geese, ducks, and swan), berries, and roots. Many of their traditional meats are high in iron, protein, and B vitamins; furthermore, marine fats are unique among dietary fats and differ from terrestrial animal fats, in their high levels of n-3 fatty acid, a type of polyunsaturated fatty acid that appears to offer some protection from ischemic heart disease (53). These people, including their children, prefer their traditional foods except for apples and canned fruit; however, children like store-bought foods more than adults do (52).

ASIA

There have been very significant improvements in child health standards in the Asia-Pacific region over recent decades, particularly in the 50 years since the end of the Second World War (54). In Japan, for example, the infant mortality rate fell from >150/1000 live births in 1900–1920 to 4.6/1000 live births today (see Fig. 1), which is said to be the world’s lowest (55). This has coincided with rapid industrialization, urbanization, increased per capita income, improved standards of living, hygiene, and nutrition, as well as the development of sophisticated medical care and maternal and child health surveillance systems (55). Over the same period the Japanese community has become very market-oriented and consumer-driven, much as in the West. The dramatic decline in infant mortality in Japan was accompanied by improved maternal mortality (176/10^5 live births in 1950 to less than 11/10^5 live births in 1989); there has also been a remarkable secular trend in growth of Japanese children in recent years which reflects their altered dietary patterns and nutritional status. In 1980, for example, infant boys were 130 g heavier and infant girls 160 g heavier at birth than was the case in 1960, whereas in 1980, 2-year-olds were 580 g heavier and

![Image](https://example.com/image.png)

**FIG. 1.** Infant mortality rate in Japan from 1880 to 1990. (Reproduced from J Paediatr Child Health, 1993; 29: 82–3, with permission)
2.5 cm longer (boys) and 790 g heavier and 3.2 cm longer (girls) than their predecessors 20 years previously (56).

Several other Asian countries are in “intermediate” phases of development and transition toward industrialization and urbanization; Thailand is a good example. Some of the demographic and social indicators for that country and national health markers are shown in Tables 5 and 6. Although there has been a significant increase in the total population, the pediatric proportion has declined, particularly under 10 years of age. School enrollment rates have improved (to well over 95% for primary school children by the late 1980s) and literacy rates for adults have increased rapidly since 1970 but large numbers of children (>8% under 14 years) and women (>45%) are still in the workforce. Health indicators for infants and young children are much better (see Table 6); infant and under-5’s mortality rates are down, immunization coverage rates have improved, and the prevalence of undernutrition in the under-5’s has been reduced. Thailand, like many other countries in rapid developmental transition, is experiencing massive urban population growth (3.6% annually) which

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**TABLE 5. Some demographic and social indicators in Thailand**

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Population (millions)</td>
<td>34.4</td>
<td>44.8</td>
<td>54.5</td>
</tr>
<tr>
<td>Age (% of total)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0–15 years</td>
<td>45.1</td>
<td>38.3</td>
<td>34.6</td>
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<td>15–24 years</td>
<td>18.6</td>
<td>22.2</td>
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<td>25–59 years</td>
<td>31.4</td>
<td>34.0</td>
<td>37.7</td>
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<tr>
<td>60+ years</td>
<td>4.9</td>
<td>5.4</td>
<td>5.9</td>
</tr>
<tr>
<td>Population growth (% per annum)</td>
<td>2.5</td>
<td>1.8</td>
<td>1.2</td>
</tr>
<tr>
<td>GNP ($US)</td>
<td>200</td>
<td>705</td>
<td>1000</td>
</tr>
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From Gracey M, Wong HB (54).

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**TABLE 6. Some health indicators in Thailand**

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<thead>
<tr>
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<tbody>
<tr>
<td>Crude birth rate (%)</td>
<td>31.5</td>
<td>23.2</td>
<td>16.0</td>
</tr>
<tr>
<td>Infant mortality rate (per 1000 live births)</td>
<td>74.6</td>
<td>54.8</td>
<td>42</td>
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<tr>
<td>Under-fives mortality rate</td>
<td>105</td>
<td>68</td>
<td>51</td>
</tr>
<tr>
<td>Malnutrition in under-fives (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First degree</td>
<td>35.6</td>
<td>28.5</td>
<td></td>
</tr>
<tr>
<td>Second degree</td>
<td>13.0</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>Third degree</td>
<td>2.0</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Maternal mortality rate (per 1000 live births)</td>
<td>2.3</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Life expectancy at birth (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>males</td>
<td>58</td>
<td>59</td>
<td>68</td>
</tr>
<tr>
<td>females</td>
<td>62</td>
<td>62</td>
<td>66</td>
</tr>
</tbody>
</table>

From Gracey M, Wong HB (54).
is having strong social impacts on the population in transition as well as putting enormous pressures on the physical and health-related infrastructures of those expanding cities (e.g., water supplies, provision of safe and reliable food supplies, and facilities and services for sewage and solid waste disposal).

Obesity is becoming recognized increasingly in children in the rapidly industrializing and newly affluent Asian countries in the Pacific basin such as Japan, Korea, Malaysia, and Singapore. These populations have had massive shifts toward urbanization and have experienced commercial pressures in the marketplace over recent years that have significantly displaced traditional food preparation and consumption patterns. In their place have come dietary patterns focused on "convenience" foods from supermarkets, out-of-home eating places, and "takeaways," some of which are part of very well-known international chains that often have close links with soft drink distributors. These influences are having powerful effects on dietary patterns in these places, particularly in cities and other large population centers and especially among children, adolescents, and young adults. These influences are likely to have significant medium and long-term impacts on the nutrition and health of those populations in future decades.

Indonesia is another very important and large Asian country that is undergoing rapid socioeconomic development; its population of about 180 million lives on an archipelago of almost 14,000 islands in Southeast Asia covering an area as large as Europe. It also is experiencing an increase in cardiovascular diseases and cardiovascular mortality, particularly in urban areas, and the limited available evidence implicates changing patterns of lifestyle, diet, and smoking (60% in males vs 6% in females) (57).

The People's Republic of China contains a fifth of the world’s population and is a developing country that has undergone rapid change over the past two decades. The birth rate has fallen markedly since the 1970s, the population is aging, and non-communicable diseases—mainly hypertension, stroke, and coronary heart disease—are now major health problems (58). Cigarette smoking, which is very prevalent in Chinese males, is considered to be a major factor.

The impact of changing dietary patterns and lifestyles on the nutrition and health of Asian populations is not confined to countries in the region. This is becoming an important consideration in countries like Australia, Canada, the USA, and in Europe, with large-scale Asian migration over recent decades. Ethnically, Asian children born in the United States are showing early obesity, which may be a warning indicator for the development of risk factors for cardiovascular disease in later life. For example, 271 U.S.-born Hmong children had mean weight-for-height z-scores that significantly exceeded National Center for Health Statistics at 3 and 4 years of age; there was more than a fourfold excess of Hmong children above the 95th percentile in weight-for-height at these ages. Interestingly, these findings were made in an ethnic group whose children were previously considered to be at low risk for obesity (59). This is consistent with the trend for Asian migrant children in Western countries or children from recently arrived Asian families who were born in a westernized country...
to experience significant changes in traditional dietary patterns with increasing acculturation, leading to increased consumption of Western foods including those high in fat (60).

Rates of coronary heart disease have been found to be higher in South Asians (Indians, Pakistanis, and Bangladeshis) settled in industrialized countries. Prevalence of ischemic ECG abnormalities was higher in South Asians \((n = 1515)\) compared with Europeans \((n = 1421)\) aged 40–69 years studied in a part of London (17% vs 12%); major Q waves were strongly associated with glucose intolerance and hyperinsulinemia in younger South Asians, and more detailed analysis of the results of this study suggested that insulin resistance underlies the high coronary risk in South Asian people (61), and although this is associated with central obesity, it seems, from one cross-sectional study, not to be simply explained by dietary patterns in these South Asians (62).

AUSTRALIAN ABORIGINES

Australia's Aborigines were the world's largest group of hunter-gatherers. They lived in isolation from the rest of the world for at least 40,000 years (63) and probably came to the island continent of Australia by a sea voyage of no more than 50–100 km from Southeast Asia when Australia and New Guinea were a joint land mass (64), before the end of the last Ice Age submerged the land bridge between New Guinea and what is now the northern tip of Queensland; the mainland of Australia also became separated from the island state of Tasmania to the south. There is radiocarbon evidence dating Aboriginal sites near Perth to about 38,000 years before the present time (65).

There may have been 250,000–300,000 Aborigines in Australia before European colonization a little over 200 years ago (66). For obvious reasons, little is known about their health before European contact (63); a study from the 1970s of 200 mostly nomadic Aboriginal men, widely distributed in remote parts of Australia, showed that their average height was 168.4 cm and their average weight 57.8 kg (67). A group of Aboriginal people newly emerged from the Great Sandy Desert in Western Australia a quarter century ago were described as "slimly built, sinewy featherweights" whose average height was 167.1 cm; only 3 of the 22 men examined weighed more than 56 kg (68). However, such information cannot be extrapolated to all other Aborigines because of their very considerable diversity and different resources, food supplies, and physical and geographic environments; in different localities on the vast Australian land mass, these range from tropical forests and coasts, to reverine and savannah environments, through harsh, hot, and arid deserts, to mild and moist wooded grasslands in the southern parts of the country (3,63).

The Aborigines were preagriculturalists at the time of European colonization in the late eighteenth century. Their food supplies were obtained by hunting and gathering and the availability or scarcity of food depended on the locality and season; in the interior of the country, food supplies were often scarce and the limited and
unpredictable water supplies were crucial to survival. Animal foods that were hunted included mammals (e.g., kangaroo, wallaby, possum, bandicoots, and bats), reptiles (e.g., crocodile, snake, goanna, turtle, and other lizards), birds (e.g., emu, parrots, bush turkey, and ducks), and fish in rivers and along the coast. Eggs of many of these creatures were important items. The men were the hunters of large animals like kangaroos and emus. Insects such as honey ants and wild bees provided bush honey that was much prized and is still popular in remote areas—this was an important carbohydrate source. Witchetty grubs are rich in fat with a similar composition to olive oil—these grubs are eaten raw or lightly cooked in the ashes of a small open fire on the ground. The fatty parts of animals such as goannas are very popular after they have been cooked whole on red hot coals on the ground and turned occasionally to cook the skin; this method is used for other animals, although in northern Australia food may be steamed while wrapped in leaves (or today in metal foil).

The seashore and river estuaries provided not only fish, sharks, stingrays, and dugongs, but crabs, oysters, mussels, other shellfish, and snails. Inland waters were very important for fish, yabbies, turtles, snakes, and birds as well as for plants such as water lilies.

The rich supply of plants the Aborigines used included fruits such as wild plums, apples, peaches, berries, figs, grapes, oranges, and desert bananas; the wild plum, *Terminalia fernandiana*, is the richest known natural source of vitamin C. There are also bush tomatoes and native vegetables such as carrots, onions, and bush potatoes. A variety of yams exists in different environments from the coast to the deserts. There is also a large range of nuts indigenous to Australia including the macadamia nut, *Macadamia*, and local chestnuts, walnuts, and almonds; these are most plentiful in Queensland (69). Seeds from bushes, such as mulga and acacia, and from grasses were painstakingly prepared and ground into a paste from which “damper” (a type of bread) was prepared by slow cooking or baking using the coals of an open fire (70). Damper, prepared with highly refined flour, is still widely used by Aboriginal people today.

In traditional times, hunting for animals that were available irregularly and had predominantly lean meats was very time consuming and required considerable effort; gathering of plant foods that were rich in vitamins, potassium, magnesium, and calcium but low in sodium, and the harvesting, gathering, and hunting of other mostly low-energy foods and small animals, also took much time and effort and was done largely by women and children; living off the land was a tough existence to which Aborigines adapted well and did so with a style of living that was rich in traditions, social structures, totemism, art, music, dancing, and magic (3, 71, 72). Traditional medicine was also an important part of Aboriginal life (69, 73).

Today, Aborigines comprise a so-called fourth-world community; these communities are characterized by their experience of being colonized, or of being a minority in relation to the dominant encompassing state. Many of these communities have been forced to assimilate, losing most of their land and their economic base, and therefore their autonomy (2). The fundamental changes that European settlement imposed on Aboriginal life led to a loss of control over their own destinies; they
became outcasts in their own country and excluded from the resources, wealth, and other advantages of the rest of the Australian population. Their lack of access to adequate housing, hygiene, education, and employment opportunities has had a serious negative impact on their health and well-being; changes in their diet and lifestyle have been integral parts of the process (2).

Most Aboriginal people now live in cities, their suburbs, regional centers, and towns in rural and remote areas; in those places their foods come from the mainstream suppliers including supermarkets, urban and town shopping centers, and “takeaways.” The rise of consumerism in major centers has been accompanied by a decline in breast-feeding (74). Even in remote areas, multinational and large national food, beverage, and tobacco companies are major suppliers to shops in small country towns, to roadhouses on main roads, and to Aboriginal community-run food stores, to the extent that many Aboriginal communities can be considered to be predominantly urbanized even in the “outback” (75). Traditional food or “bush tucker” is now a very small part of the diets of most Aboriginal people, except in some remote and remnant traditional areas or where it remains a popular occasional pastime (e.g., fishing and gathering shellfish).

The health of Aborigines compares very unfavorably with that of other Australians. Low birth weight is prevalent (76), and repeated or chronic infections and intestinal parasitic infestations are very common among infants and young children (77); these are often associated with growth faltering, failure to thrive, and sometimes frank malnutrition. Respiratory and gastrointestinal infections dominate early Aboriginal childhood, but urinary, eye, and skin infections are also important and are usually related to unhygienic living conditions (78). Despite intense efforts over recent decades, there has been little change in nutrition and growth of Aboriginal children in remote areas like the Kimberley region in far northwestern Australia (see Fig. 2), although there have been improvements in some more settled areas (79).

Nutrition-related disorders that affect adults are of increasing concern (80). Circulatory diseases are now the principal cause of death in Aboriginal men and women, who are 10 times more likely to die from these conditions than other Australians at about 40 years of age (81). Hypertension is common and seems to be related to alcohol drinking patterns and obesity (82), which in women characteristically has a central distribution (83). Non-insulin-dependent diabetes mellitus is now also a major problem (84) and appears to increase rapidly with acculturation, westernization of the diet, and increasing body mass index, which are accompanied by increasing rates of hypercholesterolemia and hypertriglyceridemia (80). Studies among apparently healthy 7- to 18-year-old Aboriginal children in the Fitzroy Valley and desert areas of northwestern Australia show that hyperinsulinemia and impaired glucose tolerance can be present for years before being “routinely” detectable (85).

Clearly, Australian Aborigines can be included in the list of more that 80 Aboriginal populations of many parts of the world whose nutrition and health have been profoundly affected by the influences of the New World (86). These rapid changes in diet and lifestyle of Aboriginal people and their effects on health have very important
public health and preventive implications, particularly for pediatricians, because of the origins of these degenerative diseases in childhood and adolescence.

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DISCUSSION

*Dr. Marti Henneberg:* Do you think that 100 or 200 years ago, cardiovascular diseases were less frequent in Aborigines than today?

*Dr. Gracey:* The strongest information we can obtain about health and disease in Aboriginal people before European contact is from skeletal remains (1,2). Some of this is quite interesting. For example, in the burial sites, of which there were many, there were large numbers of children's skeletons, suggesting high infant and child mortality. Some particular diseases, like yaws for example, can leave characteristic skeletal patterns. This is important in terms of the importation of infectious diseases; there is quite extensive evidence that after settlement in 1788, infections like smallpox, influenza, and typhoid came with European colonization (2,3). But we have no information about heart disease at that time. We do, however, have some information from more recent medical reports going back to the early years of this century; this shows that hypertension was virtually nonexistent in Aborigines up to the 1930s, and there are almost no reports of cardiovascular disease in Aborigines up to then (4). This is very similar to the reports about Native Americans in North America.

*Dr. Goulet:* Since the Aborigines were isolated on the Australian continent for more than 40,000 years, did they develop the same pattern and the same diseases as African people who stayed in Africa? I mean the same parasitic diseases, since the climate of central Africa may be close to the climate of western Australia? And did they develop leprosy?

*Dr. Gracey:* The question about migration of Aborigines to Australia is almost impossible to answer because the prehistoric evidence is limited and conjectural (2,5,6). There is some suggestive evidence from physical characteristics of Aboriginal people in comparison with some populations in southern and eastern Asia that they may have had partially common ancestry in the long distant past (2,7). The Aborigines are generally believed to have come from what is known as Sundaland in Southeast Asia (2).
The second question about patterns of infectious diseases in Aborigines in comparison to what occurs in different parts of Africa, I find difficult to answer because I am not very well informed about Africa, having not traveled there very extensively. However, I do know that many of the common tropical parasitic diseases which occur in Aborigines do also occur in African children; however, many are also quite different because climatic conditions and local features such as permanent water sources and disease vectors that can carry a parasitic infestation into a community and allow it to persist, vary so much from place to place. Those local conditions are very important in determining the likelihood of developing diseases in local communities. The third question about leprosy is very pertinent. Leprosy became prevalent among Aborigines in northern Australia in the nineteenth century. This disease may have been introduced into Australia from Asia in the 1870s, perhaps by pearlers and gold prospectors (6). It has now, by the way, been virtually eradicated.

Dr. Gruskin: To what do you attribute the development of hypertension in the Aborigines?

Dr. Gracey: I think there are several factors. Lifestyle factors are probably important (4); diet, alcohol, obesity, a sedentary life style, inadequate exercise, and high salt intakes. There may also be a biological predisposition among Aborigines.

Dr. Soriano: I would like to bring up the question of the interplay between nutrition and genetics. What about the genetic background of this population? For thousands and thousands of years, they ate no salt and very little fat. What is the genetic background that causes this population to be so sensitive to atherosclerosis when they increase their fat intake?

Dr. Gracey: Quite a lot has been published on this. It is very important to realize that Aborigines are not one homogeneous group of people. They covered a continent of 8 million km² and their total population before Europeans arrived in Australia was probably about 200,000–300,000. They lived in small groups down to about 30 or up to about 100 or 200 people; they had territories around which they traveled, hunted and gathered food, and developed their own languages. In those groups, there were, and still are to some extent, important patterns of social behavior and traditional beliefs, totems, and so on. And in those small groups of people there are also distinctive genetic characteristics, including the blood groups and white cell patterns.

I do not know whether any information has been published about genetic sensitivity to salt.

Dr. Gottrand: Could you give us information on breast-feeding in these children and why does the malnutrition begin so quickly, at 6 months of age?

Dr. Gracey: Breast-feeding is almost universal in these remote Aboriginal mothers for at least 2 years, but foods other than breast milk are also introduced, but the time of introduction varies. The generally poor hygienic conditions under which other foods are introduced encourage the transmission of infections (8). The introduction of infection, and particularly bacterial contamination of the upper intestinal tract and its effect on the absorption of nutrients, becomes part of this process. Some people call this "tropical enteropathy" which, I believe, is very important for children growing up under these conditions (9). It is most important that these infants and young children get clean food as well as breast milk.

Dr. Solarsh: We recognized very similar patterns to the ones you have been describing both in children and in adults. We have done a number of anthropometric surveys in the last 15 to 20 years, and in reviewing those surveys, certain patterns emerge. The obvious one is that there is a high level of stunting, of the order of 25–30%, which has been consistently present over 15 years. We also noted that the underweight-for-age index is substantially lower than that, probably of the order of 10%, and that the wasting rates as measured by weight-for-height generally tend to be minimal; usually around 0–4%. We have discussed this with
other people and it seems to be a pattern that is emerging elsewhere. It does seem to indicate that these children are relatively overweight for height. So they are stunted but they also appear to be relatively overweight for height. I would like to ask you whether this is a pattern that you recognize.

Dr. Gracey: Yes. Although we have a similar experience, I can't adequately explain it. I expect the reasons that these anthropometric patterns differ quite considerably from place to place, depending on the relative importance of dietary patterns, gastrointestinal infections/malnutrition, and other infections such as malaria, tuberculosis, and other respiratory infections. Certainly our experience is very much like yours. We don't have sufficient long-term data to know what the long-term consequences may be in relation to stunting, for example. I suspect that because the weight-for-height ratios are relatively intact, there would be a degree of long-term or permanent stunting in these populations until the background problems on which these conditions (malnutrition and infections) exist are overcome.

Dr. Garza: In looking at data from the world's published literature for infants who follow current feeding recommendations and live in affluent societies, it was surprising to us that fully and exclusively breast-fed children from traditional societies in India and Peru maintain weight for age until about 5–6 months if their growth patterns are compared to that of counterparts in affluent societies. If, however, we compare their growth patterns to those of the current WHO reference, their growth appears to falter by 3–4 months. Thus part of the stunting may reflect an inadequate reference. But perhaps more surprising was that length-for-age behaved differently. Faltering appeared to occur from birth onward if we used the growth of breast-fed infants as the basis for the comparison. So that stunting rather than being purely a postnatal phenomenon probably begins in utero in many societies with high rates of stunting. Whether this retardation in linear growth is a consequence of inadequate micronutrient utilization or transfer from mother to infant is not known, but it is probably the result of processes that begin during gestation. So when considering stunting, waiting until after the child is born may be too late; we need to intervene during gestation to achieve desired results.

My second point is to stress the diet's relentless effects on genomic expression. The Pima Indians in the USA offer a very valuable lesson. Their gene pool has not changed substantially, but in the last 100 years, dramatic changes in their phenotype has become evident. Thus, when we think about research needs for the next decade, it is important for nutrition science to move past the single gene–single defect model and to start to examine more critically the role of diet in the regulation of conditions determined by multiple genes.

Dr. Gruskin: What is known about vitamin D levels if anything, and secondly, is anything known about HLA typing?

Dr. Gracey: Some studies have shown that vitamin deficiencies (such as A, B, E, and C) and folate deficiency are prevalent in Aboriginal children and that urban Aboriginal children are at high risk of rickets (10–12).

The question of HLA typing is very important because of the effect of implications for tissue typing and HLA-typing protocols (13–15). In Arizona, there are hospitals for Pima Indians with renal failure requiring dialysis and renal transplantation. We are going through a similar process in Australia with Aborigines having high rates of chronic renal failure requiring dialysis and coming for transplantation. This is becoming very expensive and, of course, also very difficult to manage medically, socially, and administratively.

Dr. Canosa: If I understood you correctly, the peak of death due to hypertension is about 30 years of age. Why is it this age and why does it decrease so fast later on?
Dr. Gracey: The peak of cardiovascular disease mortality was not just due to hypertension; it was mostly ischemic heart disease, and these were relative rates rather than absolute rates, so the apparent fall after 50 years of age means that the death rates from ischemic heart disease in the non-Aboriginal population are catching up with the Aboriginal rates after 55–60 years of age.

Dr. Canosa: I realize the difficulties of getting data for the last 100 years, but based on the changes that modern society introduced in the diet of the Aborigines, what happened to the weight gain of the pregnant women and the low-birth-weight newborns? Do you have any explanation for it?

Dr. Gracey: The question of the proportion of low birth weight in Aboriginal pregnancies is very important from a public health point of view. The proportion overall is about double that of the rest of the population in Australia, but in some parts of northern Australia, the proportion is more than 25%; despite public health and nutritional interventions, it has been very difficult to bring that high proportion of low birth weight down. This is perhaps for the same sorts of reasons that we have had such limited success in improving growth rates in children in the first couple of years of life.

Dr. Fern: You mentioned that Aborigines now have houses but have difficulty adapting to live in them. How did they eat before and how do they eat now? Do they eat three meals a day or do they snack? The second question is what is the life expectancy of the Aborigines now, relative to 40 or 50 years ago?

Dr. Gracey: The meal patterns are really very variable. Food intake patterns depend on when food is available; there can be wide seasonal and day-to-day differences in what is consumed. When food was available, it was shared; Aboriginal people still tend to share in that way (6). I think it is impossible to answer your question on life expectancy because the retrospective information is not available. We have done some projections in Western Australia about life expectancy for Aboriginal people. We are winning the battle against infectious diseases in children, and the infant, and under-5 mortality rates have come down, so that there are many more survivors. But these are now dying of cardiovascular diseases, diabetes, gastrointestinal disorders, tobacco- and alcohol-related disorders (16), respiratory diseases, chronic renal failure, and as a result of accidents or violence (17).

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