

14 JAN 1982

UNDP/SPC Nutrition/WP1
9 November, 1981
Original: English
Conf. Reg. UNDP/SPC

SOUTH PACIFIC COMMISSION

THE EFFECT OF URBANISATION AND WESTERN DIET
ON THE HEALTH OF
PACIFIC ISLAND POPULATIONS

(Suva, Fiji, 7 - 16th December, 1981.)

by

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I. INTRODUCTION

A number of medical surveys undertaken during the 1960s and 1970s revealed an alarming prevalence of diabetes mellitus and other metabolic disorders in Pacific Island communities. It was recognised that these diseases were becoming major health problems and that steps should be taken to better define these disorders. The Seventh South Pacific Commission Conference on Health Services held in Port Vila, Vanuatu in 1976, recommended that health education activities be undertaken to deal specifically with the problem of diabetes and metabolic diseases. Consequently a joint South Pacific Commission and World Health Organisation Meeting on Metabolic Disorders with particular references to Diabetes and Gout was held in Nauru in 1978, to fulfill a part of this recommendation.

The Meeting participants, having reviewed prevalence rates and the problems associated with these diseases in the Pacific, expressed particular concern about the extraordinarily high rates of diabetes, gout and hypertension in certain areas in the region. High prevalence rates of these disorders appeared to be associated primarily with a movement away from a traditional way of life to a westernised lifestyle. Of great concern was the potential for these diseases to become even more critical with the continuing influence of urbanisation and westernisation in the Pacific. The Meeting therefore endorsed recommendations that it is hoped, would assist Pacific Island governments and agencies in determining approaches to deal with these current and emerging health problems. One of the recommendations suggested that:

"An expert multidisciplinary committee be established to investigate and report on the social, medical and economic impact of urbanisation and westernisation in the Pacific region".

At the same time, government officials and medical personnel were expressing concern about the growing practice of bottle feeding in place of breast feeding in the Pacific. Increased rates of infant gastroenteritis, respiratory disease and malnutrition were associated with the replacement of breast milk with artificial milk formula.

The United Nations Development Programme was approached by the South Pacific Commission in 1978 and UNDP kindly provided funds to investigate the impact of western diets and urbanisation on the health of Pacific Island populations. The project commenced in early 1981 with the development objective:

'To bring about improved food utilisation practices and better nutrition by helping communities to be aware of the changes taking place and their consequences and then provide them with the knowledge needed to seek solutions for themselves'.

The objectives of the Project are:

- (i) to compile and identify possible gaps in the existing knowledge of nutritional and dietary problems in the Pacific Islands;
- (ii) to co-ordinate research activities to fill in the gaps;
- (iii) to create more awareness in the Pacific Islands of their growing nutritional problems;
- (iv) to assist governments and administrations in the region to formulate food and nutrition policies;
- (v) to identify training needs and assist with the organisation of educational programmes at the regional or national levels.

The following interim report is in partial fulfillment of these objectives. The report examines existing statistics, surveys and reports and attempts to delineate the effect of western lifestyle and diets on health status and identify areas in which knowledge is incomplete.

The report will be circulated among government officials, medical and nutrition specialists and interested individuals, agencies and organisations involved in health and agricultural matters in the Pacific. Comments and recommendations will be sought from these individuals and agencies. The report will also serve as a working paper for a Regional Meeting on the effects of urbanisation and western diets on the health of Pacific Island populations to be held in Suva, Fiji, 7-16 December 1981.

At this meeting, government participants and consultants in the areas of health, nutrition, agriculture, economics, anthropology and migration will, it is hoped, develop recommendations to assist Pacific Island governments to formulate food and nutrition policies aimed at the improvement in and/or preservation of the health and well-being of Pacific Island peoples.

II. SUMMARY

This discussion paper reviews some of the existing data on the health of Pacific Island populations as it is, or may have been, in traditional-living island groups with comparisons to people presently living a "western" way of life in towns and cities in the Pacific. The major generalisations and/or suggestions which emerge from this comparison include:

1. Traditional living Pacific Island people were in general robust, physically fit, active and relatively free of nutritional deficiencies or disorders.
2. Infant and child mortality in the traditional life style was probably high and life expectancy may have been short.
3. The prevalence of chronic degenerative diseases such as diabetes, hypertension, gout and ischaemic heart disease is low among traditional living peoples.
4. The past four decades have brought rapid and dramatic changes to the Pacific. Population increases, economic development, movement into towns and cities, decrease in subsistence agriculture, and greater reliance on imported foods, have been of major social and economic importance.
5. The dietary pattern of "westernised" groups has changed from one predominantly of root vegetables, coconuts and fresh fish to one consisting of rice, bread, tinned fish and meat and sugar.
6. The major nutritional differences between the westernised diet and the traditional diet include increases in energy (calories), sugar, salt, fats of animal origin and alcohol and a decrease in fibre.
7. The prevalence of chronic degenerative diseases such as diabetes, hypertension, obesity, ischaemic heart disease and gout are currently reaching epidemic proportions in towns and cities in the Pacific.
8. The major causative factors in relation to these diseases include a genetic predisposition combined with environmental factors such as obesity, decrease in physical activity and diet.
9. The dietary factors which may be predominant factors in the development of these chronic diseases include increased energy, salt, animal fat, sugar, alcohol and a decrease in fibre and perhaps some trace minerals.
10. Infant and child malnutrition, while probably mild in traditional groups, appears to be increasing in severity in recent years. An increase in the incidence of kwashiorkor and marasmus has been noted in urban centres.
11. Many Pacific Island countries are taking steps to deal with the effects of urbanisation and western foods on the health of these people. These efforts include increasing emphasis on rural development and food production and the establishment of national food and nutrition policies.

III. HISTORICAL BACKGROUND

Hundreds of years before the islands of the Pacific were known to Europeans, they were settled by diverse peoples who have maintained their cultural differences down to the present day. Some 40,000 years ago hunters and gatherers from Indonesia somehow succeeded in sailing deep seas to settle in New Guinea and Australia. The islands of New Britain, New Ireland and perhaps the Solomon Islands were inhabited no later than 6,000 years ago.

These early explorers and settlers brought with them domestic pigs, dogs and chickens as well as cultivated crops such as rice, taro, yam and sugar cane. Archaeologists have found evidence of elaborate ditches constructed to drain highland swamps in Papua New Guinea. These are thought to have been in use 6,000 to 9,000 years ago for the purpose of taro cultivation (Bellwood, 1980).

4,000 years ago, Melanesian cultures were established in New Caledonia and Vanuatu. At about the same time, Micronesia may have been settled by peoples moving from the Philippines. Another group of people, the Lapita, thought to have come from eastern Indonesia or the Philippines colonised Tonga and Samoa approximately 3,000 years ago. The Lapita people were skilled mariners, practiced horticulture, caught fish, produced pottery and were highly successful colonisers of virgin islands. By 300 to 400 AD these early Polynesians had discovered and settled the Marquesas Islands and Easter Island.

Thus for hundreds of years before Europeans ventured into the Pacific, the islands were inhabited by peoples who were physically and culturally quite different and who had developed complex social, religious, economic and navigational systems. The different races of people and the areas they settled in the Pacific are generally divided in three groups; Micronesians, Melanesians and Polynesians as shown in Figure 1.

Micronesian means "people of the small islands." Micronesians are generally copper-skinned, thin lipped, have relatively straight black hair and are of comparatively short, slight build.

They settled in the Marianas, the Carolines, the Marshalls and the Kiribati islands.

Melanesians take their name from the Greek melas, meaning black and nesos meaning islands; "black islanders".

The Melanesians entered the Pacific by way of Papua New Guinea and then to the Solomons, Vanuatu and New Caledonia. Some reached as far as Fiji. Physically, the Melanesians are very dark skinned and have negroid features and hair. Melanesians seldom live on atolls but most often on volcanic mountainous islands.

Polynesian means "many islands" stretching from Hawaii to New Zealand and from Tuvalu to Easter Island. Polynesians were the last race to enter the Pacific and the most skilled navigators. They are a tall people with intimidating physiques, golden, light skin, straight or

wavy black hair and fine features. At least 150 years before Europeans entered the Pacific, Polynesians had explored as far south as New Zealand's South Island, north to Hawaii and as far east as Easter Island, 13,000 km from where it is believed they first entered the Pacific.

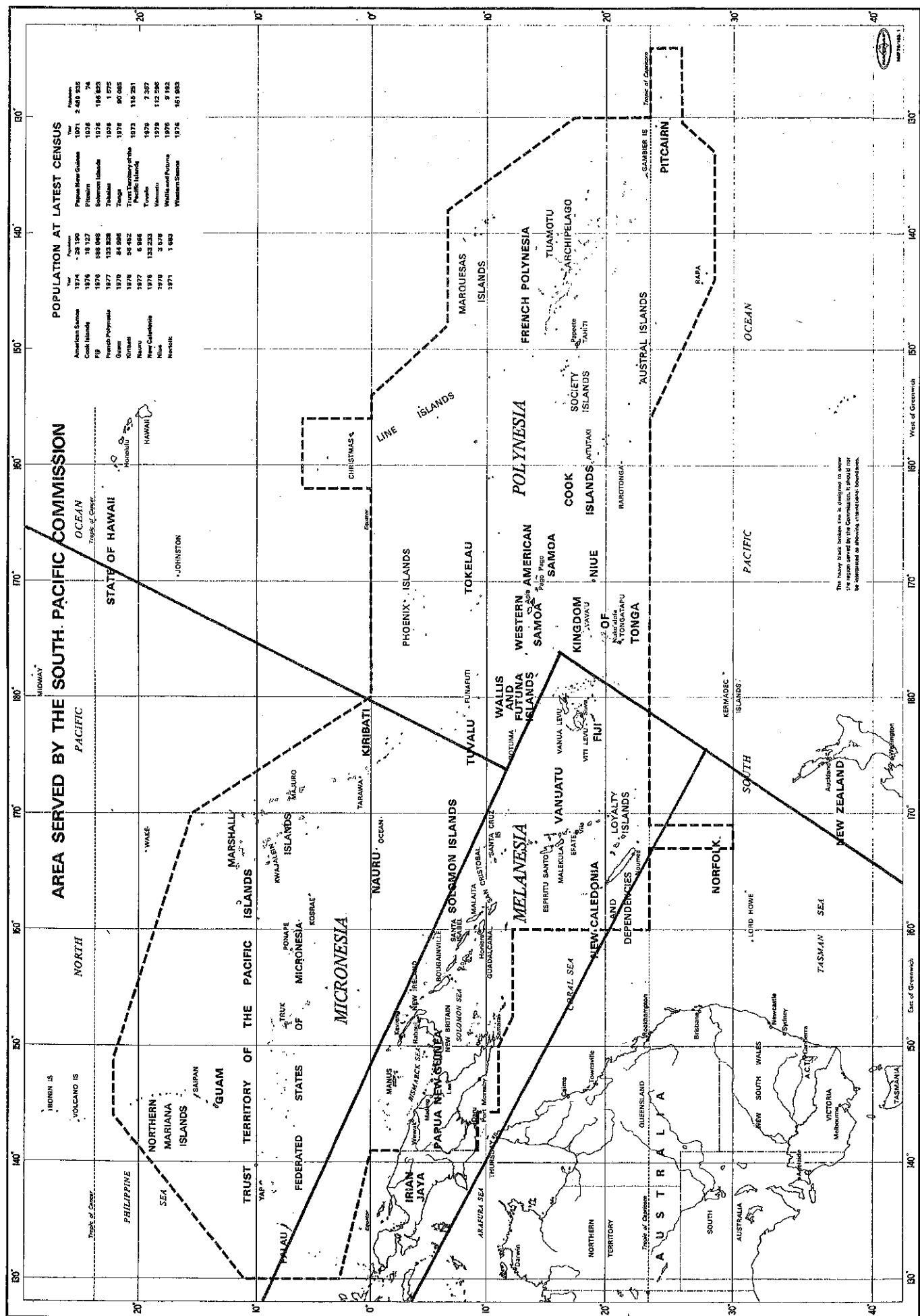


Figure 1.

EUROPEAN EXPLORERS

Spanish and Portugese explorers were the first Europeans to navigate the Pacific. Magellan, Quiros and Mendana during the 16th century travelled to islands in Micronesia, Guam, Saipan and Rota and in Polynesia, the Cook Islands, and in French Polynesia.

During the latter part of the 18th century, English and French navigators sailed throughout the Pacific claiming and naming many of the islands for their European sovereigns. In 1768, Captain de Bougainville landed on islands in Tahiti, Vanuatu, Western Samoa and spotted New Caledonia.

Captain James Cook on three voyages between 1768 and 1780 visited Tahiti, Tonga, the Cook Islands, Vanuatu and New Caledonia. Cook vividly described the physical appearance, health, food habits, and cooking methods of the inhabitants of the islands he visited (Beaglehole, 1968).

TAHITI

Description of King Georges Island:

"With respect to their persons, the men in general are tall, strong limb'd and well shaped, one of the tallest we saw measured six feet 3 inches and a half, the superior women are in every respect as large as Europeans but the inferior sort are in general small owing possibly to their early amours which they are now addicted to than their superiors".

"They have all fine white teeth".

"Not only fish but almost everything that comes out of the sea is eat and esteem'd by these people,they have hogs, fowls and dogs (next to an English lamb)".

"When any of the chiefs kill a Hog it seems to be almost equally divided among all his dependants and as these are generally very numerous it is but a little that comes to each persons share, so that their chief diet is vegetables and of these they eat a large quantity".

"Cooking seems to have been little studied, here they have only two methods of applying fire, broiling and baking as we call'd it.....and I am of the opinion that Victuals dress'd this way are more juicy and more equally done than by any of our methods, large fish in particular".

"To this plain diet salt water is the universal source, hardly anyone sits down to a meal without a cocoa nut shell full of it standing by them into which they dip most of what they eat, especially fish, drink at intervals large supps of it out of their hands, so that a man may use half a pint at a meal".

TONGA

".....They seem to be as free from disease as any Nation whatever, I neither saw a sick or lame person among them, all appeared healthy and strong a proof of the goodness of the climate in which they live".

"They have fine eyes and in general good teeth even to an advanced age".

NEW CALEDONIA

Melanesians of New Caledonia:

.... It's inhabitants..."are strong, robust, active, well made people".

"Are a much stouter race (than the people of Tonga) some were seen to measure six feet four inches".

COOK ISLANDS

"It seemed to be mostly covered with trees amongst which were the breadfruit and cocoanut and our friend told us they had plantains and the tarro root but no yams, Hogs or Dogs. Such articles as the island produceth must be in great plenty as the Inhabitants seemed to be both numerous and wellfed; the men are stout, active and well made....."

"The inhabitants of Wautieu were thought....to be as fine a race of people as any they had seen in this sea and in general stouter and fleshier".

"tendency of the inhabitants here to corpulency...."

"Many of the young men were perfect models in shape....others who were more advanced in years were corpulent and all had a remarkable smoothness of the skin". (Beaglehole, 1968).

While the physical condition of traditional living Pacific Islanders was described as robust and fit, the life span may have been short. Estimates of the average age at death of adult New Zealand Maoris before 1769 seems to have been about 30 years (Houghton, 1978). Studies of the skeletons of early Maoris have revealed no clear evidence of malnutrition, yaws, leprosy, tuberculosis or gout. There was evidence of asteroarthritis, atheroma and cancer (Houghton, 1978)..

Introduction of Disease

By the beginning of the 19th Century other adventurers had reached the Pacific. British and American whalers cruised the islands in vast numbers. In 1840, there were 500 American whaling vessels operating in the Pacific and by 1850, whales were becoming scarce. Sandlewood traders had cut all of Fiji's accessible sandlewood by 1814, but continued logging in New Caledonia and Vanuatu for another 20 to 30 years.

The first recruitment of native labour, "Blackbirding", was made by whaling ships in Vanuatu and then by the sandlewood cutters for the sugar and cotton plantations of Queensland and Fiji. By 1876, Vanuatu had provided over 13,00 recruits, about 9,000 I-Kiribati were working overseas in the 1860s and the Solomon Islands had lost almost 30,000 men by 1911. Labour recruitment brought high mortality. Disease spread amongst the recruits, killing many. Those who returned to their home islands, brought diseases with them.

Pacific Islanders had little resistance to the new diseases brought by European explorers and trading vessels. Epidemics of influenza, measles, tuberculosis, dysentery and whooping cough spread quickly, wiping out thousands of islanders. A measles epidemic in the southern islands of Vanuatu in 1866 killed thousands of ni-Vanuatu. In 1875, a measles epidemic reduced the population of Fiji by one-third. A ship known to be carrying Spanish Influenza was allowed to enter Apia, Western Samoa, in 1920. This error caused the death of 8,500 people, 22 per cent of the population of Western Samoa.

A 1948 United Nations Report of the epidemic in Western Samoa concluded:

"It ranks as one of the most disastrous epidemics recorded anywhere in the world during the present century, so far as the proportion of deaths to the population is concerned". (Carter, 1981).

Thus, by the beginning of the 20th century, the populations of many Pacific Islands had been drastically reduced as a result of introduced diseases, to which the indigenous people had little resistance, and the practice of "blackbirding". William Ellis (1853) of the London Missionary Society in his account entitled Polynesian Researches noted:

"The diseases formerly prevailing among the South Sea Islanders were comparatively few; those from which they now suffer are principally pulmonary, intermittent and cutaneous. The most fatal are, according to their account, of recent origin". (Ellis, 1853).

RECENT HISTORY

The decline in population in the Pacific Islands during the nineteenth century was not arrested until the early decades of the twentieth century when public health programmes were introduced. Infant and adult death rates fell and the rates of natural increase rose until the 1950s to between 3 and 3.5 per cent per year (Ward and Hau'ofa, 1980).

World War II had an enormous impact on the Pacific. This increased contact with western societies brought new technology, economic development, improved communications and a general trend toward a cash economy. The large number of military installations also brought with them imported foods for their military personnel and the island people who took jobs with them. By 1953, candy and chewing gum were already having an effect on the teeth of American Samoan children whose parents held jobs with the U.S. Naval base at Pago Pago (Neubarth, 1953).

During the 1960s and 1970s the rate of population increase had risen in some areas and declined in others. In Papua New Guinea and the Solomon Islands, population growth was at a rate of over 2.5 per cent per annum. The rate of population increase has fallen in the last decade in the Cook Islands, Western Samoa and Tonga due mostly to emigration to New Zealand and to a lesser extent to the United States. Land shortages and the inability to obtain an acceptable level of cash income are considered the main causes of out-migration in many of the Pacific Islands. The decline in the growth rate in Fiji is mostly due to the increase in the use of birth control techniques, later age of marriage and changes in attitudes towards family size. These same changes may also be occurring in Kiribati (Ward and Hau'ofa, 1980).

TABLE 1. Proportion of Total Population of Pacific Island countries enumerated in urban areas

| | Year | Total Population | Per Cent Urban |
|------------------|------|------------------|----------------|
| American Samoa | 1974 | 27,279 | 39.2 |
| Cook Islands | 1976 | 18,128 | 29.4 |
| Fiji | 1978 | 612,046 | 35.6 |
| French Polynesia | 1977 | 137,382 | 16.7 |
| Kiribati | 1978 | 18,116 | 32.0 |
| Nauru | 1979 | 7,700 | NA |
| New Caledonia | 1976 | 133,033 | NA |
| Niue | 1979 | 3,578 | 26.8 |
| Papua New Guinea | 1971 | 2,435,409 | 11.1 |
| Solomon Islands | 1976 | 196,823 | 8.0 |
| Tokelau | 1978 | 1,565 | NA |
| Tonga | 1976 | 90,128 | 30.1 |
| TTPI | 1980 | 136,500 | NA |
| Tuvalu | 1979 | 9,000 | NA |
| Vanuatu | 1975 | 96,532 | 28.8 |
| Western Samoa | 1976 | 151,982 | 21.1 |

The past several decades have also seen a dramatic shift of population to urban centres. The average per cent of annual rate of increase in urban areas from 1966 to 1976 in Fiji, Kiribati, Solomon Islands, Tonga and Western Samoa was between 1.2 to 4.5 per cent. Table 1 lists the proportion of the population of Pacific Island countries in urban areas (Carter, 1981; Ward and Hau'ofa, 1980).

The high rates of movement to, and the proportion of populations in urban centres suggests that towns offer better opportunities than do rural areas and that it is unlikely that this trend will reverse in the foreseeable future.

The trend to urban areas has been accompanied by a change in agricultural practices and food habits. Pacific Island people living in towns are most often employed and do not have the time for fishing or hunting or the land to grow traditional crops. It is therefore more convenient to purchase fish or meat. Rice and flour are also more convenient than root vegetables. They are often cheaper, easier to transport, take less time to prepare and are less perishable.

The diversion of labour and land to cash crops and cattle raising has meant a reduction in the availability of traditional food crops and thus a greater need for imported foods. If family income is sufficient and the range of nutritional imported foods is available, the individual, family and country may benefit. This does not, however, appear to be the case in many parts of the Pacific. Incomes still tend

to be low, the availability of a nutritious diet of imported foods limited and the cost of these foods is high.

IV. CHANGES IN DIETARY PATTERNS FROM TRADITIONAL TO PRESENT DAY DIETARY PATTERNS

The growing contact with the western world and increased urbanisation is rapidly and dramatically changing food habits in the Pacific. These changes in nutritional patterns are thought by many (Ringrose, 1979; Rody, 1978a; West, 1978; Delebecque, 1980; Zimmet, 1979) to be wholly or partly responsible for the increased rates of chronic diseases.

Traditional Dietary Patterns

Food habits throughout the Pacific differ widely particularly between atolls island or coastal groups and volcanic island groups. Turbott (1949) gives an excellent description of traditional dietary patterns on the atoll islands of Kiribati. His information was collected from "consultations and observations with the old men" on Tarawa Island and Abemama and is shown below:

Average Daily Diet

| | |
|--|----------|
| Moimoto (drinking coconuts) | 2 nuts |
| Ben (ripe coconut) | 2 nuts |
| Riki (germinating coconuts) | 1.5 nuts |
| Babai (taro root) | 1.5 lbs |
| Mai (breadfruit) | .5 lbs |
| Ika (fish, cleaned) | 1.5 lbs |
| Karewe (fresh toddy, mixed) | .25 lbs |
| Kamaimai (molasses made from fresh toddy) | .75 lbs. |

Coconuts in various stages of development form a major part of the traditional atoll diet. Green nuts are used for drinking and the soft flesh is popular for both infants and adults. The germinating nut is split and the "coconut apple" removed. This is eaten raw, or is boiled. The ripe nuts are grated and eaten with fish or sugar. The grated coconut can be squeezed so that the 'coconut cream' is extracted, or water can be added to grated coconut and the 'coconut milk' extracted by squeezing. An average of 115 ml or 3.8 fluid ounces of cream is extracted from one coconut (Murai, 1958). Parkinson (1954) estimated that the average adult Cook Islander used 3 to 4 coconuts daily. Massal & Barrau (1980) suggested that 5 to 6 nuts per person/day was the highest recorded on the atolls. The nutrient values for coconuts in various forms is shown in Table 2.

If as much as 400 grams of mature coconut (the flesh of 2 average coconuts) were consumed daily, this would contribute a large portion of energy needs, about 25 per cent of protein requirements, about 70 per cent of iron and 30 per cent of niacin recommendations (Murai et al, 1958). The fibre content can range from 3.5 to 4.5 gm, per 100 gram. 400 grams of coconut meat would therefore provide a very high intake of fibre. Coconuts are also excellent sources of potassium. While 1/3 of phosphorous needs could be supplied, amounts of calcium, thiamin and riboflavin would be small.

Drinking coconut or coconut water, provides small but natural amounts of energy, calcium, iron, phosphorous, niacin and vitamin C. If the soft young flesh is eaten, small amounts of thiamin, riboflavin and fibre are also provided as well as additional energy protein, fat and iron. Young soft coconut flesh is a common first food and weaning food for infants. Drinking coconuts are recommended for the treatment of infantile diarrhea due to the composition of potassium and other electrolytes (Brewster, 1979).

The coconut toddy is highly recommended for infants and children particularly as a source of vitamin C. The toddy also contains small amounts of thiamin, niacin, riboflavin, iron and energy.

Babai, taro root and other root crops are widely used throughout the Pacific. They were prepared in numerous ways, baked, boiled, mashed, dried and often combined with coconut milk. Table 3 shows that root crops in general tend to be slightly lower in protein than cereals but much higher in calcium, iron, vitamin C and fibre.

Breadfruit was eaten in considerable quantity on many atolls and coastal regions. It is prepared by baking in hot coals, boiled, dried or prepared into a pudding with palm syrup and/or coconut (Parkinson, 1953).

Bananas, pandanus nut and some green leaves, also supplement the diet.

Seafoods provide the mostly widely available source of animal protein which appears to be more than adequate on traditional atoll islands. Fish was often eaten raw or wrapped in leaves with coconut cream and baked. The livers from all deep sea fish were eaten as well as those of pigs, domestic fowls and sea birds.

TABLE 2. Nutritive value of Coconut

| Composition per 100 grams edible portion of various forms of coconut (Jardin and Crosnier, 1975) | | | | | | | |
|---|---------------|----------------|---------------------|-----------------|------------------|------------------------------|-------|
| | a | b | c | d | e | f | g |
| | Young meat | Mature meat | Drinking coconut | Coconut milk | Coconut cream | Sprouted Coconut apple | Toddy |
| Kilocalories | 105 | 351 | 22 | 252 | 346 | 80 | 48 |
| Kilojoules | 439 | 1469 | 92 | 1054 | 1448 | 335 | 201 |
| Protein (g) | 1.4 | 4.2 | .3 | 3.2 | 4.33 | 1.3 | .2 |
| Fat (g) | 9.1 | 34.0 | .2 | 25.0 | 34.7 | 4.1 | .4 |
| Fibre (g) | .7 | 3.3 | NA | NA | NA | .8 | NA |
| Carbohydrate (g) | 6.0 | 13.0 | 4.7 | 5.2 | 6.0 | 110.3 | 11.4 |
| 10.3 | | | | | | | |
| Calcium (mg) | 6 | 9 | 30 | 16 | 11.0 | 19 | .4 |
| Iron (mg) | .9 | 1.7 | .33 | 1.6 | 2.3 | .7 | .2 |
| Vitamin A (mcg) | 1 | 4 | NA | 3 | 4 | NA | NA |
| Thiamin (mg) | .02 | .06 | .00 | .03 | .03 | .02 | .01 |
| Riboflavin (mg) | .02 | .03 | .00 | .01 | .01 | .03 | .01 |
| Nicotinic Acid | 2 | 1.5 | .2 | 1.3 | 1.8 | 1.21 | NA |
| Vitamin C (mg) | .8 | 2 | 2 | 2 | 3 | 6 | 2 |
| Potassium (mg) | NA | 480 | 130 | NA | 324 | NA | NA |

- a) soft jelly-like layer in immature coconut
b) fully ripe nut, firm meat
c) drinking liquid of the immature nut
d) liquid made by grating mature nut, adding some of the fluid from the coconut and squeezing
e) liquid made by grating coconut and squeezing out liquid without adding any additional liquid
f) a ripe coconut which has sprouted, usually 3 to 4 months after falling to the ground
g) sap collected from the blossom or inflorescence. The flower spathe is tightly bound before the blossom opens, cutting off the tip. The sap is collected 2 or 3 times each day, cutting a little off the spathe each time. Approximately 0.65 litres per tree per day is collected (Murai et al, 1958). Toddy is drunk fresh or fermented.

TABLE 3. Composition of some staple Pacific Island foods.

Composition per 100 grams+

| Food and Measure | Kcals | Protein (gm) | Calcium (mg) | Iron (mg) | Vit.C (mg) | Vit.B (mg) | Ribo- flavin (mg) | Fibre (gm) |
|---|-------|-----------------|-----------------|--------------|---------------|---------------|-------------------------|---------------|
| Taro (colocasia) - 1/2 cup | 102 | 1.8 | 51 | 1.2 | 8 | .10 | .03 | 1.0 |
| Sweet potato - 1 medium (patate douce) | 121 | 1.6 | 33 | 2.0 | 37 | .09 | .04 | 1.0 |
| Yam (pueraria) - 2x2x5 | 199 | 2.0 | 25 | 1.0 | 10 | .10 | .03 | .8 |
| Breadfruit (artocarpus altilis) | 109 | 1.5 | 28 | 2.0 | 31 | .08 | .05 | 1.8 |
| Cassava (manioc tubercule) | 146 | 1.2 | 33 | 0.7 | 36 | .06 | .03 | 1.3 |
| Bread, white, 4 slices | 243 | 7.8 | 14 | 1.0 | 0 | .13 | .08 | .3 |
| Flour, white, 10 tablespoons | 370 | 10.9 | 16 | 1.0 | 0 | .13 | .04 | .3 |
| Rice, white, 2/3 cup boiled | 107 | 2.0 | 7 | .2 | 0 | .03 | .01 | .1 |
| Rice, brown, 2/3 cup boiled | 120 | 2.3 | 11 | .5 | 0 | .09 | .02 | .2 |
| Potato - 1 medium | 82 | 2.0 | 8 | .7 | 10 | .10 | .03 | .4 |

+ Jardin, C. and Crosnier J. (1975)

Un Taro, Un Poisson, Une Papaye. South Pacific Commission, Noumea, New Caledonia

The traditional food pattern of volcanic island dwellers may be quite different from the atolls or coastal groups. As an example, in Papua New Guinea, the diet consisted almost entirely of vegetable staples; sweet potato, yams, taro, bananas and sago. Figure 2 compares a mountain village in Papua New Guinea in 1947 with the Australian diet of 1938 (Hipsley & Clements, 1947). In the traditional diet the quantity of meat and fish is extremely low, dairy products non existent and only small amounts of grains, legumes and greens were consumed. While the energy and protein intake of the diet is quite low compared to Caucasian standards, the vitamin intake appears to be quite adequate. The intake of minerals is adequate for adults but calcium may have been in short supply for children. Iodine deficiency was noted in localised areas in the Pacific (Hipsley, 1947).

Table 4 provides a summary of the nutritional composition of traditional diets in the Pacific. Appendix A gives a more detailed comparison of nutrient intakes of various traditional-living groups as collected by dietary surveys.

Figure 2. COMPARISON OF THE PERCENTAGE CONTRIBUTION BY WEIGHT OF VARIOUS TYPES OF FOODSTUFFS IN THE AUSTRALIAN & NEW GUINEA DIETS.

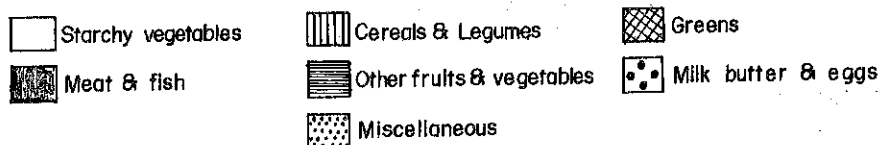
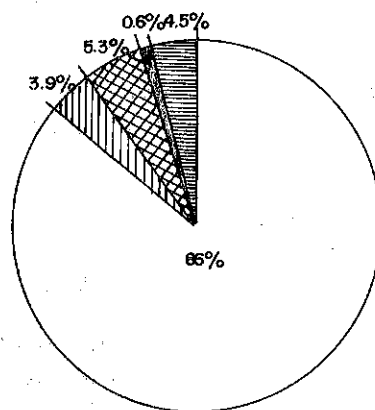
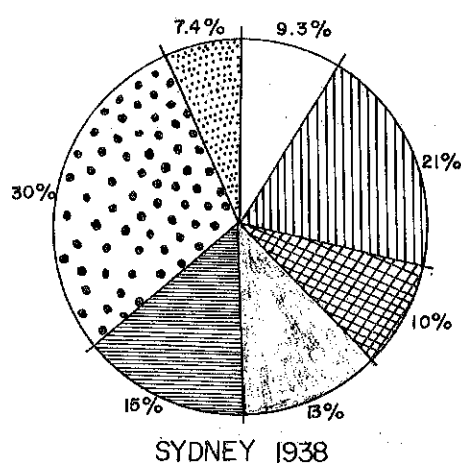


TABLE 4. Summary of the nutritional composition of
Traditional Dietary Patterns in the Pacific

ATOLL DWELLERS

MODERATE CALORIES
MODERATE TO HIGH PROTEIN
HIGH TOTAL FAT
HIGH SATURATED FAT
LOW CHOLESTEROL
LOW TO MODERATE TOTAL CARBOHYDRATE
LOW SUCROSE
LOW TO MODERATE SALT
MODERATE TO HIGH FIBRE

VOLCANIC ISLAND

DWELLERS

e.g. Papua New Guinea
Fiji

LOW CALORIES
LOW PROTEIN
VERY LOW TOTAL FAT
HIGH CARBOHYDRATE
LOW SUCROSE
VERY LOW SALT
HIGH FIBRE

In general the diet is often low to moderate in energy. Early studies by Parkinson (or Holmes - referred to hereafter as Parkinson) in Kiribati (1953), Langley in Fiji (1953), Walker in the Cook Island (1960), and Hipsley in Papua New Guinea (1947) found relatively low energy intakes among people living in subsistence agricultural economies. There is little evidence that these low intakes had any deleterious effect on adults but they may have been responsible for slow growth rates in pre-school age children. In Papua New Guinea, intakes as low as 1640 kcalories (6.8 MJ) per day were found among totally subsistent coastal dwellers. Regardless of the low energy intakes, the activities of both men and women were "associated with moderately high rates of energy expenditure". The villagers also exhibited a "very satisfactory degree of physical fitness" (Hipsley, 1965).

On the atolls protein intake appears to be moderate to high when compared to WHO recommendations for the Pacific (WHO, 1972). Intakes in Papua New Guinea, however, tend to be lower than recommended but there does not appear to be evidence of protein deficiency except among pre-school age children.

The proportion of energy which is provided by carbohydrate in the traditional diet tends to be relatively high, particularly for inland volcanic island dwellers; i.e. Papua New Guinea. The form in which the carbohydrate is eaten, however, may be more important than the amount. Throughout the Pacific, high fibre, starchy root vegetables such as taro, yams, sweet potato, cassava, arrowroot, form the major part of the diet.

The energy provided by fat was often low among inland or volcanic island people but quite high among atoll and coastal dwellers where as much as 89 per cent of the total fat comes from coconuts (Hunter, 1962). While the fat intake from animal sources was low, saturated fats from coconut was relatively high.

The fibre content of the traditional diet was probably quite high, although few surveys analysed the diets for fibre. Table 3 and Appendix A and B give an estimated crude fibre content of traditional and western foods and diets. If the survey provided information on the amounts of foods consumed, fibre was calculated on the basis of 1.5 grams of crude fibre per 100 grams of root vegetable. White bread, flour and white rice were calculated to provide 0.4 grams of crude fibre per 100 grams.

The traditional diet appeared to be adequate in vitamins and minerals. With the exception of endemic goitre, resulting from iodine deficiency, no signs of vitamin or other mineral deficiency were found in the 1947 Nutrition Survey Expedition into Papua New Guinea (Hipsley and Clements, 1947).

The diets on the remote island of Mitiaro in the Cook Islands met at least 75 per cent of Recommended Allowances; vitamin C and iron exceeding the requirements; calcium, vitamin A and riboflavin were lower than desirable. "These people seemed remarkably healthy; of good physique with clear skins and good teeth" (Walker, 1960).

TRADITIONAL INFANT FEEDING PRACTICES

All infants were breast fed well to the second year of life. Often mothers breast fed until she became pregnant or delivered the next baby; sometimes to three or four years of age. In some parts of Fiji and the Solomon Islands, the mother delivered her baby in a hut isolated from the village. Several older female relatives and friends attended and assisted the mother during labour and delivery. The mother stayed in the isolated hut for one to three months, cared for by her friends but left to rest and to devote all of her attention to the new baby.

The infant was put to the breast immediately after delivery or given a small amount of coconut milk. In Samoa the mother's milk was tested by the local midwife and the colostrum discarded if the milk was judged to be bitter or poisonous (Tuiteleleapaga, 1980). Coconut milk was given to the newborn if the mother's milk was not sufficient but more often it was given to the mother. Coconut milk taken three times a day by the mother was a local prescription which guaranteed the mother a full milk supply within two days (Malcolm, 1952).

The infant was with the mother at all times during the day and the baby was fed whenever it whimpered. At night, the baby slept with the mother and had frequent feedings "on demand".

Occasionally very young infants were given coconut milk or pawpaw juice in the early weeks of life (Parkinson, 1953) but generally infants were not fed solid foods until several teeth appeared, usually some time between seven and ten months. The soft meat of green coconuts was a popular first food. Fruit such as pawpaw, banana or mango and root vegetables; taro yams and sweet potatoes were often first chewed by the mother (premasticated) and then fed from her mouth to the baby's by finger. This practice was often discouraged as unhygienic. Yet Emmanuel and Biddulph (1969) found in the Solomon Islands that where premastication was a method of feeding, infant diarrhoea was low and where it was discouraged diarrhoea was a problem.

Between 12 and 18 months of age, toddlers were offered more foods, regularly eaten by the family. Both Malcolm (1951, 1952, 1953, 1954, 1958) and Parkinson (1951, 1952, 1953) found, however, that animal protein foods such as fish, shell fish, eggs and small game were given in very small amounts or withheld until approximately two years. Fruits and green leaf vegetables were also not given until about 18 months. By two to three years of age the young child was receiving a greater variety of foods normally eaten by the family.

Nutrient values of diets consumed by infants and small children are extremely difficult to estimate but were attempted by the early studies on infant nutrition by Malcolm.

Estimates of breast milk intake were made by weighing the infant before and after a feeding, several times during a day. This method is fraught with inaccuracies, due to differences in the milk supply from feeding to feeding and from day to day. It was not possible to estimate night feedings.

Estimates of foods consumed by the infant or small child are equally difficult as the foods were given in small amounts, at irregular intervals and perhaps by a number of different adults.

In general, Malcolm found in studies in several Pacific Island countries; Trust Territory of Pacific Islands (1955), Guam (1958), Papua New Guinea (1951), Vanuatu (1952), New Caledonia (1953) and American Samoa (1954), that up to seven or nine months of age breast milk provided adequate nourishment for the infant. After that age, however, breast milk intake decreased and the nutrients supplied by solid foods were below recommended levels. This also may have been due to the inability of the young child to consume enough of the bulky root vegetables to obtain sufficient energy. While vitamin and mineral intake was generally adequate, energy and less often protein, were below recommendations for age. After two years of age energy, protein, vitamins and minerals more closely met recommendations.

URBAN FOOD PATTERNS

The traditional food pattern has undergone dramatic changes, particularly in the past 30 years. As increasing numbers of Pacific Islanders are moving to urban areas, their diet is changing to imported western foods in place of the traditional ones. Root vegetables such as taro, yams and sweet potatoes are being replaced by low fibre bread and rice. Tinned meat and tinned fish are replacing fresh seafoods. The consumption of sugar and salt has increased enormously even over the past decade. Alcohol intake also appears to be on the rise.

Table 5 depicts the changes in the Pacific Island diets which are occurring with the move from a traditional to a western environment (Appendix B gives a more detailed nutrient analysis of urban dietary patterns).

TABLE 5.

DIETARY CHANGES

occurring with move from "Traditional" to "Urban"
environment

ATOLL DWELLERS

e.g. Tokelau
to New Zealand

Calorie intake increases
Protein intake increases
Fat intake tends to decrease
Total carbohydrate intake tends to increase
Cholesterol intake increases enormously
Sucrose intake increases enormously
Salt intake increases
Saturated fat intake tends to fall
Fibre intake decreases

VOLCANIC ISLAND

DWELLERS

e.g. Papua New Guinea
Fiji

Calorie intake increases
Protein intake increases
Carbohydrate intake decreases
Fat intake increases
Cholesterol increases
Sucrose intake increases
Salt intake increases

When atoll dwellers become urbanised there is generally an increase in caloric and protein intake. In the Cook Islands (Prior and Davidson, 1966) and Tokelau (Davidson, 1977, Harding, 1977) both calories and protein increased with increased urbanisation. Micronesians, however, living in Guam and California had lower caloric and protein intakes than their more traditional living Micronesians. The fat content of the diet decreases when coconuts are consumed less frequently. Total carbohydrate but particularly sucrose increases enormously. Surveys in

the Cook Islands (Prior and David, 1966) and Tokelau showed that sucrose increases 6 times with the rural to the urban change. Prior and coworkers (1968) estimated that the salt intake of rural Cook Islanders was at least twice that of urban Rarotongans.

For volcanic island peoples, calories and protein tend to also increase with westernised dietary changes. Ringrose (1981) found in Fiji, however, that total calories tended to decrease with urbanisation while protein increased slightly. In the Solomon Island (Jansen and Willmott, 1973) intakes of calories, protein and fat did not differ significantly between the urban and rural populations.

The major dietary changes from a traditional diet to a western one therefore appear to be a decrease in fibre, an enormous increase in sugar and a probable increase in salt. Yet it is difficult to generalise dietary changes as a result of urbanisation. It would seem that each country will need to be considered individually to determine the nature of the changes and the effect on the health of the people of these islands. Below are summarised a number of dietary surveys conducted in various countries.

MICRONESIA

Kiribati

In 1948 Turbott (Turbott, 1949) interviewed 12 families about their food intake over a period of two months. He estimated the average daily intake of 52 adults and 36 children to be:

| | | |
|--------------------------|---|----------|
| Green drinking coconuts | - | 2 each |
| Ripe coconuts | - | 2 each |
| Germinating coconuts | - | 1.5 each |
| Babai (root vegetable) | - | 1.5 lb. |
| Breadfruit | - | .5 lbs |
| Fish | - | 1.5 lbs |
| Toddy | - | 4 ounces |
| Palm syrup (toddy syrup) | - | 4 ounces |

This diet was calculated to contain 3000 - 3500 kcalories (12.6-14.6 MJ). Riboflavin, calcium and vitamin A were below recommended standards, but all other nutrients were present in adequate amounts.

In 1953, Parkinson (1953) conducted nutrition surveys in the Kiribati islands. One survey was on Maiana island which is 20 miles from the administrative centre of Tarawa but at the time was relatively inaccessible to ships. The other survey was in a boys' boarding school in Tarawa. Table 6. lists the amount of food consumed per person per day in the two areas and Table 7. the nutrient intakes of the two groups. For the rural areas, 100-200 additional kcalories (4.2-8.4 MJ) were estimated to come from bush "snacks". The tables illustrate the high carbohydrate of the schoolboys' diet coming from rice, flour and sugar and the higher fat content of the rural diet being supplied by

coconuts.

TABLE 6. Daily food consumption in the rural Island of Maiana, Kiribati and at an urban boys' school (Parkinson, 1953)

| Grams of food/person/day | | |
|--------------------------|--------------------------|--------------------------------------|
| | Rural MAIANA ----- | Urban TARAWA BOYS SCHOOL ----- |
| Coconut | 360 | None |
| Toddy | 540 | 120 |
| Kamaimai (toddy syrup) | 60 | 45 |
| Sugar | 24 | 63 |
| Fish | 300 | 75 |
| Babai (root vegetable) | 180 | 72 |
| Flour | 18 | 90 |
| Pawpaw | 27 | None |
| White rice | None | 500 |
| Tinned meat/fish | None | 315 |

TABLE 7. Energy and nutrient intakes of Kiribatisians on the Island of Maiana and boys at a boarding school in Tarawa (Parkinson, 1953)

| | Rural MAIANA ----- | Urban TARAWA School ----- |
|----------------------|--------------------------|---------------------------------|
| kcalories | 1782 | 2977 |
| MJ | 7.5 | 12.5 |
| Protein | 85 | 74 |
| Fat | 73 | 17 |
| Carbohydrate | 183 | 619 |
| Percentage of Total | | |
| Energy derived from: | | |
| Protein | 19 | 10 |
| Fat | 37 | 5 |
| Carbohydrate | 41 | 83 |

A follow-up survey was made on Kiribati, 15 years after the Parkinson survey (Willmott, 1968). There had been "considerable development" since the 1953 survey. A new hospital had been built and the port at Betio enlarged, increasing the number of ships available for inter-island travel.

Table 8 shows that from 1948 to 1968 there had been at least a 400 per cent increase in the consumption of flour, white rice and sugar and the consumption of all three was significantly higher in the urban centre of Betio than in the rural island of Maiana.

The survey did not collect dietary data but noted that adults and school children appear to be "adequately nourished" when heights and weights were compared to Fijians. Pre-school children after the age of 6-7 months, however, were significantly lighter and thinner than Australian children.

Dental caries, clinical signs of vitamin A deficiency; Bitut's spots and riboflavin deficiency; angular stomatitis, were reported in all age groups in both areas but more frequently in the urban centre.

A small survey of 16 families in Betio and Bikenibeu in 1968 revealed that 3000-3500 kcalories (12.5-14.6 MJ) and 65 gm of protein was an estimated intake. Imported foods made up 40-50 per cent of the total energy of the diet (Thompson, 1978).

A dietary survey was conducted in 1981 as part of a diabetes and cardiovascular disease epidemiology survey (Zimmet, 1981). The dietary data has not yet been analysed. The diabetes prevalence rates in urban Betio were almost 3 times higher than on the traditional-living island of Tabiteuea North.

TABLE 8. Kilograms of selected foods consumed in Kiribati per person per year

| | 1 9 6 7 / 1 9 6 8 | | | |
|------------|-------------------|------|-------|--------|
| | 1948 | 1952 | Betio | Maiana |
| | ---- | ---- | ----- | ----- |
| Flour (kg) | 7.3 | 25.1 | 42.1 | 29.3 |
| Rice (kg) | 9.2 | 11.2 | 37.8 | 24.8 |
| Sugar (kg) | 8.1 | 6.1 | 38.8 | 26.7 |

Nauru

In 1926, Bray (1927) studied the diets of Kiribati people working on Nauru. He reported the average daily diet of the indentured labourers as:

| | <u>Men</u> | <u>Women</u> |
|----------------|--------------------|--------------|
| Coconut Milk | 3-4 nuts | 2-3 nuts |
| Grated coconut | | 1 nut |
| Toddy | 2 shells | 1-2 shells |
| Pandanus | 10 segments | 8 segments |
| Fish | 1 large | 1 small |
| Biscuit | 1 | 1 |
| Sugar | 1 1/2 to 1 3/4 lb. | 3/4 lb. |

Other foods occasionally taken were white bread, cornflour, limes, pawpaw, tinned meat and fish.

A rough calculation of the diet shows that it provided a working man with 4400 kcalories (18.4 MJ), 76 per cent of which came from sugar! He observed that sugar was higher than in any other islands and that infantile beriberi was common. He did not comment on the diets of the Nauruans.

The traditional diet of Nauruans consisted almost entirely of coconut milk, toddy, grated coconut, fish and pandanus. But certainly by 1957, the diet had changed completely. A visiting nutritionist (Kirk, 1958) described this remarkable change which had occurred in less than 20 years:

TABLE 9. Mean energy and nutrient intake of adult Nauruans (Ringrose, 1978)

| | <u>Males</u> | <u>Females</u> | <u>Sexes Combined</u> |
|------------------------------------|--------------|----------------|-----------------------|
| | N=34 | N=43 | N=77 |
| kcalories | 7191 | 5223 | 6092 |
| MJ | 30.1 | 21.9 | 29.0 |
| Protein (g) | 259 | 184 | 217 |
| Fat (g) | 239 | 187 | 210 |
| Carbohydrate (g) | 890 | 688 | 777 |
| Alcohol (g) | 83 | 14 | 44 |
| Percentage of energy derived from: | | | |
| Protein | 14 | 15 | 14 |
| Fat | 32 | 34 | 31 |
| CHO | 46 | 51 | 51 |
| Alcohol | 7 | 1 | 5 |

"The native Nauruan now buys his foodstuffs almost entirely from the island stores and indigenous foods contribute little to his diet". The Nauruan diet consisted "Mainly of three foodstuffs, white rice, tinned meat and sugar".

"The native appears to have lost his taste for the coconut and rarely eats it. It's two main uses today are for making hair oils and for the collection of the sap which is drunk as toddy".

"The task of encouraging the use of more milk, margarine, fruit and vegetables (will not be an easy one) will prove to be primarily one of education, aimed chiefly at the younger members of the population who are less resistant to change than their elders" (our emphasis).

A detailed dietary survey (Ringrose, 1979) was conducted in Nauru in 1976 as part of a diabetes epidemiological survey (Zimmet et al, 1978a). The adjusted 24-hour recall method was used to interview 77 adult Nauruans. Table 9 shows an extremely high energy intake of the total population of 6092 kcalories (29.0MJ). This is more than twice the Interim Standards for developing Western Pacific countries (WHO, 1972). The intake for males between 20-39 years was 8769 kcalories (36.7MJ). This is more than three times the recommendation for U.S. males (National Academy of Sciences, 1980). If this estimate is accurate it should be accompanied by a daily weight gain of approximately 1.6 lbs!

The composition of the Nauruan diet is fairly high in the proportion of energy from protein. Imported meat and fish are easily available. The moderate fat contribution may be due to cooking meat and fish in island fashion over an open fire.

The carbohydrate proportion of the diet comes from rice and sugar and occasionally potatoes. Very little taro, pandanus or breadfruit is consumed. The fibre composition of the diet was not calculated but would appear to be low. Normally Nauruans eat very little fruits and vegetables.

The mean daily alcohol consumption for males was 83 grams which is about 7 per cent of total energy intake (503 kcalories - 2.1 MJ). This is an average of 2.6 litres of beer or 1/2 litre of sherry per day. In a French wine drinking community when a daily consumption of alcohol regularly exceeds 80 grams in men, there is a steep rise in the incidence of cirrhosis (Thaler, 1977).

Trust Territories of the Pacific Islands

As early as 1954, nutritionists (Malcolm, 1953; Murai, 1954) warned of the "impact of the American way of life" on the health of mothers and children in Guam. The families surveyed at that time had adopted an American meal pattern and purchased most of their foods. The most commonly purchased foods were rice, bread and tortillas. Cereals and grains were often incorporated in canned or other processed foods. "Starchy root vegetables were eaten in small amounts". Although there was no overall insufficiency of food, the cost and availability of fresh foods limited the quality of the diet.

A survey published in 1970 compared the diets of Chamorros living a traditional way of life on the island of Rota to those living on a total cash economy in Guam and in California (Hankin et al, 1970). A group of West Carolinians from the isolated Palau District were also included in the survey. Table 10 provides the energy intake and the percentage of energy derived from protein, fat and carbohydrate for the four groups. Daily total caloric intake of the traditional living groups were higher than the urban groups. The major difference between the groups was the proportion of energy coming from fat and carbohydrate. There was a marked increase in energy derived from fat from the isolated islands to Guam and California. It was noted that the increase was mostly due to an increase in saturated fats. Energy from carbohydrate on the other hand, decreased from the rural to the urban setting. Taro and Cassava were the predominant carbohydrate foods in Palau, rice in Rota, rice and bread in Guam and bread in California.

TABLE 10. Daily energy intake and composition of energy of Carolinians and Chamorros living in village, urban or Californian lifestyle (Hankin, 1970)

| | E N E R G Y | | Percentage of calories derived from | | |
|----------------|---------------|------------|-------------------------------------|-----|--------------|
| | kilo calories | megajoules | Protein | Fat | Carbohydrate |
| Males | | | | | |
| Palau | 2520 | 10.5 | 16 | 28 | 54 |
| Rota | 2868 | 12.0 | 14 | 23 | 57 |
| Guam | 2500 | 10.5 | 15 | 31 | 48 |
| California | 2386 | 10.0 | 15 | 41 | 42 |
| Females | | | | | |
| Palau | 2020 | 8.5 | 19 | 28 | 54 |
| Rota | 1850 | 7.7 | 16 | 28 | 58 |
| Guam | 1735 | 7.3 | 17 | 37 | 47 |
| California | 1574 | 6.6 | 16 | 42 | 41 |

The dietary survey was part of a comprehensive health survey (Reed et al, 1973) which revealed that the Chamorros and Carolinians living in a subsistence economy had lower mean serum glucose levels, lower mean serum cholesterol and triglyceride levels and were on the whole thinner than those living in Guam or California. There was little difference in uric acid levels.

In a later survey in 1973, Kincaid (1973) concluded that although a nutritionally adequate diet was available throughout the "Territory", it was not being consumed. She suggested that this was due to "economic and social changes brought about by Western education and development". The Kincaid (1973) survey included the Mariana Islands, Marshall Islands, Palau, Ponape, Truk and Yap.

Today, imports of food and beverages in this same part of Micronesia are increasing at a rate of \$1 million per year and reached \$38 million in 1976 (Rody, 1978a). The imported foods are highly refined, low in fibre and low in nutrients; white rice, bleached flour, sugar. It is estimated that in 1975, \$2.5 million worth of soft drink and alcoholic beverages was imported into Micronesia. A nutritionist-health educator wrote in the Micronesian Reporter:

"The Micronesian family is becoming increasingly dominated by foreign influences. The Micronesian is trading his self-sufficiency and healthy lifestyle for one which is costly - physically and financially", (Rody, 1978a).

MELANESIA

Fiji

The first food consumption survey was undertaken in Fiji in 1952 (Langley, 1953). One purpose of the survey was to determine any changes that may occur in the dietary pattern of the people of the village of Naduri as a result of the development of a farm project. These findings are shown in Table 11 with a 10 year follow-up survey which was completed in 1963 (Wilkins, 1963a). The table illustrates a significant increase in total energy, protein, fat and carbohydrate but the proportion of energy derived from these nutrients does not change dramatically.

During that decade, the village people had become increasingly involved in cash crop farming. There had been a noticeable increase in the consumption of processed foods, eggs and meat. Cassava, which replaced other roots as a major staple food, had doubled in consumption. New foods such as tomatoes, melons and other fruits, appeared and had a marked effect on the vitamin C content of the diet (Parkinson, 1967). Access to local markets and proximity to the river contributed to both the ease of selling the cash crops and acquiring a variety of local and bush foods.

The surveyors in 1963 noted that there was a "high standard of health in the village". There was no malnutrition seen among pre-school children and only one case of severe goitre.

TABLE 11. Comparison of nutrient intake in the village of Naduri, Fiji, at the start and after 18 months of a farm cooperative and at a 10-year re-survey (Langley, 1953; Wilkins, 1963a).

| Nutrients | June 1952 | November 1953 | 1963 |
|---------------------------------------|-----------|---------------|-------|
| ----- | ----- | ----- | ----- |
| kcalories/day | 2098 | 2461 | 3853 |
| MJ/day | 8.8 | 10.3 | 16.2 |
| Protein (g) | 54 | 58 | 85 |
| Animal Protein (g) | 34 | 24 | 41 |
| Fat (g) | 20 | 36 | 45 |
| Carbohydrate (g) | 431 | 491 | 777 |
| Percentage of energy derived from: | | | |
| Protein | 10 | 9 | 8 |
| Fat | 9 | 13 | 11 |
| Carbohydrate | 82 | 80 | 81 |

Two dietary surveys were carried out in Indian communities in Fiji. In 1954, 71 households on the outskirts of Suva were interviewed (O'Loughlin and Parkinson, 1954) and in 1964, 18 households were selected from an urban centre and rural cane farming settlements (Wilkins, 1963b). In that decade there was an increase in energy,

protein, fat and carbohydrate (Table 12). Rice and roti are the main staple foods of the Indian people. Roti is a flat bread made from coarsely ground white flour. Protein foods include dahl and fresh or tinned meat or fish. Milk was used for making ghee and many families kept chickens for eggs. Ghee and oil were used for cooking and a variety of vegetables were included in rice dishes and curries. It does not appear as though the basic diet of the Indians has changed much except that as "income increases, protein and vitamin containing foods increase" (Parkinson, 1967).

TABLE 12. Daily nutrient intakes of Indian communities in Fiji 1954 and 1964 (O'loughlin and Parkinson, 1954 Wilkins, 1963b)

| | Outskirts of Suva | Rakiraki |
|----------------------|-------------------|----------|
| | 1954 | 1963 |
| kcalories | 1966 | 2764 |
| MJ | 8.2 | 11.6 |
| Protein (g) | 63 | 71 |
| Fat (g) | 38 | 60 |
| Carbohydrate (g) | 367 | 484 |
| Percentage of energy | | |
| derived from: | | |
| Protein | 13% | 10% |
| Fat | 17 | 20 |
| Carbohydrate | 74 | 70 |

A recent diabetes survey in Fiji highlighted the differences in disease rates between Indians and Melanesians (Zimmet and Sloman, 1980). The prevalence of diabetes was at least three times higher in male Indians in Fiji than in Melanesians. Urban Melanesians had much higher prevalence rates than rural Melanesians. A dietary survey conducted along with the diabetes study revealed lower caloric intakes for urban Indians and Melanesians than for the rural groups as shown in Table 13. (Ringrose, 1981). The higher energy intakes of the rural Melanesians was attributed to greater physical activity which may also explain their lower rates of diabetes.

The major differences between the urban and rural diet was an increase in fat and a decrease in carbohydrate in urban diets. Sucrose consumption was also higher for both urban ethnic groups, but not of statistical significance.

Sorokin (Sorokin, 1975) has suggested that the highly refined carbohydrate, low fibre food pattern of Indians in Fiji is responsible for their much higher rates of myocardial infarction, diabetes mellitus, varicose veins and haemorrhoids, diverticulitis, appendicitis, gall bladder disease and toxemia of pregnancy. Fibre content is the major difference between the diets of the Indians and Fijians. He suggests

that the starchy roots containing much fibre consumed by the Fijian population may in fact be protecting them from the same disease as their Indian neighbours.

As long ago as 1962, an FAO nutritionist (Maramba, 1962) noted that food imports in Fiji of \$ F 2.6 million were about 25 per cent of the total income derived from the export of agricultural products. Of this, 43 per cent was spent on rice and wheat and 23 per cent on livestock and meat products.

"For a predominantly agricultural country, this heavy drain on foreign currency is very unwise.....It would seem that there is a need for a closer review of the reasons for the high rate of food importation before any plans for increased production can be instituted" (Maramba, 1962).

TABLE 13. Diet survey: Daily energy intake and percentage derivation from protein, fat and carbohydrate

| | INDIANS | | MELANESIANS | |
|---------------|---------|-------|-------------|-------|
| | Rural | Urban | Rural | Urban |
| MEN | | | | |
| Energy (kcal) | 2844 | 2626 | 3152 | 2177 |
| Protein % | 11 | 12 | 10 | 15 |
| Fat % | 23 | 25 | 16 | 20 |
| Carbohydrate% | 66 | 63 | 74 | 65 |
| WOMEN | | | | |
| Energy (kcal) | 2300 | 2100 | 2644 | 1910 |
| Protein % | 11 | 11 | 9 | 12 |
| Fat % | 19 | 23 | 17 | 20 |
| Carbohydrate% | 70 | 66 | 74 | 68 |

New Caledonia

There has been very little attention in this area in New Caledonia. A report by Malcolm in 1953, described the villages of Ponerihouen-Poindimie on the east coast of New Caledonia where "living conditions seemed representative of the whole population". The villages used a wide variety of local roots, greens, fish, shellfish and some wild game. Of the imported foods, sugar was used regularly but rice, bread and tinned fish and meat rarely.

The adults "appear to be in a fairly healthy condition".

The growth of pre-school children showed a slight lag in weight and length between nine months and two years of age compared to Harvard standards. Even though the diet eaten by the children, as observed by the nutritionist, very often did not meet even 1/2 of recommended amounts, "the children were in good physical and mental condition".

Only one child did not eat well and looked thin.

Recent data from another community on the east coast of New Caledonia indicates that the diabetes prevalence is low in marked contrast to that in urban Noumea (Taylor and Zimmet, 1981a). In Noumea the diet is very different to that of the east coast rural Melanesian communities, but specific data are not available.

Papua New Guinea

The traditional Papua New Guinean diet is predominantly based on a small number of staple crops. Meggitt gives a very interesting account of agriculture, hunting and fishing among the Enga-speaking people of the Enga Province (Meggitt, 1958). The main starchy crops in the lowlands are sago and banana, sweet potato, taro and yam are the main staples in the Highlands. In Oomen's excellent review of subsistence dietary patterns (Oomen, 1971), he suggests that in the Highlands 1880 kcalories (7.9 MJ) per day is an average adult's intake, while 1470 kcalories (6.2 MJ) is the average in the lower regions. In the Highlands, low protein intakes (4-6 per cent of energy) are common and are dependent on the variety of sweet potato. He also suggests that while the protein level may satisfy the amino-acid requirements for a "reference" adult in Papua New Guinea, it may not for children or for pregnant and lactating females.

The vitamin and mineral composition of the diets are usually sufficient. Ascorbic acid, carotene, calcium and iron are almost always adequate. Iodine, and perhaps sodium, is in short supply in some areas. Thiamine deficiency has been reported in some communities that are exclusively sago eaters.

Professor Oomen concludes:

"The diet of the (Papua) New Guinean tuber farmer has its limitations, but it also has its advantages. In denouncing it as insufficient, we overlook its cultural significance, its improvisatory virtues, its demographic consequences and the prevalence of a state of health and physical performance which is anything but at the bottom rung of the human ladder". (Oomen, 1971)

Changes in the Papua New Guinean diet have been reported in the urban centers. In a very poor migrant settlement in Port Moresby, Hitchcock and Oram (1967) found women weighing 7.2 kg less than women of the same height from a rural settlement and men weighing 9.1 kg less. Weight for height ratios and skinfold thickness also reflected the thinness of the group. The energy intakes at the Rabia camp were reported to be the lowest ever recorded in Papua New Guinea; 1200 kcalories (5.0 MJ) for men and 1035 kcalories (4.3 MJ) for non-lactating women. Ms Hitchcock calculated that 72 per cent of the energy was provided by flour, rice, sugar, bread and biscuits. Sugar provided 11 per cent of the energy and starchy root vegetables only 9 per cent.

In a low-income urban setting in Lae, however, Malcolm (1953) suggested that the diets were superior for improved growth and development to rural diets. These diets in which 12 per cent of energy

was provided by protein (38 per cent from animal sources) and 77 per cent from refined carbohydrates, also "increased the risk of dental caries, hypertension, elevated serum cholesterol and obesity".

Jeffries (1979) described the dietary differences of two groups of Fore language people. One group lived in a rural village, Awande, in the Eastern Highlands and the other in the urban centre of Lae. The rural people were basically sweet potato farmers who earned a small amount of cash from coffee growing. "The cash income was too low to allow households to replace a large proportion of their traditional diet with purchased foods". The Lae households were involved in full time employment, about half had small gardens and there was "generally sufficient money to buy enough food".

Dietary patterns were collected using a 24 hour recall method of frequency of types of foods eaten. Quantities of food eaten were collected from only three households in Awande. Jeffries described the rural diet as being high in unrefined carbohydrate, low protein, low fat and high in physical bulk. The weighed food intakes showed that sweet potato and some other starchy foods provided 85 per cent of the energy and 65 per cent of the protein in the diet. This diet, he suggested, is poorly suited to small children who find it difficult to eat sufficient quantities to satisfy energy and protein requirements.

The diet of the Fore people living in Lae was higher in refined carbohydrate. Rice was the main staple but sweet potato and taro were consumed only slightly less frequently. Animal protein, tinned or fresh meat, fish or chicken, was eaten almost every day. Income was sufficient and fresh fruits and vegetables were available but "a disproportionate amount of the typical budget is taken up by snack foods". On the whole the urban diet was "more refined, sweeter, higher in fat and therefore less bulky and probably lower in some vitamins and minerals". (Jeffries, 1979).

The rural people were described as being smaller but of a much higher level of physical fitness than the average Australian. Degenerative diseases such as heart disease, diabetes and cancer were absent.

Pre-school children in the Highlands, however, suffered more malnutrition than children in Lae. 47 per cent were less than 80 per cent weight for age of Harvard Standards compared to 21 per cent in the urban area.

Date et al (1981) carried out a survey in the Eastern Highlands Province. For men aged from 20 to 29 years, they reported:

| Daily Energy Intake | <u>Percentage of Energy</u> derived from | | |
|---------------------|---|----------------|------------|
| | <u>Carbohydrate</u> | <u>Protein</u> | <u>Fat</u> |
| 2814 kcal. | 91 | 6 | 3. |

The men consumed an average of 1.5 kg of sweet potatoes per day and were considered to show good health status; muscular body build, no obesity, high haemoglobin level, low blood pressure and low serum cholesterol levels.

A dietary survey was conducted in the rural village of Kalo and in a relatively affluent suburb of Port Moresby by Martin and co-workers (1980) in 1977, as part of a diabetes epidemiology survey. "The village people ate a diet in which yams, cassava and bananas were most commonly consumed with very little refined food; in contrast, the urban population ate a largely western diet in which bread, polished rice and tinned foods were most common". Estimates of the calorie intake were approximately 2300 kcalories (9.6 MJ) for urban dwellers and 1400 (5.9 MJ) calories for rural people. The diets were not analysed for other nutrients. The Port Moresby group had a significantly high prevalence of diabetes and was fatter than the rural villagers.

Solomon Islands

Dietary surveys were conducted in three locations in the Solomons in 1971 (Jansen and Willmott, 1973). A combination of questionnaire and weighed food-intake methods were employed with families in Honiara, the major city; Auki, the second largest town and the Nggela district, a rural agricultural area.

Between the three areas, the energy, protein, fat and carbohydrate intakes were adequate and did not vary significantly. Urban families, particularly those without gardens were more likely to have low intakes of vitamin A, nicotinic acid and riboflavin. The rural diets were satisfactory with regard to calcium, iron, thiamin and vitamin C. In some rural areas where garden conditions were poor, vitamin A and riboflavin intakes were marginal. Protein intakes were considered adequate for adults but fell short of the requirements for toddlers.

TABLE 14. Food components of family diets in three locations in the Solomon Islands. Weighed intake method (grams per day) (Jansen & Wilmott, 1973).

| | HONIARA ----- (urban) | AUKI ----- (administrative centre) | NGGELA ----- (traditional) |
|------------------|-----------------------------|---|----------------------------------|
| Rice | 177 + 15 | 170 + 37.8 | 23.2 + 2.6 |
| Bread | 108 + 9 | 80 + 13.5 | 2.8 + 2.2 |
| Biscuits | 10.8 + 3.8 | 11.2 + 7.0 | 4.0 + 1.2 |
| Total cereals | 296 + 10.3 | 261 + 22.3 | 30.0 + 2.1 |
| Root vegetables | 702 + 22.5 | 758 + 56.8 | 1522.5 + 64.3 |
| Cabbage etc. | 52.6 + 7.3 | 103 + 42.9 | 84.6 + 18.6 |
| Fish (fresh) | 70.3 + 13.8 | 78.4 + 38.6 | 63.1 + 14.1 |
| Fish (tinned) | 16.2 + 3.3 | 4.7 + 5.6 | 0.3 + 0.7 |
| Meat (fresh) | 16.5 + 2.6 | 5.3 + 5.2 | 4.8 + 0.3 |
| Meat (tinned) | 20.5 + 1.7 | 11.8 + 3.8 | 0.4 + 1.62 |
| Milk powder | 0.3 + 0.2 | 0 | 0 |
| Milk tinned | 9.9 + 5.6 | 1.8 + 1.0 | 0.2 + 2.7 |
| Puddings (roots) | 4.4 + 3.0 | 71.1 + 17.7 | 123 + 29.2 |
| Sugar | 34.7 + 4.0 | 23.4 + 6.0 | 5.0 + 1.4 |

The types of foods eaten by the three groups, however, were quite different as shown in Table 14. In the urban areas much more rice, bread, tinned fish and tinned meat was eaten, whereas the villagers ate twice as much root vegetables as in the urban centres. The survey did not include figures of the daily intake of coconuts but estimated a daily intake of 6 grams of coconut cream per person in Honiara. The rural diet was described as "root based" with green leafy vegetables added in the form of a soup which often contained the cream from the squeezed flesh of the mature coconut". The diets based on cereals rather than roots showed a reduction in iron and B group vitamins, "Unless protein-rich foods are eaten, which supply iron and B vitamins, the urban diet may fall well below the recommended level and it is particularly so among the low income groups that this may happen" (Jansen and Willmott, 1973).

Vanuatu

A survey was conducted among 26 families in the village of Walarano on Malekula Island (Dye, 1979) where a traditional way of life was followed. Well-tended family gardens provided a wide range of roots; yams, taro, manioc as well as pumpkin, bananas and pawpaws. Fishing was a regular and enjoyable occupation for men, women and children in the sea and in the river. Wild pigs, fowl and flying fox were hunted and trapped.

Store foods were not purchased frequently. An average family may purchase 2-4 kg of rice per month, 2 kg of sugar per month, 1 or 2 tins of fish per week. Frequency of buying store food seems to go up and down with income.

Quantitative data is not available, but analysis by the use of food groups indicated that the diets were probably moderate in energy and protein and low in fat. Vitamin C, iron, thiamin and calcium appeared to be adequate but vitamin A and riboflavin marginal. Clinical evidence of riboflavin deficiency, but no vitamin A deficiency was found during an earlier nutrition survey (Raoult, 1976a).

As income increased, there was an increase in fish and shellfish and refined grain products. Lower income families ate more root vegetables and green vegetables.

POLYNESIA

American Samoa

No reports.

Cook Islands

In early times, puraka (*crystosperma chamissonis*), a taro-like root was a major staple of the diet. Coconut, pandanus, kumara (sweet potato), banana, pawpaw, breadfruit and considerable amounts of fresh and dried fish made up most of the traditional diet (Parkinson, 1954). But as early as 1947, Abraham (1947) noted a change in food habits among Rarotongans. She commented that the traditional roots, besides containing carbohydrate, "also supply important mineral, vitamin and jaw exercise which are now lacking in the diet since the Rarotongan depends so largely on the European white bread and refined sugar for his carbohydrate".

Abraham suggested that the diseases prevalent in Rarotonga were due to inadequate vitamin intakes and "a disproportionate consumption of pure or nearly pure carbohydrate foods". Tuberculosis, bronchial diseases, influenza, measles, mumps, nutritional anaemia, gingivitis were commonly found. "Low muscular strength" was cited. "Limbs are well padded with fat from excessive carbohydrate, rather than flesh from protein foods" (Abraham, 1947).

Murphy (1955) visited the remote atoll of Pukapuka in 1951. He noted that "practically no European foods" were consumed. The diet which consisted "largely of coconuts, talo (taro), puluka and some fish, surprisingly, on analysis gave a daily intake of 3928 calories, 100.3 grams of protein, 497.7 grams CHO and 182.4 grams of fat. The bulk of the protein comes from vegetable sources".

Fry (1957) reported that bread and sugar were regularly consumed by villagers engaged in subsistence agriculture on Rarotonga. The average family was consuming 1535 grams of white bread and 106 grams of sugar per day.

A number of dietary surveys have been carried out in the Cook Islands and are summarized in Table 15. The surveys were all done by different investigators but the methodologies were quite similar; 7 day household food records with food weighed before and during the survey. On the whole, energy intake for urban people was higher than for those living traditional lifestyles. The 1960 Rarotongan energy intake may be especially high because more well-do-do areas of Rarotonga were chosen to represent the "western diets" view point. We might also expect the richer volcanic island of Mitiaro to have a higher energy intake than the Pukapuka atoll.

TABLE 15. Nutrient intakes of Cook Islanders as determined by various surveys

| | 1954* | 1 9 6 0+ | | 1 9 6 6** | |
|------------------------------------|--------------|------------|--------------|-------------|--------------|
| | Pue Village | | | | |
| | Rarotonga(a) | Mitiaro(b) | Rarotonga(c) | Pukapuka(d) | Rarotonga(e) |
| NUMBER | 70 | 54 | 192 | 30 | 107 |
| kcalories | 2395 | 2445 | 3363 | 1800 | 2100 |
| MJ | 10.0 | 10.2 | 14.1 | 7.5 | 8.8 |
| Protein (g) | 60 | 54 | 97 | 60 | 60 |
| Fat (g) | 53 | 102 | 89 | 70 | 63 |
| Carbohydrate | 408 | 336 | 539 | 225 | 320 |
| Percentage of energy derived from: | | | | | |
| Protein | 10 | 8 | 12 | 13 | 11 |
| Fat | 20 | 37 | 24 | 35 | 27 |
| Carbohydrate | 68 | 55 | 64 | 50 | 60 |
| (sucrose) | (12) | (2) | (11) | (2) | (7) |
| Sodium (mEq) | - | - | - | 50-70++ | 120-140++ |

- (a) Pue village, outside of Avarua, the urban administrative center. Most people come from island of Pukapuka. Cash economy, a few gardens.
- (b) Mitiaro traditional way of life - low lying island, small area of volcanic soil where food is cultivated. "Ships call at the island once or twice a year".
- (c) "Rich families" in Rarotonga from the village of Avatu and Arorangi. Most work for wages in administration, shipping and hospitals. Many were land owners and also grew their own food.
- (d) Traditional subsistence economy, isolated atoll. Males and females 40-69 years.
- (e) Urban centre of the Cook Islands. Males and females 40-69 years.

* Parkinson, 1954

+ Walker, 1960

** Prior and Davidson, 1966

++ Prior and Evans, 1969.

TABLE 16. Daily food consumption as determined by dietary surveys in Cook Islands (grams per person).

| | 1 9 5 4 | 1 9 6 0 | |
|------------------------------|--------------------------|-------------------|-----|
| | Pue Village Rarotonga | Mitiaro Rarotonga | |
| Starchy Roots (g) | 787 | 1511 | 677 |
| Cereals-flour,bread,rice (g) | 331 | 16 | 524 |
| Tinned fish & meat (g) | 45 | - | 77 |
| Sugar and jam (g) | 75 | 10 | 91 |
| Coconuts (each) | 1 | 1.6 | .23 |

The major differences in nutrient intake between the traditional-living islanders and the urban dwellers appear to be fat and carbohydrate. The percentage of energy derived from fat was higher in the rural than the urban diets and carbohydrate was lower.

It may be more meaningful to look at the changes in types of foods eaten. Table 16 shows that in traditional Mitiaro more than twice the root vegetables were eaten as in the urban areas, practically no flour or rice, virtually no tinned foods and very little sugar. Much of the higher carbohydrate consumption of the urban dwellers appears to come from sucrose. A little over one and a half coconuts per day in Mitiaro would account for the higher fat intake than in Rarotonga. It would also seem that the fibre content of the traditional diet is much higher than the urban diet.

French Polynesia

The traditional staple diet of Tuamotu atoll inhabitants consisted of coconuts in various forms, screwpine fruit, arrowroot and taro. These foods are virtually forgotten. Breadfruit, bananas, domestic fishing and rearing of livestock are becoming rare.

Western and eastern traders bought copra and sold tinned food. As early as 1956 Barrau (1956) found that imported foods; flour, sugar, rice, biscuits, vegetable fats and tinned foods accounted for more than 2000 calories of the daily food intake. McKee (1957) estimated that the average consumption of flour on Raroia atoll as 410 gram per person per day and sugar as 77 grams; or 5 tablespoons of sugar per person per day.

The increase in the proportion of total daily energy from imported foods has been rising steadily and today represents 90 per cent of French Polynesian's food intake (Jacobser, 1977):

| <u>Year</u> | <u>Calories Provided by Imported Foods per person per day</u> |
|-------------|---|
| 1934 | 1119 calories |
| 1947 | 1745 calories |
| 1973 | 2810 calories |

The food intake of the average French Polynesian today is described by Jacobser (1977) as:

- excessive in energy;
- moderate in protein;
- adequate in amounts of carbohydrates, but of poor quality foods; refined sugar, bread and flour have replaced the higher fibre breadfruit, taro and sweet potato;
- excessive in imported fats; oil and tinned butter used for frying;
- lacking in fresh fruits and vegetables;
- excessive in alcohol. Approximately 350 calories (50 gm) of alcohol are consumed by the average Polynesian over the age of 15 years.

This food pattern is considered to be largely responsible for the obesity and resulting ill health of Tuamotu atoll inhabitants. A recent health survey (Delebecque, 1980) found that 15.6 per cent of adults had hypertension most of which was associated with obesity.,

The children as well are suffering from the influence of the "west". The practice of breast feeding is dying out. Infants are often fed on nutritionally unbalanced sweetened condensed milk and weaning foods which are predominantly white bread and sugar.

"It is not surprising that later these children grow into adults who have no teeth, are obese, suffer from high blood pressure, are diabetic and display every possible complication that these conditions can generate" (Delebecque, 1980).

Tokelau

In 1968 a survey was made of the food intake of 222 Tokelauans living on the isolated atoll of Fakaofo (Davidson, 1977). Coconut and breadfruit were the only plants grown of major importance. Some pulaka, a taro-like root, bananas and pawpaws were grown in small amounts. Fish

from the sea, reef and lagoon provided the major portion of protein. Pigs and chickens were reserved for feasts. A survey was also conducted among 55 Tokelauans who had subsequently migrated to New Zealand (Harding, 1977).

The energy intake of Tokelauans who had migrated to New Zealand appears to be higher than those living on atolls. (Table 17). This could be because there were more young adults in the New Zealand group. The distribution of energy from protein, carbohydrate and fat changed considerably with the migration to New Zealand. Protein and carbohydrate increased while fat decreased.

Table 17 shows a three fold increase in meat and fish consumption among the New Zealand Tokelauans. Dairy products and eggs also added to the protein value of the diet. Fat is most likely decreased because coconuts are no longer a main-stay of the diet. Bread, rice and particularly sugar account for the increase in carbohydrate.

TABLE 17. Nutrient intake of Tokelauans on atolls and in New Zealand (Davidson, 1977; Harding, 1977)

| | ATOLLS N=222 ----- | NEW ZEALAND N=55 ----- |
|---|--------------------------|------------------------------|
| kcalories | 1930 | 2280 |
| MJ | 8.1 | 9.5 |
| Protein | 55 | 85 |
| Fat (g) | 119 | 104 |
| Carbohydrate (g) | 166 | 251 |
| Cholesterol (mg) | 85 | 340 |
| Percentage of calories derived from: | | |
| Protein | 12% | 15% |
| Fat | 53% | 41% |
| Carbohydrate | 35% | 44% |
| (Sucrose) | (2%) | (13%) |
| Cholesterol (mg/1000kcal) | 45 | 145 |

Although sodium was not calculated, it was obvious that salt intakes were much higher in New Zealand as processed foods were used daily and salt was used liberally in cooking and on the table. On the atoll, no salt was added to food, almost no processed foods were used and rarely was salt or even sea water used in cooking (Davidson, 1977).

Zinc and copper of Tokelauan atoll foods, were analysed and mean daily intakes of adult males estimated (McKenzie, 1978). The traditional diet was found to be very low in both zinc and copper compared to recommended levels.

| | ATOLLS | US RECOMMENDATIONS |
|-------------|--------|--------------------|
| Zinc (mg) | 4.5 | 15 |
| Copper (mg) | 1.5 | 2 |

Consumption of alcoholic beverages appears to rise quickly after migration. In 1968-1971 only 5.4 per cent of Tokelauans drank toddy (Stanhope, 1979). In New Zealand, 49 per cent of males were drinking alcohol 2.2 years after migration and 60 per cent 4.8 years after migration. The mean intake of alcohol per month was 8 ml in Tokelau, 105 ml in New Zealand during 1967-70 and 181 ml from 1972-1974. These figures appear to be low when compared to the general New Zealand population consumption of 900 ml per month.

Tonga

Jansen (1973a) conducted one of the few nutrition surveys in the Kingdom of Tonga in 1972. Pre-school and school aged children and mothers were included. A 24-hour recall dietary survey compared the types of foods eaten by women in rural villages compared to the capital of Nuku'alofa. The diets were not analysed for nutritive content. In general the rural women consumed more taro, plaintain, ripe banana, fresh fish, shell fish, green vegetables and fruits than the urban women. The Nuku'alofa diets contained more bread, sweet potato, cassava, mutton, pork, tinned fish, beef, butter and tea. The diets of the school children were similar. The lack of fresh green vegetables and fruit in the urban centre was considered "severe".

Tuvalu

Before western influence, the customary diet on this atoll island consisted of fish, coconut, breadfruit, taro, banana and puluka (a variety of taro). During the 1940s the establishment of an Allied naval and air base brought considerable change to the island way of life. By 1976, four years after hurricane Bebe, the island of Funafuti was dependent on imported foods for 80 per cent of its total food needs (Wicking, 1981).

The present day diet is similar to other urban centres throughout the Pacific. The composition of the diet as analysed by 24-hour recall (Wicking, 1981) revealed a mean energy intake of 3133 kcalories (13.1 MJ) for males and 2629 (11.0 MJ) for females (Table 18). The distribution of energy from protein, fat and carbohydrate is similar to the urban surveys and quite different than the distribution found in more traditional diets, (Parkinson, 1953; Walker, 1960).

The protein and fat contribution is high and the carbohydrate contribution of 47 per cent is lower than early studies (Langley, 1953, Massal, 1954). Outboard motors, motorcycles and cars have replaced feet as a method of transport and the energy now expended is in the form of petrol rather than calories. The foods imported are concentrated sources of energy, protein and fat and are often high in sugar, low in nutrients and almost lacking in fibre (Wicking, 1981).

TABLE 18. Daily dietary intakes of Tuvaluans living on Funafuti Island (Wicking, 1981)

| Nutrient | Males N=47 | Females N=63 | Total sexes Combined N=110 |
|---------------------------------------|---------------|-----------------|----------------------------------|
| kcalories | 3133 | 2624 | 2841 |
| MJ | 13.1 | 11.0 | 11.9 |
| Protein | 116 | 88 | 100 |
| Fat | 127 | 111 | 118 |
| Carbohydrate | 370 | 312 | 337 |
| Percentage of energy derived from: | | | |
| Protein | 15% | 13% | 14% |
| Fat | 36% | 38% | 37% |
| Carbohydrate | 47% | 48% | 47% |

Western Samoa

Breadfruit, taro and green bananas were the main source of energy in the traditional diet on the island of Manono (Parkinson, 1951). Coconut cream was used every day. A man could squeeze about 3 pints of cream from 20 coconuts and an average meal would contain 2 to 4 ounces of cream. Fresh fish was eaten 4 to 5 times a week. Pork and chicken were only prepared for special feasts.

In the villages near Apia, the main urban centre of Western Samoa, changes were taking place as early as 1951. Parkinson (1951) pointed out that there is a "tendency to replace root vegetable with white bread". Sweet tea and jam were replacing coconut cream and fish as accompanying dishes. Ms Parkinson also noted that even though large amounts of white bread were purchased at one time, there was a "preference for taro and breadfruit when those foods may be obtained".

There have been no recent dietary reports found from Western Samoa.

Food Imports

Food import figures have been calculated for several Pacific Island countries for selected foods; meat, fish, sugar, cereal products and alcoholic beverages (Table 19). These figures are as accurate as the record keeping system in the various countries and may require further interpretation. For instance, the figures for Nauru are based on foods imported from Australia which may account for decreases in imports of fish, sugar and cereal products. Perhaps these foods have been imported from other countries. Decreases in imports of meat in the Solomon Islands and Vanuatu is most likely due to domestic cattle production. The decrease in the imports of alcoholic beverages in Fiji and Papua New Guinea is probably due to local brewing of beer.

TABLE 19. Food Imports in some Pacific Islands

| | Years | M E A T | | | F I S H | | | S U G A R | | |
|-------------|---------------------|-------------------------------------|-----------------------|--------------------|----------------------------|-----------------------|--------------------|-------------------------------------|-----------------------|--------------------|
| | | Mean Annual Imports '000kg | Per Capita (kg) | In- crease % | Total Imports '000kg | Per Capita (kg) | In- crease % | Mean Annual Imports '000kg | Per Capita (kg) | In- crease % |
| A. Samoa | 1974-1979 | 2897 | 95.9 | 9 | 1710 | 56.6 | 16 | 1320 | 43.7 | 12 |
| Fiji | 1976-1978 | 5126 | 9.1 | 171 | 11377 | 20.2 | 31 | 543 | .96 | -7 |
| Kiribati | 1971-1979 | 531 | 9.9 | 89 | 172 | 3.2 | 309 | 1528 | 28.5 | 46 |
| Nauru* | 1971/72- 1978/79 | 515 | 70.5 | 54 | 40 | 5.5 | -81 | 327 | 44.9 | -31 |
| Niue | 1970-79 1971/72 | 107 | 25.0 | -7 | 59 | 13.8 | 9 | 56 | 13.0 | 7 |
| P.N.G. | 1971/72- 1975/76 | 17218 | 5.8 | 8 | 17693 | 6.1 | 44 | 19926 | 6.9 | 5 |
| Solomon Is. | 1970-1978 | 599 | 3.3 | -28 | 409 | 2.3 | -17 | 1232 | 6.8 | 7 |
| Tonga | 1976-1978 | 22875 | 31.5 | 17 | 225 | 2.5 | 62 | 1307 | 14.3 | 50 |
| Vanuatu | 1972-1976 | 719 | 7.9 | -46 | 1343 | 14.8 | -66 | 1162 | 12.8 | -32 |

TABLE 19. Cont.. Food imports in some Pacific Islands

| | Years | All Cereal Products | | | Beverages Alcoholic | | |
|--------------------|---------------------|--|-----------------------|----------------------|--|---------------------------|----------------------|
| | | Mean annual imports (^{'000} kg) | Per capita (kg) | Per cent increase | Mean p.a. (^{'000} litres) | Per capita (litres) | Per cent increase |
| A. Samoa | 1974-1979 | 2515 | 83.3 | -5 | 2867 | 95 | 8 |
| Fiji | 1976-1978 | 60848 | 107.8 | 52 | 2028 | 3.6 | -10** |
| Kiribati | 1978/79 | 4414 | 82.5 | 40 | 991 | 18.5 | 63 |
| Nauru* | 1971/72- 1978/79 | 692 | 94.9 | -18 | 970 | 132.8 | 78 |
| Niue | 1970-79 1971/72 | 159 | 37.0 | -22 | 201 | 46.8 | 23 |
| PNG | 1971/72 1975/76 | 82362 | 28.3 | 9 | 3430 | 1.2 | -79** |
| Solomon Islands | 1970-78 | 5228 | 29.0 | 7 | 1063 | 5.9 | 80 |
| Tonga | 1976-78 | 4038 | 44.2 | 59 | 1063 | 11.6 | 26 |
| Vanuatu | 1972-76 | 5673 | 62.3 | -5 | 2333 | 25.6 | -28 |

* Imports from Australia only

** Began producing local beer during this time

Mean per capita imports for the years given indicate that American Samoa has the highest imports per capita for meat and fish and close to the highest for the other food items. Nauru is just slightly lower than American Samoa, but alarmingly higher than all countries in alcohol imports.

Food import figures by quantity were not available for other Pacific Island countries at this time.

V. CHRONIC DISEASES ASSOCIATED WITH A WESTERN LIFESTYLE

Increasingly, the adult Pacific Islander choosing a western way of life is also acquiring the degenerative disease pattern of western societies. Diseases which were once extremely uncommon in traditional groups are now reaching epidemic proportions in towns and cities in the Pacific. Prevalence rates of these disorders are not only many times higher in urban environments than in rural setting, but they are often many times higher than in the affluent western countries. Table 20. provides a summary of the changes in disease prevalence associated with a western life style.

Diabetes mellitus is considered a major health problem among urbanised Pacific Islanders today. Recent studies have found rates of diabetes two to six times higher in urban residents compared to their neighbours in traditional villages. One small island, Nauru, has the highest rate of diabetes yet reported in the world, 30.3 per cent (Zimmet, 1977).

Hypertension, cardiovascular disease and other risk factors associated with coronary heart disease are also on the rise. Heart disease is the second leading cause of death in the Trust Territories of Pacific Islands (TTPI, Bureau of Health Services, 1979). Prevalence rates of hypertension in urban areas are at least twice those of rural communities. Other risk factors such as serum cholesterol and triglyceride levels, obesity and sedentary life style are also more prevalent in the urban or town centres.

While high levels of serum uric acid have been found in traditional Pacific Island groups, gout is relatively uncommon until the western influences of a high calorie diet, obesity and alcohol occur.

Obesity, which was appreciated among the affluent chiefs in traditional societies, is now the norm. Numerous surveys have shown the increase in obesity with the adoption of a western way of life and the association of obesity with the major chronic diseases; diabetes, hypertension and gout. There is no doubt that obesity is a major risk factor associated with these diseases but it is not the only factor.

TABLE 20. Changes in disease prevalence associated with move from "traditional" to "urban" environment

| | |
|------------------------|------|
| DIABETES | ↑↑↑↑ |
| BLOOD PRESSURE LEVELS | ↑↑ |
| DENTAL CARIES | ↑↑ |
| OBESITY | ↑↑↑↑ |
| CORONARY HEART DISEASE | ↑ |
| HYPERURICAEMIA | ↑ |
| GOUT | ↑ |
| ALCOHOLISM | ↑ |
| CANCER | ↑ |

The effect of urbanisation is most clearly seen on the prevalence of dental caries in children. There is a strong positive correlation between sugar imports and dental caries in Pacific Island countries.

Very little is known about the diseases of alcoholism and cancer.

Each of these diseases is discussed in detail and by country in the following section and summarised in Table 20. But it is perhaps worth quoting the comments of Hipsley and Clements (1947) in their report of the Papua New Guinea Nutrition Survey Expedition:

"When the disease pattern of the New Guinea native is compared with that of civilised nations, it is seen that a few diseases are represented in both, notably tuberculosis and gonorrhoea; but many which are common in civilised races are conspicuously rare in the native people; dyspepsia, appendicitis, constipation, atherosclerosis and eclampsia are almost unknown; gall stones, dental caries, urinary calculi and (so far as is known), some cancers, are all of a comparatively rare occurrence; some types of psychoneurosis are apparently uncommon." (Hipsley & Clement, 1947).

DIABETES MELLITUS

Diabetes, a disease which was once completely unrecognised in the Pacific, is now a health problem of major importance. While diabetes is still uncommon among people who have maintained their traditional way of life, the prevalence among groups who have adopted an urban, western lifestyle is extremely high. Polynesians, Micronesians and Melanesians are all experiencing this phenomenon.

This rise in prevalence has been shown in other groups where there has been a recent transition from a traditional lifestyle to a western way of life. American (Pima) Indians of Arizona (Bennett, 1971), Australian Aborigines (Wise et al, 1970) and Indians living in South Africa (Marine et al, 1909) in urbanised settings have been found to have high rates of diabetes. The diabetes in these communities and in the Pacific is the non-insulin dependent (maturity-onset) form and requirement for insulin even for treatment of the disease is uncommon. Insulin dependent diabetes (juvenile type) is rare throughout the region.

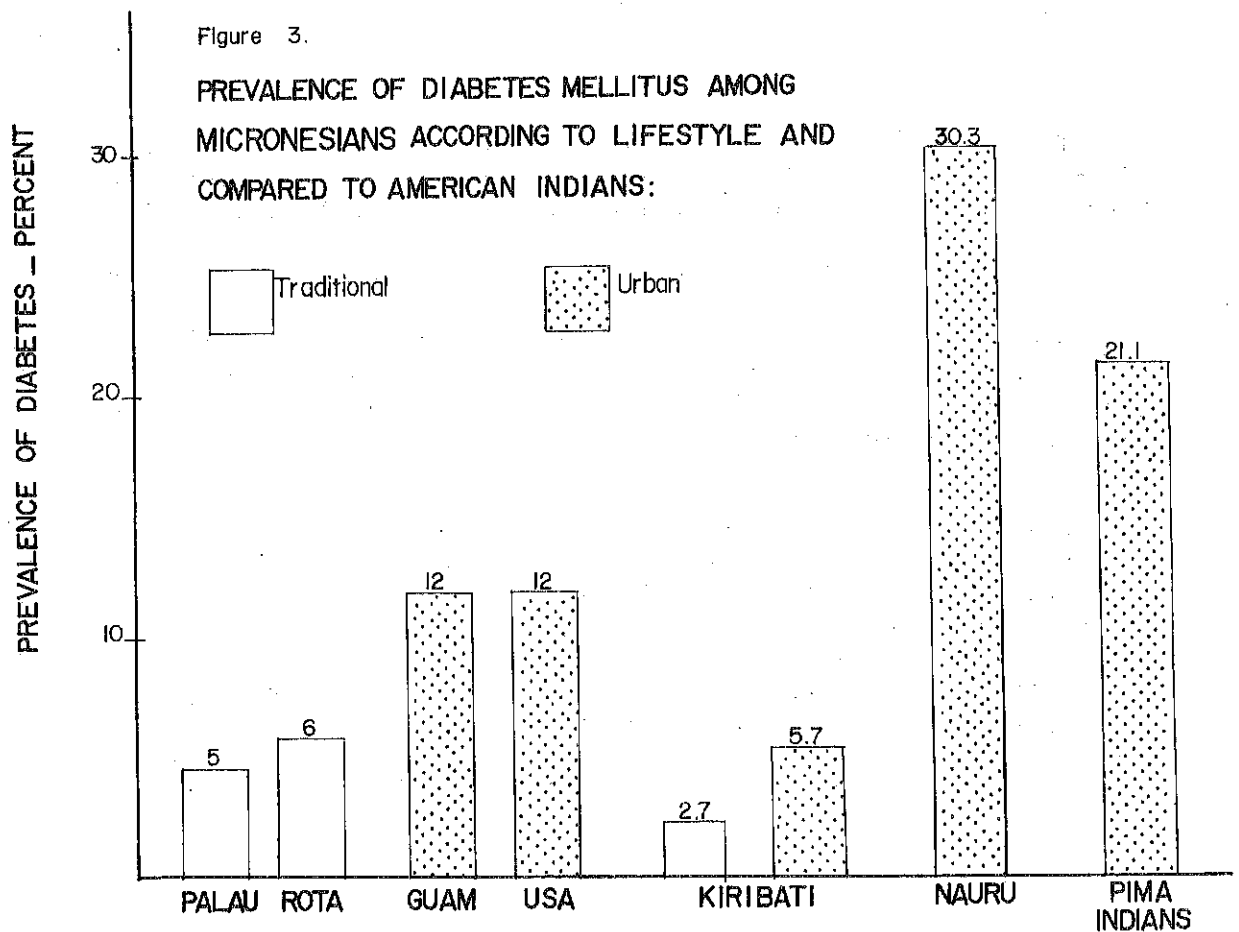


FIGURE 4. Prevalance of Diabetes Mellitus among
MELANESIANS according to life style.

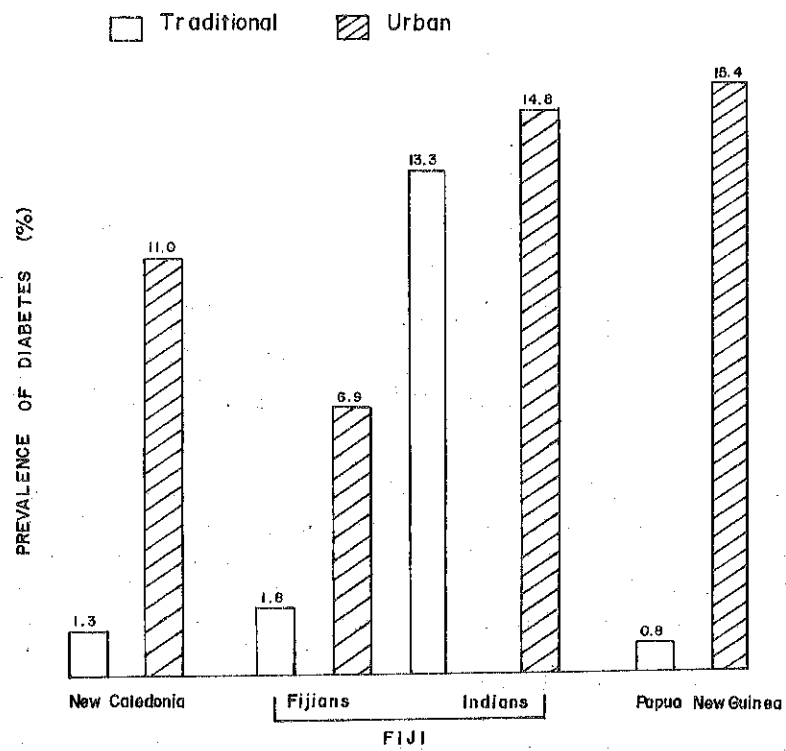
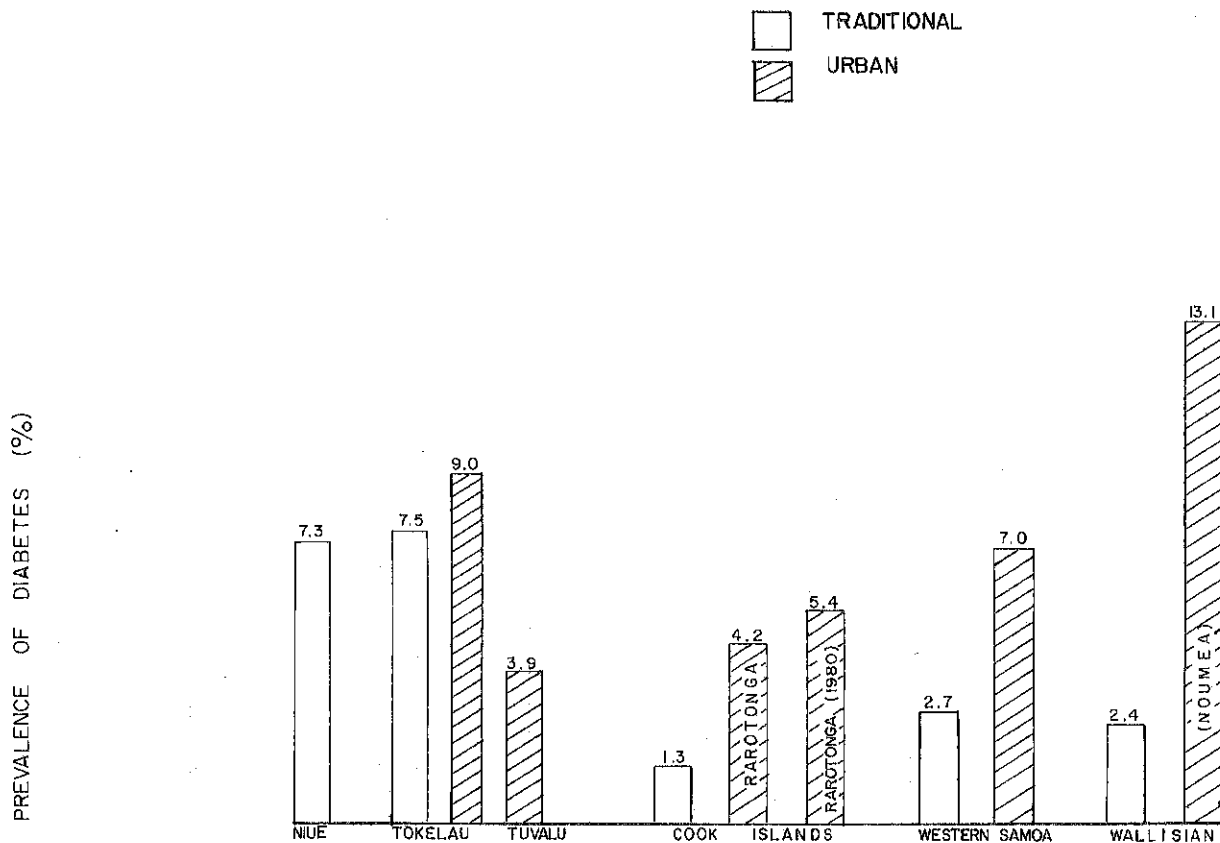


Figure 5. PREVALENCE OF DIABETES MELLITUS AMONG POLYNESIANS ACCORDING TO LIFE STYLE



Figures 3, 4 and 5, and Table 21. compare the prevalence of diabetes for urban and rural groups in the Pacific Region. The rates given for most of the studies are generally comparable in that the age groups, methodologies and diagnostic criteria are similar except as noted below. The more recent studies conducted by Zimmet and/or Bennett in the 1970s have used World Health Organisation diagnostic criteria for diabetes:

diabetes mellitus was diagnosed in individuals with a fasting plasma glucose of > 140 mg/100ml (7.8 mmol/l) and/or a plasma glucose > 200 mg/100ml (11.0 mmol/l) 2 hours following an oral glucose load.

Impaired glucose tolerance was diagnosed when the fasting glucose concentration is less than 140 mg/100ml (7.8 mmol/l) and the plasma glucose response to an oral glucose load is between 140 and 199 mg/100ml at 2 hours after the glucose load. Only adults over the age of 20 years have been included in the surveys.

Those studies from the Cook Islands (Prior and Davidson, 1966), Australia (Wellborn, 1968) and New Zealand (Prior and Davidson, 1966) used slightly lower diagnostic criteria and would therefore be expected to have slightly higher rates.

TABLE 21. Prevalence of Diabetes in Pacific Island Urban and Rural Groups

| Location | Number Examined | Diabetes Prevalence % |
|----------------------|--------------------|-----------------------|
| MICRONESIA | | |
| Nauru (u) | 456 | 30.3 |
| Kiribati (u) | 1917 | 7.5 |
| (r) | 1083 | 2.7 |
| Chamorro (u) | 1214 | 10.0 |
| Palau (R) | 519 | 5.0 |
| MELANESIA | | |
| Papua New Guinea (u) | 185 | 15.8 |
| (R) | 105 | 1.0 |
| Fiji-Melanesian (u) | 861 | 6.9 |
| (R) | 477 | 1.8 |
| Fiji-Indian (u) | 848 | 14.8 |
| (R) | 452 | 13.3 |
| New Caledonia (u) | 166 | 11.4 |
| (R) | 699 | 1.3 |
| POLYNESIA | | |
| Cook Islands (u) | 107 | 4.2+ |
| (R) | 30 | 1.3 |
| Tuvalu (u) | 397 | 3.9 |
| Wallis Island (u)* | 475 | 13.1 |
| (R) | 618 | 2.4 |
| Western Samoa (u) | 744 | 7.0 |
| (R) | 745 | 2.7 |
| Tokelau (u) | 1001 | 6.2 |
| (R) | 916 | 3.9 |
| Tonga (u) | 373 | 6.2 |
| (R) | 366 | 5.2 |
| Pima Indians - USA | 3733 | 21.1 |

+ 2-hour blood glucose > 130 mg/100ml

* Noumea, New Caledonia

The population groups have been divided into the three major ethnic groups in the region - Micronesians, Melanesians and Polynesians. The geographic locations of these groups have been shown in Figure 1.

MICRONESIA

Guam

Diabetes was indicated as a problem in Guam as early as 1964 when Yen (1964) demonstrated the effect of diabetes during pregnancy on the increased incidence of maternal and perinatal complications.

Reed and colleagues (1973) found higher mean blood glucose levels in Micronesians living in Guam and California compared to those living on traditional outer islands.

Kuberski and Bennett (1979) have reviewed morbidity and mortality rates for Guam. Some of their findings include:

1. Between 1971 and 1977 diabetes ranked among the top 10 causes of death and accounted for 2.7 per cent of all deaths.

2. Among those over 35 years of age, diabetes ranked as the third equal leading underlying cause of death, second only to heart disease and cancer.

3. Among deaths in persons aged 45 years and over at Guam Memorial Hospital in 1976, 50 per cent of Chamorros and 36 per cent of Filipinos had evidence of diabetes at the time of death.

4. Direct hospital costs associated with diabetes at Guam Memorial Hospital alone exceeded \$600,000 for one year.

5. "As direct hospital costs comprise only one fifth of the socio-economic costs of diabetes in the mainland United States, the cost of diabetes on Guam is conservatively estimated at more than \$3,000,000 per year".

Marshall Islands

During 1974, 375 adults in the Marshall Islands were examined to determine the incidence and nature of diabetes in the islands. The overall incidence of diabetes was reported as 26 per cent (Conard, 1975). In this survey a blood glucose level of >120 mg/100ml, either fasting or 2 hours following a 75 g oral glucose load, was taken as indicative of abnormal glucose tolerance. This criteria is considerably lower than in other surveys and would therefore give a higher incidence of diabetes. Retinopathy and peripheral vascular disease did not appear to be increased among the diabetics.

Kiribati

A recent survey completed by Zimmet et al (1981) found a prevalence rate for diabetes of 7.5 per cent among I-Kiribati living in the urban area of Betio. People living a more traditional way of life in Tabiteuea North had a diabetes prevalence rate of 2.7 per cent but a higher rate of impaired glucose tolerance than would have been expected from a traditional living group of people. Many of the people, however, had spent long periods in urban settings such as Betio or Nauru.

I-Kiribati living in an urban setting in the Solomon Islands also experience a much higher rate of diabetes than local Melanesians in the same environment (SPC, 1978).

Nauru

Diabetes was not mentioned as a health problem in a survey conducted in Nauru in 1933 (Grant, 1933). In 1962, Tulloch (1962) reported diabetes in 21 Nauruans, 1 per cent of the population.

A subsequent survey, conducted in 1975 by Zimmet and co-workers (1977a), found approximately one third (30.3 per cent) of 456 Nauruans to be diabetic. This is one of the highest prevalences recorded in the world. A strong hereditary factor was evident with 72 per cent of the diabetics reporting a family history of diabetes.

The rate of diabetes increased progressively with age and was highest among females aged 50-59 years with a prevalence of 78.6 per cent. The rate for males was 54.6 per cent in the same age group.

Obesity is extremely common in the Nauruan community. The mean weights of men and women were 11 and 19 kg. higher, respectively, than those of a comparable Caucasian population. Yet, the mean weight and body mass index (weight/height²) were not significantly different for diabetics and non-diabetics.

Nutrient intakes were calculated on 77 individuals using an adjusted 24 hour recall (Ringrose, 1979). The mean caloric intake of males between 20-39 years was 8769 calories. This is approximately three times that recommended for developing western Pacific countries (WHO, 1972). caloric intake for males and females combined is twice that recommended for Australian males, (NH & MRC, 1979). The contribution of total calories from carbohydrate was 48 per cent, from protein 15 per cent and from fat 33 per cent.

The present dietary pattern is markedly different from the traditional diet of fresh fish, fresh meat, coconut and pandanus. With increased wealth and westernisation, tinned meats and fish, white rice and sugar have totally replaced the higher fibre, lower fat, traditional menu.

Wealth and westernisation have also brought cars, motorbikes and outboard motors and a decrease in physical activity. Thus with a high caloric intake the development of obesity is a precipitating factor for diabetes in this population with a strong hereditary disposition to the disease.

MELANESIA

Until recently diabetes was thought to be rare in Melanesians (Zimmet, 1979a). Surveys from Papua New Guinea, Fiji and New Caledonia, however, indicate that diabetes is becoming a significant health problem in these countries.

Fiji

Diabetes prevalence in Fijian Melanesians until recently was thought to be extremely low. A 1967 rate of 0.6 per cent was found in 1000 Fijians over 21 years of age (Cassidy, 1967). In the Indian population, however, the prevalence was 10 times as high - 5.7 per cent.

Recently Zimmet (1980a) discovered a rate of diabetes of 6.9 per cent in Fijians living in urban settings. Again this is an apparent ten fold increase in a little over 10 years. The rural population in Fiji may also have an increased rate of this disease. Indians in Fiji continue to have high rates whether living in a rural environment or urban lifestyle (Table 22.).

While the life styles of these groups vary considerably, diet is probably the most variable of the environmental factors. The Indians have retained the custom of a diet of white rice, roti and chapatis made of coarsely milled flour and highly spiced dishes. The rural Fijian diet continues to consist of cassava, taro and yams with seafood providing a major source of protein. As Fijians become urbanised, however, this pattern is changing to a greater reliance on western, refined, processed foods (Ringrose, 1981).

Ringrose (1981) found, however, that rural Fijians had a higher energy intake than either urban Fijians or rural or urban Indians as shown in Table 22. This suggests that high levels of physical activity or genetic differences may be more important and override other environmental influences between these groups.

One important difference between the diet of the Indian and urban Fijians and the diet of rural Fijians is the fibre content. The Indian diet derives 59 per cent of calories from cereals which are basically refined white rice and milled flour. The rural Fijian diet contains 54 per cent of energy from root crops. Sorokin (1975) calculated the fibre content of the rural Fijian diet at 10.9 grams whereas the Indian diet contained only 4.2 grams of fibre. Both groups consumed similar quantities of sugar.

TABLE 22. Energy intake and diabetes prevalence of urban and rural Fijians and Indians in Fiji

| | Fijians | | Indians | |
|---------------|---------------|------------------------|-----------|------------------------|
| | kcalories/day | Diabetes Prevalence(%) | kcalories | Diabetes Prevalence(%) |
| Rural Males | 3152 | 1.5 | 2844 | 13.0 |
| Urban Males | 2177 | 5.3 | 2626 | 15.5 |
| Rural Females | 2644 | 2.0 | 2254 | 13.1 |
| Urban Females | 1910 | 8.7 | 2108 | 14.4 |

New Caledonia

Until 1979, diabetes was seldom reported in New Caledonia. A survey was conducted among the Melanesians by Taylor and Zimmet (1981a), in the town of Noumea, in a rural village, and on an outer atoll island. The rural population of Melanesians had a low prevalence of 1.3 per cent whereas in the urban people of Noumea, the rate was 11.0 per cent.

The investigators also compared Polynesians (Wallisians) living in Noumea to those living on Wallis Island. A prevalence rate of 2.4 per cent was found on Wallis Island where subsistence agriculture is still the norm. Wallisians who had migrated to Noumea had a rate of 13.1 per cent.

Papua New Guinea

Diabetes was not mentioned in the extensive "Report of New Guinea Nutrition Survey", 1947 (Hipsley and Clement, 1947). In fact, the editors commented that "diseases common in civilized races are conspicuously rare". Campbell described ten cases of diabetes at Port Moresby between 1958 and 1961 (Campbell, 1963).

In 1962, Hingston and Price (1964) performed urine glucose examinations in two traditional rural villages and four suburban settlements around Port Moresby. No diabetes was found in the rural villages and only two cases were found in Port Moresby after those with glycosuria were subjected to glucose tolerance testing. This was a prevalence in Port Moresby of 0.2 per cent.

A similar study reported in 1966 (Price and Tulloch, 1966) noted a higher prevalence of diabetes in Port Moresby adults (1.4 per cent) particularly in suburbs with the longest contact with the Western way of life compared to suburbs with shorter Western contact.

In approximately ten years, this rate was to apparently increase ten fold. In a survey conducted in 1977 by Martin and co-workers (Martin et al, 1980), a rate of 15.8 per cent was found in a relatively affluent suburb of Port Moresby (Koki). The prevalence of diabetes was only 1.0 per cent, however, in the rural village of Kalo where subsistence farming was the predominant occupation. The response rate, however, was only 30 and 28 per cent in Port Moresby and Kalo respectively so the rates may not be totally representative. Dietary analysis described the food patterns in the village of Kalo as consisting mostly of yams, cassava and bananas with very little "refined food". The average caloric intake for the rural people was 1400 calories. The mean caloric intake for urban residents was 2300 calories coming mostly from white bread, white rice and tinned food. Obesity was more of a problem in the urban group but there was no relationship in either group between weight and plasma-glucose.

Melanesians in Papua New Guinea are reported to show a slightly different picture of diabetes than other Pacific Island groups. "The presence of young, non-obese, non-ketotic diabetics who tolerate high blood glucose for a long time is more common in Papua New Guinea than in other countries " (Martin, 1980).

Complications of severe infections and gangrene occur frequently in this population (Price, 1973, Martin, 1978). Martin (1978) examined medical records in four Papua New Guinea hospitals from 1974-1977 finding that although atherosclerosis and retinopathy were rare, proteinuria was present in 36 per cent of cases, severe neuropathy in 25 per cent and hypertension in 25 per cent. Amputations were performed on the lower limbs of 28 out of the 127 diabetic patients reviewed.

Solomon Islands

"Diabetes not a problem" (Tulloch, 1962). There have been no recent reports from the Solomon Islands.

Vanuatu

"Population well-nourished - existing basically on vegetarian diet". No diabetes reported, (Tulloch, 1962). Diabetes was not mentioned in a 1964 health survey (Norman-Taylor, 1964) or a 1976 survey (Jabre, et al, 1976).

POLYNESIA

American Samoa

A survey of a small group of Samoans living in San Francisco, estimated a diabetes prevalence rate of 15 per cent using a fasting glucose level of 160 mg/100ml. When the investigator (Pawson and Jones, 1981) compared the weight of U.S. Samoans with those living in Hawaii, American Samoa and Western Samoa, he found the San Francisco Samoans weighed significantly more than the other groups. In fact, the mean weight of males in San Francisco was over 100 kg and the mean weights of females over 90 kg, in all age groups. Pawson concluded that "our work so far has led us to believe that Samoans who have moved to California may represent the world's fattiest and heaviest sub-population".

Cook Islands

In 1962-1963, Prior et al (1966) investigated the prevalence of diabetes in two communities in the Cook Islands. One group lived in the isolated coral atoll island of Pukapuka and had a low prevalence of diabetes of 1.3 per cent. A rate of 4.2 per cent was found in the community on Rarotonga, where exposure to Western diet and lifestyle had been so for ten years or more. These rates were still much lower than those reported in New Zealand Maoris (Prior, 1966) of 8.1 per cent, but higher than New Zealand Europeans (2.7 per cent) as shown in Table 23. In this survey participants were tested for urinary glucose and then a modified glucose tolerance test was performed on those with glycosuria. A two-hour level of 130 mg/100ml was taken as abnormal. The New Zealand Maoris also had the highest energy intake and Pukapukans the lowest as seen in Table 23.

TABLE 23. Comparison of nutrient intakes and diabetes prevalence of different Pacific Groups (Prior & Davidson, 1966)

| | New Zealand New Zealand | | | |
|---------------------|-------------------------|-------------|--------|-----------|
| | Pukapukans | Rarotongans | Maoris | Europeans |
| | N=30 | N=107 | N=104 | N=61 |
| Diabetes Prevalence | 1.3 | 4.2 | 8.1 | 2.7 |
| kcalories | 1800 | 2100 | 2560 | 2270 |
| MJ | 7.5 | 8.8 | 10.7 | 9.5 |
| Protein - gm | 60 | 60 | 73 | 73 |
| Fat - gm | 70 | 63 | 125 | 99 |
| Carbohydrate - gm | 225 | 320 | 284 | 272 |
| Sucrose - gm | 9 | 35 | 71 | 61 |

When this survey was repeated in Rarotonga in 1980 by Bennett (1981), the rate had increased from 4.2 to 5.4 per cent. These rates, however, are not strictly comparable due to different methodologies and much stricter criteria used by Bennett (2 hour plasma glucose > 200 mg/100ml) as compared to Prior >130 mg/100ml).

French Polynesia

A survey of 6 atolls of the Tuamotu/Gambier group examined 1125 people including children for glycosuria. Using the AMES reactive strip method 33 cases or 2.9 per cent were found with glycosuria. Obesity was associated with glycosuria in half of the cases (Delebecque, 1980).

Australia

Diabetes among urbanised Australian Aborigines was at least five times that found in an Australian Caucasian community (Wise, 1970).

Hawaii

The prevalence of diabetes in Hawaiian Polynesians was reported as seven times that of Caucasians and more than twice that of Japanese, Chinese and Filipinos living in the same region (Sloan, 1963). Bassett (1966) found a prevalence rate of 12 per cent in the adult male population of the island of Niihau.

New Zealand

Maoris living in both rural and urban areas of New Zealand had combined prevalence rates of 9.2 per cent for males and 9.0 per cent for females compared to 1.5 per cent and 3.9 per cent in European males and females from a small New Zealand community (Prior and Davidson, (1966).

Obesity was associated with the prevalence of diabetes in both males and females. The New Zealand Maoris consumed significantly more calories and fat than the European group. Sugar consumption was also higher than the European and the Cook Island groups.

Niue

Results of a survey reported by Bennett (1981) revealed that 4.9 per cent of males and 9.6 per cent of females, were diabetic. These figures are comparable with other Polynesian groups.

Tokelau

Surveys were conducted with Tokelauan people in 1968 and 1971 in the Tokelau Islands and again on those who had migrated to New Zealand between 1972 and 1974 (Prior et al, 1978). Prior and co-workers compared Tokelauans who remained in Tokelau to those who migrated to New Zealand and to New Zealand Maoris (Table 24.). A diagnosis of diabetes was based on the plasma glucose levels one hour after a 100 gm glucose load. "Definite" diabetes required a level of 250 mg/100ml or more, "probable" diabetes was between 200-249 mg / 100 ml.

TABLE 24. Prevalence of Diabetes in New Zealand Maori, New Zealand Maori, New Zealand Tokelau and Tokelau Islanders by Sex (Prior et al, 1978)

| | Maori 1968-1969 | Tokelau (New Zealand) | Tokelau (Islands) |
|--------|--------------------|--------------------------|----------------------|
| Male | 9.6 | 5.0 | 1.9 |
| Female | 9.6 | 7.3 | 5.9 |

Prior reported that the Tokelauans in New Zealand had higher prevalence rates of diabetes than those in the islands but the difference was not significant.

The dietary patterns of the two groups, however, were quite different. For the island dwellers, fish and coconut supplied the major proportions of calories which appears to account for the high fat, low carbohydrate content and high saturated fat content of the diet. Breadfruit, some taro and very small amounts of rice, made up the starchy portion of the diet.

The Tokelauans' diet in New Zealand was higher in energy. Meat, eggs and dairy products replaced fish and probably account for the higher protein intake. The lower fat intake would be due to the decrease in coconut dishes. Carbohydrate foods included rice and bread, potatoes instead of taro and breadfruit (and substantially more sugar).

The prevalence of diabetes was found to increase with body mass in both groups of Tokelauans and New Zealand Maoris, but the increase was significant only for the females living in the islands. These findings, however, confirm the importance of obesity in the etiology of diabetes.

Tonga

Prior and co-workers (1978) in 1973 found little difference between prevalence rates of diabetes between urban Tongans (Nuku'alofa) and those living in traditional isolated villages (Foa). This survey revealed a prevalence of 6.2 and 5.2 per cent respectively in Nuku'alofa and Foa.

A plasma glucose level of 180 mg/100ml two hours following a 75 gm glucose load was the diagnostic level for "definite" diabetes.

Weight, skin fold measurements, blood pressure and serum uric acid levels were greater in some age groups of urban dwellers than in the traditional villages.

Tuvalu

A survey was undertaken in 1976 on the major island of Funafuti (Zimmet, 1977) of 397 people over 20 years of age of whom 3.9 per cent had diabetes.

Obesity was an important problem in this population. In the males examined, there was no significant difference in weight or body mass index (weight/height) between the diabetic and non-diabetic participants. The female diabetics, however, were significantly heavier and had a higher body mass index than the non-diabetics.

The traditional diet of this atoll island consisted mainly of fish, coconut, breadfruit, banana, taro and pulaka (a variety of taro). By 1976 the island was dependent on imported foods for 80 per cent of its total food needs. The composition of the present diet as analysed by 24-hour recall (Wicking, 1981) revealed a mean energy intake of 3133 kcalories (13.1 MJ) for males and 2629 (11.0 MJ) for females.

Western Samoa

In 1978, surveys were conducted in rural villages and the urban centre by Zimmet and co-workers (Zimmet, 1980) with the following results:

| | <u>Rural</u> | <u>Urban</u> |
|---------------------------------|--------------|--------------|
| Number examined | 745 | 744 |
| Prevalence of diabetes per cent | 2.7 | 7.0 |

The urban center of Apia, on Upolu, is the administrative center of Western Samoa where much imported food is now the norm. The rural villages from the Falealili district of Upolu and from the Tuasivi district on Savai'i, were still following a subsistence agricultural way of life, but some modernisation was already occurring.

Along with the higher prevalence of diabetes in the urban population, was also a greater degree of obesity, less physical activity and a diet rich in imported foods. Imported foods were chiefly of high caloric density (high calories for weight), low in fibre and rich in either fat or sugar.

COMPLICATIONS OF DIABETES IN THE PACIFIC

There have been very few studies on the prevalence of complications of diabetes in the Pacific. It appears, however, that complications may vary by ethnic groups and are increasing in several populations. From 1974-1977, Martin (1978) examined hospital records in four hospitals in Papua New Guinea. Of the 127 diabetes patients, only 27 per cent had diabetes for more than three years. The major complications found in the group included:

| | | |
|------------------------|---|--------|
| Proteinuria | - | 36% |
| Severe Neuropathy | - | 25% |
| Hypertension - females | - | 43% |
| males | - | 32% |
| Obesity - females | - | 49% |
| males | - | 27% |
| Retinopathy | | "rare" |

Peripheral complications of the lower limb were due to a combination of infection and neuropathy. Amputations of the lower limbs were performed on 28 patients. "Myocardial ischaemia and strokes were rarely seen and it would seem that at present in Papua New Guinea there is no increase in atherosclerotic large vessel disease in diabetics, but microangiopathic and metabolic complications occur frequently" (Martin, 1978).

In Nauru, Zimmet (Zimmet and Taft, 1978) found a similarly high prevalence of small vessel disease in 52 known diabetics first studied in 1972:

| | | |
|-----------------------|---|---|
| Duration of Diabetes | - | 2 months - 18 years (mean 4.1 years) |
| Retinopathy | - | 25 patients (48%) |
| Nephropathy | - | 17 patients (33%) |
| Hypertension | - | 29 patients (53%) |
| Peripheral neuropathy | - | 30 patients (58%) |

In Fiji, Sorokin (1975) reported that "a very large number of the Fijian patients are discovered to have diabetes when they present septic lesions on the feet and legs. After surgical treatment the carbohydrate disturbance often reverts to normal or the diabetes is of a mild nature and the patient returns home to live in an asymptomatic state".

Kuberski and Bennett (1979) reviewed death records in Guam for the

year 1976. Table 25. shows the frequency of complications associated with death according to the duration of diabetes. The investigators also noted that arteriosclerotic heart disease, myocardial infarction, hypertension and congestive failure as well as cerebrovascular disease, nephropathy, cataract and gangrene, were all significantly more frequent in diabetics than non- diabetics. Nephropathy and gangrene occurred almost exclusively among diabetics. In hospitalised patients, 14 out of 17 amputations (82 per cent) were performed on diabetics.

TABLE 25. Complications of Diabetes in Guam, 1976
(Kuberski and Bennett, 1979)

| Complication ----- | Duration of Diabetes | |
|--------------------------------|----------------------|------------------|
| | 5 years ----- | 5 years ----- |
| | (N=32) | (N=22) |
| | Per cent | |
| Arteriosclerotic heart disease | 66 | 73 |
| Myocardial infarction | 25 | 27 |
| Hypertension | 25 | 45 |
| Congestive heart failure | 28 | 41 |
| Cerebrovascular disease | 38 | 9 |
| ALS/PD | 22 | 9 |
| Nephropathy | 16 | 16 |
| Gangrene | 6 | 18 |
| Cataract | 19 | 32 |

The authors calculated that the total direct hospital costs associated with the treatment of diabetes at a conservative estimate of \$150 per day, would amount to a direct cost of over \$600,000 in 1976.

Prior (1970) studied mortality rates of New Zealand Maoris between 1968 and 1974. Over this period of five years, the age standardized death rates showed:

In the 35 to 74 year age group, the death rates from coronary heart diseases over the five year period were:

"These data indicate that diabetes is associated with increased risk of death from all causes as well as from coronary heart disease

alone" (Prior, 1970).

Important conclusions reached at a meeting on Metabolic Disorders in the South Pacific (SPC/WHO 1978) were:

"Complications from diabetes vary in frequency, but diabetic eye disease (cataracts and retinopathy), cardio-vascular disease, gangrene and gout are increasing problems".

POSSIBLE CAUSITIVE FACTORS OF DIABETES IN THE PACIFIC

The previous summary of surveys in the Pacific indicates the high prevalences of diabetes among many Pacific Island populations. These rates are:

- (a) many times higher than caucasian groups
- (b) associated with obesity
- (c) associated with a change of life style from a traditional village way of life to an urbanised, western environment.

This change has been shown in other racial groups who have recently adopted a western life style (Bennett, 1971 West, 1978).

Some factors which may be responsible for the high prevalence of diabetes in Pacific Island populations include:

- (a) Genetic Factors. While the consensus of opinion relating diabetes to heredity is still controversial, there is evidence to suggest that some differences among societies may have a genetic basis (West, 1978).

One theory which has been proposed is the "thrifty genotype" hypothesis. Neel (1962) suggests that the diabetic genotype is an advantage for survival where a feast and famine situation exists. Those with the diabetic genotype may be more efficient in the storage of nutrients at feast times and therefore better able to survive the 'famine'. When exposed to the 'feast' of the high calorie, high fat, high sugar western diet, however, the diabetic is too efficient in his storage of nutrients, becomes obese and develops diabetes.

The hereditary factor was supported in Nauru where 72 per cent of the diabetics had a family history of the disease (Zimmet and Taft, 1978). Further research is needed to elucidate the role of genetic factors in the Pacific.

- (b) Obesity is the most important nutritional factor in the aetiology of diabetes (West, 1978). In most of the groups studied in the Pacific; Nauru, Cook Islands, Tuvalu, Tokelau, Tonga, Samoa and New Zealand Maoris, obesity and a high prevalence of diabetes

were found together. There was not, however, always a significant difference between obesity in diabetics and non-diabetics.

Nauruans, one of the most obese groups, also experienced the highest rates of diabetes. The prevalence of diabetes was 2 - 4 times higher in obese Nauruans compared to lean Nauruans in age groups under 40 years. For the older age groups, however, there was little difference in prevalence rates between obesity and lean participants. This finding suggests that obesity may influence the time at which diabetes appears rather than whether or not diabetes develops (Zimmet, 1980).

Diabetics in Papua New Guinea, however, are not as obese (Martin, 1980) nor is obesity mentioned in relation to Fijian and Fijian-Indian diabetics. This suggests that while obesity may be a major precipitating factor for diabetes in the Pacific, it may be more important in some ethnic groups than in others.

(c) Altered dietary patterns.

Groups with high prevalence rates of diabetes depend almost entirely on imported foods. Tinned fish, meat, vegetables, rice, sugar, tea, soft drinks and alcohol have replaced the traditional foods. This diet provides the consumer with a high fat, high sugar, low fibre concentrated source of calories (Ringrose, 1979 Martin, 1980 and Sorokin, 1975).

West (1978) has reviewed the possible causative nutritional factors related to diabetes and has concluded the following:

Generally acknowledged as contributing factors:

- Excessive calories (obesity),
- excessive alcohol (pancreatitis)
- excessive iron consumption (hemochromatosis)

Widely suspected as aetiological factors:

- Potassium deficiency
- protein deficiency

Other possible factors to be considered:

- Sugar consumptions,
- Fat consumption,
- Low carbohydrate consumption,
- Low dietary fibre,
- Cassava consumption,
- Deficiencies of chromium, zinc, iron and pyridoxine,
- Infrequent feeding - 'gorging'.

There is a need for more investigation into the composition of diets of high and low prevalence groups in the Pacific. It would seem that important factors to be considered are total calories, alcohol consumption, sugar, fat and fibre content of the diet, as

well as any possible deficiency of specific vitamins or minerals.

(d) Physical Activity. Another major difference in the way of life between high and low diabetes prevalence in communities is exercise. In the traditional village, activities such as fishing, canoing, walking and gardening, all require substantial physical exertion (Hipsley, 1965, Dye, 1979). In the westernised communities outboard motors have replaced canoes, motor cycles and cars have replaced walking, and tractors have replaced hoes.

It is not clear whether physical activity is protective of diabetes due to improved glucose tolerance and/or lower insulin requirements or whether the more physically active individuals are leaner as a result of utilising more calories than the less active.

Measuring levels of exercise is difficult but these are questions that need to be answered in the Pacific.

(e) Stress. It has been suggested that the fairly rapid change from the traditional environment to a cash economy and an urbanised desk job may be stressful for an easygoing islander (Zimmet, 1979). This factor may be difficult to assess but should not be excluded as playing a role in the etiology of diabetes.

CARDIOVASCULAR DISEASE AND CARDIOVASCULAR DISEASE RISK FACTORS

Cardiovascular disease is one of the leading causes of death and disability in affluent western countries. Diseases of the cardiovascular system includes coronary heart disease, cerebrovascular disease and hypertension.

There is very little information on the prevalence of cardiovascular disease in the Pacific. The causes of death are not known in many Pacific Island countries. Where records have been kept or investigated (Federated States of Micronesia, Guam, New Zealand), it appears that deaths from coronary heart diseases may be increasing particularly in more "westernised" communities. There is even less information regarding cerebrovascular disease as a cause of death or disability.

A number of factors are known to be associated with an increased risk of coronary heart disease:

- familial susceptibility
- associated diseases - hypertension, diabetes, gout
- environmental factors, diet, elevated blood lipids, smoking, lack of exercise and stress.

Of these factors, hypertension is most important; (a) as a disease in itself resulting in stroke or renal failure and (b) as a causative factor increasing the risk of coronary heart disease. Hypertension is

an increasing health disorder in the Pacific. The increase is seen in those groups that are quickly adopting a western lifestyle. Diabetes and gout are other associated diseases which also predispose to CHD.

Other factors such as diet, elevated blood lipids, lack of physical activity, smoking and stress are more controversial in their aetiological role and more difficult to measure. All of these factors also appear to be on the increase as more and more Pacific Islanders move to urban settings.

The discussion to follow will deal with each of these topics separately:

- Coronary Heart Disease, CHD, - the limited statistics in the Pacific.
- Hypertension - the prevalence in various countries and the difference between rural and urban groups;
- Other cardiovascular risk factors - changes in diet, serum cholesterol, serum triglycerides and other risk factors related to urbanisation.

CORONARY HEART DISEASE

Relatively little is known about the prevalence of coronary heart disease in the Pacific. In most western countries CHD is a major cause of death. With increasing westernisation, it could be expected that deaths from coronary heart disease and other forms of vascular disease would be increasing in the Pacific as well.

There are some indications that deaths from coronary heart disease are increasing. The death rate for New Zealand Maori women between 40-45 years of age is almost four times higher than for New Zealand European women (National Heart Foundation, 1971). Hawaiian males experience more than three times as high a rate of death from atherosclerotic heart disease as Japanese males living in Hawaii (Bennett et al, 1962).

Figures from the whole of the Trust Territories indicate that heart disease was the second leading cause of death from 1972 to 1978. Cerebrovascular disease was listed as the 8th cause of death.

"Across the Trust Territories the chronic disease of the industrialised nations (Cancer, Heart and Cerebrovascular Diseases are increasing their tolls and playing a major role in mortality" (Trust Territories Bureau of Health Services, 1978).

Kuberski and Bennett (1979) reported that heart disease was the leading cause of death in Guam over the years 1971-1977 and accounted for 18 per cent of all deaths. A high percentage of the deaths from heart disease were associated with diabetes.

Beaglehole and co-workers (1980a) analysed death rates for a 10-11

year period for three Polynesian groups aged 20 years and over. In 1963-1964, the investigators examined Cook Islanders who lived a traditional way of life in Pukapuka, those living in the urban area on the island of Rarotonga and New Zealand Maoris. They compared the 10-11 year death rates of the three groups of Polynesians to New Zealand Europeans living in Carterton. Figure 6 shows that age standardised death rates from all causes increase with increased westernisation. This is most apparent in the New Zealand Maori men.

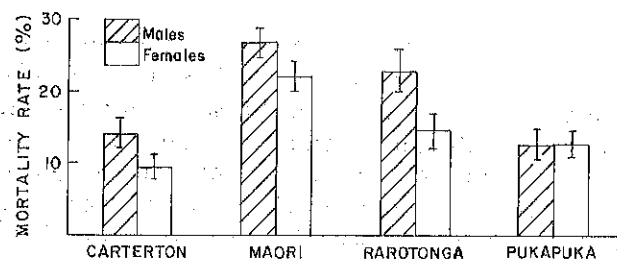


Figure 6.—Age standardised all causes death rates (1963-64 to 1974), South Pacific populations by sex.

(Beaglehole, et al, 1980a)

Reed and co-workers (1970) examined the death records of 1509 Chamorros on Guam and 86 adult deaths of Chamorros living in California over a 10-year period, from 1955-1964. As shown in Figure 7 the proportionate mortality rates for coronary heart disease were higher for the California Chamorros than the Guam Chamorros and similar to the California population.

Health effects : Chamorro westernization and migration

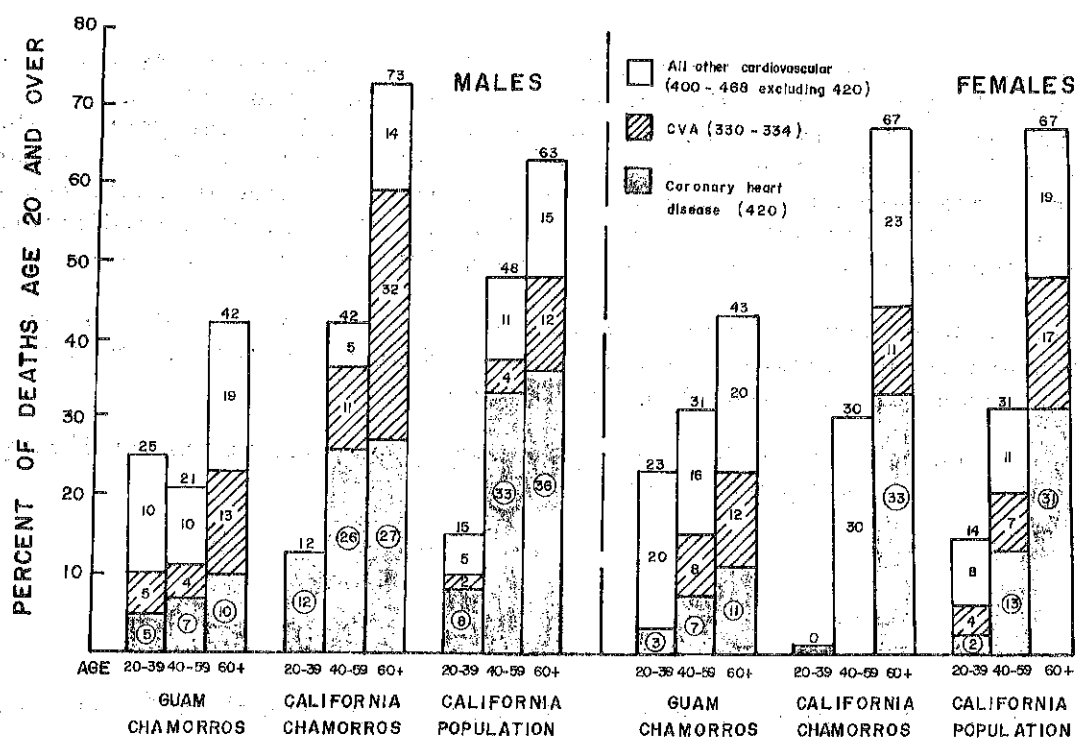


Figure 7. Proportionate mortality for cardiovascular diseases by area, age and sex. (REED 1970)

Sinnet and Whyte (1973a,b) conducted a thorough study of cardiovascular disease among isolated tribes in the Lagaip district in the Inga Province of Papua New Guinea. They found a virtual absence of arteriosclerosis, namely ischemic heart disease, peripheral vascular disease and cerebrovascular accident. Electrocardiograph findings showed that the frequency of all codable items was low. The rates of codable Q waves which are considered to be a fairly specific but not a highly sensitive index of coronary heart disease, were among the lowest rates reported worldwide.

Cardiovascular disease is thought to be rare among Fijians but may be a severe health problem within the Indian community. Cassidy (1967) noted that ischemic heart disease was significantly more common in Indian diabetics, 10 per cent, compared with less than 1 per cent for Fijian diabetics. Sorokin (1975) reviewed statistics for a 3 year period, 1970-1973 at the Lautoka District Hospital. The number of Indians with confirmed myocardial infarctions was 20 times that of Fijians, even though Indians make up 50 per cent of the population:

Number of persons with myocardial infarctions

| | Indian | Fijian | Indian |
|--------|--------|--------|--------|
| | ----- | ----- | ----- |
| Male | 201 | 8 | 24 |
| Female | 16 | 3 | 9 |
| Total | 217 | 11 | 33 |

Zimmet (1980a) reviewed the figures for ischemic heart disease in Fiji from 1971 to 1978. The number of cases rose from 429 in 1971 to 1956 in 1978. This is an increase of 460 per cent in seven years. The ratio of Indian to Fijian cases was 10:1. Resting and exercise stress electrocardiographs also showed considerable more abnormalities among Indians than Fijians (Zimmet, 1980a). The electrocardiograph differences between the rural and urban populations were not major.

There were also no major differences in the prevalence of abnormal electrocardiograph readings between rural and urban males or females in Western Samoa (Zimmet, 1980a) as shown below:

Percentage of Western Samoans with abnormal electrocardiograph characteristics

| | Rural | Urban |
|---------|-------|-------|
| | ----- | ----- |
| Males | 32.2 | 32.8 |
| Females | 29.3 | 23.9 |

The rural females, however, had higher "probably" CHD but the significance of this is not known.

Rural Melanesians and Polynesians (Wallisians) living in New

Caledonia had higher rates of abnormal ECG's than those living in urban Noumea (Taylor and Zimmet, 1981b). Table 26 also indicates that there was little difference between Wallisians living in an urban setting or on their more traditional Wallis Island.

The significance of these results is not clear at this time but may indicate that further investigation in relation to coronary heart disease in these communities is needed.

TABLE 26. Prevalence of abnormal electrocardiograph characters among urban and rural Melanese and Polynesians in New Caledonia and Wallis Islands

| Percentage of Electrocardiograph Abnormalities | |
|--|------|
| <u>MELANESIANS (New Caledonia)</u> | |
| Urban Noumea - males (Le Nickel factory) | 2.7 |
| Urban Noumea - females | 5.9 |
| Rural - Ouvea-Touho | |
| - males | 13.6 |
| - females | 12.1 |
| <u>POLYNESIANS (Wallisians)</u> | |
| Urban Noumea - males | 4.9 |
| - females | 2.4 |
| Rural - Wallis Island | |
| - males | 4.2 |
| - females | 1.2 |
| Rural - Ouvea-Touho | |
| - males | 8.7 |
| - females | 6.7 |

HYPERTENSION

Hypertension is a major disease in the industrialised world and left untreated leads to stroke and renal damage. Hypertension is also one of the most important risk factors for the development of coronary heart disease.

Studies carried out throughout the world on blood pressure levels in various societies have shown several things. One, in traditional living populations, blood pressure levels are low and they tend to remain low throughout life. These traditional societies have little or no contact with the western, urbanised world. Two, in the modern societies of the western world, blood pressures are considerably higher than in the less affluent countries and these levels rise with age.

Genetic determinants such as body build and height are related to blood pressure levels. Environmental influences such as obesity, dietary salt intake and stress are also commonly regarded as factors responsible for increasing blood pressure levels.

Recent and not so recent studies in the Pacific, are showing a trend of increasing blood pressure levels, high rates of hypertension and a rise in blood pressure with age. Table 27 lists mean systolic and diastolic blood pressure levels and rates of prevalence of hypertension in various Pacific Island populations. The higher rates of urbanised groups compared to traditional-living people are quite clear. We do not know, at this point, what effect this increase is having on the incidence of heart disease, kidney disease and stroke among the people of the Pacific Islands.

TABLE 27. Prevalence of Hypertension and Mean Systolic and Diastolic Pressure Measurements of Various Pacific Groups

| M A L E S | | | | |
|---------------------------------------|------------------|---------------------------|---------------------|---------------------|
| Location Source | Number in Sample | Percent with Hypertension | Mean Systolic mm/Hg | Mean Diastolic mm/H |
| MICRONESIA | | | | |
| Nauru - Zimmet (1980) | 299 | 35.8% | 154.6 | 101.5 |
| Chamorro-Rota-Reed (1970) | | 31 % | | |
| " Guam-Reed (1970) | | 34 % | | |
| " California-Reed(1970) | | 34 % | | |
| Kiribati-Taylor (1981) | | | | |
| MELANESIA | | | | |
| PNG- Western Highlands | 391 | 0 % | 124 | 82 |
| -Sinnott & White (1973) | | | | |
| PNG Wogupmeri River - Maseroni(1976) | 50 | - | 112 | 71 |
| PNG Karkar Island-Boyce (1978) | 128 | - | 120.7 | 71.1 |
| (21 - 40 years) | | | | |
| Fiji Melanesian-Cassidy (1967)* | 70 | 14.2% | - | - |
| Fiji Indian - Cassidy (1967)* | 340 | 10.5% | - | - |
| Fiji Melanesian - Zimmet(1980) | | | | |
| rural | | 2.0% | | |
| urban | | 7.6% | | |
| Fiji Indian Zimmet (1980) | | | | |
| rural | | 7.2% | | |
| urban | | 8.8% | | |
| Vanuatu - Norman Taylor & Rees(1964)* | 218 | 6.2% | 120.9 | 79.1 |
| " Rural-Malekula-Raoult (1976) | 136 | 15.4% | | |
| " Urban-Vila - Jabre (1976) | 37 | 24.3% | | |
| POLYNESIA | | | | |
| Tuvalu-Funafuti - Zimmet (1980) | 269 | 8.2% | 133.4 | 83.5 |
| Cook Islands-Pukapuka-Murphy (1980) | 96 | 0 % | 108.4 | 67.6 |
| " Atiu Mitiaro-Hunter (1962)** | - | 10 % | 128.0 | 82.1 |
| " Rarotonga -Hunter (1962)** | - | 25 % | 141.5 | 94.3 |
| " Pukapuka - Prior (1966)** | 188 | 3 % | 122.7 | 77.7 |
| " Rarotonga - Prior (1966)** | 243 | 28 % | 140.2 | 89.5 |
| " Aitutaki - Raoult (1977) | 160 | 16.3% | | |
| " Rarotonga - Raoult (1977) | 556 | 19.6% | | |
| Tokelau - Prior | 258 | 4.4% | 128.6 | 75.1 |
| Western Samoa - Rural-Zimmet (1980) | 358 | 18.3% | 124.4++ | 85.1++ |
| Western Samoa - Urban Apia | 325 | 33.9% | 131.7 | 90.8++ |
| American Samoa-Rural | | | | |
| - McGaven & Baker (1979) | 108 | - | 125.5 | 82.0 |
| American Samoa-Urban- | | | | |
| - McGaven & Baker (1979) | 268 | - | 132.7 | 86.7 |
| Niue - Bennett (1981) | 577 | 10.1% | | |

Criteria 160 and/or 95
 * Sexes Combined - Total Sample
 + 40 - 49 year age group
 ** 40 years of age and over
 ++ Age adjusted

TABLE 27. Cont. Prevalence Rates of Hypertension and Mean Systolic and Diastolic Pressure Measurements of Various Pacific Island Groups.

F E M A L E S

| Location Source | Number in Sample | Percent with Hypertension | Mean Systolic mm/Hg | Mean Diastolic mm/H |
|--------------------------------------|------------------|---------------------------|---------------------|---------------------|
| MICRONESIA | | | | |
| Nauru - Zimmet (1980) | 338 | 19.5% | 140.1 | 87.4 |
| Chamorro-Rota-Reed (1970) | | 30 % | | |
| " Guam-Reed (1970) | | 35 % | | |
| " California-Reed(1970) | | 32 % | | |
| Kiribati-Taylor (1981) | | | | |
| MELANESIA | | | | |
| PNG- Western Highlands | 386 | 0 % | 124 | 82 |
| -Sinnott & White (1973) | | | | |
| PNG Wogupmeri River - Maseroni(1976) | 50 | - | 112 | 71 |
| PNG Karkar Island-Boyce (1978) | 150 | - | 115.4 | 68.4 |
| (21 - 40 years) | | | | |
| Fiji Melanesian-Cassidy (1967)* | - | - | - | - |
| Fiji Indian - Cassidy (1967)* | - | - | - | - |
| Fiji Melanesian - Zimmet(1980) | | | | |
| rural | | 8.4% | | |
| urban | | 9.2% | | |
| Fiji Indian Zimmet (1980) | | | | |
| rural | | 5.8% | | |
| urban | | 8.4% | | |
| Vanuatu - Norman Taylor & Rees(1964) | 205 | | 123.1 | 78.2 |
| " Rural-Malekula-Raoult (1976) | | 18.2% | | |
| " Urban-Vila - Jabre (1976) | | 28.6% | | |
| POLYNESIA | | | | |
| Tuvalu-Funafuti - Zimmet (1980) | 308 | 13.6% | 139.2 | 85.6 |
| Cook Islands-Pukapuka-Murphy (1980) | 1086 | 0 % | 109.0 | 68.8 |
| " Atiu Mitiaro-Hunter (1962)** | - | 21 % | 141.1 | 89.0+ |
| " Rarotonga -Hunter (1962)** | - | 26 % | 171.2 | 108.0+ |
| " Pukapuka - Prior (1966)** | 191 | 7 % | 121.2 | 75.0 |
| " Rarotonga - Prior (1966)** | 228 | 47 % | 143.4 | 90.0 |
| " Aitutaki - Raoult (1977) | 264 | 23.1% | | |
| " Rarotonga - Raoult (1977) | 621 | 27.9% | | |
| Tokelau - Prior | 316 | 12.2% | 130.0 | 79.9 |
| Western Samoa - Rural-Zimmet (1980) | 387 | 15.8% | 127.1++ | 85.2++ |
| Western Samoa - Urban Apia | 419 | 33.9% | 138.4 | 90.6++ |
| American Samoa-Rural | | | | |
| - McGaven & Baker (1979) | 196 | - | 128.2 | 82.0 |
| American Samoa-Urban- | | | | |
| - McGaven & Baker (1979) | 395 | - | 130.4 | 84.2 |
| Niue - Bennett (1981) | 615 | 10.2% | | |

Criteria 160 and/or 95

* Sexes Combined - Total Sample

+ 40 - 49 year age group

** 40 years of age and over

++ Age adjusted

MICRONESIA

Guam.

When Reed and his investigators (1970) examined Chamorros living in rural Rota, urbanised Guam or California, he found little difference in blood pressure levels. All three groups, even those living a fairly traditional way of life, had high prevalence rates of hypertension and stroke. No mention was made of salt intake, but it would be interesting to know if Rota people use salt as a method of preserving fish, as has been noted in some islands in Northern Micronesia.

In Guam, cerebrovascular disease was the sixth leading cause of death in the years 1971-1977 (Kuberski and Bennet, 1979). There are no data on rates of hypertension from Guam.

Kiribati.

Early blood pressure studies from Kiribati, the Marianas, the

Carolines and the Marshalls reported low readings with only a slight tendency to rise with age (Kagan, 1976).

In a more recent study in Kiribati, Zimmet (1981) showed that the prevalence rates for hypertension were higher in the urban area of Betio than in the traditional Tabiteuea North:

| | <u>Urban - Betio</u> | <u>Traditional - Tabiteuea</u> <u>North</u> |
|--------|----------------------|--|
| Male | 13.1% | 10.5% |
| Female | 9.3% | 6.9% |
| Total | 11.0% | 8.6% |

Nauru.

Zimmet and co-workers (1980c) found an overall prevalence rate of hypertension of 35.8 per cent in males and 19.5 per cent in females in Nauru. The mean blood pressures rose with age and are the highest to be found in the Pacific.

MELANESIA

Fiji

Hypertension was reported by Cassidy (1967) as a complication of diabetes. Of 70 Fijian diabetics, 14.2 per cent were hypertensive and of 340 Indian diabetics, 10.5 per cent were hypertensive. Ischaemic heart disease, however, was more common among the Indians than the Fijian diabetics.

Zimmet (1980) showed that overall hypertension prevalence rates were also lower in rural Melanesians as compared to Indians but similar for both urban groups. Rural Fijian women, however, had four times the rate as rural men. Lakeba, a small but prosperous outer island, had the highest hypertension rates in Fiji.

TABLE 28. Hypertension prevalence rates in rural and urban Fiji (Zimmet, 1980)

| | Prevalence of hypertension (Per cent) | | |
|--------------------|---------------------------------------|---------|----------------|
| | Males | Females | Sexes Combined |
| <u>MELANESIANS</u> | | | |
| Rural | 2.0 | 8.4 | 5.1 |
| Urban | 7.6 | 9.2 | 8.4 |
| Lakebe | 10.6 | 9.5 | 9.9 |
| <u>INDIANS</u> | | | |
| Rural | 7.2 | 5.8 | 6.7 |
| Urban | 8.8 | 8.4 | 8.6 |

New Caledonia

Data have recently been collected on Melanesians in the city of Noumea, in rural Ouvea, as well as Polynesians in Noumea and Wallis Island, but is not available at this time (Taylor, Bennett and Zimmet).

Papua New Guinea

In contrast to the Micronesians, Boyce (1978) found the inhabitants of Karkar Island, Papua New Guinea to have very low mean systolic and diastolic blood pressure readings. This survey provides the example of the "virtual absence", at least in males, of any systematic rise in blood pressure with age within a traditional subsistence economy population. It also supports, along with other studies in Papua New Guinea (Sinnott and Whyte, 1973a; Sinnott and Whyte, 1973b), the view that the rise of blood pressure with age, which is the norm in Western countries, is related to life style rather than an inevitable part of the aging process.

Masironi and co-workers (1976) also found extremely low blood pressure readings among village people living along the Wogupmeri River in the Sepik River region. They analysed the river water for calcium content and found that the calcium content decreased as the river flowed downstream. The blood pressures of the villagers, however, increased as the calcium levels of the river water decreased. This study was conducted on very few people, but lends support to the theory of a beneficial relationship between water hardness and cardiovascular disease (Neri, 1972; Punsar, 1975).

Hypertension is now a common complication accompanying diabetes in Papua New Guinea. Martin (1978) reports that of 106 diabetic patients he reviewed, 32 per cent of the males and 43 per cent of the females had systolic blood pressure measurements above 140 mm / Hg.

Coronary heart disease and obesity also seem to be absent in rural Papua New Guinea. Dietary intakes of total energy, fat and salt are

also quite low (Sinnett, 1978). A few cases of hypertension have been reported and those patients reside in urban centers (Mathews, 1974).

Solomon Islands.

Page and co-workers (1974) reported that the most Westernised populations in the Solomon Islands had the highest blood pressure, levels, serum cholesterol and uric acid levels and westernised diets. All groups were traditional agriculturalists but those groups with the highest salt intake had the greatest numbers of persons with elevated blood pressures. In the most traditional villages, blood pressures declined with age, but in males only.

Vanuatu

An early blood pressure survey in 1962 (Norman-Taylor, 1964) found only 6.2 per cent of a large population from villages on Malekula and Efate with systolic blood pressures above 150 mm / Hg.

A later study in Vila (Jabre, 1976) on very small numbers, indicated that 24.3 per cent of (9/37) males and 28.6 per cent of (16/56) females were hypertensive.

"Obesity and hypertension were very uncommon in traditional villages on Malekula (Raoult, 1976), 15.4 per cent of the males and 18.2 per cent of the females were hypertensive".

POLYNESIA

American Samoa

Blood pressure levels of Samoans living in American Samoa and in Hawaii were not significantly different but tended to be lower in Samoans in Hawaii as illustrated in Figure 8. (McGarvey and Baker, 1979). The investigators were not able to explain this reversed trend. They suggested that perhaps those Samoans with a longer integration into urban society had adjusted to urban pressures and therefore had lower blood pressures than Samoans who were caught in a more transitional situation, i.e. urban island centers. But Figure 9 shows the higher blood pressures of Samoans who live in the "modern" center of Pago Pago compared to those in the "intermediate" villages on the main island and the "traditional", more isolated villages. Body fat, as measured by skin fold thickness, was positively associated with blood pressure for all groups except one. With the Samoans living in Hawaii, fatness (weight and skinfold) was the most important discriminating factor between hypertension and normotensive adults (Hanna and Baker, 1979).

Pawson also compared Samoans who lived in California, Hawaii, American Samoa and Western Samoa and showed a definite increase in blood pressures at all ages with increased urbanisation (Pawson and Jones, 1981). Cook Islands

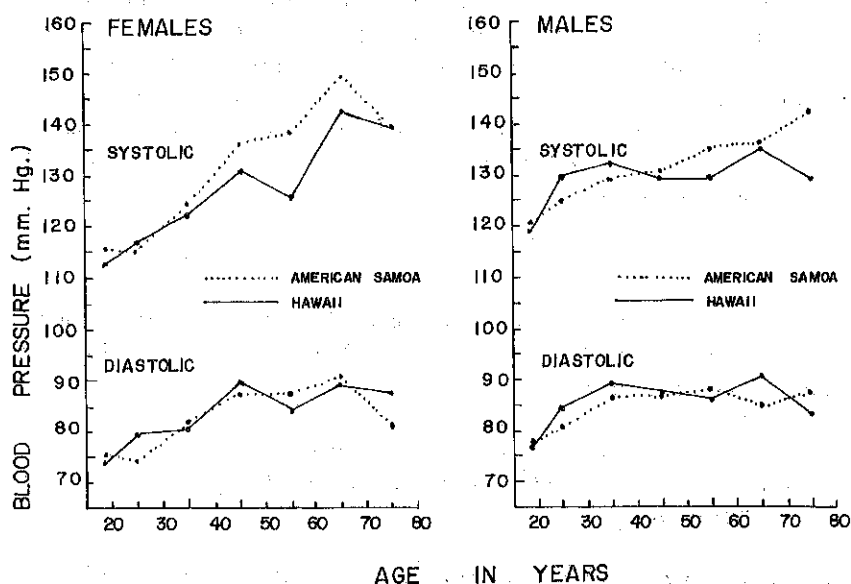


Figure 8. Mean blood pressures for Samoans in American Samoa and Hawaii
(McGarvey and Baker, 1979)

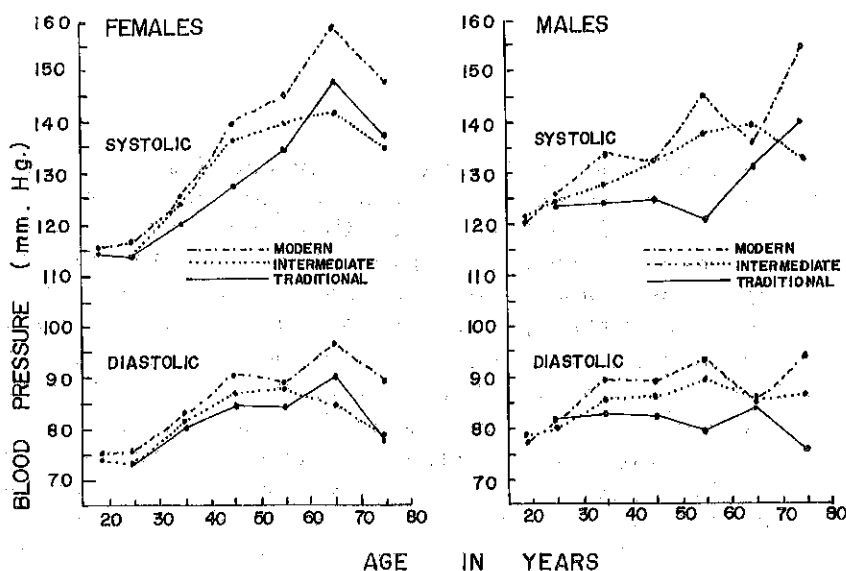


Figure 9. Mean blood pressures for three subsamples of American Samoans
(McGarvey and Baker, 1979)

There was no hypertension among the people of Pukapuka when Murphy (1955) measured blood pressure on this isolated atoll in 1951. The only case he found was an "obese woman visiting from Rarotonga". The mean systolic and diastolic measurements were extremely low and did not increase with age. Murphy noted that "practically no European

foodstuffs" were consumed and that "cardiac abnormalities were uncommon". Murphy further commented that the only clocks "discovered were either stopped or broken".

When Hunter (1962) examined urban and rural Cook Islanders about 10 years later, his findings were quite different. The mean blood pressures rose with age among both the urban Rarotongans and the villagers of the islands of Atiu and Mitiaro (Figure 10). By the age of 40 years, the Rarotongans had much higher mean systolic and diastolic readings than the traditional groups. The prevalence of hypertension among urban males 40 years and over was much greater than for rural males and this was statistically highly significant. Urban females had higher rates than traditional females but it was not statistically significant.

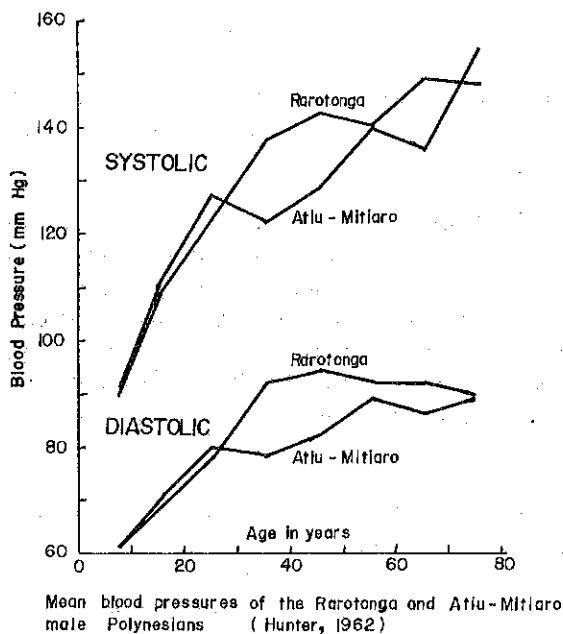


Figure 10

Prior and co-workers (1966a) found a very similar situation when they examined urban and rural groups a few years later. Again the Rarotongans had much higher mean systolic and diastolic values than the traditional Pukapukans and very much higher rates of hypertension in persons 40 years and over. The Rarotongans mean blood pressures increased with age whereas the Pukapukans did not. It is also interesting to note a marked increase in mean blood pressures of the Pukapukans from 1955 to 1966, but still a fairly low prevalence of hypertension.

Another survey (Raoult, 1977) carried out 11 years later on another isolated island (Aitutaki) showed higher rates of hypertension than the earlier rural studies. Does this mean that hypertension may be increasing in the rural areas as well?

In a recent survey in Rarotonga, Bennett (1981) found 19.6 per cent of men and 27.9 per cent of women with hypertension.

French Polynesia

Of adults on six atolls of the Tuamotu Islands who were examined for hypertension (Delebecque and Delebecque, 1980), 23.2 per cent had high blood pressure. The rates increased with age. Obesity was associated with 40 per cent of the cases of mild hypertension and 89 per cent of the cases of serious hypertension.

Niue

Hypertension was reported in 10.1 per cent of males and 10.2 of females in a recent survey (Bennett, 1981). These rates compare with the more traditional living Pacific Island groups.

Tokelau

The effect of urbanisation on blood pressure levels has been shown by Prior and his group as part of the Tokelau Migrant Study (Prior, 1974).

The mean systolic and diastolic blood pressures of Tokelauan islanders who remained on the islands were in a moderate range compared to more urbanised centres in the Pacific. Their mean blood pressures increased only slightly with age (Prior et al, 1974). Rates of hypertension of those who remained on the atolls were moderately low; 4.4 per cent for males and 12.2 per cent for females. For those who had migrated to New Zealand, however, the rates were 12.0 and 16.7 per cent for males and females respectively.

The same investigators (Beaglehole et al, 1978a) examined all Tokelauan children in New Zealand and in Tokelau in 1975 and 1976. Of the New Zealand Tokelauan children, 64 per cent were born in New Zealand, the remainder were born in Pacific islands. They showed that mean systolic pressures were greater in all age groups of boys and all age groups of girls except one for the New Zealand children compared to the Tokelauan island children. This was significant for children less than eight years of age. The New Zealand children were also heavier and taller than the Tokelauan children.

These investigators again compared children on Tokelau to Tokelauan children who had migrated to New Zealand between 1971 and 1977 (Beaglehole et al, 1979). The average length of stay in New Zealand was 1.9 years, a range of 2 months to 5 years. On the whole, the Tokelau migrant children had higher systolic and diastolic pressures than the children on the atolls. These were statistically significant for the 5-9 year age group males and for the diastolic of 5-9 year age group females. Weight and Body Mass Index was also statistically significantly higher in the younger age groups of both girls and boys in New Zealand.

Tonga

"The urban dwellers of Nuku'alofa were heavier, and had larger skinfolds, higher blood pressures and greater serum uric acid levels in some age groups than those in traditional villages (Prior et al, 1978)".

Tuvalu

Both mean blood pressure levels and rates of hypertension rose with age in 269 Tuvaluans examined in Funafuti (Zimmet et al, 1980a). They were both moderately high as compared to other areas of the Pacific.

Western Samoa

The prevalence of hypertension among urban living Western Samoans is almost twice that of those living a more traditional way of life (Zimmet, 1980a). Mean blood pressure levels rose with age in both the rural and urban groups, but were higher in the urban groups at most ages. Obesity was associated with the high prevalence of hypertension in all age groups.

FACTORS RELATED TO HYPERTENSION

Although there is much that is not understood about hypertension, a number of factors are known to be related to blood pressure levels. Genetic factors are thought to be important but environmental factors may be equally or more responsible for higher levels. Obesity has been shown in Caucasian populations to be closely associated with hypertension (Davidson et al, 1979). In Pacific Island groups surveyed, mean blood pressures tend to increase as mean weight and Body Mass Index increase but this does not satisfactorily explain the problem.

Dietary salt intake has been implicated as a major factor affecting blood pressure. Dahl (1972) has shown data from a number of groups which support the hypothesis that where salt consumption is high a large majority of genetically susceptible people develop hypertension.

A comprehensive cardiovascular disease survey by Page and co-workers (1974) showed that salt intake was the most important variable among six groups of Melanesians. Thru Solomon Island groups and thru Bougainville groups had a rise in blood pressure as salt intake increased.

In the Cook Islands, Prior (1969) estimated the dietary intake of sodium of traditional living Pukapukans as between 50-70 mEq. Of urban living Rarotongans, he estimated 120 to 140 mEq and of European New Zealanders, 150 to 180 mEq. Table 29. compares the prevalence of hypertension in Cook Islanders over 40 years of age with estimated sodium intakes and urinary sodium outputs for the three groups. These figures would support the theory that as salt intake increases the prevalence of hypertension in susceptible persons also increases. Salt intake also emerged as a major difference between traditional and urban Tongans (Prior et al, 1973).

TABLE 29. The prevalence of hypertension, mean dietary sodium intake and mean 24-hour urinary sodium outputs

| | % of Hypertension age:40 years & over | Estimated Dietary Sodium | Mean Urinary Sodium |
|-----------------|--|--------------------------------|---------------------------|
| ----- | | | |
| MALES | | | |
| ----- | | | |
| Pukapuka N=98 | 8 | 50 - 70 | 62 |
| Rarotonga N=115 | 70 | 120 -140 | 114 |
| Carterton N= | 57 | 156 -180 | 188 |
| FEMALES | | | |
| ----- | | | |
| Pukapuka N=90 | 21 | 50 - 70 | 63 |
| Rarotonga N=134 | 74 | 120 -140 | 102 |
| Carterton N= | 70 | 156 -180 | 149 |

Dietary fibre (Wright, 1979) and physical activity are other factors linked to hypertension but the data is scant at this time. Stress is also known to have a marked effect on blood pressure. This could be another factor involved in increasing blood pressure with increasing urbanisation in the Pacific. Hanna and Baker (1979) found the highest blood pressures in Samoans who had recently arrived in Hawaii and the lowest levels in long term Samoan-Hawaiian residents. They suggested that the stress of arrival in a new setting, acculturation, and job seeking could have a pronounced effect, especially on the males. They did not rule out, however, the effects of heredity, obesity and salt intake.

Cassel (1977) also postulated a cultural basis for differences in blood pressures. He reported on blood pressure studies conducted on the islands of Ponape and Palau. The two areas are considered quite similar; both with a modern town "intermediate zones" and "traditional villages". The author felt that the intensity and duration of exposure to western life style was similar on the two islands. Yet the Ponapeans had consistently lower blood pressures than the Palauans:

"It does not appear unreasonable to postulate that certain cultures are more successful than others in preserving a degree of coherence in the face of cultural contact, thus continuing to accept and tolerate those previously socially sanctioned patterns of behaviour despite the new culture".

Prior (1978) found that Tokelauan migrants in New Zealand "who were the most cushioned by, or restricted themselves to,

Tokelauan societies and activities, were less subject to high blood pressure than those who were more integrated into a European way of life. In other words, there seems to be basis for believing that those who were more involved in the European way of life were paying for it in higher blood pressure".

There is a need in the Pacific to understand those factors which may be responsible for increasing blood pressures with urbanisation; obesity caused by either excess food and/or decreased exercise; high salt intake, lack of dietary fibre, increased stress or other physical or cultural factors.

TABLE 30. Mean serum cholesterol and triglyceride values of some Pacific Island groups.

| M A L E S | | | | F E M A L E S | | | |
|--|------------------------|------------------------------------|----------------------------------|------------------------|------------------------------------|----------------------------------|--|
| | Number in Sample | Serum Triglycerides mmol / l | Serum Cholesterol mmol / l | Number in Sample | Serum Triglycerides mmol / l | Serum Cholesterol mmol / l | |
| MICRONESIA | | | | | | | |
| Palau (Reed,1973) | 219 | | 4.2 | 291 | | 4.5 | |
| Rota (Reed,1973) | 122 | | 4.8 | 149 | | 5.2 | |
| Guam (Reed,1973) | 273 | | 5.1 | 355 | | 5.3 | |
| California (Reed,1973) | 164 | | 5.5 | 151 | | 5.4 | |
| Nauru (Ringrose,1979) | 128 | 1.7 | 5.6 | 142 | 1.4 | 5.5 | |
| MELANESIA | | | | | | | |
| Vanuatu, Malekula (Raoult,1976) | 26 | .69 | 5.1 | 26 | .60 | 6.1 | |
| POLYNESIA | | | | | | | |
| Cook Islands, Rarotonga (Hunter, 1962) | 155 | | 5.5 | | | 6.2 | |
| Atiu-Mitiaro (Hunter, 1962) | 216 | | 5.9 | 69 | | 6.7 | |
| Cook Islands, Rarotonga Pukapuka (Prior, 1974) | 188+ | .93 | 4.5 | 191+ | .83 | 4.6 | |
| Tokelau (Prior, 1974) | 166 | .61 | 5.5 | 202 | .51 | 5.7 | |
| Tuvalu (Zimmet, 1980) | 108 | 1.01 | 4.3 | 116 | 1.03 | 4.6 | |
| Western Samoa, Rural (Zimmet, 1980) | 356 | .87 | 4.7 | 384 | .92 | 4.5 | |
| Urban (Zimmet, 1980) | 319 | 1.15 | 4.9 | 415 | 1.06 | 4.6 | |

+Smaller numbers in sample had serum triglycerides performed

Serum triglycerides - 1 mmol / l = 88.5 mg/100ml (1.7 mmol / l = 150 mg/100ml)
 Serum cholesterol - 1 mmol / l = 38.6 mg/100ml (5.6 mmol / l = 216 mg/100ml)

OTHER CARDIOVASCULAR DISEASE RISK FACTORS

Other risk factors which are important in the development of cardiovascular disease are:

- cigarette smoking
- obesity
- sedentary life style
- elevated serum cholesterol
- elevated serum triglycerides
- diabetes mellitus.

All of these factors are associated with a modern, western way of life and are increasing in the Pacific.

Beaglehole et al (1980b) investigated certain risk factors as predictors of death in an 11 year study on the Cook Islands in Pukapuka, Rarotonga and in New Zealand.

Statistically significant relationships with death rates were found with the following groups:

| <u>Risk Factor</u> | <u>Population Group</u> |
|---|--|
| Systolic Blood Pressure | Maori men |
| Serum Cholesterol (negative correlation) | Maori men and women Rarotongan men and Pukapuka women |
| Body Mass Index | Maori men and women |

The inverse relationship between serum cholesterol and death rates is a surprising finding. Elevated serum cholesterol levels have been associated with increased risk of coronary heart disease in numerous studies in western countries (Davidson et al, 1979). The finding of lower death rates associated with higher serum cholesterol levels may indicate that serum cholesterol has a different significance in Polynesians.

MICRONESIA

Guam.

The effect of urbanisation on risk factors related to cardiovascular disease was demonstrated in studies conducted in 1968, by Reed (1970) and Hankin (1970). They examined Chamorros living in a traditional village on Rota, in the urban center of Guam and the cities of California. They also examined Carolinians from an isolated island of the Palau District. Table 30 provides mean serum cholesterol and serum triglyceride levels of these and other groups in the Pacific.

MEAN SERUM CHOLESTEROL BY AREA, AGE & SEX

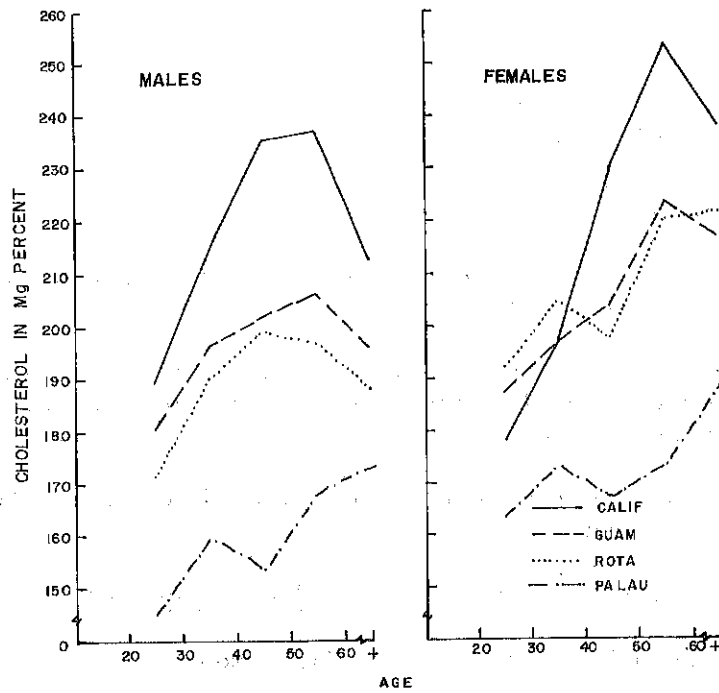


Figure 11. Mean serum cholesterol by area, age and sex.
(Reed, 1970)

MEAN SERUM TRIGLYCERIDE BY AREA & SEX

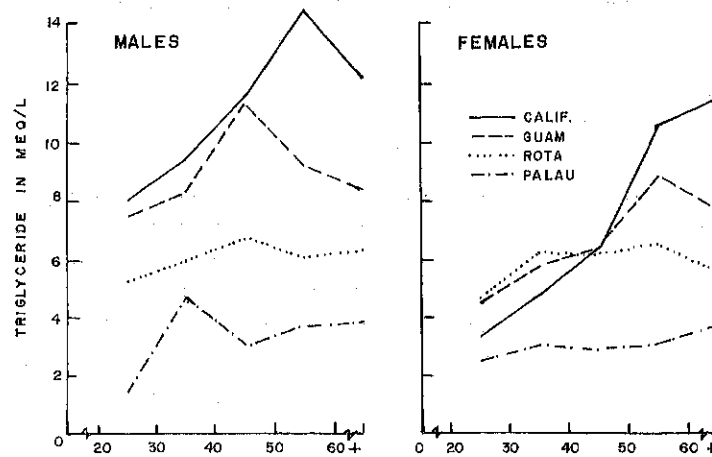


Figure 12. Mean serum triglyceride by area, age and sex
(Reed, 1970)

Figures 11 and 12 illustrate the dramatic increase in mean serum cholesterol and mean serum triglyceride levels from the rural villages to the cities of California. The investigators reported the much higher mortality proportion for cardiovascular disease among Chamorros living in California compared to those living in Guam (Figure 7). They also found a high correlation between blood lipid levels and obesity, total dietary fat intake, saturated fat intake and serum glucose levels. Carbohydrate intake decreased with urbanisation.

Kiribati

No reports - (soon to be reported, Zimmet et al, 1981).

Nauru.

The mean serum cholesterol levels for Nauruan males and females was 5.6 and 5.5 mmol / litre + respectively. Mean serum triglyceride levels were 1.7 and 1.4 mmol / liter++ for males and females (Ringrose, 1979). Both of these values are at the upper limits of the normal ranges (Davidson, et al, 1979) and are the highest levels reported yet in the Pacific. Nauruan males and females are among the most obese in the Pacific. Mean weights and Body Mass Index (Zimmet et al, 1978a) are within the ranges considered "severely obese". This small but prosperous island also experiences the highest reported rates of diabetes, hypertension and gout in the Pacific (Zimmet, 1978). This leads to the prediction unfortunately, that deaths from coronary heart disease will increase dramatically in the near future.

MELANESIA

Fiji.

The prevalence rates for ischaemic heart disease based on electrocardiograph abnormalities are similar to or lower than that reported in other Pacific Islands (Zimmet et al, 1980a). In-patient hospital statistics indicate, however, that the number of myocardial infarctions are on the rise and may be higher among Indians than Melanesians. Serum cholesterol and serum triglyceride levels were not reported in a recent survey (Zimmet, 1980).

New Caledonia.

Serum cholesterol and serum triglyceride levels have not yet been reported in a recent diabetes survey (Taylor and Zimmet, 1981a).

Papua New Guinea.

The prevalence of cardiovascular disease and associated risk factors are low in Papua New Guinea (Sinnott, 1973). But "coronary

+cholesterol conversion factor - 1mmol / 1 = 38.6 mg / 100 ml. (5.6 mmol / 1 = 216 mg / 100 ml)

++triglyceride conversion factor - 1mmol/1 = 88.5 mg / 100 ml. (1.7 mmol/1 = 150 mg / 100 ml.

heart disease may already be increasing in urban centers such as Port Moresby. Certainly cases are being recognised clinically at Port Moresby Hospital" (Sinnott, 1978). Statistics and surveys have not yet shown a significant rise in cardiovascular disease in Papua New Guinea. Risk factors associated with cardiovascular disease such as obesity, hypertension, high dietary fat intake and elevated serum cholesterol while virtually absent in the rural areas (Sinnott and Whyte, 1973a; Whyte and Lee, 1958; Boyce, 1958; Martin, 1980) are increasing in urbanised centers (Sinnott, 1978).

Aiken and co-workers (1974) investigated seven cases of sudden death in Port Moresby residents which, by necropsy, were attributed to atherosclerotic heart disease. The deaths occurred over a 16 month period in 1973-1974 and the following factors emerged:

1. all subjects were males
2. all subjects left a village environment during adult life and had been residing in Port Moresby for an average of 16 years.
3. all subjects were relatively young at the time of death, between 28 and 45 years of age.
4. six of the seven were cigarette smokers.
5. slight obesity occurred in only one subject.
6. the diet was supplemented with European type foods but was probably restricted due to low wages and preference for alcohol and tobacco.
7. none had occupations involving strenuous activity but none could be called sedentary.
8. psychological stress may have been important as low wages, unemployment, housing and budgeting were frequently problems disclosed upon investigation into the social backgrounds.

Solomon Islands.

Page and co-workers (1974) showed an increase in serum cholesterol levels among Solomon Island groups and Bougainville groups as the degree of acculturation is increased. All groups had serum cholesterol levels below 165 mg / 100 ml and they did not rise with age. Uric acid levels were also higher in the more acculturated groups compared to those with minimal western contact.

Vanuatu.

There have been no reports of cardiovascular disorders from Vanuatu. Serum cholesterol levels of small numbers of villagers from Malekula show moderate mean serum cholesterol levels for males and females; 197 mg/100 ml (5.1 mmol/l) and 235 mg/100 ml (6.1 mmol/l) respectively. Triglycerides were 61 mg/100 ml (0.69 mmol/l) and 53 mg/100 ml (0.60 mmol/l) for males and females respectively, (Raoult, 1976a). Obesity and hypertension were also rare on this still fairly traditional island. Hypertension and obesity were beginning to be seen in Vila, however, (Jabre et al, 1976). Thus heart disease may emerge as a problem in this urban setting.

POLYNESIA

American Samoa.

In a recent study, Hornick (1979) found that Samoans living in Hawaii and American Samoa had lower mean serum cholesterol levels than U.S. Caucasians. As well, traditional living Samoans on an outer island had lower mean serum cholesterol and triglyceride levels than the "acculturated Samoans of Pago Pago (Pawson, 1980)".

Samoans living in California are considered to be "the world's heaviest sub-population" but to date there are no reports concerning their rate of coronary heart disease (Pawson and Janes, 1981).

Cook Islands.

Hunter (1962) examined two groups of Cook Islanders to determine the effect of diet on serum cholesterol levels. A diet high in saturated fatty acids has long been known to increase the level of cholesterol in the blood. The diet of the traditional-living people on the islands of Atiu and Mitiaro is high in saturated fatty acids due to the consumption of coconut fat. They were compared to their racially identical neighbours in Rarotonga who are more affluent, consume more food, take less exercise and eat less coconut fat.

Figure 13 shows that both the males and females of the population who eat large amounts of coconuts had significantly higher serum cholesterol levels than the western-diet Rarotongans. These figures suggest that indeed diet, especially one high on saturated fatty acids can elevate serum cholesterol levels. We might have expected the more modern Rarotongans to have higher serum cholesterol levels since the males in particular are more overweight, have higher blood pressures and have higher rates of hypertension. Evidence of cardiovascular disease as indicated by electrocardiograph readings, however, was virtually absent for both groups of males.

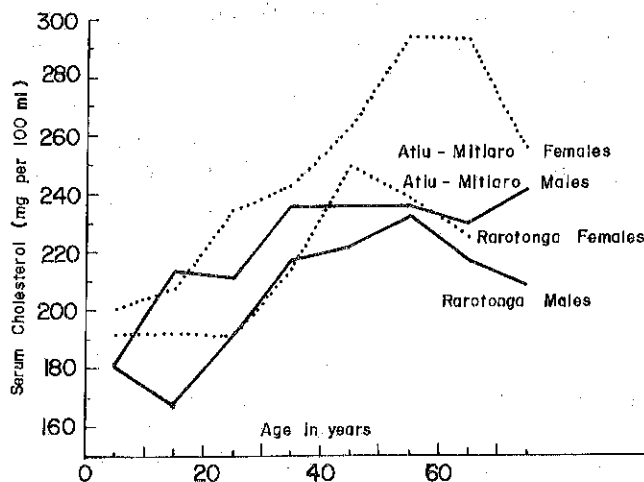


Figure 13. Comparison of mean serum cholesterol levels between the two Polynesian groups. (HUNTER 1962)

When Prior et al (1966a) examined the Rarotongans and Pukapukans in 1966, he found evidence of heart disease more frequently in Rarotongans than in Pukapukans. Electrocardiograph abnormalities, angina, hypertension and obesity were all much more common in the urban living Polynesians than those following a traditional way of life. Serum cholesterol levels were significantly lower in the Pukapukans compared to the Rarotongans. This is in contrast to the findings of Hunter in 1962. The Pukapukans, like people of the Atiu-Mitiaro islands, tend to be lean, active and consume relatively low energy but high fat diets. 75 per cent of the fat in the Pukapuka diet comes from coconut, 89 per cent in the Atiu-Mitiaro diet and only 22 per cent of the Rarotonga diet (Prior et al, 1966a, Walker, 1960).

Tokelau.

Tokelauan males who migrated to New Zealand since 1971 had higher mean levels of serum LDLC (low density lipoprotein cholesterol) and triglycerides and lower mean levels of HDLC (high density lipoprotein cholesterol) than Tokelauan males who remained in Tokelau (Prior, 1974). High density lipoprotein cholesterol (HDLC) is thought to be associated with some protective mechanism against heart disease (Truswell, 1978). No differences were reported in death rates or morbidity rates of coronary heart disease between the two groups but the duration of migration has been short.

Tonga.

"There were no apparent differences between the two groups (urban Nuku'alofa and traditional Foa) in their height, mean fasting and 2-hour plasma glucose levels, cholesterol levels or triglycerides" (Prior et al, 1978)

Tuvalu.

Funafutians were found to have mean serum cholesterol levels and serum triglycerides within the lower ranges of normal when examined as part of a diabetes-cardiovascular disease survey (Zimmet, 1977). Blood pressure levels, rates of hypertension and obesity were lower than in some of the more "westernised" islands in the Pacific. These "moderate" rates of disease are related to a lesser degree of and a more recent effect of modernisation. Heart disease was not mentioned as a problem as such but it was noted that the prevalence of hypertension was similar to caucasian populations (Zimmet et al, 1980c).

Western Samoa.

The cardiovascular disease survey conducted by Zimmet et al in 1978 (1980) found serum cholesterol levels consistently higher but cardiovascular disease rates similar, in rural, traditional living islanders than in the urban participants. These differences were statistically significant only in a few age groups; mostly the younger age groups. This finding lends support to Hunter's (1962) results in the Cook Islands where populations which consumed large amounts of coconut had increased levels of serum cholesterol and Beaglehole's theory that serum cholesterol in Polynesians may have a different

significance than in Caucasians. Serum triglyceride levels were higher in the urban sample than for the rural group, as may be expected as they were also more obese.

There was very little difference in electrocardiograph characteristics between rural and urban dwellers. Rural females tended to have slightly more abnormal electrocardiograph readings than urban females. Other risk factors associated with coronary heart disease were more prevalent among urban dwellers; mean blood pressure levels, prevalence rates of hypertension, mean serum uric acid levels and prevalence of gout.

Conclusions.

It would appear that the outlook is not good for coronary heart disease for Pacific Island people following a western life style. There is evidence from Hawaii, New Zealand and Guam that death rates from disease of the heart are already very high.

In the Pacific, the risk factors which are most predictive of heart disease in western countries are now at rates which exceed those in western countries. The prevalence of diabetes, hypertension, obesity and gout among urbanised Pacific Islanders often surpasses the prevalence in Caucasian countries. Cigarette smoking, lack of physical exercise, and stress are other important risk factors which have so far received little attention.

There is an urgent need to learn more about cardiovascular disease and how it is affecting or may affect Pacific Island people. A number of questions must be asked; What are current morbidity and mortality rates from cardiovascular disease? Are they changing? What is the extent of ethnic and geographic variation in cardiovascular disease in the Pacific Region? What are the risk factors responsible and can the risks be altered by intervention, which factors should intervention be directed against?

HYPERURICAEMIA AND GOUT

Gout, which is characterised by elevated serum uric acid levels, hyperuricaemia, and joint pain, has both a genetic and environmental aetiology. The disease tends to run in families and certain population groups. Environmental factors, particularly overweight, alcohol and a diet high in purines, increase serum uric acid levels and precipitate attacks of gout.

Hyperuricaemia is extremely common among urbanised Micronesians and Polynesians. High serum uric acid levels have also been found among traditional living groups such as Chamorros, Palauans, Pukapukans, Tokelauans and Western Samoans but gout is rare.

It is possible that with a genetic predisposition and a diet high in fish (high in purines) hyperuricaemia is common among traditional living atoll dwellers. But with a genetic predisposition and a rapid increase in obesity and perhaps alcohol as seen in some urbanised

communities such as Nauru, gout becomes a severe problem.

TABLE 31. Prevalence of Hyperuricaemia and Gout and mean values of serum uric acid in some Pacific Island populations.

| Location | | Number | Prevalence of: | | Mean serum |
|--------------------------------------|----------|--------|----------------|------|------------|
| - Source | examined | | Hyperuricaemia | Gout | uric acid |
| | | | Per cent | | mmol/l |
| ----- | | | | | |
| MICRONESIA | | | | | |
| Mariana Is. | | | | | |
| -Chamorros (Burch, 1966) | 160 | | | | .37 |
| -Carolinian " " | 26 | | | | .43 |
| Chamorros (Reed, 1972) | | | | | |
| -California | 164 | 30 | | | .39 |
| -Guam | 273 | 48 | ! | | .42 |
| -Rota | 122 | 52 | ! | 5 | .43 |
| Palauans (Reed, 1972) | | | | | |
| -Koror | 109 | 40 | | | .40 |
| -Peleliu | 41 | 25 | | | .37 |
| -Nger | 69 | 40 | | | .40 |
| Nauru (Zimmet, 1978)* | 217 | 63 | | 6.9 | .45 |
| MELANESIA | | | | | |
| Vanuatu-Malekula (Raoult, 1976)* | 22 | (1/22) | | 0 | .30 |
| Papua New Guinea (Jeremy, 1971) | 306 | - | | | .40 |
| " " " (Sinnott and Whyte, 1973) | 365 | 20 | | 0 | .32 |
| POLYNESIA | | | | | |
| Cook Islands (Prior, 1966)* | | | | | |
| Pukapuka " " | 188 | 49 | | 5 | .42 |
| Rarotonga " " | 243 | 44 | | 2 | .40 |
| Rarotonga (Bennett, 1981) | 556 | 16.7 | | | |
| NZ Maoris (Prior, 1966) | 366 | 48 | | 10 | .42 |
| A. Samoa (Healey & Jones, 1971) | 71 | - | | | .40 |
| Tokelau (Prior, 1974) | 162 | | | | .42 |
| W. Samoa (Jackson, in press)* | | | | | |
| Rural | 356 | 43.3 | | 2.3 | .41 |
| Urban | 319 | 36.4 | | 2.3 | .40 |
| Niue (Bennett, 1981) | 577 | | | 3.8 | |
| New Zealand Caucasians (Prior, 1966) | | | | | |
| | | 23 | | 2 | |

* criteria for hyperuricaemia

** 1mmol/l=16.8 mg/150ml

TABLE 31. Cont. Prevalence of Hyperuricaemia and Gout and mean values of serum uric acid in some Pacific Island populations (cont.)

| Location | Number examined | F E M A L E S | | Mean serum uric acid mmol/l |
|---|--------------------|--|-------|-----------------------------------|
| | | Prevalence of: Hyperuricaemia Per cent | Gout | |
| ----- | | | | |
| MICRONESIA | | | | |
| Mariana Is. | | | | |
| -Chamorros (Burch, 1966) | 175 | - | - | .30 |
| -Carolinian " " | 29 | - | - | .34 |
| Chamorros (Reed, 1972) | | | | |
| -California | 151 | 19 | 1/4 | .29 |
| | | | 1/4 2 | |
| -Guam | 355 | 30 | 1/4 | .32 |
| | | | 1/4 | |
| -Rota | 149 | 31 | 1/4 | .32 |
| Palauans (Reed, 1972) | | | | |
| -Koror | 145 | 22 | - | .31 |
| -Peleliu | 57 | 30 | - | .33 |
| -Nger | 89 | 18 | - | .29 |
| Nauru (Zimmet, 1978) | 238 | 60 | 0.4 | .38 |
| MELANESIA | | | | |
| Vanuatu-Malekula (Raoult, 1976) | 22 | (1/22) | 0 | .26 |
| Papua New Guinea (Jeremy, 1971) | - | - | - | - |
| " " " (Sinnott and Whyte, 1973) | 370 | 720 | 0 | .31 |
| POLYNESIA | | | | |
| Cook Islands (Prior, 1966) | | | | |
| Pukapuka " " " | 191 | 49 | 0 | .37 |
| Rarotonga " " " | 228 | 44 | 0 | .36 |
| Rarotonga (Bennett, 1981) | 621 | | 6.4 | |
| NZ Maoris (Prior, 1966) | 381 | 40 | 2 | .35 |
| A. Samoa (Healey & Jones, 1971) | - | - | - | - |
| Tokelau (Prior, 1974) | 196 | - | - | .37 |
| W. Samoa (Jackson, in press) | | | | |
| Rural | 384 | 29.5 | 0 | .32 |
| Urban | 415 | 23.3 | 1.3 | .31 |
| Niue (Bennett, 1981) | 615 | | 2.6 | |
| New Zealand Caucasians (Prior, 1966) | | 16.0 | 0 | |
| criteria for hyperuricaemia | | 1.42 | | .36 |
| 1mmol/l=16.8 mg/150ml | | | | |

Table 31. provides prevalence rates of hyperuricaemia and gout and mean serum uric acid levels for traditional living and urbanised communities in the Pacific.

MICRONESIA

Kiribati.

No reports. Zimmet et al to be published.

Mariana Islands

In 1966 Burch and O'Brien (1966) reported hyperuricaemia among 355 Chamorros on Guam, Saipan, Tinian and Rota and 55 Carolinians also living in this area. The Carolinians, both male and female, had significantly higher serum uric acid levels than the Chamorros. Uric acid levels from samples of Carolinians living on Truk suggested that Carolinians have elevated uric acid levels in their homelands as well. Uric acid levels were positively associated with height, weight and body surface in the Rota group. Hyperuricaemia was found in 21 per cent of the Chamorros and 32 per cent of the Carolinians. Definite gout was reported in 5 Chamorros and 3 Carolinians.

Reed et al (1972) reported similar findings when they examined Chamorros living in California, Guam and traditional Rota and Palauans living in Koror, Peleliu and Ngerchelung. Koror is the modern centre, Ngerchelung an isolated village and Peleliu a traditional village but close to the district centre. The mean serum uric acid levels for both the Chamorros and Palauans were similar and in high ranges. For all groups males had higher mean levels than females and these tended to increase with age. Among the Chamorros mean levels were lower for the California group than for those in Guam or Rota. The differences between the Palauan groups were inconsistent. In both groups serum uric acid levels were positively associated with measures of blood pressure, obesity and serum triglycerides. There was no consistent association with ECG abnormalities, serum cholesterol, serum glucose, smoking habits or other socio-economic factors, i.e. occupation.

The prevalence rates of hyperuricaemia again was high and similar between the Chamorros and Palauans. Among the Chamorros, the rates were lowest in California but among the Palau groups there was no consistent difference related to lifestyle. Gout was listed as a health problem in Guam and Rota but not in Palau.

Gout was reported for 5 per cent of the Chamorro males and 2 per cent of the Chamorro females. In Palauans there was no gout reported.

Nauru.

Zimmet et al (1978a) reported that Nauruans have the highest prevalence of hyperuricaemia of any population yet found. 64 per cent of men and 60 per cent of women had elevated uric acid levels. Mean serum uric acid levels were 0.45 mmol / l (7.6 mg/100 ml) for males and 0.38 mmol / l (6.4 mg/100 ml) for females; the highest reported in the Pacific. Seven (7) per cent of males and one (1) per cent of women had clinical gout. This is in striking contrast to a New Zealand Caucasian population where 23 per cent of males and 16 per cent of females had hyperuricaemia, and 2 per cent of males and 0.4 per cent of females had clinical gout (Prior et al, 1966).

MELANESIA

Fiji

No cases of gout were reported by Zimmet (1980a) among rural Fijians or Indians. Only one urban Fijian was seen with gout. The prevalence of gout in urban Indians was 0.8 per cent.

New Caledonia.

Uric acid levels were not reported in the preliminary findings of a survey conducted by Taylor and Zimmet, (1981a).

Papua New Guinea

Relatively high mean serum uric acid levels (0.40 mmol/l; 6.76 mg/100 ml) were found in males in Eastern Highland villages in Papua New Guinea. The highland villagers had slightly higher levels than highlanders working in Goroka (Jeremy and Rhodes, 1971). Gout was not seen.

Sinnett and Whyte (1973), however, reported relatively low mean serum uric acid levels among traditional agriculturalists in the Western Highlands of Papua New Guinea. The mean value for males was 0.32 mmol/l (5.4 mg/106 ml) and for females 0.31 mmol/l (5.2 mg/100 ml). Twenty per cent of both males and females had levels above 0.036 mmol/l (6.0 mg/100 ml). No cases of gout were seen.

Vanuatu - Malekula.

"Uric acid levels were low, which bears out our clinical finding that gout was exceedingly rare" (Raoult, 1976).

POLYNESIA.

American Samoa

The mean serum uric acid of 71 adult American Samoan males was 0.40 mmol/l (6.8 mg/100 ml) (Healey and Jones, 1971). Hyperuricaemia and gout were reported as "common among American Samoans but prevalence rates were not obtained (Healey and Jones, 1971).

Cook Islands

Serum uric acid estimations were made on Cook Islanders in the urban center of Rarotonga and on an isolated atoll of Pukapuka and compared to New Zealand Maoris (Prior et al, 1966a). All three groups had high mean levels of serum uric acid. The prevalence of clinical gout was highest in Maori males (10.2 per cent), 5.3 per cent in Pukapukan males and 2.4 per cent in Rarotongan males. Of females, only Maori females were affected with gout (1.8 per cent).

The finding of hyperuricaemia among the New Zealand Maoris was associated with high rates of obesity, hypertension and diabetic abnormalities. Higher dietary intakes of energy and access to alcohol could

be important contributing factors. The elevated levels of uric acid among the Pukapukans, however, is somewhat suprising. Their low energy intakes and almost complete absence of alcohol indicate a strong genetic pre-disposition to the disease. Six of the 10 Pukapukans with clinical gout were related. Obesity, hypertension and diabetes were not associated with serum uric acid levels in this traditional living group.

In a more recent survey in Rarotonga much higher rates of gout were reported (Bennett, 1981). 16.7 per cent of the males and 6.4 of the females reported a history of gout. This rate for males is approximately 6 times higher than the previous survey and also higher than that reported for Maoris.

The prevalence of gout was the same for rural and urban males. No rural females suffered from gout but 1.3 per cent of urban females reported gout.

Serum uric acid levels were positively correlated with BMI (Body Mass Index) but this was strong only for urban females. There was a strong correlation in all age groups between serum uric acid and serum creatinine.

Niue

A history of gout was reported by 3.8 per cent of males and 2.6 per cent of females in a recent survey (Bennett, 1981).

Conclusions

The studies from Guam (Reed, 1972), the Cook Islands (Prior et al, 1966b) and Western Samoa (Jackson, in press) found a rather weak association between hyperuricaemia/gout and urbanisation. Obesity, hypertension, high energy intake and easy access to alcohol are common risk factors for gout and are increasing health problems for urbanised Pacific Islanders. These factors may in the future have a greater effect on an increase in the prevalence of gout in urban centres in the Pacific.

It may also be that genetic factors are more important than environmental factors. Elevated serum uric acid levels and gout were not often reported in Melanesia in spite of urbanisation, but this may be due to the lack of surveillance.

OBESITY

More and more evidence is accumulating to show that migration into cities and towns, away from traditional village life, and the resulting changes in life style, are responsible for the increasing prevalence of obesity in the Pacific. There are, however, indications that more affluent Pacific islanders may have manifested obesity in earlier times and the tendency to 'corpulence' may well have been common in Pacific societies before western influence. Obesity may have a genetic, as well as social basis, particularly for some groups in Polynesia.

Captain Cook described the men of the Cook Islands as:

"stout, active and well made....."

"as fine a race of people as anything seen in this sea and in general stouter and fleshier"...

"tendency of the inhabitants here to corpulency".

(Beaglehole, 1968).

"Tahitian chiefs were much 'rounder' than their subjects".

(Ellis, 1853).

Being overweight may be seen in many Pacific societies as an indication of prosperity, health, success and social standing. The roundish figure of the middle age island gentleman may be simply an expression of his status. Obesity among females may as well reflect her husband's ability to provide for her and/or her social position within the community.

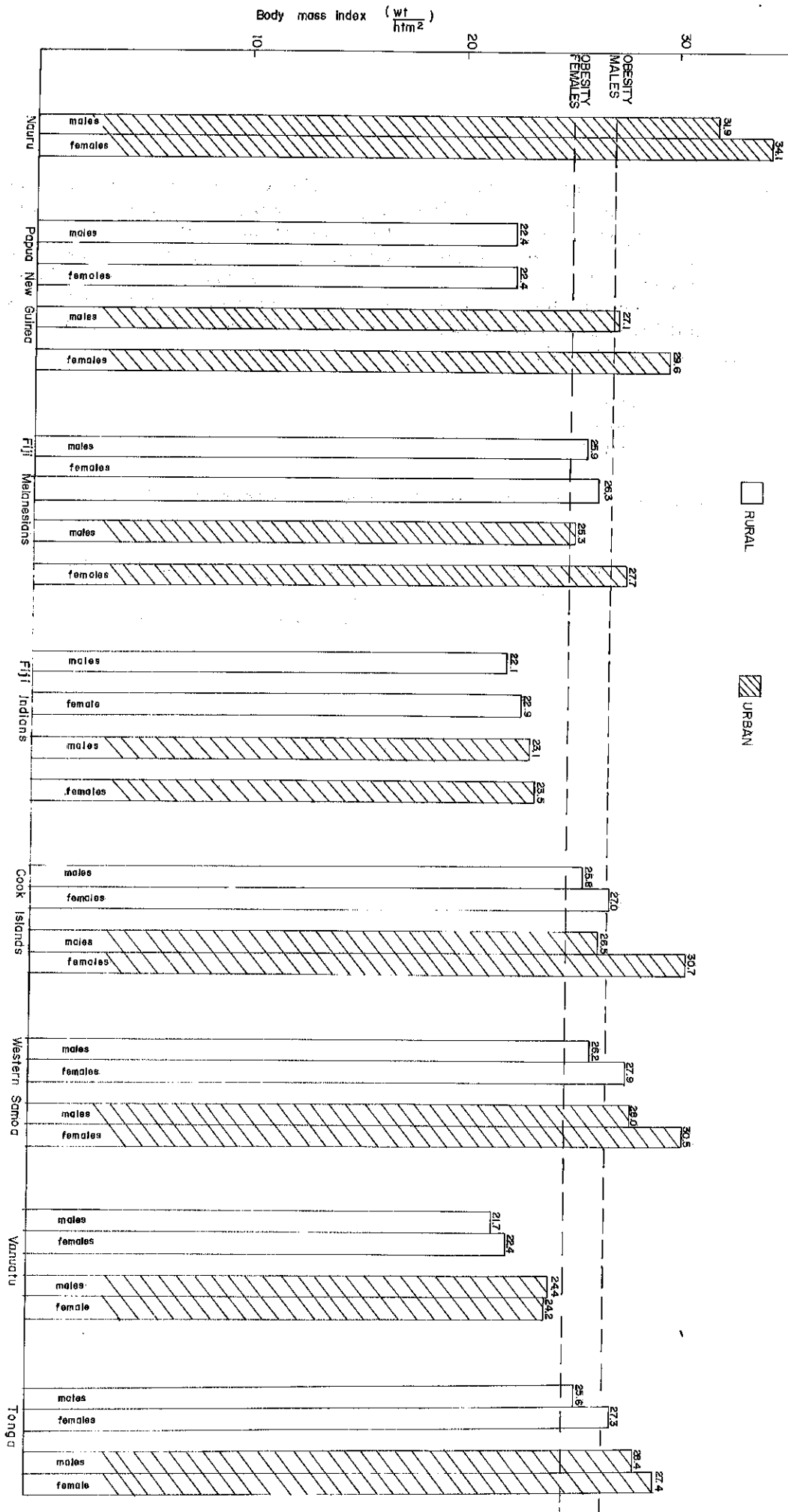


FIGURE 14. MEAN BODY WEIGHT MASS INDICES (BMI) OF PACIFIC ISLAND POPULATIONS.

Figure 14 today illustrates that in the cities and westernised communities of the Pacific, obesity is, however, becoming the norm. Mean height and weight figures and the prevalence of obesity are presented in Table 32, for various countries. The table shows the relationship between urbanisation and increased weights and Body Mass Index. Recent surveys have used the Body Mass Index (BMI) which is considered a satisfactory estimation of obesity (Keys, 1972; Prior et al, 1969) and is calculated:

$$\text{BMI} = \frac{\text{WT (KG)}}{\text{HT (M)}^2}$$

The definition of obesity commonly used is (Bennett, 1979):

| | BMI Non Obese | BMI Obese | BMI Severely Obese |
|---------|------------------|--------------|-----------------------|
| Males | 27 | 27 - 31 | 32+ |
| Females | 25 | 25 - 29 | 30+ |

TABLE 32. Mean weights, heights and indicators of obesity for various Pacific Island populations

| Location - Source | Number in Sample | M A L E S | | | Sample | F E M A L E S | | |
|----------------------------|------------------------|------------|------------|--------|--------|---------------|------------|--------|
| | | Weight(kg) | Height(cm) | BMI | | Weight(kg) | Height(cm) | BMI |
| | N= | | | | N= | | | |
| MICRONESIA | | | | | | | | |
| Kiribati | | | | | | | | |
| -Willmott(1968) | 27 | 67.0 | 169.2 | (23.4) | 30 | 58.8 | 157.4 | (23.7) |
| Nauru | | | | | | | | |
| -Zimmet(1978) | 128 | 88.7 | 166.8 | 31.9 | 142 | 82.6 | 155.4 | 34.1 |
| MELANESIA | | | | | | | | |
| PNG - W.Highlands | | | | | | | | |
| -Sinnet & Whyte (1973) | 391 | 45.0 | 153.5 | (19) | 386 | 37 | 147.7 | 17.0 |
| PNG - Chimbu | | | | | | | | |
| -Ven Katachalam (1962) | 116 | 53.6 | 156.2 | (22.0) | 3 | 47.9 | 147.8 | (22.0) |
| PNG - coastal | | | | | | | | |
| -Hipsley & Kirk (1965) | 31 | 59.3 | 163.1 | (22.3) | 31 | 51.5 | 154.7 | (21.5) |
| PNG - Wogupmeri River - | | | | | | | | |
| Masironi(1976) | 50 | 58.9 | 158.8 | (23.4) | 50 | 47.5 | 149.8 | (21.2) |
| PNG - Karkar Is. | | | | | | | | |
| Boyce(1978) | 130 | 55.8 | 160.8 | (21.5) | 155 | 47.8 | 151.5 | (20.8) |
| PNG - Kalo-rural | | | | | | | | |
| Martin (1980) | 40 | 60.6 | 164.4 | 22.4 | 65 | 57.5 | 157.4 | 22.4 |
| PNG - Port Moresby | | | | | | | | |
| - Martin(1980) | 139 | 70.2 | 161.7 | 27.1 | 46 | 66.3 | 150.0 | 29.6 |
| Fiji - Naduri | | | | | | | | |
| Langley(1953) | 26 | 74.4 | 175.0 | (24.3) | 21 | 62.2 | 162.8 | (23.5) |
| Fiji - Naduri | | | | | | | | |
| Wilkins(1963) | 28 | 75.2 | 172.5 | (25.2) | 31 | 64.2 | 162.5 | (24.3) |
| Fiji - Indian | | | | | | | | |
| Wilkins(1964) | 35 | 61.8 | 149.6 | (27.5) | 39 | 51.8 | 151.2 | (22.6) |
| Fiji - Indian | | | | | | | | |
| Hawley(1978) | 1229 | 69.7 | 171.4 | (23.7) | 1350 | 64.0 | 161.4 | (24.6) |
| Fiji - | | | | | | | | |
| Melanesians-U | | | | 25.3 | | | | 27.7 |
| -R | | | | 25.9 | | | | 26.3 |
| Indians -U | | | | 23.1 | | | | 23.5 |
| -R | | | | 22.1 | | | | 22.9 |

TABLE 32.
Continued

Mean weights, heights and indicators of obesity for
various Pacific Island populations

| Location - Source | Number in Sample | M A L E S | | | F E M A L E S | | | |
|-----------------------|------------------------|------------|------------|--------|---------------|------------|------------|--------|
| | | Weight(kg) | Height(cm) | BMI | Sample | Weight(kg) | Height(cm) | BMI |
| Vanuatu-Vila | | | | | | | | |
| Jabra(1976) | 37 | 64 | 162.0 | (24.4) | 56 | 58 | 155 | (24.2) |
| - Malekula | | | | | | | | |
| Raoult(1976a) | 136 | 59.4 | 165.6 | (21.7) | 154 | 55.9 | 158.1 | (22.4) |
| POLYNESIA | | | | | | | | |
| Cook Is.Rarotonga | | | | | | | | |
| -Hunter (1962) | 89 | - | - | 28.1 | 27 | - | - | 32.2 |
| Cook Is.Atiu | | | | | | | | |
| Mitiaro (1962) | 109 | - | - | 26.1 | 53 | - | - | 31.5 |
| Cook Is.Rarotonga | 243 | 75.4 | 168.7 | (26.5) | 227 | 76.5 | 157.9 | (30.7) |
| Pukapuka | 188 | 69.9 | 164.4 | (25.8) | 191 | 74.4 | 154.4 | (27.0) |
| - Prior(1966) | | | | | | | | |
| Tokelau - | | | | | | | | |
| - Prior (1974) | 266 | 76.4 | 168.8 | (26.8) | 319 | 75.0 | 159.5 | (29.5) |
| Tonga - rural | | | | | | | | |
| - Prior (1978) | 198 | 75.3 | 171.4 | 25.6 | 172 | 71.6 | 161.8 | |
| Tuvalu - | | | | | | | | |
| - Holmes(1953) | 286 | 72.5 | 165.5 | (26.5) | 214 | 61.3 | 154.8 | (25.5) |
| Tuvalu - | | | | | | | | |
| - Wicking(1981) | 269 | 74.6 | - | 26.6 | 308 | 73.1 | - | 29.0 |
| Western Samoa | | | | | | | | |
| -rural - Jackson | | | | | | | | |
| in press | 358 | 76.9 | 171.1 | 26.1 | 385 | 72.4 | 161.1 | 27.6 |
| Western Samoa | | | | | | | | |
| -urban - Jackson | | | | | | | | |
| in press | 324 | 84.8 | 173.4 | 28.0 | 417 | 80.7 | 161.3 | 30.5 |
| American Samoa | | | | | | | | |
| -Samoa-McGravey | | | | | | | | |
| (1979) | 963 | 86.8 | 170.1 | (30.0) | 995 | 84.2 | 158.9 | (33.4) |
| American Samoa | | | | | | | | |
| -Hwaii | 249 | 90.4 | 170.8 | (31.0) | 342 | 84.3 | 160.0 | (32.9) |
| U.S. Reference Male | | | | | | | | |
| 23 - 50 years | | 70 | 178 | (22.0) | | 55 | 163 | (20.7) |
| New Zealand-Birkbeck | | | | | | | | |
| -1980 50% 20-29 years | | 74.3 | 176.1 | (24.0) | | 60 | 163.5 | (22.5) |

* Body Mass Index = $WT (kg) / HT (m)^2$

BMI without brackets = mean of individual calculations

with brackets = (estimated BMI from mean weight and mean height of the sample)

MICRONESIA

Guam and Palau

Traditional living Palauans had much lower mean percentage body fat compared to urban Paluans. Yet among Chamorros, those who lived in Guam had lower per cent body fat than rural Chamorros (Reed, 1973). Percentage body fat was calculated from triceps and subscapular skinfold thicknesses.

| | <u>Per cent</u> | | <u>Body Fat</u> | |
|-----------|------------------|---------------|------------------|---------------|
| | <u>R u r a l</u> | | <u>U r b a n</u> | |
| | <u>Male</u> | <u>Female</u> | <u>Male</u> | <u>Female</u> |
| Chamorros | 21 | 30 | 17 | 21 |
| Palauans | 14 | 18 | 25 | 30 |

Blood pressure, serum glucose and uric acid were associated with each other and with per cent body fat, (Reed, 1970). Heights and weights were performed but the data not presented.

Kiribati

A diabetes survey was carried out in urban and rural Kiribati in 1981. The preliminary report (Zimmet et al, 1981) does not include weight, height or BMI data.

Mariana Islands

When studying hyperuricaemia and gout in adults from Rota, Burch and O'Brien (1966) found higher mean uric acid levels in taller and heavier individuals. Actual heights and weights were not given.

Nauru

Nauru appears to be one of the most highly "westernised" of the Pacific Islands and has the highest mean weight and BMI (Ringrose, 1979). The mean Body Mass Index of males, 31.9, is close to the "severely obese" range and that for females above the "severely obese" range. Nauruans also exhibit the highest rates of diabetes, hypertension, hyperuricaemia and gout in the Pacific. Dietary energy intakes are three times recommended levels (Ringrose, 1981).

MELANESIA

Fiji

There were no differences in Body Mass Indices (BMI) between urban and rural Melanesian or Indians in Fiji (Ringrose, 1981), urban Melanesians, however, had higher diabetes prevalence rates and skinfold thickness than rural Melanesians. Urban Indians had slightly higher diabetes rates, BMI and skinfold thickness. Energy intakes were higher for the rural groups which suggest that: Physical activity and fitness may explain some part in the difference in rates of diabetes,

particularly for the Melanesians.

New Caledonia

Data on weight and height of urban and rural Melanesians have not yet been included in a report on diabetes and cardiovascular disease in New Caledonia (Taylor and Zimmet, 1981a).

Papua New Guinea

Numerous studies in Papua New Guinea (Hipsley and Clements, 1947; Hipsley and Kirk, 1965; Venkatachalam, 1962; Sinnett and Whyte, 1973; Bryce, 1978; Masironi, 1976) have shown that in general traditional living Papuans are shorter and lighter than Europeans. "Male adults appear well built, with good muscular development" (Venkatachalam, 1962). "Physical fitness was assessed to be high and superior to Australians.... Obesity was practically non-existent" (Sinnett and Whyte, 1973).

When Martin and co-workers (1980) examined Papuans in Port Moresby, he found them significantly heavier than adults from the rural village of Kalo. Mean weights and BMIs of the urban groups were higher than the rural adults. The rural groups were also taller.

| | Urban | | Rural | |
|----------------------|-------|---------|-------|---------|
| | Males | Females | Males | Females |
| Number | 139 | 46 | 40 | 65 |
| Mean Weight (kg) | 70.2 | 66.3 | 60.6 | 57.5 |
| Mean Height (cm) | 161.7 | 150.0 | 164.4 | 157.4 |
| Mean Body Mass Index | 27.1 | 29.6 | 22.4 | 22.4 |

In the urban group there was a tendency for weight to increase with mild glucose intolerance, but as glucose intolerance increased, weight tended to decrease in both groups so that there was no significant relation between weight and plasma glucose.

Jeremy and Rhodes (1971) also found that highlanders employed in Goroka were significantly heavier than village highlanders. They found no positive correlation between disease and weight or obesity in the total group, but noted that in the older Goroka group higher uric acid levels were associated with length of employment, relative obesity and a higher alcohol consumption.

Solomon Islands

Page et al (1974) reported on a survey of 1390 males and females over the age of 15 years in six areas in the Solomon Islands and three groups in Bougainville. Weights, heights and skinfold thicknesses were all well below U.S. standards. No obesity was found and weight was not correlated with blood pressure.

Vanuatu

Obesity and hypertension were "very uncommon" among traditional Malekulan men (Raoult, 1976a). They were in general vigorous and well developed but below standard in stature. The women were also short but of normal weight for height. Overweight, however, was more common in women than in men (20 per cent).

Smaller numbers of males and females were examined at Tagabe, a poor migrant community near Port Vila. Both males and females were heavier and shorter than those seen at Malekula with corresponding higher Body Mass Index (Jabre et al, 1976).

Hypertension was found more frequently among the Tagabe group than the Malekula adults.

POLYNESIA

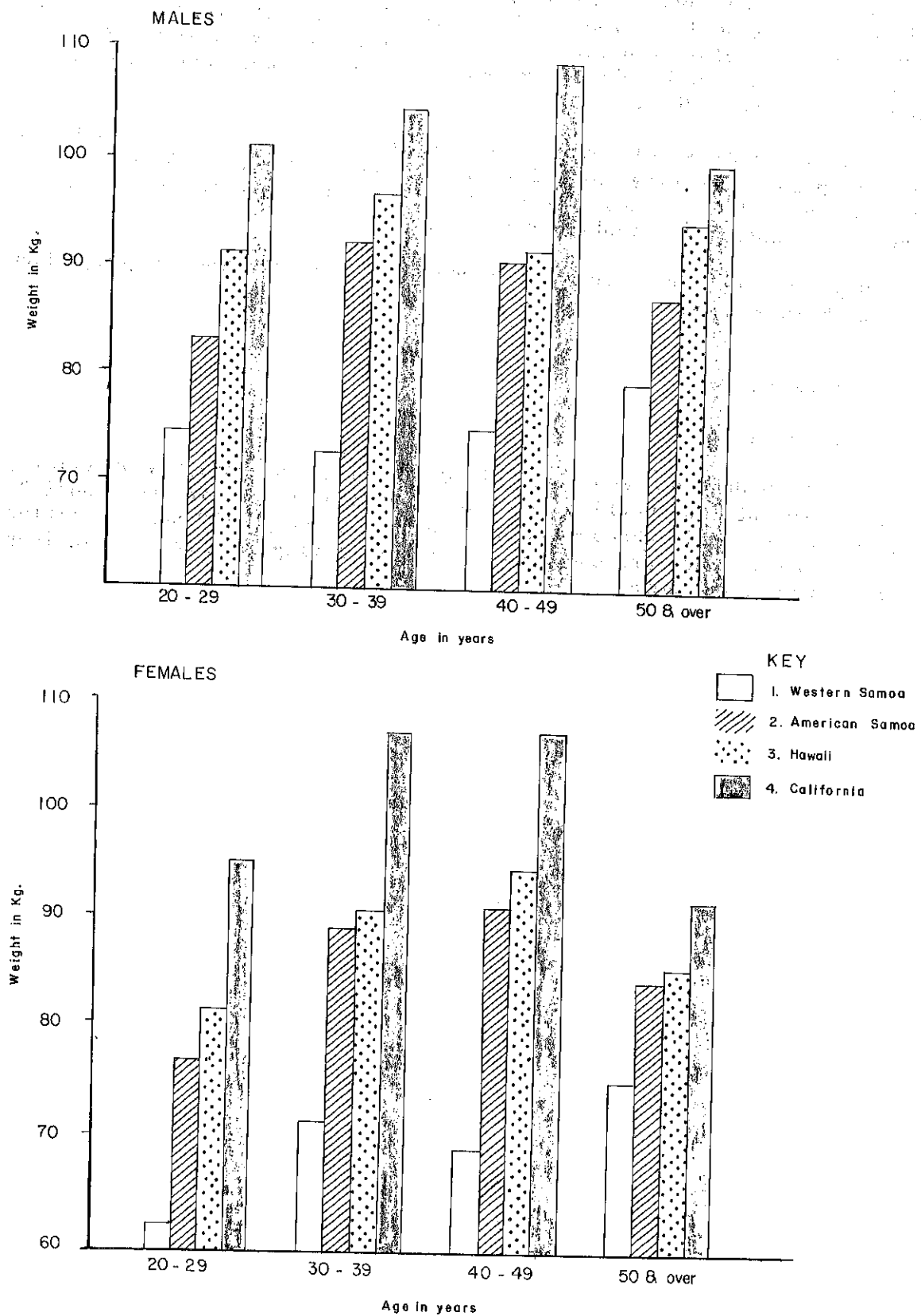
American Samoa

American Samoans who live in California, suggests Pawson (1981), "may represent the world's heaviest sub-population in the world". Figure 15 shows this phenomenon but represents only 190 Samoans living in California who are compared to Samoans living in Hawaii, American Samoa and Western Samoa.

FIGURE 15

ADULT WEIGHT IN FOUR SAMOAN SUB-POPULATIONS

(PAWSON 1980)



McGarvey and Baker (1979) found a significantly positive association between triceps skinfold and both systolic and diastolic blood pressure in groups of American Samoans except the traditional-living males.

Cook Islands and Tokelau

Prior (1977b) examined the weights of New Zealand Maoris, Tokelauans and Cook Islanders living in Rarotonga and Pukapuka. The increase in weight for males with greater urbanisation is clearly evident here as elsewhere. (New Zealand Maori males were more obese than other Polynesian group). The weights of the Tokelauans are higher than the Pukapukans, yet both are traditional living societies.

The Polynesian females of Rarotonga, however, are heavier than in New Zealand. It is not possible to definitely determine whether in New Zealand physical activity is greater, energy intake lower or social pressure to slimness greater than in Rarotonga. The Rarotongans on the whole had approximately twice the rate of obesity in males and females as the Pukapukans (Prior and Davidson, 1960b).

The rates of obesity among Rarotongans are also associated with higher rates of diabetes, hypertension, serum cholesterol levels, cardiovascular disease and gout compared to the rural Pukapukans.

French Polynesia

A survey on 6 atolls of the Tuamotu/Gambier groups included 1125 people including children. Of the total number 11.3 per cent were obese (20 per cent above international standards). Twenty three (23) per cent were hypertensive and of those, 40 per cent were obese.

Thus, it appears that obesity is increasing in the urban centre of the Pacific. Evidence from Nauru, Palau, Papua New Guinea, Vanuatu, the Cook Islands, Tonga, Western Samoa and American Samoa show an increase in obesity, as measured by Body Mass Index, with increased urbanisation. Surveys from Fiji and Guam, however, did confirm these findings.

It is also apparent the obesity is closely associated with increased rates of diabetes, hypertension, hyperuricaemia and gout.

Tonga

A survey of diabetes and hypertension, carried out in 1973, found a positive association between BMI and diabetes prevalence only among urban women. Urban males and females had significantly higher mean weights and Body Mass Indices compared to rural males and females (Prior et al, 1978). There was, however, a positive association between BMI and fasting plasma insulin levels for both males and females in urban and rural areas. The correlation was strongest among the urban groups.

Tuvalu

The mean Body Mass Indices for males and females were 26.6 and 29.0 respectively. Those fall within the "obese" range (Wicking, 1981).

While obesity was positively associated with diabetes prevalence in females, it was not in males and could not fully explain the much higher diabetes prevalence in females (Taylor and Zimmet, 1981c).

Hypertensive males and females also had higher BMIs than normotensive adults but the difference was significant only for females.

Western Samoa

Urban males and females had significantly higher mean weights and Indices (BMI) than rural males and females (Jackson et al, 1981). In males, impaired glucose tolerance and diabetes prevalence, increased with increasing BMI. The trend was similar in females but not significant (Taylor and Zimmet, 1981).

Obesity was significantly correlated to hypertension in both the rural and urban groups (Zimmet et al, 1980). Serum uric acid levels were positively correlated with BMI but the correlation was not strong except for urban females (Jackson et al, 1981).

Diseases associated with obesity

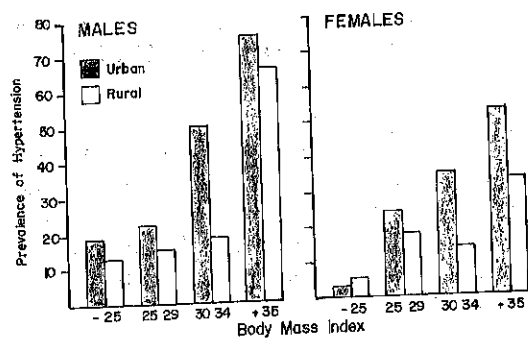
Mean body weight and mean Body Mass Index (BMI) are closely associated with prevalence rates of diabetes. This is especially true for Nauru which has the highest mean BMI and the highest diabetes prevalence rates in the world (Figure 14). Diabetes prevalence rates increase with increase in BMI in Papua New Guinea, the Cook Islands, Western Samoa and Tonga. Fijian males were the only group not to show a similar increase.

In most of the above diabetes surveys, obesity was positively related to diabetes, but the correlation was not always statistically significant. In Guam (Yen, 1964), Papua New Guinea (Martin, 1980), 1981) diabetics were usually more obese than the non-diabetics but this was not always a consistent or significant difference. A number of other researchers have reported similar findings (Kobberling, 1971; Keen et al, 1974 showed that while obesity is positively correlated, it may be only one factor in the aetiology of diabetes. West (1978), however, gives evidence that obesity plays more than a "precipitating" role in the development of diabetes. He suggests "that in affluent societies obesity is more often the prime cause, with heredity frequently playing a precipitating role".

Bennet and co-workers (1979) have shown that the incidence of diabetes is highest in the younger but more obese Pima Indians. Young but lean Pimas have a relatively low rate. When Zimmet and co-workers (1981), re-examined Nauruans, he found a similar pattern. These findings suggest that obesity may precipitate diabetes at an earlier age in susceptible persons. Those who are not obese, but have an inherited susceptibility may have the onset of diabetes delayed until later life

Obesity was also associated with hypertension in surveys in the Pacific, although the association was not as strong as for diabetes (Figure 16). Again Fijian males do not show the same trend of increase in prevalence rates of hypertension with increase in BMI. These finding

suggest that while obesity plays an important aetiological role in the development of hypertension, other environmental factors, i.e. salt intake and/or physical fitness, may be also at work.



Age standardized (Direct to Western Samoan census)

FIGURE 16 The age standardized prevalence of hypertension by body mass index in males and females for rural and urban Western Samoans.
(ZIMMETT 1980)

The association between obesity and hyperuricaemia and gout is less clear. Hyperuricaemia was reported in the relatively lean traditional communities in the North Marianas (Burch, 1966; Reed, 1972), Palau, Pukapuka (Prior et al, 1966b), Papua New Guinea (Jeremy and Rhodes, 1971), Tokelau (Prior, 1974) and Western Samoa (Jackson, in press). In many of the studies, however, serum uric acid levels were positively related to body weight or Body Mass Index; Nauru (Zimmet, 1978), Chamorros and Paluans (Reed, 1972), the Cook Islands (Prior et al, 1966) and Western Samoa (Jackson, in press).

Obesity thus appears to be a major factor if not the major factor in the precipitation of the leading chronic degenerative diseases throughout the urbanised areas of the Pacific. A genetic predisposition coupled with increased energy intake and decreased physical activity appear responsible for the rapid development of obesity and these diseases in Pacific Island populations.

DENTAL CARIES

Early explorers and early written reports commented often on the excellence of the teeth of Pacific Island peoples. Captain James Cook (Beaglehole, 1968) remarked on Tongans:

"They have fine eyes and in general good teeth even to an advanced age."

The French Navigator de Bougainville (de Bougainville, 1773) described Tahitians:

"the remarkable brightness of their regular rows of immaculate teeth, that they keep till they are quite elderly..."

adding:

"what better proof of the wholesomeness of the air and the good effects of these peoples diet...."

Cook (Beaglehole, 1968) also admired the Tahitians he met:

"They have all fine white teeth."

In dramatic contrast to the early explorers, Professor Baume (1974) found 14 and 15 year old Tahitian children whose mouths were "already completely toothless". He referred to Tahiti as:

"the paradise of toothless smiles".

Very early studies in American Samoa provide quite clear evidence of the effect on urbanisation on dental health. In 1934, Ferguson (1934) investigated the dental health of 2116 school aged children in American Samoa. Of children who attended school near the naval base 22 per cent had dental caries while only 3 per cent of children in the small "jungle" schools had one or more carious teeth. Ferguson believed that this was one of the lowest incidences of carious teeth ever reported. "Infuse of foreign blood" and "papalagi" (white man's food) were cited as the major causes of dental caries among the "urban" school children. The children attending the jungle schools were "absolutely unaffected by outside influences, being strictly Samoan in diet, customs and lineage". No mention was made of fluoride content of water or foods.

Neubarth (1954) completed dental examinations on 4768 American Samoan school children in 1953. He found a much higher rate of dental caries but again showed the relationship between contact with the European way of life and dental caries (Table 33).

TABLE 33. Dental conditions in school children of American Samoa (Fergusson, 1934 and Neubarth, 1954)

| Location | Percentage of children with carious teeth | |
|------------------------------------|---|------|
| | 1934 | 1953 |
| Pago Pago Bay Area | 22.3 | 72.7 |
| Schools along main negotiable road | 9.5 | 59.6 |
| Remote outlying villages | | |

| | | |
|-------------------------|-----|------|
| - "jungle" schools | 3.2 | 42.3 |
| Manu'A group of islands | 4.2 | 21.7 |

Children in the Pago Pago Bay area had the highest prevalence of dental decay. Many of the families were employed by the island government and consumed quantities of European foods. Locally available candies, soda pop, chewing gum and ice cream were frequently eaten. In the outlying villages and on the Manu'A group of islands, the families had no steady income and obtained their food from the surrounding area. "Their diet is mainly devoid of European carbohydrates, and consequently the low percentage of decay is the apparent result" (Neuborth, 1954). French Polynesia offers another example of the effect of changes in life style on dental caries. In 1678 de Bougainville (1773) described the beautiful Tahitians and "their regular rows of immaculate teeth, that they keep till they are quite elderly". 200 years later, however, the appalling state of dental health among Tahitian children was investigated by Acker and Mootgat (Baume, 1974). Surveys conducted among 7,000 French Polynesians in 1955 and 1957, revealed that 50 per cent of children of Tahiti and Bora Bora were affected by dental caries.

Baume again examined French Polynesian children in 1971 (Baume, 1974). In the Society Islands which include Tahiti and Bora Bora, he found 80 per cent of children up to the age of 14 years to be affected by dental caries. At the age of 13, the mean number of DMF teeth was 12! - but even this figure, which is as high as in developed countries, did not reflect the severity of dental decay. In Tahitian children a DMF count often indicated a tooth completely decayed or missing due to decay while among Europeans or Americans it may indicate only a small filling or incipient caries (Baume, 1974).

Baume also indicated that the enamel of the tooth of Tahitian children was more susceptible to dental caries and that this was due to enamel hypoplasia resulting from early post natal malnutrition especially at the time of weaning.

The surveys conducted by Speake et al (1979a) between 1975 and 1977 revealed that in urban Tahiti on the island of Huahine, NO 11 year old children were free of caries. DIMFT rate for 5 out of the six areas was between 4.1 and 6.8 for 11 year olds.

The above investigators unanimously agreed that the present day dietary patterns of Tahitians is responsible for the rampant dental caries. Baume (1974) suggested that the sugar consumption of urban Tahitians is 68 kg per person per year! Speake et al (1979) estimated 46 kg per person per year for all of French Polynesia.

It has long been known that frequent eating of sugar containing foods causes an increase in dental decay. Numerous animal and human studies have conclusively proven that foods containing simple sugar, sucrose in particular, but also glucose and fructose, are responsible for an increase in production of caries (Russell, 1974).

TABLE 34. Number of Decayed, Missing and Filled Permanent Teeth (DIMFT) and percentage of caries-free children (Speake, Cutress and Ball, 1979)

| Group | Sample Size | 8-Year olds | | Sample Size | 11-Year olds | |
|---|-------------|----------------------|------------------------|-------------|---------------------|------------------------|
| | | DIMFT* | Percentage Caries Free | | DIMFT* | Percentage Caries Free |
| 1 Tarawa (urban) (Gilbert Islands) | 98 | 0.3 (0.1 to 0.5) | 61 | 49 | 0.7 (0.3 to 1.1) | 49 |
| 2 Tahiti (urban) (French Polynesia) | 20 | 2.4 (1.4 to 3.7) | 7 | 37 | 5.6 (4.4 to 6.9) | 0 |
| 3 Tahiti (rural) (French Polynesia) | 54 | 3.0 (2.3 to 3.8) | 4 | 55 | 5.7 (4.7 to 6.8) | 3 |
| 4 Moorea (rural) (French Polynesia) | 41 | 1.6 (1.0 to 2.3) | 22 | 33 | 5.2 (4.0 to 6.5) | 3 |
| 5 Huahine (rural) (French Polynesia) | 3 | 6.3 (2.4 to 11.9) | 0 | 48 | 6.8 (5.6 to 8.0) | 0 |
| 6 Rurutu (rural) (French Polynesia) | 23 | 0.6 (0.2 to 1.3) | 44 | 56 | 0.5 (0.3 to 0.9) | 59 |
| 7 Marquesas (rural) (French Polynesia) | 35 | 2.2 (1.4 to 3.0) | 20 | 39 | 4.1 (3.1 to 5.2) | 5 |
| 8 Rarotonga (urban) (Cook Islands) | 145 | 2.2 (1.8 to 2.6) | 14 | 154 | 5.0 (4.4 to 5.6) | 8 |
| 9 Viti Levu (urban)* (Suva, Fiji) | 231 | 0.5 (0.4 to 0.7) | 48 | 267 | 1.4 (1.2 to 1.6) | 30 |
| 10 Viti Levu (rural) (Suva, Fiji) | 119 | 0.6 (0.4 to 0.8) | 47 | 112 | 1.8 (1.4 to 2.2) | 22 |
| 11 Saipan (urban) (TTPI) | 88 | 1.9 (1.4 to 2.4) | 13 | 82 | 3.3 (2.6 to 3.9) | 7 |
| 12 Majuro (urban) (TTPI) | 65 | 1.5 (1.1 to 2.1) | 25 | 68 | 3.4 (2.7 to 4.1) | 10 |
| 13 Ponape (rural) (TTPI) | 83 | 1.6 (1.2 to 2.1) | 25 | 77 | 4.3 (3.6 to 5.1) | 9 |
| 14 Yap (rural) (TTPI) | 63 | 0.2 (0.1 to 0.5) | 62 | 64 | 0.6 (0.4 to 1.0) | 50 |
| 15 Tongatapu (urban) (Tonga) | 112 | 0.8 (0.5 to 1.1) | 39 | 116 | 1.5 (1.1 to 1.9) | 27 |
| 16 'Eua (rural) (Tonga) | 83 | 0.3 (0.2 to 0.6) | 58 | 82 | (0.4 to 1.0) | 45 |

* Shown as mean value (with 95% confidence interval in brackets), based on transformed square-root mean values.

Annual sugar and confectionery consumption (Kg per person)

Figure 17. Prevalence of Dental Caries (mean DMF (T) at 14 years) compared to per capita annual sugar consumption.

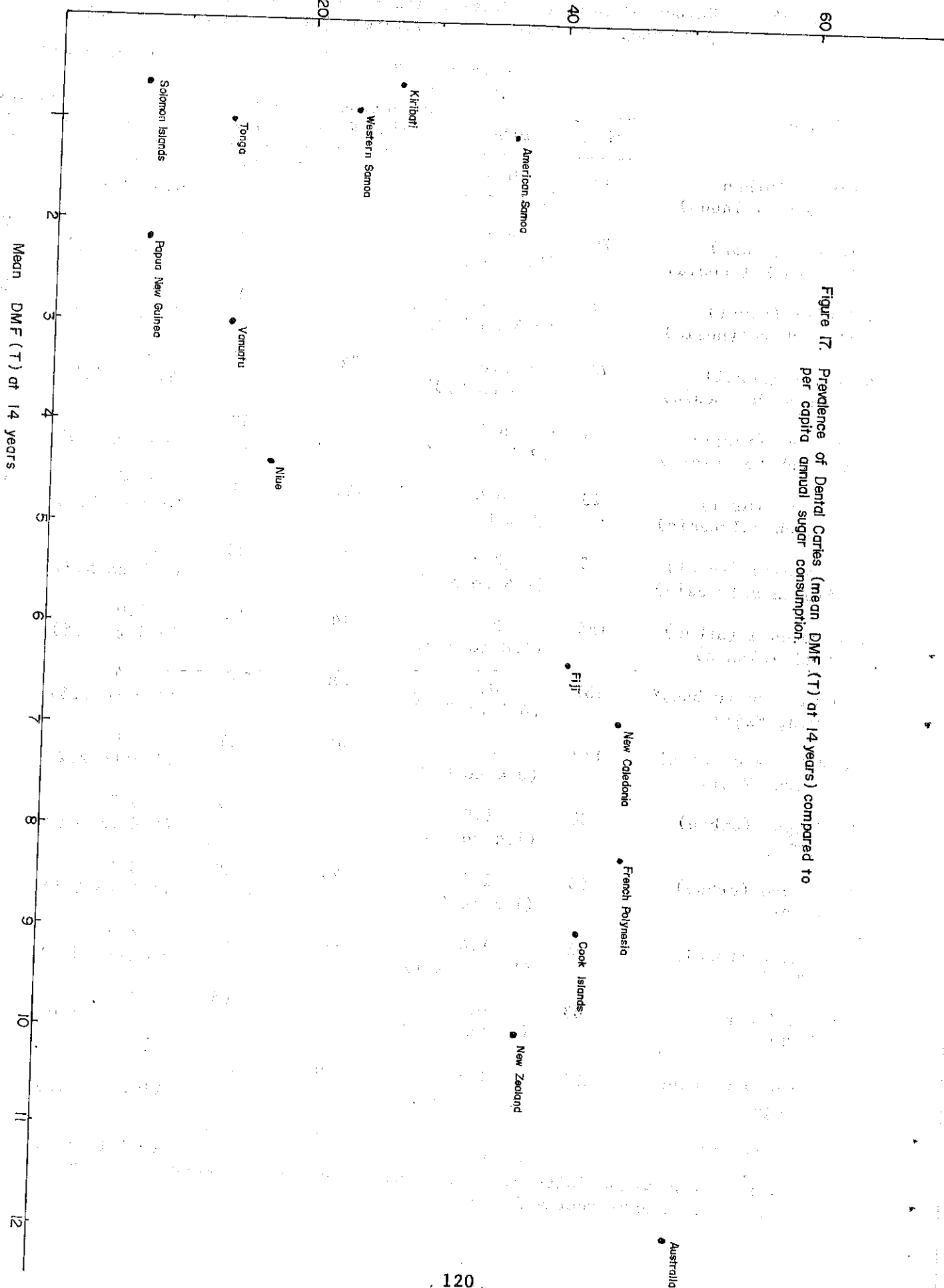


Figure 17 illustrates the relationship between the prevalence of dental caries and annual per capita consumption of sugar and confectioneries for many of the South Pacific countries. The data by country for dental caries was presented at a joint WHO/SPC Seminar on Dental Health Services in 1971, (Regional Office for the Western Pacific, 1972). For Fiji, a more recent survey on urban children was obtained (Speake et al, 1979). Sugar consumption figures were calculated for each country using the mean of the years 1970 to 1976. The graph shows the high prevalence of dental caries (DMF(T)) and high sugar consumption in French Polynesia, the Cook Islands, New Caledonia and Fiji, conversely the low rate of caries and sugar consumption in the Solomon Islands, Papua New Guinea, Vanuatu and Tonga. The surveys in American Samoa and Western Samoa were conducted from 1966 to 1968 and may not reflect the more current status of dental caries. The low prevalence in Kiribati, despite high sugar intake, probably reflects the high enamel fluoride protection (SPC, 1978).

Extensive dental health surveys were conducted between 1975 and 1977 in six countries in the South Pacific (Speake et al, 1979). Examinations were made on 2602 from 148 communities on 17 islands. The communities were grouped together on the basis of urban/rural characteristics, distance from the sea, height of the village above sea level and ethnic mix of the population.

Table 34 provides the mean DIMFT + values and percentage of 8 and 11 year old children who are carie free. The mean DIMFT for 8 year olds ranged from a low in Tarawa of 0.4 to a high in rural Huahine, French Polynesia, of 6.3. The 11 year olds also showed wide differences between groups. Low scores less than 1.0 per cent were found in Tarawa, Rurutu, Yap and 'Eua, whereas Tahiti, Huahine and Rarotonga had high scores (5.0-6.8). At this age 20 permanent teeth are present, thus one-third of the teeth are decayed.

The percentage of 8 year old children who experience no tooth decay was highest in 'Eua, Rurutu, Yap and Tarawa. In Tahiti, Rarotonga and Saipan, however, there were fewer children who did not suffer. The percentage of carie free children was reduced among the 11 year olds. Again in 'Eua, Yap, Rurutu and Tarawa, about half the children were carie free. It should be noted, however, that in 8 of the 16 groups over 90 per cent of the children experienced decay.

-
- +D - decay present but can be rehabilitated
 - I - decayed but unsavable
 - M - missing due to extractions for caries
 - F - dental filling which has restored the tooth from effects of decay
 - T - teeth per child-mean.

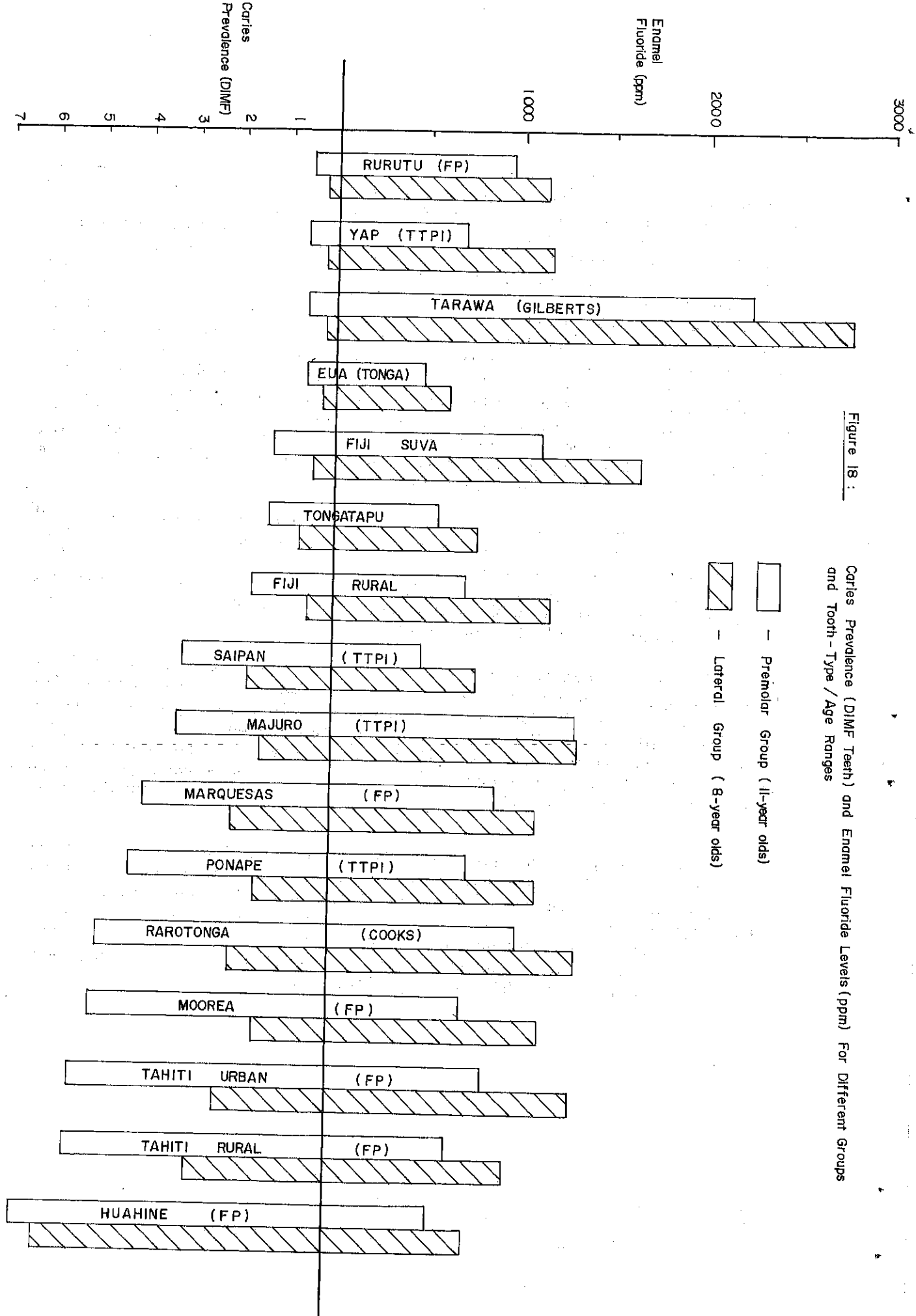


Figure 18 :

Caries Prevalence (DIMF Teeth) and Enamel Fluoride Levels (ppm) For Different Groups and Tooth - Type / Age Ranges

The relationship between mean DIMFT and mean enamel fluoride concentration is shown in Figure 18. There is no distinct relationship between enamel fluoride concentration and carie prevalence.

Although Tarawa had the lowest carie prevalence and highest enamel fluoride concentration, this was not true with other groups. Yap, 'Eua, Tongatapu and Rurutu, had low carie prevalence and relatively low fluoride. Thus it is evident that factors other than, or perhaps in conjunction with enamel fluoride, contribute to the wide variation in dental caries, between the groups in this study (Speake et al, 1979).

It would appear that environmental factors, namely sugar consumption, is a major variable between the groups and outweigh any influences of sub-optimal fluoride levels. In this survey sugar consumption was not available by community, but only by country. It is known that sugar consumption in French Polynesia is high, but it would be interesting to know the difference in sugar consumption for example for Huahine and Rurutu where carie prevalence is quite different. A major recommendation to emerge from the first Regional Meeting of Chief Dental Officers in 1978 (SPC, 1978) was that:

further research into the relationship between fluoride, sugar consumption and dental caries in the Pacific be undertaken

ALCOHOLISM

There is relatively little information on the effects of health related to alcoholism or alcohol abuse in South Pacific populations. Cirrhosis of the liver, which is most often a result of excessive alcohol consumption, was listed as the 9th leading cause of death in Guam over the years 1971 to 1977 (Kuberski and Bennett, 1979). Cirrhosis was also listed as an underlying cause of death in 2 per cent of persons whose death certificates also mentioned diabetes. In a Pennsylvania study, cirrhosis was an underlying cause of death in only 0.6 per cent of diabetic deaths. In the Trust Territory of the Pacific Islands cirrhosis of the liver was the 11th leading cause of death for the years 1974 to 1976 (TTPI Dept. of Health Services, 1979). MacMarshall (1979) gives an account of alcohol consumption, behaviour and attitudes in the Caroline Islands of Mirconesia. A survey of alcohol use among Tokelauans in Tokelau and Tokelauans who had migrated to New Zealand was conducted by Stanhope and Prior (1979). They found that in 1971 in Tokelau, alcohol was seldom used. The little that was consumed was in the form of toddy and drunk mostly by the males (Table 35). By 1976 the use of imported alcoholic beverages had increased and more males and females were using alcohol.

In New Zealand after migrations, more Tokelauan males and females became drinkers and those who drank, did so more frequently. The use of alcohol among Tokelauans in New Zealand, however, was much less than in the general New Zealand population. It was estimated that 91 per cent of males and 83 per cent of females were current drinkers and consumed an average of 900 ml of alcohol per month. This is considerably higher

than 60 per cent of Tokelauan drinkers and the 181 ml consumed by the Tokelauans.

In Nauru, alcohol consumption is high, Ringrose (1979) reported a mean intake of 113 grams of alcohol per day in males between 20 and 39 years of age. This amount accounted for 8 per cent of the total energy intake and would be the equivalent to 3.7 litres of beer or 10 ounces of whisky per day. In France, a rise in the incidence of cirrhosis of the liver is seen when the daily consumption of alcohol regularly exceeds 80 grams per day (Thaler, 1977).

A report on drinking in Tahiti (Blacker, 1971) revealed that between 1958 and 1971 beer consumption increased by 400 per cent and whisky by 26 times. Public drunkenness and traffic accidents were becoming serious concerns.

Figures on the importation of alcoholic beverages in various countries (Table 36.) show a significant increase in most countries within the past decade. Fiji and Papua New Guinea showed a decrease in imports, most likely due to the production of local beer. Based on import figures the annual consumption of alcoholic beverages is highest in Nauru, 132.8 litres per person per year and lowest in Tonga (11.6 litres) and the Solomon Islands (5.9 litres).

There is little need for additional data on the prevalence of alcohol abuse in the Pacific. It would seem wise to closely monitor the import and consumption of alcoholic beverages and the diseases and consequences related to alcohol abuse, namely cirrhosis of the liver, pancreatitis, motor vehicle accidents, accidents of violence, childhood malnutrition.

TABLE 35. Alcohol drinking among Tokelauan adults in Tokelau and in New Zealand (Stanhope and Prior, 1979)

| | In Tokelau | | In New Zealand | | |
|----------------------------------|------------|------|----------------|---------|---------|
| | 1968-71 | 1976 | 1967-70 | 1972-74 | 1975-77 |
| Number of adults | 974 | 807 | 386 | 1,034 | 1,177 |
| Mean migration time (yrs) | - | - | 22 | 4.8 | 7.1 |
| Per cent of males drinking | 34 | 50 | 49 | 60 | 56 |
| Per cent of females drinking | 0 | 8 | 2 | 3 | 5 |
| Per cent of females drinking | | | | | |
| No. days/month of drinkers | 2.2 | 3.8 | 4.3 | 4.7 | 6.7 |
| Mean monthly alcohol intake (ml) | 8 | - | 105 | 181 | - |

TABLE 36. Importation of alcoholic beverages in Pacific Island countries

| Country | Years | Mean imports of Alcoholic Beverages (litres '000) | Increase | |
|------------------|---------|--|---------------------------|---------------------------------------|
| | | | during the time Period | Annual per capita litres/person |
| Nauru | 1971-78 | 970 | 78% | 132.8 |
| American Samoa | 1974-72 | 2,867 | 7 | 95.0 |
| Niue | 1970-79 | 202 | 23 | 46.8 |
| Kiribati | 1971-79 | 991 | 63 | 18.5 |
| Fiji | 1970-72 | 2,028 | -11* | 3.6 |
| Solomon Islands | 1970-71 | 1,062 | 80 | 5.9 |
| Vanuatu | 1972-72 | 2,332 | -29 | 25.6 |
| Tonga | 1976-71 | 1,063 | 26 | 11.6 |
| Papua New Guinea | 1971-73 | 3,430 | -79* | 1.1 |

* Began producing local beer during this time

CANCER

There is relatively little information on the prevalence of cancer in the South Pacific Islands. Malignant neoplasms were the leading cause of death in the Trust Territory of the Pacific Islands for the years 1974-1976 (TTPI, Department of Health Services, 1978). Cancers were the second leading cause of death in Guam for the years 1971 to 1977 (Kuberski and Bennett, 1979). Cancer as a cause of death for other South Pacific countries was estimated from examining approximately 100 death certificates per country (SPC/WHO, 1978). The type of cancer was not cited.

TABLE 37. Review of death certificates by cause of death (SPC/WHO, 1978)

| Country | Number of death certificates reviewed | Percentage of deaths due to cancer |
|-----------------|--|---------------------------------------|
| Cook Islands | | |
| - Rarotonga | 50 | 26 |
| American Samoa | 100 | 15 |
| Western Samoa | 62 | 16 |
| Fiji | 100 | 12 |
| Tonga | 100 | 12 |
| Guam | 466 | 9 |
| Tuvalu | 75 | 8 |
| Solomon Islands | 98 | 7 |
| Vanuatu | 83 | 5 |
| Niue | 29 | 3 |

Cancer registration has been kept in Papua New Guinea since 1958.

Table 38. lists the number and frequency of the 15 most commonly reported cancers in Melanesians in Papua New Guinea (Henderson and Aiken, 1978).

TABLE 38. No. and frequency of 15 most commonly reported cancers in Melanesians. Papua New Guinea Tumor Registry, 1958-73+ (Henderson and Aiken, 1978)

| Site | M A L E | | F E M A L E | | TOTAL | | M:F |
|--------------------------|---------|---------|-------------|---------|-------|---------|-------|
| | No. | Percent | No. | Percent | No. | Percent | ratio |
| Oral cavity | 686 | 18.6 | 204 | 8.2 | 890 | 14.4 | 3.4 |
| Skin(squamous cell type) | 587 | 15.9 | 267 | 10.7 | 854 | 13.8 | 2.2 |
| Liver | 430 | 11.6 | 107 | 4.3 | 537 | 8.7 | 4.0 |
| Cervix, invasive | - | - | 405 | 16.3 | 405 | 6.5 | - |
| Breast | 11 | 0.3 | 262 | 10.5 | 273 | 4.4 | - |
| Non-Hodgkin's lymphoma | 178 | 4.8 | 60 | 2.4 | 238 | 3.9 | 3.0 |
| Colon | 155 | 4.2 | 60 | 2.4 | 215 | 3.5 | 2.6 |
| Leukemia, acute | 116 | 3.1 | 62 | 2.5 | 178 | 2.9 | 1.9 |
| Stomach | 126 | 3.4 | 50 | 2.0 | 176 | 2.8 | 2.5 |
| Melanoma | 88 | 2.4 | 68 | 2.7 | 156 | 2.5 | 1.3 |
| Burkitt's lymphoma | 98 | 2.7 | 51 | 2.1 | 149 | 2.4 | 1.9 |
| Thyroid | 37 | 1.0 | 84 | 3.4 | 121 | 2.0 | 0.4 |
| Ovary | - | - | 115 | 4.6 | 115 | 1.9 | - |
| Lung | 84 | 2.3 | 19 | 0.8 | 103 | 1.7 | 4.4 |
| Skin (basal cell type) | 45 | 1.2 | 49 | 2.0 | 94 | 1.5 | 0.9 |
| Other cancers | 1,059 | 28.5 | 623 | 25.1 | 1,682 | 27.1 | |
| All cancers | 3,700 | | 2,486 | | 6,186 | | |

+ The figures in this table include a small number (2.8% of the total) of cancers in Melanesians from Irian Jaya and the British Solomon Islands. However, for practical purposes, it can be considered to reflect the pattern of cancer in Papua New Guinea.

Cancer of the oral cavity is the most commonly reported form of cancer and is attributed to betel nut chewing. The forms of cancer

which have been related to diet are rare. Cancers of the bowel which have been linked to a low fibre content of the diet (Burkett, 1971) are uncommon. Breast cancer is 50 times lower in Papua New Guinean women than Caucasian in the United States. High fat diets have been suggested as one factor in the risk of breast cancers (Davidson et al, 1979). A low intake of vitamin A has been implicated in the development of lung cancer (Bjelke, 1975) which are also low in Papua New Guinea.

The prevalence of the various forms of cancer should be carefully monitored by Pacific Island countries. As the dietary pattern is changing from a generally high fibre diet to a more highly refined western one, it may be expected that cancer of the bowel, diverticulosis and other diseases of the bowel may increase. Other types of cancer and their relationship to dietary changes should also be investigated.

DIETARY FACTORS WHICH RELATE TO DISEASE PATTERNS

During the past 40 to 50 years, the composition of the average diet of urbanised Pacific Islander has changed radically. Carbohydrates which were once liberally supplied by high fibre, high nutrient, root vegetables such as taro, yams and sweet potatoes now come increasingly from refined white flour, white bread, white rice and white sugar. Fat and protein have increased and come more from tinned meats and animal fat than from coconut and fresh fish. The consumption of sugar has increased enormously in the past decade. Salt consumption may be three times higher than the traditional diet. Imports of alcoholic beverages have increased considerably over the past decade.

The dietary pattern and foods consumed in the Pacific now resemble those of the urban poor in North America and/or Europe. The foods imported by the Pacific countries are the worst of the western cuisine. Flour, bread, rice, sugar and soft drinks are cheap to process, store and transport. Fruit and vegetables are costly to import and even if available, are often too expensive for the average Pacific urban dweller.

Pacific Island communities are rapidly acquiring the diseases of the rich American and European countries. Diabetes, obesity and hypertension are already major causes of disability and death in the Pacific. Heart disease, cancer and cirrhosis of the liver may well be on the increase.

There is a great deal of evidence and it continues to accumulate, which strongly suggests, and in some cases proves, that the major degenerative chronic diseases in western society are related to the foods eaten. These diseases include coronary artery disease, some important forms of cancer, hypertension, diabetes, obesity and other chronic diseases.

Calories - Energy

The overconsumption of food in general may be the single most important dietary factor for these diseases in the Pacific. Increased energy intake, together with decreased physical exercise, is creating communities in which a majority of people are overweight. Obesity is a major risk factor in diabetes, hypertension, hyperuricaemia (gout), arteriosclerosis, hernia, gall bladder disease and liver disease. Weight reduction or prevention of obesity can reduce the incidence of most of these diseases.

The change in types of foods may be largely responsible for an increase in energy consumption and the resulting obesity. Traditional root vegetables tend to be bulky and "filling" and by weight and volume fairly low in energy (calories) compared to bread and other flour products. Sugar and sugar-based foods, i.e. soft drinks, sweet biscuits, cakes and pastries tend to be concentrated forms of energy ("Five minutes in the mouth, five years on the hips-foods"). Fats are the most concentrated form of energy (9 kcalories per gram) and alcohol next (7 kcalories per gram). Carbohydrate and protein supply only 4 kcalories per gram.

Fibre.

A very obvious and major difference between the traditional diet and the western diet in the towns and cities of the Pacific is in the fibre content. Very few of the dietary surveys have analysed for fibre as it has only recently come into nutritional vogue. Where the surveys reported actual foods consumed by weight, we have made a rough estimate of the crude fibre content. The traditional diet appears to have a significantly higher fibre content than the urban diet. Root vegetables on average have three times the crude fibre content of refined cereal products. Other traditional foods such as breadfruit, pandanus nut and various fruits are also high in fibre as is the mature meat of the coconut. (See Table 3. composition of some staple Pacific Island foods). There is a need for Pacific Island foods to be analysed for fibre content by up to date methods.

There are some conflicting results and controversies concerning the effects of diets high in fibre on health. West and Kalbfleisch (1971) suggested a negative correlation existed between dietary fibre and diabetes when they looked at prevalence studies throughout the world. Some studies suggest that diabetes control is improved when fibre is added to the diet but other studies have shown no difference in blood sugar control of diabetes on low or high fibre bread (West, 1978). Plasma cholesterol levels are lower in communities that eat high fibre diets. In controlled studies legumes have a cholesterol lowering effect whereas wheat fibre does not (Truswell and Kay, 1976). A diet rich in fibre has been recommended for the prevention and treatment of obesity (Haber et al, 1977), diseases of the colon (Burkitt, 1971) and gall bladder disease (Davidson et al, 1979).

Sugar.

The increase in sugar consumption in the Pacific is related to increase in disease. There is no doubt that the rate of dental caries is directly related to sugar consumption (Russell, 1974). Sugar and sugar-based foods are concentrated sources of energy (kcalories) of poor nutritional quality. High sugar consumption may increase the need for other nutrients, i.e. thiamin and chromium may be needed for metabolism of sugar. The relationship between sugar intake and prevalence of diabetes is still controversial. High rates of diabetes have been found in groups who consumed large amounts of sugar; Yemenites in Israel, African blacks, Australian Aborigines, Eskimos and Maoris in New Zealand (West, 1978). In the Pacific there appears to be positive correlation between annual per capita sugar consumption and prevalence of diabetes. West (1978) points out, however, that a number of medical scholars have reviewed the sugar consumption studies and concluded that sugar per se was not an important causative factor in diabetes. In countries where the prevalence of diabetes and the consumption of sugar is related, so is the relationship between diabetes and the number of motor vehicles, television sets and bath tubs. There are as well, several countries where sugar consumption is high and diabetes prevalence low; Nicaragua, Costa Rica, Columbia, Mauritius. In Fiji, the sugar consumption of Fijians and Indians is similar but Indians have a much higher rate of diabetes (Sorokin, 1975).

The most important problem caused by sugar is that these refined carbohydrate foods may be replacing other complex carbohydrate (starchy) foods which are high sources of other nutrients and fibre. It could well be that the replacement of fibre is the critical factor related to sugar consumption.

Salt

The increase in salt consumption is thought by several medical experts to be an important factor in the increasing prevalence of hypertension in urban Pacific Island populations (Page et al, 1974); (Prior and Evans, 1969). Very few dietary surveys have calculated salt or sodium intake because it is indeed difficult to measure amounts of salt added to cooking or to individual servings. Nevertheless, traditional foods contain small amounts of sodium, but salt may have been added to foods in the form of sea water. Processed imported foods, on the other hand, contain large amounts of sodium (Table 39). Prior and Evans (1969) estimated that urban Cook Islanders consumed twice as much sodium as their atoll island neighbours.

TABLE 39. Sodium content of some common present day Pacific Island foods

| FOOD | AMOUNT | SODIUM (mg) |
|---------------------------------|----------|-------------|
| Fish, fresh steamed | 75 gram | 85 |
| Mackerel, tinned | 75 gram | 657 |
| Chicken, roasted | 75 gram | 60 |
| Corned beef | 75 gram | 1305 |
| Hot dog - breadroll & frankfurt | | 1002 |
| Meat pie 4 1/2 inch. | | 494 |
| Sweet potato | 100 gram | 5 |
| Taro | 100 gram | 7 |
| Rice, boiled (no salt added) | 100 gram | 1 |
| White bread | 2 slices | 233 |
| Pawpaw 1/4 | 100 gram | 3 |
| Banana, 1 medium | 100 gram | 1 |
| Doughnut, 1 average | | 183 |
| Sweet biscuits, 2 plain | | 26 |
| Chocolate, milk 4 - 6 squares | | 25 |
| Coconut mature | 100 gram | 5 |
| Coconut water - 1 cup | | 8 |
| Gingerale, 1 glass | | 16 |
| Curried prawns - 1 meal | | 3050 |

A high salt intake has been shown to cause an increase in blood pressure and rates of hypertension in individuals and groups who are genetically susceptible. High salt intakes have had the effect of slowing the body's ability to clear fats from the blood stream. Both of these link high salt consumption with cardiovascular disease. High salt diets have also been connected to stomach cancer.

Fat

The fat composition of the diet has increased dramatically for volcanic island dwellers who have started to consume western diets. Their traditional diet provides a fairly low proportion of energy from fat (5-28 per cent) and this is almost doubled when a western diet is consumed (20-37 per cent). Saturated fats in the western countries have been linked to raised serum cholesterol levels and higher incidence of heart disease. For atoll dwellers, however, there is little change in the proportion of energy derived from fat. High fat intakes on traditional living atolls (37-53 per cent) are not much different than a western-style diet of 41-42 per cent. Also the type of fat consumed by the atoll inhabitants is mainly saturated fat from coconuts. For example, in the Tokelauan atoll dwellers' diet 45 per cent of energy comes from the saturated fat of coconuts and on the Cook Island villages of Mitiaro, 89 per cent of fat comes from coconuts. The traditional village people of Mitiaro had higher serum cholesterol levels than Polynesians living in Rarotonga who were more overweight and had high blood pressure (Hunter, 1962). Heart disease was not at that time a health problem in either the village or the urban setting. So while the U.S. Dietary goals recommend a reduction in saturated fat to 10 per cent of total energy intake, (Select Committee on Nutrition & Human Needs, 1977). This would seem an unwise recommendation for coconut-eating traditional people. It may be important to consider a reduction in fat intake for urban populations, however.

Protein

The intake of protein in the traditional diet appears to be adequate for adults. In the village setting, the pre-school child may not receive sufficient protein or energy due to the bulkiness of the root vegetables. Care should be taken then to assure that protein and energy needs of the pre-school child are met.

The western diet is rich in protein, often coming from high fat animal meats such as tinned or fresh meats. If fats need to be restricted, different sources of protein may need to be considered.

VI. INFANT AND CHILD MALNUTRITION

Malnutrition among infants and pre-school children most likely did exist among traditional-living Pacific Island groups but may have mild growth retardation in the one to two year age groups. Today, however, malnutrition appears to be increasing in severity and occurring at younger ages in urban centres. Infant and second year mortality rates, considered gross indicators of nutritional status, were probably high. Grant (1933) noted that in 1926 in Nauru, infant mortality may have been as high as 300 / 1000 live births due to infantile beri beri. Infant mortality in Fiji was reported at 185 / 1000 in 1930 (Bell and Wills, 1952). In the 1950s infant mortality ranged from 50 to 70 deaths per 1000 live births in Fiji.

The earliest surveys of infant growth and nutrition were conducted in the 1950s in a number of Pacific Island countries by Sheila Malcolm and Susan (Holmes) Parkinson (hereafter referred to as Parkinson). The findings of these surveys are summarised in Table 40 and discussed in greater detail by country in the following section.

TABLE 40. Summary of early surveys of infant and child nutrition in various Pacific Island countries

| Country | Year | Weight for age Per cent of standard 12 - 23 months of age | Anaemia | Rickets | Goiter | Vitamin Deficiency |
|--|------|---|---------|---------|--------|-----------------------|
| Palau, Yap, Truk, Ponape, Marshall Is. | 1953 | 86 | NA | 0 | 0 | 0 |
| Guam | 1958 | 85 | | | | |
| Kiribati | 1953 | 80 - 85 | 30% | 0 | 0 | Riboflavin |
| Papua New Guinea | 1951 | 73 - 79 | 0 | 0 | 0 | 0 |
| " " | 1958 | 71 - 82 | | | | |
| Vanuatu | 1951 | 84 - 88 | NA | + | 0 | 0 |
| New Caledonia | 1952 | 81 | NA | 0 | 0 | 0 |
| Solomon Is. | 1952 | 79 | ++ | 0 | 0 | 0 |
| Cook Is. | 1950 | 82 | 0 | 0 | 0 | 0 |
| American Samoa | 1952 | 93 | 0 | 0 | 0 | 0 |

The various surveys in the 1950s showed a similar growth pattern throughout the Pacific. Infants growth in general followed or exceeded international standards until between 6 and 9 months of age. Then the growth rate slowed and between 12 and 23 months of age growth retardation was noted. This is also the age when malnutrition is most commonly seen in developing countries. At this time the child is particularly susceptible to infection, parasites and malnutrition. The mean weight for age in this age group in most Pacific countries fell between 80 and 90 per cent of standard. Less than 80 per cent of standard weight for age is commonly used as criteria for malnutrition. Severe malnutrition was rarely found in these early surveys. After two years of age, growth increased again and by four years in many countries, weight for height compared favourably with international standards.

Haemoglobin determinations were not done in most of the survey. In Kiribati and the Solomon Islands, however, anaemia was found in approximately 30 per cent of children from birth to four years of age. Rickets was reported in Vanuatu and signs of riboflavin deficiency were seen in Kiribati. In general vitamin deficiencies were rare.

Both Parkinson and Malcolm provided mean weights for infants by month up to one year and then by year. Mean heights were not always reported. In order to compare the various surveys mean weights and heights were calculated for six-monthly intervals to one year and compared to reference heights and weights recommended by the World Health Organisation (WHO, 1978). These standards are based on recent data collected on U.S. children. Up to five years of age, the WHO standards compare closely to the older standards used by Jelliffe (1966).

More recent surveys of infant and child nutrition in the Pacific, however, are showing an increase in the severity of malnutrition and that malnutrition is occurring more frequently in cities and towns than in rural areas. Surveys conducted in the late 1960s and 1970s in the Trust Territory of the Pacific Islands (Kincaid, 1973), in Kiribati (Crawford and Wilmott, 1971), in Fiji (Goodall, et al, 1973; Lambert and Yee, 1981b), in Vanuatu (Niiranen, 1975; Jabre et al, 1976) in the Solomon Islands (Tekieru and Luialamo, 1981) and in Western Samoa (Brazill, 1979) all show an increase in the severity of malnutrition compared to earlier studies in the same countries. Frank malnutrition, conditions such as kwashiorkor and marasmus, were rarely reported in the early studies by Malcolm and Parkinson. Changes in the texture and colour of hair, pigmentation of the skin, enlarged liver (pot belly) and oedema which are common clinical signs of severe malnutrition were not mentioned in the 1950s' surveys.

A number of the reports during the 1970s also noted that malnutrition was seen more often in urban centres, towns and resettlement schemes. Goodall and coworkers (1973) showed that of 40 children admitted to Colonial War Memorial Hospital in Suva, Fiji, all lived in or near Suva. In Vanuatu (Jabre et al, 1976), severe malnutrition was found in nine children between one and three years of age living in a very low income suburb of Port Vila. Brazill (1979) found a ten-fold increase in the percentage of malnourished children in

the town of Apia compared to an earlier survey and only a slight increase in the rural areas. Higher rates of malnutrition were reported in two resettlement schemes in Papua New Guinea when compared to nearby villages (Benjamin, 1975; Lambert, 1978; and Cox, 1979).

The trend away from breast feeding to bottle feeding is listed by many of the investigators as the major cause of the increase in malnutrition in some Pacific Island communities. Goodall and Jansen (1971) described malnutrition in Fiji as a "man-made disease" and that "a new vulnerable group has appeared in the towns and is spreading to the rural areas, the group of the bottle-fed infant" (Goodall, 1973). All of the 40 malnourished children admitted to Colonial War Memorial Hospital in Suva were bottle fed or weaned. In Western Samoa seven times as many artificially fed infants were hospitalised for gastroenteritis as breast fed infants, six times as many were treated in outpatient visits for gastroenteritis and three times as many were malnourished (Quested, 1978). Another survey in Western Samoa (Brazill, 1979) showed that 75 per cent of malnourished children were bottle fed compared to 37 per cent of well nourished children. Undernourished children were more likely to come from poor families with no access to land, more likely to receive imported tinned baby foods and less like to receive traditional foods.

In order to combat the problem of malnutrition associated with bottle feeding, Papua New Guinea instituted legislation in 1977 to control the sales of baby bottles and teats. Reports two years after the legislation showed a significant increase in breast feeding and a decline in severely malnourished children in Port Moresby (Lambert, 1979) as well as a substantial decline in morbidity and mortality from gastroenteritis (Weekly Epidemiology Report, 1981).

Further details on infant nutrition are reported below by country.

Criteria of Malnutrition

Weight and height have long been used as the most sensitive measures of nutritional status in children. To interpret them they have to be compared with some reference standard. Weight for age is the most commonly used criteria of nutritional status. Malnutrition is generally considered to be present if weight is 80 per cent of the reference standard. For most surveys, the Harvard 50th percentile is used as the standard, i.e. 100 per cent.

Height for age gives a picture of the past nutritional history. Short stature, or "stunting" reflects past or chronic malnutrition.

Weight for height provides an indication of present nutritional status and is less dependent on age. Thus a child who is short in stature and therefore underweight for his age may not necessarily be underweight for his height. A child whose weight is below reference standards for his height is presently considered malnourished.

Waterlow (1976) and Jelliffe (1966) have proposed criteria for classification of nutritional status which is generally accepted throughout the Pacific (Table 41).

The most widely used reference standard in the Pacific and elsewhere is the fiftieth percentile of the Harvard standard (Jelliffe, 1966). More recently the World Health Organisation (1978) has recommended standards based on recent surveys of American children. The Harvard standards and the newer WHO standards compare quite closely.

TABLE 41. Classification of Protein Energy Malnutrition expressed as Percentage of Harvard Reference Standard.

| Author | Index | Normal | Mild PEM | Moderate PEM | Severe PEM |
|-----------------|-------------------|--------|----------|--------------|------------|
| Jelliffe (1966) | Weight for age | 100-90 | 90-80 | 80-70 | < 70 |
| Waterlow (1976) | Height for age | 95+ | 95-90 | 90-85 | < 85 |
| Waterlow | Weight for Height | 90+ | 90-80 | 80-70 | < 70 |

More severe forms of malnutrition have generally been classified as follows:

Kwashiorkor - child whose minimum weight is not less than 60 per cent of weight for age with oedema present, plus either enlarged liver or dermatosis;

Marasmus - child whose weight is less than 60 per cent of weight for age with no oedema or other specific signs;

Marasmic-kwashiorkor - child whose weight is less than 60 per cent of standard with oedema or other signs of protein-energy malnutrition (Waterlow, 1978).

Mid arm circumference and skinfold thickness are other measurements commonly used to identify malnutrition. Mid arm circumference corresponds closely to weight for age and skinfold thickness to body fat. These measurements may be more difficult to interpret and compare, especially in mildly malnourished populations.

MICRONESIA

Guam

Malcolm (1958) surveyed infant nutrition in Guam in 1956. The growth rates of the Guam children fell behind standards after 6 months of age. Although the numbers were small the Guam children appeared to be lagging in height as well (Often an indication of long term chronic undernutrition) at two years of age.

The practice of bottle feeding was well in vogue at this time in Guam. Only one-third of 166 infants at one month of age were exclusively breast fed. By three months many of these children were also receiving artificial milk feedings. By 11 months, only 3 infants were receiving breast milk and all were receiving bottles as well.

"One is inclined to think that changing social patterns and urbanisation are important factors" (in the decline of breast feeding) (Malcolm, 1958).

Gastroenteritis was the leading cause of pediatric hospitalisation for the year July 1954-June 1955. 41 per cent of the 1161 pediatric admissions were for children 4 to 12 months of age. This age group corresponded to the time when breast feeding ceased and/or was supplemented with bottle feeding.

Commercially prepared baby foods were widely advocated by the medical staff but use by the mothers was questioned; a small 4 oz can cost 25-35 cents in 1956!

We have been unable to obtain recent reports related to infant nutrition from Guam.

Kiribati

"Most native babies are breast fed (or nursed) just so long as the mother has any milk left. The average time being approximately twelve months" (Turbott, 1949).

The first foods fed to the infant were pawpaw juice, raw mashed pawpaw, coconut milk and grated coconut, eggs, fish, chicken, pumpkin and bananas. Rice, bread, milk and cabin biscuits were also given when available at the store (Turbott, 1949).

Parkinson (1953) conducted an extensive nutrition survey in Tarawa and Maiana islands in Kiribati in 1953. Mean weight for age and height for age were below WHO reference standards at all ages but lowest in the 1 to 2 year age group (Table 42.).

TABLE 42. Mean weight and height of I-Kiribati children in 1953 expressed as per cent of WHO Reference Standard

| | Per cent of Standard | | | Per cent of Standard | | |
|------------------|----------------------|---------|---------|----------------------|---------|---------|
| | M A L E S | | | F E M A L E S | | |
| | Number | Wt./Age | Ht./Age | Number | Wt./Age | Ht./Age |
| 0 - 5.99 months | 9 | 90 | 94 | 12 | 107 | 93 |
| 6 - 11.99 months | 20 | 93 | 96 | 21 | 98 | 92 |
| 1 - 1.9 years | 17 | 80 | 90 | 14 | 85 | 90 |
| 2 - 2.9 years | 25 | 97 | 99 | 16 | 92 | 92 |

There was no mention of severe protein-calorie malnutrition but 7 infants were described as having clinical signs of riboflavin deficiency. Cheilosis, cracks and fissures on lower lip and corners of the mouth and scarlet painful mouth were associated with infants who for several different reasons were not receiving adequate breast milk. Food records of adults also showed a low riboflavin intake.

Anaemia was found in approximately 30 per cent of children under four years of age. The mean haemoglobin for 223 children was within the normal range; 11.6 g / 100 dl.

Figures on breast feeding were not provided, assuming all infants were breast fed. Green coconut was given to the babies if the mother's milk was in short supply or absent (Parkinson, 1953).

Crawford and Willmott (1971) visited Kiribati in 1968 and examined 246 children up to four years of age on Betio and Maiana. Betio, an urban port, had been using imported foods for the previous 15 years. In Maiana people still relied primarily on traditional crops. Mean weights and heights were not given for the two islands separately or for both sexes, probably due to the small numbers of children in each group. Mean weights and heights for the whole sample do not vary significantly from the 1953 survey but show low mean weights in the 1 to 3 year age groups. They did find, however, 9 children (4 per cent) who were less than 70 per cent of Harvard standards which is generally considered severe malnutrition. There were cases of marasmus and one case of kwashiorkor was described as having been seen in Betio Hospital.

Clinical signs attributed to vitamin A and riboflavin deficiency were much more common in Betio than on Maiana or in the 1953 survey (Table 43). Haemoglobin determinations were not performed.

TABLE 43. Mean weight and height of ni-Kiribati children in 1968
Expressed of percentage of WHO Reference Standard

| | Number | Per cent of standard | |
|----------------|--------|----------------------|----------------|
| | | Weight for age | Height for age |
| 0 to 6 months | 61 | 112 | 103 |
| 6 to 12 months | 45 | 89 | 97 |
| 1 to 2 years | 58 | 84 | 94 |
| 2 to 3 years | 45 | 85 | 93 |

TABLE 44. Incidence of clinical signs of nutritional deficiency in I-Kiribati children in 1953 and 1968.

| | <u>1 9 5 3</u> | | <u>1 9 6 8</u> | | | |
|----------------------|----------------|------|----------------|------|-------|------|
| | Survey | | Maiana | | Betio | |
| | No. | % | No. | % | No. | % |
| Bitot's spots | Not mentioned | | 0 | 0 | 6 | 5.8 |
| Conjunctival xerosis | 1 | 0.3 | 5 | 25.0 | 13 | 12.3 |
| Angular stomatitis | 74 | 28.0 | 29 | 37.1 | 39 | 79.6 |

The practice of breast feeding in 1968 appeared to have declined dramatically since 1953. "A number of women on Betio complained of having no breast milk and started bottle feeding in the first few weeks" (Willmott, 1968). The introduction of fish and other protein rich solid foods was begun at about one year of age.

Percentage of Infants Breast Fed at
6 months of age

| | |
|--------|------|
| Betio | 36.0 |
| Maiana | 87.5 |

"More infants are being bottle fed because of a change in the way of life resulting from urbanisation, reasons of prestige or because mothers themselves are unadequately fed to produce enough milk" (Willmott, 1968).

Although the numbers of children examined in the 1953 survey and the 1968 survey are small, it appears that the nutritional health of infants and pre-school children had declined. Protein, caloric malnutrition, kwashiorkor and marasmus, signs of vitamin A and riboflavin deficiency and bottle feeding all increased over this 15 year time period.

Infant mortality rates were determined by interview in 1968 as 106 / 1000 in Betio and 93 on Maiana. The 1978 figure for Kiribati was 87 / 1000 live births (Tiro and Tito, 1981).

Nauru

Only one report dealing with infant and child health in Nauru has been found and that was published in 1933 (Grant, 1933). Dr. Grant reported that the infant mortality rate "formerly" had been 300/1000 live births due to infantile beri beri but that this had fallen to 2 deaths per 60 births in 1931. An emulsion of cod liver oil and the yeast obtained from toddy was responsible for the reduction in beri beri.

The average weight of four week old infants was 3.85 kg which is 90 per cent of standard weight for age. Only four infants at that age were above the 60th percentile (Grant, 1933).

Palau, Yap, Ponape, Truk and Marshall Islands

In 1953, Sheila Malcolm (1955) conducted extensive investigations into infant feeding practices and infant nutritional status in the former Trust Territory of the Pacific Islands. Although birth weights were slightly below Australian norms, the infants grew rapidly during their first 6 to 8 months and approximated Caucasian standards. Mean weights and heights at age 6 months was 93 per cent of WHO standards. After about 8 months of age, when weaning frequently began, the mean weights fell below standards (84 per cent). Weight gain was slow to about 24 months but height proceeded satisfactorily.

Mean weight and height expressed as
percentage of standard of WHO reference

| | 6 months | 12 months | 24 months |
|--|----------|-----------|-----------|
|--|----------|-----------|-----------|

| | | | |
|----------------|----|----|----|
| Weight for age | 93 | 84 | 86 |
| Height for age | 95 | 94 | 94 |

There was no evidence of frank malnutrition. Kwashiorkor and marasmus were not seen. But of the total sample of 936 children, 30 per cent were considered underweight "with soft flabby muscles, enlarged abdomen and sometimes of oedema of the hands and feet" (Malcolm, 1955).

Very few children showed any signs of changes from the normal condition of hair, skin, eyes, mouth and tongue.

Breast feeding was commonly practised although the effects of western influence were clearly being seen. In the Marshall Islands less

than half of the infants were breast fed to 6 months of age whereas in Truk and Ponape breast feeding was continued until about one year.

The mothers carried their babies with them during the daytime and usually the baby slept with the mother. So the child was able to breast feed frequently on demand. Weaning was often begun around 8 months and completed by about 1 year.

Bottle feeding was almost never observed in Ponape, but beginning to be seen in the town in the Palau district. Evaporated milk, whole powdered milk and unsweetened condensed milk were available. Hygiene of bottle feeding was seldom practised; measures were rarely used, bottles and teats not frequently sterilised or kept safe, water often not boiled.

Supplementary foods during the first year of life were often the water and soft meat of green coconuts, coconut milk, toddy, green leaves and fruit juices and then progressed to mashed root vegetables. By one year of age fish, shellfish, meat and eggs were fed to the child and its diet was similar to the family's. Malcolm (1955) felt that the quantity and variety of supplemented foods during the first year of life was limited and those weaned at about 8 months may not be receiving adequate nutrients for growth. Those who were still being breast fed may not be receiving enough nourishment due to "decrease in milk supply of the mother."

Murai (1954) studied the nutrient intake of 1 to 3 year old children in the Marshall Island and Truk district. The Marshall Island children had low intakes of calories, protein, calcium and riboflavin. The children of the Caroline Islands had adequate intakes of calories and protein but low iron, vitamin A and citamin C. Both Malcolm (1955) and Murai (1954) have noted the extreme difficulty in assessing quantitative food intakes of this toddler age group.

A survey similar to the Malcolm (1955) study was undertaken in 1973 by Jean Kincaid (1973). This investigation also included Saipan as well as the other districts of TTPI. The growth pattern observed was similar to the earlier survey. From birth to 6 months infant weights were close to Caucasian standards but after one year the percentage of children less than 80 per cent of standard increased. Children below 80 per cent of standard are generally considered to be moderately malnourished.

| | <u>Per cent below 80 per cent of standard</u> |
|-------------------|---|
| Birth to 6 months | 4 |
| 7 to 12 months | 7 |
| 1 to 2 years | 13 |
| 2 to 4 years | 21 |
| Total group | 45 |

Frank malnutrition was not mentioned.

It is difficult to determine if malnutrition has increased or

decreased during this 20 year time period due to the nature of the data provided. It seems, however, that malnutrition may have changed since Malcolm (1955) cited 30 per cent of 0 to 3 year children below standard and Kincaid (1973) 45 per cent of 0 to 4 year old children as moderately malnourished.

Breast feeding practices did change dramatically over the 20 years. Kincaid (1973) reported only 55 per cent of infants being breast fed from birth to 6 months which is a decrease of 23 per cent from that observed by Malcolm (71 per cent) as seen in Table 45.

TABLE 45. Changes in Breast Feeding Practices in the Districts of the Trust Territory of the Pacific Islands between 1953 and 1973 (Malcolm, 1953 and Kincaid, 1973).

| | Percentage of Infants Breast Fed | |
|--------------|----------------------------------|------|
| | 1953 | 1973 |
| At 6 months | 71 | 55 |
| At 12 months | 56 | 19 |
| At 18 months | 21 | 12 |

An analysis of nutrient intakes of a smaller sample of 1 to 3 year olds revealed that while protein intakes met recommendations, total calories and iron intakes fell considerably short of recommendations.

The major factors responsible for "poor infant nutrition, besides poor sanitation included":

- a) introduction of bottle feeding
- b) introduction of "empty calorie" foods such as flour products, sugar, cordial and sweet drinks
- c) lack of an adequate substitute when milk is no longer available or no longer the primary food in the diet
- d) lack of knowledge in growth and development and its relation to food intake
- e) lack of supervision of a child's food intake after the child learns to walk

(Kincaid, 1973).

A more recent survey on infant feeding was undertaken by Marshall and Marshall (1980) in a small village 5 miles from the district centre in Truk, Eastern Caroline Islands. Only 9 children of 49 included were breast fed exclusively for the first year of life. Of the other 40 infants 5 were exclusively bottle fed, 20 weaned before 6 months and 15 breast and bottle fed. The mothers took particular care to clean the bottles and teats, follow measuring instructions and use boiled water yet only 3 families had refrigerators so milk formula were frequently kept at room temperature.

Although the number of children in the sample was very small, the findings showed that breast fed infants experienced fewer hospitalisations than bottle fed infants. None of the infants who were breast fed for the first year of life were hospitalised during their first year whereas 5 of the bottle fed infants were hospitalised (Marshall and Marshall, 1980).

MELANESIA

Fiji

"Following the birth of a baby the traditional Fijian mother rested for 100 days. Food was brought to her by female relatives, thus she was able to devote all of her attention to her baby" (Langley,

1953). Usually the infant received only breast milk for the first 8 to 12 months. By one year of age mashed pawpaw, root vegetables, fish, eggs and green vegetable soups were given to the infant (Langley, 1964).

The first nutrition survey conducted in Fiji in 1950 concluded: "malnutrition is not a serious problem" (Bell and Wills, 1952). Infant mortality rates which had been as high as 185/1000 in 1930 were 60.4 / 1000 in 1950. Although weights and heights were not taken, a recommendation to provide the weaned child with sufficient protein indicated that this age group was of some concern. Rickets was observed but appeared to be rare. Anaemia was found among one to 2 year old Indian children but less often in Fijian children (Bell and Wills, 1952).

Early dietary surveys of Fijian households (Langley, 1953); Wilkins, 1963) described the small numbers of pre-school aged children seen as healthy and well nourished. Breast feeding was universal but several older infants were also receiving supplements of fresh or powdered cow's milk. A few children were seen with "a poor muscle tone" and skin infections, but no other signs related to nutritional status were mentioned. Too few children were weighed to draw any conclusions regarding growth retardation.

Less than ten years later severe forms of protein caloric malnutrition, kwashiorkor and marasmus, were observed with increasing frequency (Goodall and Jansen, 1971). The investigators described this malnutrition as a "man-made disease" and that "a new vulnerable group has appeared in the towns and is spreading to rural areas, the group of the bottle-fed infant" (Goodall et al, 1973).

During a five month period in 1971, 40 children were admitted to Colonial War Memorial Hospital in Suva with malnutrition (Goodall et al, 1973). The majority of the children were Fijian and showed the classical signs of protein-caloric malnutrition; muscle-wasting, thin, sparse and dyspigmented hair, and dyspigmented skin.

The malnourished children were grouped according to age and location. All 5 of the 0 - 9 month old infants lived in or near Suva and all were bottle-fed.

TABLE 46. Age and residence of 40 malnourished children admitted to Colonial War Memorial Hospital May-Sept 1971 (Goodall et al, 1973)

| | N | 0 - 9 months | 9 - 18 months | 18 - 36 months |
|------------|----|--------------|---------------|----------------|
| Rural | 12 | - | 11 | 1 |
| Semi-urban | 16 | 1 | 8 | 7 |
| Urban | 12 | 4 | 2 | 6 |
| | 40 | 5 | 21 | 14 |

Of the 21 children in the 9-18 month group, all had been weaned and few had been given milk in another form. Diet histories, revealed that solid foods given to the 18 to 36 month old children were nutritionally inadequate.

Anaemia was diagnosed in 65 per cent of the malnourished children and gastrointestinal infection were present in 25 of the 40 children. It is noteworthy that at this same time the back cover of the Fiji School of Medicine Journal carried ads for infant milk formula along with a diarrhoea medication and an intramuscular iron preparation.

The practice of breast feeding continued to decline in an urban centre of Suva in the late 1970s. Lambert and Yee (1981a) reviewed child health records kept at Maternal and Child Health Clinics in Suva from 1977 to 1980 and the town of Labasa on the island of Vanua Levu in 1980. Their findings shown in Tables 47 and 48 revealed several trends:

- 1) a decline in the practice of breast feeding in Suva over a fairly short period of time;
- 2) Indian children were more likely to be bottle-fed than Fijian children.
- 3) breast feeding was more common in Labasa than in Suva, particularly for Indian children. 50 per cent of Indian children in Labasa were breast fed compared to less than 20 per cent in Suva.

TABLE 47. Changes in infant feeding practices in Suva from 1971 to 1980 (Lambert and Yee, 1981a)

| Year | Number | | Percentage of Infant | | | |
|-------|--------|--------|----------------------|--------|-----------------------|--------|
| | | | Breast fed only | | Artificially fed only | |
| | Fijian | Indian | Fijian | Indian | Fijian | Indian |
| 1977 | 4424 | 3657 | 60.2 | 26.3 | 23.8 | 52.1 |
| 1978 | 6407 | 6149 | 56.6 | 22.4 | 32.1 | 60.1 |
| 1979 | 6735 | 7785 | 47.2 | 18.7 | 40.0 | 63.6 |
| 1980* | 3966 | 4329 | 45.6 | 19.1 | 35.0 | 60.1 |

* Figures for 6 months only for 1980

TABLE 48. Percentage of children breast fed or artificially fed in Labasa in 1980 (Lambert and Yee, 1981a)

| Year | Number | | Breast fed only | | Artificially fed only | |
|------|--------|--------|-----------------|--------|-----------------------|--------|
| | | | | | | |
| | Fiji | Indian | Fiji | Indian | Fiji | Indian |
| 1980 | 115 | 964 | 62 | 50 | 23 | 35 |

The investigators also analysed records at the paediatric ward of the Colonial War Memorial Hospital in Suva for 1979. Of 100 children admitted suffering from clinical malnutrition, 25 were 12 months of age or less and 22 were Fijian.

TABLE 49. Type of feeding of 25 children seen at Colonial War Memorial Hospital suffering from clinical malnutrition (Lambert & Yee, 1981)

| | Number | Per cent |
|-----------------------|--------|----------|
| Bottle fed only | 20 | 80% |
| Breast and bottle fed | 2 | 8% |
| Breast fed only | 3 | 12% |
| | 25 | 100% |

The figures in Table 49. confirm the earlier findings of Goodall et al (1973) that bottle feeding is a major factor in the aetiology of infant malnutrition in urban areas.

The Fiji National Nutrition Survey conducted in 1980 focused on children under 5 years of age and used less than 80 per cent of standard weight for age as the criteria of malnutrition (Lambert and Yee, 1981b).

TABLE 50. Nutritional status of Fijian and Indian children - Fiji National nutrition survey (Lambert and Yee, 1981b)

| | Number | Percentage of children | Weight for age |
|--------|--------|------------------------|-------------------|
| | | 80% of STD or over | Less than 80% STD |
| Fijian | 24,705 | 92 | 8 |
| Indian | 19,470 | 76 | 24 |

Weights were collected on all Fijian and Indian children seen at Maternal and Child Health Clinics during the month of October, 1980. Table 50 shows that three times as many Indian children (24 per cent) would be considered malnourished using this criteria as compared to 8 per cent of Fijian children. Without having height for age or weight for height data, it is difficult to say whether all of the children are indeed malnourished. It is possible that the older children are short for their age, as a result of earlier malnutrition. As well as low in weight for their age but their weight for their height may be within normal ranges. Among Indian children the highest percentage of underweight children was seen in the 4 to 5 year age group.

Severe malnutrition, less than 60 per cent of standard was found in 92 Fijian children (0.4 per cent) and 274 Indian children (1.4 per cent). This type of malnutrition which warrants immediate medical attention was highest in 0 to 11 month age groups. Of the severely malnourished Fijian children, 30 (33 %) were less than one year of age and 68% of the severely malnourished Indian children were under one year of age. These figures may implicate bottle feeding as one explanation for the high prevalence of severe malnutrition among 0-1 year old Indian infants. Maternal nutrition and low birth weights may also be factors.

New Caledonia

Only one survey of infant feeding and growth has been found for New Caledonia. In 1952, Sheila Malcolm (1953) investigated infant nutrition in the rural villages of Ponerihouen-Poindimie on the mid east coast of New Caledonia.

For the first six to eight months of life the mean weight and height of Ponerihouen-Poindimie children was close to Caucasian standards. After about 8 months weight began to fall further below

standards until around two years of age when weight increased again. Length also began to lag during the later part of the first year and growth was slow during the second year. By two years, however, height was again close to Caucasian standards; 96 per cent of standard. Using weight for height as an indicator of acute undernutrition it appears that during the second year of life there is evidence of mild malnutrition. No clinical signs of protein-calorie malnutrition or vitamin or mineral deficiency were noted (Malcolm, 1953).

TABLE 51. Mean weight and height of Ponerihouen-Poindimie, New Caledonian children in 1952 expressed as per cent of standard weight for age and height for age

| Age in months | N | Weight for Age | Height for Age | Weight for Height |
|---------------|----|----------------|----------------|-------------------|
| 0 - 5.99 | 38 | 93 | 96 | 104 |
| 6 - 11.99 | 52 | 85 | 94 | 98 |
| 12 - 17.99 | 38 | 84 | 93 | 96 |
| 18 - 23.99 | 51 | 81 | 92 | 92 |

Of the 74 children in the survey whose diet was studied, 69 (93 per cent) were breast fed, 15 receiving additional milk. Weaning occurred "sometime during the second year". The physiological weaning may occur earlier when the mother is no longer producing sufficient milk. Pregnancy of the mother or adoption were the reasons given for artificially feeding of 5 infants. Four of the 5 bottle fed infants appeared healthy; one was lithless, thin and its muscles were soft.

Solid foods were introduced between 8 and 12 months consisting of taro, rice, bread, manioc, banana and yam. The amount given was small and the frequency irregular. The diets of four children studied during the second year of life revealed that only about half of the recommended intake was met for energy, protein and vitamin A from riboflavin, thiamin, niacin and vitamin C intakes met recommendations.

Thus the rural New Caledonian children in 1952 appeared small but well nourished, except during the second year of life. It would seem that the quantity and regularity of the foods offered were inadequate rather than the quality of the diet.

There is a need for more current information regarding infant nutrition and infant feeding in New Caledonia.

Papua New Guinea

An enormous number of studies have reported on growth retardation and protein-calorie malnutrition among infants and pre-school age children in Papua New Guinea. One of the first investigations was that of Sheila Malcolm (1951) in 1950 in New Ireland, Rabaul and the

Trobriands. In general, the children were smaller than standard in length and weight from birth but their weight gain followed the Caucasian pattern until about 6 to 8 months of age. Note in Table 52. that mean weight for height were within acceptable ranges for the first six months.

TABLE 52. Mean weights and heights of Papua New Guinean children in 1951 expressed as percentage of WHO Reference Standard

| | New Ireland ----- Number (209) | Rabaul ----- (310) | Trobriands ----- (263) |
|-------------------|--------------------------------------|--------------------------|------------------------------|
| Weight for age | | | |
| 0 - 6 months | 78 | 88 | 92 |
| 7 - 12 months | 79 | 79 | 80 |
| 13 - 24 months | 79 | 76 | 73 |
| Height for age | | | |
| 0 - 6 months | 90 | 96 | 95 |
| 7 - 12 months | 91 | 92 | 95 |
| 18 - 24 months | 91 | 92 | 92 |
| Weight for height | | | |
| 0 - 6 months | 109 | 98 | 95 |
| 7 - 12 months | 95 | 95 | 91 |
| 13 - 24 months | 92 | 88 | 86 |

After 6 to 8 months, however, the growth pattern slows down considerably and the 1 to 2 year age group is far below standards particularly in weight for age and weight for height in Rabaul and the Trobriands.

Ms. Malcolm also investigated breast milk supply and supplementary foods and concluded that breast milk was not adequate for the child after 7 to 8 months. Food intakes were observed and were found to be below recommendations in energy protein, fat, calcium, iron and various vitamins with the exception of vitamin C. The diet may have been sufficient for metabolic needs, however, as no signs of vitamin deficiency were mentioned. Neither kwashiorkor or marasmus was described.

Oomen and Malcolm (1958) conducted extensive surveys of nutrition and health of the Papuan child in 1954-1955. They visited several villages of the Netherlands New Guinea as well as in the Sepik and Chimbu areas. They found a similar pattern of growth to that reported by Malcolm (1951). Infants were small at birth, although the investigators were unable to obtain the actual birth weights. Weight and height progressed at a satisfactory pace until 6 to 8 months when differences were noted. By the second year of life the mean weight of

the Chimbu children was 8.2 kg, 71 per cent of WHO standard and 9.5 kg, 82 per cent of WHO standard in the Sepik children. Although severe protein-calorie malnutrition was seen in Sepik, it was relatively rare. Kwashiorkor was anything but infrequent at Chimbu" (Oomen and Malcolm, 1958). The average Sepik child in his second year of life had a higher caloric and protein intake (710 kcal and 10 grm respectively). In Chimbu the basic diet was sweet potatoes whereas the Sepik people had a wider variety of foods from gardens, hunting and fishing.

Numerous reports (Bailey, 1963; Malcolm, 1970; Binns, 1976; Malcolm LA, 1974; Allen et al, 1980; Sharp and Harvey, 1980; De Buse, 1974; Jeliffe and Maddock, 1964; Wyatt and Wyatt, 1978; Heywood and Yupae, 1979, Heywood and Nakikus, 1980) have suggested that moderate to severe protein caloric malnutrition in Papua New Guinea is associated with a number of interrelated factors:

- low birth weights which may be attributed to malaria of the mother during pregnancy or poor maternal diet;
- illness - malaria and infectious diseases create and exacerbate malnutrition;
- inadequate food intake. Where root crops are staple foods the young child may not be able to consume sufficient energy and protein;
- food shortages;
- other socio-economic factors such as birth interval, attitude of the mother or the community toward child feeding or resettlement.

Whether there has been an improvement in the nutritional status of Papua New Guinea children in recent years is not clear. Lambert (1975) showed an increase in mean weights of pre-school age Chimbu children in 1975 over children examined by Venkatachalam (1962) in 1976 (Table 53).

TABLE 53. Mean weight and weight expressed as per cent of WHO Reference of Chimbu children in 1956 and 1975 (Lambert, 1975)

| Age in months | (N) | 1 9 5 6 | | 1 9 7 5 | |
|---------------|-----|----------------------------|-------------------------|----------------------------|-------------------------|
| | | Mean weight for age(kg) | Per cent of standard | Mean weight for age(kg) | Per cent of standard |
| 0 - 5.99 | | 5.0 | 83 | 6.4 | 107 |
| 6 - 11.99 | | 7.1 | 77 | 8.3 | 90 |
| 12 - 23.99 | | 8.7 | 76 | 9.4 | 82 |
| 24 - 35.99 | | 10.1 | 74 | 11.6 | 85 |
| 36 - 47.99 | | 11.6 | 74 | 13.6 | 87 |
| 48 - 59.99 | | 14.0 | 79 | 15.5 | 88 |

Yet results of the National Nutrition Survey (1978) indicate 22 to 61 per cent of children in various provinces were less than 80 per cent of standard weight for age. The 1978 survey showed on improvement in the numbers of children in low weight categories since 1975 but whether this is an improvement over earlier studies is not clear.

The effect of urbanisation on infant and child health is also conflicting. Malcolm (1973) reported that in urban Lae infant mortality and 1 to 4 year mortality rates were lower than village figures. While the mean birth weights of Lae infants (2.96 kg) was lower than Caucasian infants, it was higher than some Papua New Guinea figures. Although growth in weight is behind standards between six months and three years, weight for length is reasonably satisfactory and higher than that of most village populations (Malcolm, 1973).

High rates of malnutrition were reported in two resettlement schemes when compared to nearby villages. Benjamin (1975) found that 41 per cent of children under 5 years of age at a red palm oil resettlement scheme were less than 80 per cent weight for age compared to only 23 per cent of nearby village children as shown in Table 54. The results of the National Nutrition Survey in 1978 revealed a wider difference between the palm oil resettlement and the village children (Lambert, 1978). Similar differences in the percentage of underweight children were also found in East Sepik Province, Gavien Rubber Settlement (Cox, 1979).

TABLE 54. Percentage of resettlement and village children in Papua New Guinea below 80 per cent of the Standard Weight for age

| | Resettlement Scheme | Traditional Villages |
|---|---------------------|----------------------|
| <hr/> | | |
| West New Britain Province (Red Palm Oil Resettlement Scheme) | | |
| Benjamin, 1975 | 41 | 23 |
| Lambert, 1978 | 51 | 15 |
| East Sepik Province (Gavien Rubber Settlement) | | |
| Cox, 1979 | 66 | 36 |

In Port Moresby, 28 per cent of children were less than 80 per cent of standard weight for age as summarised by the National Nutrition Survey (Nutrition Section, 1978). This was considerably less than national average of 38 per cent and well below many of the rural areas.

Breast feeding is the norm in most parts of Papua New Guinea and often continues well into the second or third year of life. Baby bottles are rare in most villages. A survey of infant feeding practices in five settlements in Port Moresby in 1975-76, however, revealed that of 127 children under 2 years of age, 45 (35 per cent) were artificially fed (Lambert, 1977), 52 children (41 per cent) were below 80 per cent of standard weight for age and of those a significant proportion were artificially fed.

Legislation was passed in 1977, restricting the sale of baby bottles and teats through registered pharmacists. Bottles and teats could only be obtained with a prescription from an authorised health worker.

Two years after the legislation was enacted, a re-survey showed a significant increase in breast fed infants and a decrease in severely malnourished children (Lambert, 1979). There was also a general increase in weight for age but this was not statistically significant.

In Papua New Guinea then, the effect of urbanisation and western influence on infant malnutrition is ill-defined. Reports from Lae and Port Moresby indicate slightly better nutritional status than the national norm. But resettlement schemes may have an effect of increasing malnutrition. Bottle feeding legislation in 1977 may have prevented some serious consequences of artificial feeding in urban areas.

Solomon Islands

In 1952, Parkinson (1952) examined 256 Solomon Island children from birth to four years of age. She noted that infant growth for the first six months was normal, but that infants between 6 and 18 months suffered intermittent malarial attacks and often appeared dehydrated. Two cases of severe malnutrition were seen, but none under 12 months of age. The diet of the infant under one year, was supplemented with root vegetables. The slow weight gain after six months may have been due to unsufficient breast milk as Ms Parkinson noted a low standard of health and nutrition among women.

TABLE 55. Mean weight of Solomon Island children in 1952 expressed as per cent of WHO Standard Weight for Age

| <u>Age in months</u> | <u>Number</u> | <u>Per cent of Standard</u> |
|----------------------|---------------|-----------------------------|
| 0 - 5 | 36 | 105 |
| 6 - 11 | 26 | 74 |
| 12 - 23 | 63 | 79 |
| 24 - 35 | 83 | 88 |
| 36 - 47 | 48 | 90 |

In 1966, Emmanuel and Biddulph (1969) examined children in the Kwaio of Malaita Island. They also visited the Nasioi of Bougainville.

The Kwaio people had had minimal contact with Europeans and agriculture was the primary occupation of men and women. Staple foods were sweet potato and taro; yams, other roots, plantains, fruits, green leaves and nuts made up the remainder of the diet. The animal protein content of the diet was small, except near the coast.

Women delivered their babies in an isolated area attended by married relatives or friends. The mother remained alone with her baby for about 30 days. The baby was breast fed, usually until the next baby came along, sometimes 4 or 5 years later. Taro, sweet potato, banana, yam, pawpaw was premasticated by the mother and fed to the baby. Interestingly, infant diarrhoea diseases were rare among the Kwaio who fed infants premasticated food but common among the Christianised Kwaio who disapproved of this practice (Emmanuel and Biddulph, 1969).

Of the 107 children from birth to 17 years examined, the following descriptions suggestive of nutritionally related disorders were noted.

Number of ChildrenDescription

5

Poorly nourished, 1 child had hair changes as the only sign suggestive of kwashiorkor. One 7 year old girl also had acute malaria.

1

Hypertrophic tongue papillae

16

Paroted enlargement

23

Protuberant abdomen

6

Haemoglobin values below 10 g/ dl.

Nutritional disorders were more common in the Kwaio compared to the Nasioi of Bougainville "but they were not severe" (Emmanuel and Biddulph, 1969).

The diets of pre-school children aged one to three years were studied in 1971 (Jansen and Willmott, 1971). Children living in the urban centres of Honiara and Auki had a higher intake energy and protein than children in rural Nggela. The urban children met nutrient recommendations for all nutrients except energy. The nutrient intake of the rural children, however, was below recommendations for energy and just slightly below for calcium and riboflavin.

The lower energy intake of the rural children may account for the statement that the Nggela children were small for their age (Jansen and Willmott, 1971). The report did not include weight and height data.

Recent surveys have been done in the Solomon Islands, Tekieru and Luialana (1981) reported that malnutrition is a minor problem in most of the provinces. Kwashiorkor, marasums and kwashiorkor-marasmus are seen mainly in the one to three year age group. Prolonged breast feeding is common in rural areas but bottle feeding is used in the towns and cities (Tekieru and Luialana, 1981).

Vanuatu

Traditional infant feeding was well described by Malcolm (1952) and Dye (1979):

"It is customary to take the baby immediately after birth and to tickle his throat with a reed to make him vomit. After this he is given one coconut cream which has previously been boiled until it is thick.

Then the baby is given to his mother for breast feeding. Sometimes, the colostrum is not given" (Malcolm, 1952).

The baby was fed at any time during the day or night, whenever it would whimper. If a mother was lacking in milk the local prescription was for the mother to drink coconut milk 3 times a day. This was guaranteed to produce milk in 2 or 3 days.

All children were breast fed until about 18 months of age. By foods were given until 10 to 12 months of age. Yams, taro, sweet potato, breadfruit, pumpkin and pawpaw were the first and staple foods offered, usually with coconut milk added. Manioc, banana, fruits and green leaves were added after one year of age. Fish, fowls and eggs were not given to the child until at least 18 months and then in small amounts. The diet of children after the age of 10 months, however, was judged to be unsatisfactory mostly due to the lack of the use of supplementary foods (Malcolm, 1952).

Sheila Malcolm (1952) conducted nutrition investigations in 1951 in traditional villages on Tanna and the urban centre of Port Vila. The Tanna infants had a slightly higher birth weight (3.1 kg) than the Port Vila infants (3.0 kg) and fared better in weight for age (Table 56). The Tanna children increased in weight following Caucasian standards until

TABLE 56. Mean weight and height of rural Tanna and urban Port Vila Children as expressed in per cent of WHO Standard - 1951.

| Age group (months) | T A N N A | | | P O R T V I L A | | |
|--------------------|-----------|--------|--------|-----------------|--------|--------|
| | N | WT/age | HT/age | N | WT/Age | Ht/Age |
| 0 - 6 | 163 | 83 | 95 | 28 | 91 | 95 |
| 7 - 12 | 59 | 89 | 90 | 16 | 80 | 93 |
| 13 - 18 | 51 | 85 | 90 | 25 | 80 | 91 |
| 19 - 24 | 41 | 88 | NA | 22 | 84 | 91 |

about 10 months when weight gain slowed. The Port Vila children's weight began to fall off at about 6 months of age and weight gain was unsatisfactory until about 2 years. The factors given for the poorer growth of the Port Vila children were:

- failure of breast milk due to the poor quality of the mother's diet and/or adequate milk mixture given by bottle. Weaning was completed earlier in Port Vila than on Tanna.
- inadequate diet between 8 and 13 months. The urban infant's diet was lacking in variety, lacking in protein and irregularly consumed.
- the tendency to use high carbohydrate and highly processed foods without including fruits, green leaves and protein foods.

- the use of tea instead of fruit juices, milk or coconut water.

There were no clinical signs of protein-caloric malnutrition or vitamin deficiency observed in either groups. No children with rickets were seen but 5 or 6 cases of rickets were seen at the Port Vila Hospital in a year (Malcolm, 1952).

A health survey carried out in 1952 in the Maskelyne Islands, lying off Malekula and South West Bay in the south west corner of Malekula did not examine children but the general impression was that "nutrition was good" in the Maskynes (Norman-Taylor and Rees, 1964). There the diet consisted of fish and a variety of crops. At South West Bay, however, "children with pot bellies, dry skin and spindly legs were common". Fish was rare and the diet more monotonous. Infant mortality was calculated as 83/1000 live births in the Maskelynes and 133/1000 at South West Bay (Norman-Taylor and Rees, 1964).

In 1974, a growth study of 139 pre-school children in the Wala Rano areas of Malekula was conducted (Niiranen, 1975). The people of these villages are predominantly involved in agriculture and did not rely on store foods (Dye, 1979). The survey indicated that on the whole the children were at a lower per cent of standard weight for age than either the urban or rural children examined by Malcolm in 1951. Table 57 suggests that the Wala Rano children are particularly at risk during the second year of life with mean weights for age of those age groups at 75 per cent of the standard.

TABLE 57. Mean weight and height of ni-Vanuatu children in 1951 and 1974 expressed as per cent of WHO Reference Standard

| Age group - months | Per cent of Standard | | | | | |
|-----------------------|----------------------|-------|----|----------------|-------|----|
| | Weight for age | | | Height for age | | |
| | 1951 | 1974 | | 1951 | 1974 | |
| | Rural | Urban | | Rural | Urban | |
| 0 - 6 | 83 | 91 | 88 | 95 | 91 | 98 |
| 7 - 12 | 89 | 80 | 80 | 90 | 80 | 95 |
| 13 - 18 | 85 | 80 | 75 | 90 | 80 | 95 |
| 19 - 24 | 88 | 84 | 76 | - | 84 | 93 |
| 24 - 36 | - | - | 78 | - | - | 93 |
| 37 - 48 | - | - | 80 | - | - | 94 |
| 49 - 60 | - | - | 76 | - | - | 93 |

The WalaRano children were close to height for age standards during

the first six months of life but gradually slowed. Retardation in length was not as marked as in weight. None of the children were less than 80 per cent of standard height for age, whereas 28 per cent of children were less than 70 per cent of standard weight for age; a level commonly accepted as severe malnutrition.

Triceps and subscapular skinfolds, arm circumference and mid-arm muscle circumference were 50 to 90 per cent of standard.

Thus it appears that severe acute malnutrition is occurring among preschool age children, particularly during the second year of life. All of the children are breastfed for one to one and a half years but details of the food intake of preschool children are not available. Dye (1979) suggested that food availability may be a major factor. Infant diarrhoea was also mentioned as a common problem.

A nutritional survey conducted in 1975 in the suburb of Tagabe, Port Vila, found more severe malnutrition (Jabre et al, 1976). The community is a poor one, most often used by people coming from outer islands to Port Vila to seek employment. Of the 79 pre-school children seen, the following details were given. Actual weight and height data were not provided, (shown in Table 58).

TABLE 58. Clinical findings of pre-school age children at Tagabe, Port Vila (Jabre et al, 1976)

| <u>Age group</u> | <u>Number</u> | <u>Remarks</u> |
|------------------|---------------|--|
| 0 - 6 months | 7 | 6 children above 100% of standard 1 child below 100% of standard No abnormal symptoms |
| 6 - 12 months | 7 | 1 moderate protein-calorie malnutrition 1 rickets 3 anaemia (pallor of mucus membranes) Mean weight at 12 months 8.75 kg; 86% of standard |
| 1 - 3 years | 20 | 5 protein-calorie malnutrition 1 Kwasheorkor, oedema 4 Marasmus, muscle wasting, degeneration of hair 9 alterations in colour & texture of hair 8 anaemia (clinical assessment only) 1 rickets |

3 to 5 years

45

12 anaemia

12 degeneration & discolouration of hair

2 oedema

These findings should alert us to the severe problems of malnutrition in poor urban areas. Even though there were very small numbers of children examined, the fact that 5 children in the 1 to 3 year age group were suffering from debilitating malnutrition should cause concern.

The Vanuatu Government is taking steps to continue to actively and vigorously promote breast feeding and adequate infant feeding practices. Improvement in data collection related to infant health and a National Nutrition Survey is planned during the next three years (Bowden 1981).

POLYNESIA

American Samoa

Only one survey of infant feeding and nutrition has been found for American Samoa. That survey was conducted in 1952 by Sheila Malcolm (1954). The infant mortality rate for the years 1947 through 1952, was 55.3/1000 live births. In 1952, a whooping cough epidemic accounted for 79 per cent of paediatric ward deaths at hospital in American Samoa. Twelve per cent of deaths were due to malnutrition.

Ms Malcolm examined 774 children from 0 to 3 years in villages on Tutuila. While the traditional Samoan diet was still the norm in most of the villages, increasing reliance on imported foods was necessary due to food shortages, especially in Pago Pago Bay.

TABLE 59. Mean weights and heights of American Samoan children in 1952 expressed as percentage of WHO standard

| Age group (months) | N | Weight for age | Height for age | Weight for Height |
|--------------------|-------|----------------|----------------|-------------------|
| 0 - 6 | (168) | 103 | 103 | 97 |
| 6 - 12 | (170) | 94 | 100 | 96 |
| 12 - 18 | (174) | 89 | 97 | 93 |
| 18 - 24 | (128) | 93 | 96 | 98 |
| 24 - 36 | (134) | 94 | 96 | 100 |

The mean birth weight of Samoan children was 3.4 kg which is slightly above WHO standards. From birth to about 10 months of age, the children gained weight rapidly and steadily. From 10 months to 19 months weight gain slows but increased again after the second birthday.

The investigator did not observe any clinical signs which could be attributed to under nutrition.

The practice of breast feeding was common. 82 per cent of infants were breast fed between birth and 9 months of age. The average weaning time was between 10 and 14 months. The main reasons for artificially feeding were twins, mother working or the infant not gaining weight satisfactorily.

TABLE 60. Percentage of infants breast fed by age in Samoa in 1952 (Malcolm, 1954)

| Age group | N=289 | Percentage breast fed |
|----------------|-------|-----------------------|
| 0 - 9 months | | 82 |
| 10 - 14 months | | 46 |
| 15 - 19 months | | 8 |

A third of the infants received solid foods between four and five months of age; green coconut soup, pawpaw soup, taro, banana, breadfruit, bread, rice and oatmeal. By the age of 10 months all infants were given food but the variety and quantity was often limited. Fish, eggs and meat played a very small part in the diet and green leafy foods and fruits were not usually given until 18 months or older.

Thus in American Samoa in 1952, malnutrition did exist between one and two years. It is important to know if the nutritional health of Samoan children has deteriorated in recent years as in other Pacific Island countries.

Cook Islands

The first nutrition survey in the Cook Islands was conducted in 1950 by Faine and Hercus (1951). Although the diet at the time consisted predominantly of locally grown foods, reliance on imported meat, flour, sugar and biscuits was becoming more common. The investigators found only one child of "poor" nutritional state. He was eight months old and had a bout of diarrhoea several weeks before. No anaemia was found in any children under the age of 16 years. Infant mortality for all of the Cook Islands for 1949-50 was 113/1000 live births. Three deaths in 1948-49 were attributed to Marasmus, or malnutrition.

TABLE 61. Mean weights and heights of Cook Island children examined in 1950 and 1964 expressed as per cent of WHO Standard

| Per cent of standard weight for age | 1 9 5 0 | 1 9 6 4 | |
|-------------------------------------|---------------------|----------|-----------|
| | Arorangi, Rarotonga | Pukapuka | Rarotonga |
| | (62) | (192) | (273) |

| Age in months | Sexes Combined | Boys | Girls | Boys | Girls |
|---------------|----------------|------|-------|------|-------|
| | | | | | |
| 0 - 5.99 | 107 | - | - | - | - |
| 6 - 11.99 | 90 | - | - | - | - |
| 12 - 23.99 | 82 | 96 | 102 | 96 | 94 |
| 24 - 35.99 | 92 | 101 | 98 | 94 | 102 |
| 36 - 47.99 | 93 | 96 | 93 | 100 | 98 |
| 48 - 59.99 | 90 | 97 | 100 | 98 | 95 |

Per cent of standard
height for age

| | | | | | |
|------------|----|----|----|----|----|
| 12 - 23.99 | - | 95 | 95 | 94 | 98 |
| 24 - 35.99 | 99 | 97 | 93 | 95 | 96 |
| 36 - 47.99 | 94 | 94 | 94 | 97 | 96 |
| 48 - 59.99 | 94 | 93 | 97 | 97 | 97 |

% of standard weight for height

| | | | | | |
|------------|----|-----|-----|-----|-----|
| 12 - 23.99 | - | 104 | 108 | 105 | 94 |
| 24 - 35.99 | 95 | 107 | 111 | 104 | 110 |
| 36 - 47.99 | 95 | 107 | 105 | 108 | 107 |

The weights and heights of the 1950 survey children have been compared to a survey conducted in 1964 by Neave (1969) on Pukapuka and in the urban centre of Rarotonga. Although the numbers of children in each group are small, it appears that the Pukapuka and Rarotonga children grew quite closely to WHO standards. Their percent weight for age and height for age is higher in all age groups, especially in the one to two year age group whereas the children seen in 1950 were considerably below standards. The mean per cent of weight for height for the children seen in 1964 was above the standards for all age groups and higher than the 1950 children.

Neave (1969) reported that no cases of protein malnutrition were seen; no oedema, no skin or hair changes and no signs of thiamin, riboflavin, niacin or vitamin A deficiency recognised.

In the Faine and Hercus (1951) survey, no anaemia was found, but the later survey showed that 80 per cent of Pukapukan and 66 per cent of Rarotongan children aged six to 12 months were found to be anaemic. Mean haemoglobin levels for both groups was 9.8 g / dl. In the older age groups 16 to 71 per cent were also anaemic. The criteria used was Haemoglobin less than 10.8 g / dl.

Later growth studies in Rarotonga (Elliot, 1974) and the island of

Mangaia (Boulton et al, 1978) found close comparison of Cook Island children and British and Australian children. No malnutrition was found. If anything the Cook Island children were slightly fatter than British and Australian children, during the first six months of life with a slight decline in later pre-school years.

Malnutrition, however, may be increasing in the Cook Islands (Raoult and Jabre, 1976) in more recent years. A survey of Atutaki in 1975 did not provide mean weights and heights of the children but a summary can be made of the children examined:

| <u>Age Groups</u> | <u>Number</u> | <u>Remarks</u> |
|-------------------|---------------|---|
| 0 - 6 months | 28 | Median weights and lengths well above the Iowa standard. |
| 6 - 12 months | 33 | 2 children with protein calorie malnutrition with oedema. 1 rickets. |
| 1 - 3 years | 131 | 23 per cent less than 3rd percentile Iowa standard (undernourished). 1 child with protein calorie malnutrition with oedema 6 abnormal hair growth |

In 1977, five children under four years were admitted to Rarotonga Hospital for nutritional deficiencies (Lambert, 1981).

In the earlier studies, breast feeding was continued into the second year of life. The average duration of breast feeding in 1964 in Pukapuka was nine months and in Rarotonga 6.6 months. By 1975, Raoult (1976) commented the "drastic change to bottle feeding" and Lambert (1981) commented on the wide spread bottle feeding. Of 254 children born in Rarotonga in 1980, 13 per cent were bottle fed from birth. Of those breast feeding 27 per cent were weaned by 3 months of age (Mokotupu, 1981).

Traditionally the first foods were given around nine months and often were the meat of immature coconut, pawpaw or taro. Fish was usually given before one year. Current feeding practices have not been described.

It appears that malnutrition may not have been a problem in the Cook Islands until recently. The earliest study in 1950 (Faine and Hercus, 1951) indicated the growth retardation may have occurred in the second year of life but the number of children examined was extremely small. The surveys of the 1960s (Neave, 1969) and 1970s (Elliot, 1974; Boulton, 1978) indicate that Cook Island children grew closely to WHO

standards.

Evidence from the late 1970s, however, (Raoult, 1976; Lambert, 1981) suggests that some forms of malnutrition may be occurring. More recent statistics are necessary to determine if malnutrition is indeed a problem and if so, could it be related to a decline in breast feeding.

French Polynesia - No reports available.

Tokelau

The 148 Tokelauan children examined by Naeve (1969) in 1964 had mean weights and heights very close to WHO standards. The lowest per cent of standard was for girls between 1 and 2 years of age (Table 62). Using weight for height as an indicator, it would appear that there was virtually no acute malnutrition.

TABLE 62. Mean weights and heights of Tokelauan children in 1964 expressed as per cent of WHO standard.

| Age group - years | Weight for age | | Height for age | | Weight for height | |
|-------------------|----------------|-------|----------------|-------|-------------------|-------|
| | Boys | Girls | Boys | Girls | Boys | Girls |
| 1 - 2 | 96 | 94 | 100 | 98 | 100 | 102 |
| 2 - 3 | 95 | 95 | 94 | 97 | 102 | 101 |
| 3 - 4 | 97 | 99 | 100 | 98 | 99 | 103 |
| 4 - 5 | 101 | 96 | 95 | 95 | 109 | 106 |
| 5 - 6 | 99 | 106 | 97 | 98 | 106 | 109 |

The four to five year olds may even tend towards overweight. Obviously, no signs of malnutrition were noted among the Tokelauan children.

The average duration of breast feeding was 10.4 months. This is longer than either the Pukapukan or Rarotongan duration of breast feeding. The Tokelauan children obtained 45 to 70 per cent of their calories from coconuts. Coconuts plus a relatively high fish consumption provided an estimated protein intake of 1.9 g / kg / day and 63 cal / kg / day for weaned children. This would exceed protein recommendations for the pre-school age group but fall short of energy recommendations.

Tokelauan children who were residents of New Zealand in 1972-1973 were compared to Tokelau children living in Tokelau in 1971 (Tonkin et al, 1979). The investigators showed that the New Zealand Tokelauan children had significantly heavier birth weights compared to rural Tokelauan infants, 3.4 kg and 3.1 kg respectively, but similar to

infants of the administrative centre of Fakoafo, 3.4 kg. The Tokelauan children to New Zealand were heavier and had larger subscapular and tricep skinfolds at all ages than the children living in Tokelau. They were also heavier than New Zealand Maori children. Height differences between the two groups were not significant.

The investigators (Tonkin et al, 1979) did not provide mean weights and heights, so it is not possible to compare those children with the Neave (1969) survey or with WHO standards. It would be interesting to know if the New Zealand Tokelauan children developed obesity, but overweight was not discussed by the researchers.

There have been no recent reports related to infant nutrition from Tokelau. It would be important to know if feeding practices and status of nutrition has changed over this period.

Tonga

A survey conducted in Tonga in 1972 by Dr. A.A.J. Jansen (1973) reported that "protein-calorie malnutrition is common". In 1971, 55 cases of malnutrition were noted by the Maternal and Child Health Service, 36 of them on the capital island of Tongatapu. Seven children died of malnutrition (1 of kwashiorkor), 5 from Tongatapu.

TABLE 63. Mean weights and heights of Tongan children in 1972 expressed as per cent of WHO Standard

| Age group (months) | N | Weight for age | Height for age | Weight for height |
|--------------------|------|----------------|----------------|-------------------|
| 0 - 6 | (28) | 115 | - | - |
| 6 - 12 | (23) | 91 | - | - |
| 12 - 18 | (19) | 92 | - | - |
| 18 - 24 | (30) | 103 | - | - |
| 24 - 36 | (51) | 97 | 99 | 100 |
| 36 - 48 | (51) | 104 | 95 | 115 |
| 48 - 60 | (43) | 104 | 96 | 112 |

The mean birthweight of children born at Vaiola Hospital was 3.38 kg. During the first six months of life, weight gain was rapid and excelled standards. After six months, however, weight gain slows until about three years when the children are overweight for their height. Height appears to remain close to standards.

Jansen (1973) found two children between 6 and 12 months below the "borderline of malnutrition" and 5 between, 2 and 3 years. A total of 10 children, 3.5 per cent were classified as malnourished.

Two children with severe malnutrition were seen suffering from marasmus at the ages of 14 and 16 months. Clinical signs of vitamin A

and riboflavin deficiencies were also observed in 14 and 20 per cent respectively of children under 5 years of age. Dr. Jansen did not comment on infant feeding practices.

A later survey reported in 1980 by Clark (1980) showed that rural Tongan children from two to five years of age were heavier and taller than IOWA standards and significantly heavier and taller than urban Tongan children. Of hair samples taken from the rural children, 16 per cent indicated malnutrition whereas 43 per cent of urban children had hair samples indicative of malnutrition. The investigator did not provide mean weights or heights for comparison with the Jansen survey but leaves us to speculate on the incidence of malnutrition among urban Tongan children. Yet Lambert and Biddulph (1981) were impressed with the "general absence of undernutrition".

Breast feeding is still widespread in Tonga. A survey in 1980 in the Nukunuku area showed that 94 per cent of infants were breast fed at birth and 24 per cent continued to breast feed into the second year of life (Taumoepeau, 1981). Bottle feeding is becoming more common, however, 51 per cent of the breast fed babies also had complements by 6 months.

Tuvalu

No published reports of infant feeding have been found for Tuvalu, which may or may not indicate that there is little malnutrition. A report presented at a recent seminar on Maternal and Infant Nutrition (Salesa, 1981) revealed that "there are a few cases of malnutrition, but there is an increase in the number of anaemic children and pregnant mothers".

Breast feeding is currently widely practised, continuing until about twelve months. A few mothers continue to breast feed after two years. Yet bottle feeding is becoming more and more common not only on the Capital Island but in the outer islands as well. Reasons suggested for an increase in bottle feeding were employment of the mother and the convenience of and social status of bottle feeding (Salesa, 1981).

Western Samoa

An early nutrition survey in Western Samoa in 1950 (Bell, 1950) may well have laid the ground work for the high rates of malnutrition found in these islands in 1979. The purpose of the 1950 survey was to examine the "haemoglobin and serum protein content of the bloods of the Pacific Island peoples". No weights or heights were measured. Anaemia was not widespread, serum protein levels rose in infants and by two years was higher than the normal average. The "people studied were apparently in normal health".. No definite statement could be elicited as to whether fish was in plentiful supply". "The stature and physique of the Samoans indicate that there is no gross deficiency of protein in the diet". With these statements discussed, the investigator then stated as recommendation No.1:

"Particular attention should be paid to the diet of the infant in the period of weaning. It is suggested that a cheap form of milk powder, for example skim milk powder (our emphasis) could be

dispersed from the clinic van on a subsidised basis....." (Bell, 1950).

One wonders if this early advice eventually led to the widespread practice of bottle feeding and resulting malnutrition as found in the late 1970s in Western Samoa.

Traditional Western Samoan babies were breast fed up to the age of two years or until the mother knew she was pregnant. In 1951, Parkinson (1951) noted an average age of weaning of 20 months, despite instructions from the district nurse to wean at nine months! (our emphasis). The infant was fed whenever he cried.

During the first week of life it was not uncommon for mothers to give their babies pawpaw, coconut milk and sugar cane juice (Tuiteleleapaga, 1980). The food was chewed and softened by the mother and then fed from the mother to the infant's mouth by finger.

"It is common belief that "mouth to mouth" feeding is of value in cases of sickness. The mother thinks that by chewing the food she may pass on her own strength to the child." (Parkinson, 1951).

Medical education in the 1950s strongly discouraged this practice for reasons of hygiene, perhaps to the detriment of the infants' nutrition. The 32 children under one year of age examined by Parkinson (1951) closely followed or exceeded the WHO standards until about 7 months of age. By 12 months of age the mean weight was approximately 89 per cent of standard. No cases of severe malnutrition were observed but the investigator noted "listless, poorly nourished children".

In 1965 and 1967 Naeve (1969) examined 287 Western Samoan children in rural and urban villages. The number of children in urban centres was not given. Table 64 shows that mean weight for age, height for age and weight for height were close to WHO standards except for children one to two years of age. The boys especially were below standards for both weight and height.

TABLE 64. Mean weights and heights of Western Samoan children in 1965 and 1967 expressed as per cent of WHO Standard

| Age in years | Weight for Age | | Height for Age | | Weight for Height | |
|--------------|----------------|-------|----------------|-------|-------------------|-------|
| | Boys | Girls | Boys | Girls | Boys | Girls |
| 1 - 1.99 | 87 | 94 | 85 | 95 | 98 | 103 |
| 2 - 2.99 | 98 | 100 | 95 | 96 | 107 | 108 |
| 3 - 3.99 | 101 | 103 | 96 | 97 | 109 | 109 |
| 4 - 4.99 | 101 | 103 | 95 | 97 | 109 | 109 |
| 5 - 5.66 | 98 | 103 | 96 | 97 | 105 | 107 |

No cases of protein-calorie malnutrition or evidence of nutritional

deficiencies were found although 6.5 per cent were below the malnutrition borderline in this survey. Fifty six (56) to 83 per cent of each age group were anaemic with haemoglobin values less than 10.8 gm / dl. Hookworm infestations were found in 26 per cent of the children 0 to 4 years of age (Neave, 1969).

Wigg (1978) examined 419 children who were seen at the general outpatient clinic at the National General Hospital at Apia. For the first six to nine months, Western Samoan children were heavier and taller than British children. Weight fell slightly at about one year but height continued to follow British standards. The investigator did not state when the study was conducted. At about the same time in 1966, 106 children between 6 months and 3 years of age were admitted to the General Hospital at the urban centre of Apia with severe malnutrition (Naeve, 1968). An illness, usually diarrhoea, preceded the hospitalisation and oedema, anaemia and dermatitis were common associated problems. Family circumstances were considered major factors in over half of the cases of malnutrition. Death or illness of one or both parents, early pregnancy of the mother or employment of the mother in urban jobs or rural plantations were causes of separation and early weaning of the child (Neave, 1968).

A recent survey of infant feeding (Quested, 1978) showed the effect of the trend away from breast feeding and resulting illness. Table 65 shows that seven times as many artificially fed infants were hospitalised for gastroenteritis as breast fed infants, six times as many were treated in outpatient visits for gastroenteritis and three times as many malnourished.

TABLE 65. Illness related to feeding method of Western Samoan children (Quested, 1978)

| Feeding method | No. 1,009 | Gastroenteritis | | Other | Malnutrition |
|------------------------------|--------------|-----------------------|-----------------------|-----------------------|--------------|
| | | Outpatients visits | Hospitali- sations | Hospitali- sations | |
| Breast feeding | 522 | 2.5 | 2.3 | 6.5 | 5.2 |
| Breast fed and artificial | 95 | 5.2 | - | 4.2 | 3.2 |
| Artificially Fed | 174 | 15.5 | 16.1 | 14.4 | 16.7 |
| Weaned (no milk) | 218 | 10.1 | 5.5 | 4.1 | 18.8 |

In Western Samoa in 1978, more urban infants were wholly or partially artificially fed, though bottle feeding was practised in rural Upolu and to a lesser extent in Savaii (Table 66). Four times as many Apia children were artificially fed compared to more traditional Savaii.

TABLE 66. Method of feeding infants by location.
Per cent of children from birth to 2 years
(Quested, 1978)

| Feeding method | Number | Savaii | Upolu | Apia |
|---------------------------|--------|--------|-------|-------|
| | | (279) | (437) | (293) |
| Breast fed | | 56 | 58 | 38 |
| Breast & artificially fed | | 6.5 | 8 | 14 |
| Artificially fed | | 7.5 | 13 | 33 |
| Weaned (no milk) | | 30 | 21 | 15 |

Another recent survey of infant nutrition included 972 children under three years of age selected by district nurses in Western Samoa (Brazill, 1979). These children were compared with a survey conducted in 1969 by Jansen (1977) including 4,000 children under five years. The 1979 survey employed stricter criteria as a definition of malnutrition; below 75 per cent of the Harvard standard, compared to the 1969 study; 15 per cent below IOWA standards. Even if there was a bias in selecting more under nourished children as the author has suggested, there was still an alarming increase in the incidence of malnutrition from 1969 to 1979, 7 per cent compared to 20 per cent. Almost three times as many children in the total sample in 1979 were considered malnourished as in 1969. The increase in malnutrition appears to be closely related to urbanisation. Almost 10 times as many children appeared malnourished in 1979 compared to 1969. There was a slight decrease in the percentage of Savaii malnourished children.

TABLE 67. Percentage of Western Samoan children malnourished
in 1969 and 1979. (Jansen, 1977; Brazill, 1979)

| | 1 9 6 9 | 1 9 7 9 |
|----------------------------------|---------|---------|
| Number | 3933 | 972 |
| Total malnourished | 6.9 | 19.5 |
| Apia | 3.4 | 30.0 |
| Rural Upolu | 7.1 | 23.1 |
| Savaii | 8.4 | 6.0 |
| Children less than 1 year of age | 4.6 | 33.0 |

The age at which malnutrition occurs is also cause for concern. In 1969 malnutrition was found least often in the under one year age group (4.6 per cent) but in the 1979 survey malnutrition was highest in this age group (33 per cent).

The study also looked at factors which were associated with malnutrition (Brazill, 1979). Artificial feeding and early weaning were implicated in the development of malnutrition. 75 per cent of malnourished children were bottle fed compared to 37 per cent of well nourished children. The undernourished children were two to three times as likely to come from poor families with no access to land. They were also less likely to receive high energy traditional foods but more likely to receive imported commercial baby foods. The age of introduction of solid foods did not appear to be a major factor.

TABLE 68. Factors related to malnutrition in Western Samoa, (Brewster, 1979)

| | Well nourished children | Malnourished children |
|-------------------------------------|-------------------------|-----------------------|
| | ----- | ----- |
| Number 972 | (782) | (190) |
| Artificially fed | 37 | 75 |
| Weaned from breast before 6 months | 23 | 54 |
| Families without plantation (Apia) | 16 | 45 |
| Weekly income less than \$20 | 24 | 61 |
| Traditional Samoan foods given | 47 | 17 |
| Commercial baby foods given | 18 | 23 |
| Solid foods started before 6 months | 85 | 85 |

In Western Samoa then it appears that the nutrition of infants, especially those under one year of age has deteriorated drastically over the past decade. Artificially feeding is suggested as a major cause of infant illness and malnutrition (Brewster, 1979). Children from poor families, without land in urban areas are most at risk.

VII. CONCLUSIONS

Increasingly, Pacific Island people are migrating to towns, district centres and cities and it is unlikely that this trend will be reversed, in the foreseeable future. While urban living in the Pacific offers opportunities for employment, cash income, and western technology, it is also accompanied by a decrease in physical exercise, a reliance on imported foods and an increase in the chronic diseases of western societies.

Diseases which were uncommon in traditional Pacific cultures, diabetes, hypertension, gout and dental caries, occur now, in urban populations, at rates up to or exceeding the rates found in affluent countries. Coronary heart disease, alcoholism and cancer appear to be rising and may also be becoming significant health problems. Infant and child malnutrition and diarrhea seem to be more severe in urban centres. The rise in infant malnutrition is considered to be due to a decline in breast feeding.

There is clear evidence that all of the above diseases are more prevalent in towns and cities in the Pacific than in traditional villages. The factors which are associated with these diseases, however, are many, complex and probably interrelated. For most of the health problems in the Pacific, a genetic predisposition is often a component. Heredity plays a part in the development of diabetes, heart disease, hypertension, gout and perhaps also in obesity and certain types of cancer. Yet for all of those diseases environmental determinants are thought to play an even more important role.

Diet and physical activity appear as the most significant factors involved in the development of these chronic diseases. Although there have been no detailed studies of reduced physical activity in towns and cities, it would appear that employment is often sedentary, cars and motorbikes are used instead of walking, outboard motors instead of canoes and tractors instead of hoes. Decreased physical activity without a similar reduction in caloric intake or with an increase in caloric intake will lead to obesity as appears to be the case in many urban centres.

Other dietary factors which are seen with changes from a traditional to a western lifestyle are also implicated. An increase in sugar intake is certainly responsible for increased dental caries and may play a part in the development of obesity. Tinned soft drinks have twice the calories and almost three times as much sugar as drinking coconuts! Sugar consumption may also be responsible for replacing other foods containing necessary nutrients, such as fibre and/or some trace minerals. A reduction in dietary fibre has been associated with cancer of the large bowel and increased fibre with lowering of serum cholesterol levels. High salt intakes have been closely related to increased blood pressure in susceptible people. Excessive alcohol consumption is clearly a causative agent in the development of cirrhosis of the liver and gout but could also be a factor in the development of obesity, as alcohol is a concentrated source of calories.

Stress has been implicated in a number of diseases as well. Stress

is thought to be a factor in hypertension and cardiovascular disease but could also be involved in diabetes and related to an increased consumption of alcohol. Urban living for many people is stressful; seeking and holding a job, paying the rent, budgeting money and being apart from family and friends. These situations would be even more stressful for the newly arrived urban resident who first experiences these circumstances.

While it seems obvious that the traditional Pacific diet consisting ideally of root vegetables, fish, coconut, tropical fruits and some green leaves is more healthful and may be personally more enjoyable than the imported foods generally available in towns and cities, the reality of procuring a traditional diet is not always easy. Fresh root crops, greens, fruit and fish are often higher in price than imported foods.

Transportation and distribution of highly perishable fresh foods from the garden or sea to the urban market place is difficult.

Research and Data Collection Needs

A review of the factors associated with the changing pattern of disease in the Pacific points out the many gaps in existing information and the many questions which still need to be answered. Some of these include:

Food Production and Food Processing.
Research into ecologically sound agricultural technologies, livestock raising and fishing methods need to be continued and expanded to increase the production of locally grown foods. New methods of preserving Pacific Island foods should be investigated. Answers need to be sought on how to increase national self sufficiency in food production and at the same time maintain traditional food patterns.

Mortality and Morbidity Data.
For many countries in the Pacific, the cause of death is not known. Cause of death, underlying causes of death and death rates by age and sex group, are necessary to determine the nature and effects of these diseases. Infant and child mortality and morbidity rates are indications of malnutrition in a community. Death rates for heart disease, cerebrovascular disease, diabetes, and cirrhosis will provide clues which relate to nutrition health. It is necessary to regularly interpret morbidity and mortality rates to determine whether they are increasing or decreasing and to which age or sex group preventive and/or treatment measures need to be geared.

Food Availability and Food Costs.
More information is needed on the types of foods available to both urban and of rural populations, their cost in relation to income and importance, whether the Pacific Island urban dweller is able to obtain a nutritious diet on his/her income.

Nutritional Composition of Pacific Island foods and diets
There are great gaps in the knowledge of the nutrient composition of Pacific Island foods. Food composition tables in present use are incomplete for several nutrients and may have used out of date

techniques for the analysis, for example, of fibre. Traditional, imported and locally processed foods need to be analysed for specific nutrients; sugar, fibre, sodium, potassium and zinc as well as the major nutrients. Other trace minerals may also require investigation.

Because food composition tables are not accurate or complete it is difficult to judge many aspects of dietary intakes. The dietary studies undertaken by Hankin (1970) and Ringrose (1979, 1981) comparing nutrient intakes of traditional and western living islanders need to be expanded to provide further clues to the role of diet in the development of these degenerative diseases.

Relationship of specific nutrients in the aetiological process of particular diseases.

While per capita sugar consumption in most countries is accompanied by an increase in dental caries and appear to correlate with diabetes prevalence rates, the role of sugar in disease states is uncertain. Is high sugar consumption a factor in the development of obesity and therefore other diseases? Is sugar replacing foods containing other nutrients, such as fibre or some minerals, which may offer a protective effect. Does a decrease in dietary fibre have an effect on increasing diseases such as diabetes or risk factors such as serum cholesterol? How strong is the relationship between salt intake and hypertension in the Pacific? It would be valuable to look for further examples, similar to Page (1974), of traditional groups who have a high salt intake but are not obese and do not suffer from stress.

Are elements such as potassium, chromium or zinc involved in either diabetes or hypertension aetiology? Potassium may be high in the traditional diet due to the high content of coconuts and unprocessed foods. Low intakes have been loosely associated with diabetes and hypertension. A better picture of the role of alcohol consumption and its effect on the development of cirrhosis, gout and diabetes is necessary. The relationship between alcohol consumption and infant malnutrition deserves further investigation.

Relationship between physical activity and caloric intake and their effect on disease prevalence

There are little accurate data on the change in physical activity from the traditional way of life to the western setting. Perhaps decreased physical activity is a more important factor than total calories in the development of obesity and thus diabetes and hypertension as well as a risk factor for cardiovascular disease. Increased caloric intake has been shown to be involved in increased prevalence rates of diabetes in a number of surveys, but not all. Is it possible to measure instead excess caloric intake; calories consumed in excess of calories expended (physical activity). This task would be difficult but may answer some important questions.

The role of obesity in the development of disease

Obesity is an important risk factor in the development of diabetes, hypertension and gout. Yet the relationship between obesity and these diseases is not always significant. Additional research is necessary to elucidate the significance of obesity on these diseases, the stage or severity at which obesity becomes a health problem and if there is a

genetic pre-disposition to obesity similar to the "thrifty gene theory". Perhaps those groups of people who develop obesity are genetically more economical in energy utilisation and therefore easily store fat. If this is so, what are the metabolic differences in these groups?

Stress and Cultural Factors..
Stress should be investigated in relation to hypertension, heart disease, diabetes and alcoholism. Cultural factors may be involved with stress and thus these diseases. Cassel (1977) and Prior (1978) have suggested that those islanders who retain customs and cultural ties, even in the face of western influence suffer less hypertension. Social science research should also be undertaken to develop nutrition education messages and approaches to health care which are culturally meaningful.

It is realised that many of the questions raised here have also been raised before, and are difficult to answer, that research is expensive and time consuming to perform. Yet it is the responsibility of government leaders and their advisors to identify the major nutritional health problems in their countries and establish priorities to answer the questions which may lead to an alleviation of those disorders.

POSSIBLE SOLUTIONS

It is now crucial for Pacific Island countries to look more closely into the problems of health, nutrition and food supply, as many Pacific Island countries are currently doing. There are, of course, no easy solutions. But some activities geared at addressing these problems have been in progress in the Pacific and are worth examining:

Development of National Food and Nutrition Policies

A food and nutrition policy has been defined as - "a coherent set of principles, objectives, priorities and decisions adopted by the State and applied by its institutions as an integral part of the National Development Plan, in order to provide all the population, within a specified time, with the food and other social, cultural, and economic conditions essential to satisfactory nutrition and dietary well-being" (WHO, 1976). A number of western countries have already begun to put policies into practice. The United States and Australia have developed "dietary goals" as one means of influencing food patterns.

Papua New Guinea (Lambert, 1978), Fiji (Lambert, 1980) and Western Samoa (Weerasinghe, 1980) have already begun to develop National Food and Nutrition Policies. Summarised below are policy statements and examples of implementation of these policies in Pacific Island countries:

- An increase in the production and marketing of domestic foods such that the volume of imported foods decrease or at least remain constant.

This may involve improved technology applied to the production of traditional or non-traditional foods. Besides agricultural techniques; transportation, preservation and distribution factors have to be examined.

- A number of countries already have policies, technologies and training programmes aimed at increasing the supply, yields and varieties of locally grown foods and increasing the availability of fresh fish, poultry, eggs and meat. One problem encountered for instance, with poultry raising in Micronesia has been that the price of the imported poultry feed makes the venture unprofitable. Cheaper locally produced poultry feeds and fertilizers may need to be available.

New technologies in processing of local foods are also being considered; in Kiribati a dried snack from the pulp of the pandanus fruit may be sold as an excellent date-like tasting "health food" (a Kiri-bar), breadfruit might be processed into flour as a substitute for wheat flour (Ward and Proctor, 1980).

- A pineapple fruit juice plant recently opened in French Polynesia (Dixon, 1981) "the whole fruit pure juice, pasturised and packed in wax cartons, proved superior in quality to currently imported canned juice and prices will be maintained competitively". The plant employs 14 workers. Studies are under way for utilisation of the pulp byproducts,

perhaps as animal feed.

- National Nutrition Education Programmes be implemented through the coordinated action of agencies responsible for health, education, primary industry and the media.

Positive health promotion campaigns have been implemented in Fiji, "EAT FIJI FOODS" has a mass media approach with postage stamps, T-shirts, radio and posters carrying the message to a wide audience. Many countries have begun mass media education with the "BREAST IS BEST" slogan. "THINGS GO BETTER WITH COCONUTS" is a campaign to promote drinking coconuts as a beverage instead of soft drinks in Micronesia (Rody, 1978b). Coconuts are more nutritious and probably more refreshing than soft drinks and may also offer the business-man a higher profit. Profits should also be made by the local grower, gatherer and transporter. Coconut containers are also reusable and biodegradable. The author noted that in one shop in Micronesia, drinking coconuts were sold in tins which had been imported from California!

Other health promotion campaigns could be directed towards physical fitness, and Pacific Islanders' well-known prowess in sports.

Collection of data monitoring nutritional status and nutrition research should be the responsibility of departments or ministries of health

Indirect measures of nutritional status such as infant and child mortality, causes of death of adults by age and sex groups, hospital morbidity statistics by age and by diagnosis, give an overall view of changes in health patterns. Simple methods and standards should be sought for long term monitoring of nutritional status. Weight and height for both children and adults are simple and excellent indicators of nutritional health.

One agency in each country should be responsible for coordinating and monitoring a National Food Nutrition Policy.

In some countries this may be those agencies responsible for health, in other countries it could be the Central Planning Office. However, agencies and organisations involved in the actual planning of nutrition policies should include the departments of health, agriculture, fisheries, education, women's interests, economic development and/or planning and also include representatives of groups such as village leader/chiefs, businessmen, consumers, politicians and religious organisations. It is important that planning for National Food and Nutrition Policies be built on a broad base of community support.

Nutritional health is not only a principle basic need but it is also a measure of economic development. Therefore nutritional considerations need to be integrated into national development plans.

APPENDIX A. cont..

| Location | % of energy derived from | | | Calcium (mg) | Iron (mg) | Vit A IU | Thiamin (mg) | Ribo- flavin (mg) | Niacin (mg) | Ascorbic Acid (mg) |
|--|-----------------------------|-----|------|-----------------|--------------|----------|-----------------|-------------------------|----------------|--------------------------|
| | PRO | FAT | CHO | | | | | | | |
| Palau-TTPI | | | | | | | | | | |
| -males | 16 | 28 | 54 | - | - | - | - | - | - | - |
| Palau-TTPI | | | | | | | | | | |
| -females | 19 | 28 | 54 | - | - | - | - | - | - | - |
| Rota-TTPI | | | | | | | | | | |
| -males | 14 | 23 | 57 | - | - | - | - | - | - | - |
| Rota-TTPI | | | | | | | | | | |
| -females | 16 | 28 | 58 | - | - | - | - | - | - | - |
| Kiribati | | | | | | | | | | |
| -Maiana | 19 | 37 | 41 | 297 | 13.7 | 179 | .59 | .53 | 1267 | 58.6 |
| PNG- | | | | | | | | | | |
| -Kavitarua | 10 | 5 | (85) | 300 | - | - | 1.25 | - | - | 142 |
| PNG- | | | | | | | | | | |
| -Patep | 5 | 5 | (90) | 600 | - | - | 1.7 | - | - | 244 |
| Fiji | | | | | | | | | | |
| -Naduri | 10 | 9 | 82 | 670 | 21.9 | 1098 | 1.2 | 1.0 | 10.3 | 3380 |
| Fiji-Males | | | | | | | | | | |
| -Melanesians | 10 | 16 | 74 | | | | | | | |
| Fiji-Males | | | | | | | | | | |
| -Indians | 11 | 23 | 66 | | | | | | | |
| Solomon Is. | | | | | | | | | | |
| -Nggela | 10 | 11 | 81 | 602 | 29.2 | 325 | 2.0 | 1.04 | 12.7 | 313 |
| Cook Is. | | | | | | | | | | |
| -Mitiaro | 8 | 37 | 55 | 374 | 15.4 | 141 | 1.05 | .83 | 11.0 | 195 |
| Tokelau | | | | | | | | | | |
| -Fakaofu | 12 | 53 | 35 | - | - | - | - | - | - | - |
| Cook Is. | | | | | | | | | | |
| -Pukapuka | 13 | 35 | 50 | - | - | - | - | - | - | - |
| Recommendations for Developing Western Pacific Countries (55kg male) | | | | 400-500 | 5 | 4500 | 1.1 | 1.6 | 18.7 | 30 |
| U.S. RDA 1980 | | | | 800 | 10 | 1000 | 1.4 | 1.6 | 18 | 60 |

APPENDIX B. Nutrient intakes of some urban living Pacific Island groups.

| LOCATION | E N E R G Y | | Protein (gms) | Fat (gms) | Carbohydrate | | Estimated (gms) Fibre | Alcohol (gms) |
|---|-------------|-------|------------------|--------------|--------------|-------|-----------------------------|------------------|
| | kcal | KJ | | | Total | Sugar | | |
| Chamorros (Guam)-male | 2500 | 10460 | 91 | 85 | 303 | | | - |
| Chamorros (Guam)-female | 1734 | 7255 | 72 | 71 | 202 | | | |
| Chamorros (California) -male | 2386 | 9983 | 87 | 108 | 252 | | | - |
| Chamorros (California) -female | 1574 | 6586 | 64 | 74 | 1611 | - | - | - |
| Nauru-male | 7191 | 30087 | 259 | 239 | 890 | - | - | 83 |
| Nauru-female | 5223 | 21853 | 184 | 187 | 688 | - | - | 14 |
| PNG-Port Moresby* | 1200 | 5021 | 31 | 17 | 231 | - | 1.7 | - |
| Fiji- Melanesia -male | 2177 | | | | | | | |
| Indian | 2626 | | | | | | | |
| -male | 2626 | | | | | | | |
| Indian | 2764 | 11565 | 71 | 60 | 484 | | 2.7 | |
| Solomon Is. -Honiara | 2349 | 9828 | 59 | 27 | 466 | | 11.7 | |
| Cook Is. -Rarotonga | 2100 | 8786 | 60 | 63 | 320 | | - | 3 |
| Cook Is. -Rarotonga | 3363 | 14071 | 97 | 89 | 539 | | 12 | |
| Tuvalu -Funafuti | 2841 | 11887 | 100 | 118 | 337 | | | |
| Tokelauan -New Zealand | 2280 | 9540 | 85 | 104 | 251 | | | |
| New Zealand National Diet Survey - 50th%ile males (20-29 years) | 3793 | 15870 | 1214 | 165.1 | 377 | | | 80.5 (5.7%) |

* poor migrant labour camp.
1 kilocalorie=4.184 kilojoules

APPENDIX B. cont..

| | % of energy derived from | | | Calcium (mg) | Iron (mg) | Vit. A | Thiamin (mg) | Ribo- flavin (mg) | Niacin (mg) | Vit. C (mg) |
|-------------------------------|-----------------------------|-----|-----|-----------------|--------------|-----------|-----------------|-------------------------|----------------|-------------------|
| | PRO | FAT | CHO | | | | | | | |
| Chamorro (Guam, male) | 15 | 31 | 48 | | | | | | | |
| Chamorro (Guam Female) | 17 | 37 | 47 | | | | | | | |
| Chamorro (California, male) | 15 | 41 | 42 | | | | | | | |
| Chamorro (California, female) | 16 | 42 | 41 | | | | | | | |
| Nauru - males | 14 | 32 | 46 | | | | 1.5 | | | 116 |
| Nauru -females | 15 | 34 | 51 | | | | 1.1 | | | 77 |
| PNG Pt Moresby* | 10 | 13 | 77 | 157 | 4.2 | 312 | 0.58 | .4 | 6.5 | 32 |
| Fiji Males | | | | | | | | | | |
| Melanesians | 15 | 20 | 65 | | | | | | | |
| Fiji - males | | | | | | | | | | |
| Indians | 12 | 25 | 63 | | | | | | | |
| Fiji Indians | 10 | 20 | 70 | 503 | 14.7 | 129 | 0.91 | 1.0 | 9.2 | 64 |
| Solomon Islands | | | | | | | | | | |
| Honiara | 10 | 10 | 79 | 542 | 15.7 | 263 | 1.38 | 0.85 | 13.3 | 217 |
| Cook Islands | | | | | | | | | | |
| Rarotonga | 10 | 24 | 64 | 11 | | | | | | |
| Cook Islands | | | | | | | | | | |
| Rarotonga | 11 | 27 | 61 | 7 | | | | | | |
| Tuvalu | | | | | | | | | | |
| Funafuti | 14 | 37 | 47 | | | | | | | |
| Tokelau | | | | | | | | | | |
| New Zealand | 15 | 41 | 44 | 13 | | | | | | |
| New Zealand | | | | | | | | | | |
| National | | | | | | | | | | |
| Diet Survey - | | | | | | | | | | |
| 50th%ile males | | | | | | | | | | |
| (20-29 years) | 14 | 41 | 40 | 999 | 18.6 | | 1.4 | 3.1 | 25.1 | 90 |

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