

9/83/11/31/20



#1

NAURUAN MORTALITY 1976-1981 and a review of previous mortality data

Richard Taylor
Epidemiologist
South Pacific Commission
Noumea, New Caledonia

Kiki Thoma
Director of Medical Services
Republic of Nauru
Central Pacific

South Pacific Commission
Noumea, New Caledonia
April 1983

NAURUAN MORTALITY 1976-1981

and a review of previous mortality data

Richard Taylor
Epidemiologist
South Pacific Commission
Noumea, New Caledonia

Kiki Thoma
Director of Medical Services
Republic of Nauru
Central Pacific

South Pacific Commission
Noumea, New Caledonia
April 1983

TABLE OF CONTENTS

	<u>Page</u>
<u>Summary</u>	1
<u>Introduction</u>	2
<u>Part I</u>	3
<u>Background and Review of Previous Health and Mortality Data</u>	3
1.1 Background	4
1.2 Review of previous health and mortality data	7
<u>Part II</u>	15
<u>Mortality Analysis 1976-1981</u>	15
2.1 Methods	16
2.2 All-cause mortality and life expectancy	19
2.3 Mortality by cause in the various main age groups	20
2.4 Mortality from accidents and injuries	22
2.5 Mortality from cardiovascular disease	23
2.6 Mortality from liver disease	23
2.7 Mortality from and with diabetes	25
2.8 Alcohol-related mortality	25
2.9 Cancer mortality	26
2.10 Death from and with kidney failure	26
2.11 Mortality in non-Nauruans	26
<u>Part III</u>	27
<u>Conclusions and Recommendations</u>	27
3.1 Conclusions	28
3.2 Recommendations	28
3.3 Constraints	30
<u>Postscript: Nauruan deaths 1982</u>	32
<u>Bibliography</u>	33
<u>Tables</u> 1 - 31	37-72
<u>Figures</u> 1 - 13	73-87
<u>Appendix</u> Life expectancy at birth and at age 15 in Pacific Island countries and metropolitan nations of the South Pacific Commission.	89

Summary

1. The major health problem in Nauru is the excessive premature mortality amongst adult males. Nauruan male mortality in the 15-64 year age group during 1976-81 was three times higher than that of Nauruan females, and over five times higher than the mortality rate in Australian males.
2. The life expectancy at birth for Nauruan males is 49 years and that for females, 62 years. The male life expectancy is one of the lowest in the Pacific, comparable to estimates for Papua New Guinea and Kiribati. Male life expectancy at age 15 years is the lowest recorded in the region.
3. Comparison of mortality during 1976-81 with data from the 1960s indicates that adult male mortality has risen (doubled) and adult female mortality has fallen (halved) over this period.
4. Analysis of deaths by cause reveals that:
 - (a) Accidents and injuries are the most important cause of death in children and adults, are the most significant contributor to years of life lost in adults from premature death, and account for a large proportion of the difference between adult male and female mortality. Motor vehicle accidents are the most common reason for death from injury, and alcohol and motorcycles appear to be involved in many cases. The mortality rate in Nauruan male adults from motor vehicle accidents was five times higher than the death rate from this cause in Australian males.
 - (b) Cardiovascular disease and diabetes are the second most important cause of premature death in Nauruan adults and also the second most important contributor to the years of life lost in adults due to premature death. Stroke was responsible for half of adult deaths from non-rheumatic cardiovascular disease, and it is probable that both hypertension and diabetes contribute to cardiovascular mortality.
 - (c) Hepatitis is an important cause of mortality in both children and adults - particularly males. Further investigation of this problem is warranted and consideration should be given to immunisation of the population.
5. The major causes of mortality in Nauruans are environmental and behavioural factors related to the way of life, and are a consequence of the history, geography and economy of the Republic.
6. A large proportion of premature mortality in Nauru is preventable, particularly accidental death. The difference in the death rate between males and females indicates that current levels of mortality in males are not inevitable.

INTRODUCTION

This report contains an analysis of mortality in Nauru for the period 1976-1981, and a review of previous health and mortality data.

No apology is made for including a review of the history, geography, politics and economy of Nauru. The present patterns of mortality - as well as those in the past - can only be understood in the context of the changes in the way of life in the Republic. These changes have been a consequence of the historical, social and economic forces outlined.

Mortality is inevitable, but premature mortality is not. It is hoped that the description and analysis of premature mortality amongst Nauruans will contribute to the identification of the major health problems in the Republic, and stimulate the application of effective preventive measures.

Diseases made by man are preventable by man, and true development must encompass the social, economic and technical mechanisms for prevention and control of the adverse health effects which may result from improved economic circumstances.

1.1 BACKGROUND

Nauru is a small raised coral atoll just south of the equator (latitude 0°32') in the central Pacific Ocean (longitude 166°56' east of Greenwich). The island is oval shaped and approximately 20 km in circumference (Figure 1). The reef is 100-200 m in width and beyond the narrow beach is a fertile strip of land of 150-300 m which completely encircles the island. There is no large enclosed lagoon and at low tide much of the reef is exposed, although a series of shallow ponds still hold water.

On the inner side of the coastal fringe a coral cliff formation rises abruptly to a height of 15-35 m above sea level, and this marks the edge of the central plateau (also known as "topside") which contains the coral pinnacles and phosphate deposits for which the island is famous. This plateau contains features which range up to 70 m above sea level at the highest point, to the saucer-shaped depression of Buada lagoon which, although within the plateau area, is at sea level.

Much of the central plateau is covered with pinnacles, some of which rise 10-15 m from the floor of the old coral formation. Between these pinnacles phosphate has been deposited, the removal of which leaves a rugged, wasteland terrain which has been described as "moonscape". In the areas not yet mined there is a tangled vegetation which includes the gnarled trunks and dark green leaves of the Tomano tree. In the areas mined some time ago, considerable secondary vegetation is obvious between the pinnacles.

The area around Buada lagoon contains many coconut and other fruit trees, and, apart from the coastal fringe, is the only fertile area on the island. Coconut, pandanus, papaya, banana, plantain, mango and lime trees grow, but except for coconut and pandanus, are present only in small quantities.

The weather is hot and humid, although sea breezes are almost constant. The rainfall is comparatively low and irregular, and since there is no natural catchment, drought can pose a serious problem.

Nauru is divided into fourteen districts; these date from pre-contact times, but were formalised at the time of German annexation of the island in 1888. There were twelve tribes, but two are now extinct. Descent and inheritance is principally matrilineal (Wedgewood, 1936a and 1936b). The Nauruan language is not closely related to any other Micronesian language and, although all Nauruans are fluent in English, the indigenous language is the main form of verbal communication between Nauruans.

Nauru was first sighted by Europeans in 1789 when Captain John Fearn of the Hunter observed that "... on near view it shows a soil, rocky, and for the most part very cragged, appearing so at intervals among the trees, with which it is finely ornamented, but not thickly covered, excepting, however, its low part, close behind a fine beach that surrounds the island. This seems a girdle of larger coconut trees, which regularly lines the beach, and amongst them several smaller trees, of a beautiful deep green foliage; amongst these I saw houses in great numbers, the capacious size and regularity of which bespeaks the possessors not meanly lodged" (Fearn, 1816). He named it Pleasant Island.

There was little contact after Fearn's visit until the 1830s when Nauru became an important source of food and water for whaling vessels in the area. It was during the next forty years that Nauru had sporadic contact with passing trading vessels, and a selection of undesirable Europeans came to live for

extended periods on the island. In 1843 Commander T. Beckford Simpson, Master of the Giraffe, which touched on Nauru on a voyage from Sydney to Manila, wrote in his diary: "This island, and many others in the Pacific, are infested by Europeans who are either runaway convicts, ex-convicts, or deserters from whalers, and for the most part men of the very worst description, who, it appears, prefer living a precarious life of indolence and ease with the unenlightened savage, rather than submit to the salutary laws of civilized society" (quoted in Viviani, 1970). It is likely that some of the Europeans who lived and worked on Nauru subsequently were not too dissimilar in character.

These Europeans brought with them disease, a taste for alcohol, and firearms. By 1864 it was claimed that "many Nauruans suffered from venereal disease, all spoke good English and there was an abundance of firearms in evidence" (Viviani, 1970). Alcohol, in the form of fermented coconut toddy, was said to have been introduced by the Gilbertese (Stephen, 1936), and was taken up avidly by the beachcombers when nothing else was available. It is possible, however, that the Europeans had a greater role in the introduction of fermented toddy, since historical evidence indicates that it was they who introduced its consumption to the Gilbertese (Marshall and Marshall, 1975).

Clan warfare, which had been sporadic in previous times, became more intense and bitter when the Europeans became involved and firearms and alcohol were available. Stephen (1936) refers to this time as the "guns and gin period" and undoubtedly the "Ten Years War" (1878-1888) resulted in much loss of life and suffering. These developments were replicated in many other Pacific islands, for example, Fiji.

The Anglo-German convention of 1886 divided the western Pacific into spheres of influence, but it was not until 1888 that the German gunboat Eber arrived and the island was proclaimed German Territory. The German colonisers found that the island "looked like a battlefield". The 1889 Census enumerated 1294 Nauruans, of whom 1008 were adults and only 286 were children. Women outnumbered men by 30 per cent. With annexation, firearms and alcohol were banned, and the important business of evangelising begun (Viviani, 1970).

Phosphate was discovered in 1900, and mining began in 1906 under the auspices of the Pacific Phosphate Company. Right from the beginning Nauruans played only a small role in the phosphate operations, and Caroline Islanders and Chinese were imported to supply labour.

Nauru was occupied by the Australian expeditionary force in 1914, and the Germans were deported. Under the Treaty of Versailles the sovereignty of Nauru was vested in the British Crown - although it was administered jointly by Australia, New Zealand and Great Britain, which also appointed the three Commissioners of the (now renamed) British Phosphate Company (Pope, 1920-21).

Modernisation of the economy came early in Nauru and by the 1920s the availability of purchasable items increased the demands by Nauruans for higher phosphate royalties, which were at a very low level. Also in the early 1920s the Nauruan Co-operative Store was founded, but not before the instigator, one Timothy Detudamo, was jailed for two years at the first attempt for "disturbing the peace". During the 1920s and 1930s phosphate operations continued and royalty payments to Nauruans slowly rose. Some Nauruans were employed in the administration, or worked for the British Phosphate Company, but expatriates, principally Chinese, continued to form the core of the labour force.

Nauru was occupied by Japanese military forces in 1942, and 1201 adult Nauruans were sent as labourers to Truk in the Carolines, where they suffered

great hardship, and many died. The island was reoccupied by the Australian military in 1945, and the remaining Nauruans on Truk were repatriated. At the beginning of the war the Nauruan population stood at 1848, and at the end, numbered 1278 - a reduction in population of almost one-third (Annual Report 1947/48).

In 1947 an agreement was signed for the administration of Nauru by Australia, New Zealand and the United Kingdom under the United Nations trusteeship system, and phosphate mining and export resumed. This situation continued until independence in 1968. Thus, for over fifty years the colonial administrations "ran a kind of a shell game, fending off awakening Nauruans on one hand and bamboozling successive agencies of the League of Nations and the United Nations on the other. Duly admonished to run the island for the natives' benefit, the administration persuaded itself that it was doing so ..." (Howells, 1981).

Since the early 1900s phosphate has played a major role in the economy and social development of Nauru. Of the total land area 78 per cent is, or was, phosphate bearing. By the opening of the Second World War, 10 per cent of the estimated phosphate reserves had been mined and exported to Australia or New Zealand for agricultural use. The extraction rate increased in the decades following the end of the Second World War, so that by 1980, only ten years' supply of phosphate was left.

There has, for many years, been a comparatively large population of non-indigenous people on Nauru because of the need for labour by the phosphate mining industry. In fact, only half of the population on Nauru was indigenous from the close of World War II until the 1970s. The 1977 Census indicated that the proportion of Nauruans had increased, and comprised almost 60 per cent of the total enumerated on the island (Census, 1977). Prior to 1950 most of the labourers brought to Nauru were Chinese, but in the mid-1950s this trend changed, and there is now a majority of other Pacific Islanders - mainly from Kiribati and Tuvalu (Connell, 1983). Most of the Chinese remaining are shopkeepers, labourers, cooks or restaurant workers.

Nauru became an independent Republic in 1968 with the President elected by the members of the legislature, thus incorporating much of the Westminster style of government.

Since independence, phosphate profits have been passed through the Nauru economy by the Government-owned Nauru Phosphate Corporation. Part of the phosphate profit is used for running the national and local government and social services, part is invested by the government in various enterprises designed to provide Nauru with an income after exhaustion of the phosphate reserves, and a remainder is paid in royalties to the owners of the land that is being mined (Skinner, 1976). Through a complex system of reciprocal responsibilities and via the business of buying and selling, much of the royalty payments, although made to individuals or families, are diffused throughout the Nauru population.

The ready availability of cash has enabled considerable consumption expenditure on imported items such as food, drink, cigarettes, motor vehicles and hi-fi and video equipment. The relative affluence in Nauru has been commented on by several observers, and reference to adverse effects on health and high accident rates as a result of this affluence have been made (McQuade, 1975; Holmes, 1976).

1.2 REVIEW OF PREVIOUS HEALTH AND MORTALITY DATA

(a) Contact to the end of German administration (1914)

The Nauru population at the time of European contact has been put at approximately 1500, and it is likely that there was limitation of the population as a result of circumstantial factors, particularly drought.

High infant mortality is characteristic of isolated and traditional societies in the Pacific, and subsequent observations have suggested that periods of drought (which occur at intervals on Nauru) exacerbate this already high mortality. It was observed during the 1920s and 1930s that drought led to reduction in the supply of coconut toddy, the major source of thiamine (Vitamin B₁), and that mortality from infantile beri-beri (B₁ deficiency) was considerable during periods of very low rainfall (Grant, 1933; Viviani, 1970). Child-spacing customs also probably limited the population, and traditionally there was a taboo on sexual intercourse between birth and when the child could walk (Wedgewood, 1936b) - a sensible provision in a subsistence society.

During the period after contact and prior to German annexation a population decline occurred as a result of introduced infectious disease, and clan warfare, which was exacerbated by alcohol and facilitated by firearms. The 1889 Census counted 1250 Nauruans (including only 250 children), and an excess of women over men of 30 per cent. It is presumed that the deficiency of adult males was due to deaths from fighting during the "Ten Years War". This was not to be the last occasion in which alcohol and imported technology combined to cause considerable mortality in Nauruan males.

Under the German administration, firearms and alcohol were banned and the population slowly rose back to 1500 in 1905 (Figure 2). Small epidemics followed the arrival of ships, and "ten died of influenza when Delaporte the (first) missionary came to Nauru" (Stephen, 1936). Phosphate mining began in 1906, indentured labourers were brought in, and serious epidemics of infectious disease decimated the Nauruan population. In 1907 a dysentery epidemic resulted in 150 Nauruan deaths, and in 1910 an epidemic of infantile paralysis (poliomyelitis) caused 50 deaths (Wedgewood, 1936a). Hambruch (1914-15) noted that in October 1908 an average of four people died per week. This is equivalent to an annual mortality rate of 15 per cent. It can thus be seen that, right from the beginning, phosphate has had a significant effect on the health of Nauruans.

Dr A. Miller, the senior medical officer in Nauru in 1908, was "very sceptical about the long-term survival prospects of the island population and regards its extinction as inevitable" (Hambruch, 1914-15).

(b) The tripartite British Administration 1914-1942

The population recovered somewhat to number almost 1300 in 1913, but was decimated again by the worldwide influenza pandemic of 1919-1920, in which 230 Nauruans died. During the first and second decades of the century, endemic diseases such as yaws, tuberculosis and leprosy were also introduced. The Nauruan population of 1084 in 1921 was the lowest ever recorded (Viviani, 1970).

Debilitation of the survivors of the influenza epidemic was given as one of the reasons for the rise in tuberculosis and leprosy which followed. By 1924, one quarter of the Nauru population were lepers (Austin, 1952). Investigations traced the probable original source to a leprous Gilbertese woman who was

allowed to land in 1911 or 1912, despite the protestations of the medical officer at the time (Morgan, 1923; Bray, 1930). Leprosy was contained, and eventually suppressed in the 1930s by strict isolation of cases and treatment with chaulmoogra oil (Wade and Ledowsky, 1952).

The traditional Nauruan diet consisted mainly of the produce of the coconut tree and fish which were caught from outside the reef, or farmed in Buada lagoon. Pandanus and other fruits, shellfish, and small birds were also eaten. It is not entirely clear when significant changes in diet occurred, but "by 1922 the old foods had increasingly given way to polished rice, sugar, and condensed milk" (Viviani, 1970). The founding of the Nauru Cooperative Store in the early 1920s also probably indicates a significant shift in diet to imported foodstuffs.

In the early 1920s infant mortality was high, and was attributed to pneumonia and gastroenteritis; however, on further investigation, the underlying factor was found to be Vitamin B₁ (thiamine) deficiency. This deficiency was a result of a decline in toddy drinking (the main source of Vitamin B₁) by mothers and babies, and substitution by polished rice - which is without the thiamine found in the husk (Grant, 1933). This is the first documented instance of nutritional disorder in Nauruans resulting from the introduction of imported food.

The problem of infantile beri-beri was solved by increasing the production and consumption of toddy, substituting undermilled rice for polished rice in the stores, and the distribution of an emulsion of fresh yeast, and cod liver oil or coconut toddy to pregnant women and infants (Grant, 1933). Distribution of the ubiquitous "vegemite" was also begun. These measures were successful and by 1927 the infant mortality rate was down to 100 (per 1000 live births), whereas it had been over 300 during most of the early 1920s. Drought, and a consequent decline in the toddy supply, a failure of pregnant women to eat suitable foods, and a prejudice against breast feeding (no doubt due to European examples) were blamed for the resurgence in infant mortality during the mid 1930s (Viviani, 1970).

By 1930, tuberculosis was the greatest killer of adults, and it was managed, as was leprosy, by case detection and isolation. It was not until the 1950s that tuberculosis was controlled by chemotherapy, and the death rate dropped precipitiously. The death rate from tuberculosis during the period 1924-1958 is set out in Table 1.

Neither diabetes mellitus nor hypertension was mentioned by Grant (1933) in his detailed report of a medical survey and review of the available statistics in Nauru during the period 1927-1932.

(c) World War II and Japanese occupation 1942-45

During the Second World War, Nauru was occupied by the Japanese, and 1201 Nauruans were sent to Truk in the Carolines as labourers. Only 759 returned. There were 626 Nauruans left on the island after the relocation to Truk, and at the time of Australian re-occupation three years later this number had been reduced to 589. In three years the population of Nauru has been reduced by almost one-third (Figure 2). If births, which were probably low, are ignored, this is a crude mortality rate in excess of 10 per cent per year. This mortality was attributed by the Australians to "malnutrition, starvation, disease and war atrocities" (Annual Report 1947/48). Although not an unbiased source under the circumstances, they were probably right.

One of the effects of this high wartime mortality, and that of similar high mortality in the past, may have been genetic selection, with survival of those who started out with greater reserves of body fat. This has particular relevance considering the subsequent development of a high prevalence of diabetes mellitus in the population, and in light of the "thrifty gene hypothesis".

(d) The Trust Territory and Australian administration (1947-1968) to the early years of independence (1975)

In 1942 the Nauruan population was over 1800, and by the end of the war (1945) it was 1200. The population then increased quickly, and the psychologically important figure of 1500 was reached again in 1949. Since then, the Nauruan population has increased steadily; it reached 2000 in 1952, 3000 in 1962 and 4000 in 1976. Latest estimates suggest a population of almost 4,700 in 1981 (Figure 2). This population growth is the result of high fertility, and mortality rates (particularly those in infants) which are low in comparison. The rate of population growth was 4.0-4.6 per cent during 1947-1957, 3.7-3.8 per cent during 1957-1967 and 3.3 per cent during 1967-1977. It has been said that the aim of Nauru is to have a population of 10,000, and to achieve this it has been suggested that all women should have seven children, although apparently many women consider that five children is quite enough.

In the examination of previous mortality in Nauruans, one is constrained by the data available and the way in which they were tabulated. The reports on the administration of Nauru to the UN General Assembly contain important information on medical and health matters, and actual data on population, births and deaths for the period 1947/48 to 1967/68 (Annual Reports 1947/48-1957/58). However, breakdown of deaths and population by age, sex and ethnic group is not always available, and thus exact comparisons with later mortality data are not possible. However, much important information is available in these reports and relevant material has been abstracted.

A firm of actuaries - Palmar, Trahair, Owen and Whittle - were engaged by the Nauru Government in the early 1970s to analyse Nauruan vital statistics from the 1960s, and make population projections. They prepared a report which contains data on mortality in Nauruans by age group and sex for the period 1960/61-1969/70 (Palmer et al., 1972), and this information can be directly compared to the all-cause mortality rates found in the present study (1976-1981).

Dr Archie Guinea was Director of Medical Services in Nauru during the early-to-mid 1970s, and produced a report in 1975 which included mortality data (Guinea, 1975). Age and sex-specific numbers of deaths are available for only one year (1974), and so the numbers are small. However, total deaths by sex by cause for 1972, 1973 and 1974 are presented in the report, and this information can be used for comparison with prior and subsequent periods.

To examine mortality in Nauruans it is necessary to aggregate several years in order that numbers of deaths are sufficient to calculate meaningful mortality rates by age group by sex by cause. It would seem that a decade is a suitable period to examine in order to obtain some idea of mortality rates in the various subgroups, and for documentation of secular changes.

Changes in mortality rate and cause of death. The data available indicate a crude mortality rate in Nauruans of 10-11 per 1000 since the close of the Second World War, except for the 1960s, during which period the mortality rate was much lower at 6.8 per 1000 population (Table 2). One would not necessarily expect the crude death rate to fall in a population experiencing a mortality

decline in young persons if the proportion in older age groups increased over the same period. However, the relatively low mortality in Nauru during the 1960s cannot be explained on the basis of demographic changes, and age-specific and age-standardised data to be presented will demonstrate how male adult mortality in Nauruans has significantly increased from the period 1961-1970 to 1976-1981.

There have been important changes in the cause of death in Nauruans since 1947. There are significant problems in comparing different periods because of different systems of reporting deaths and classification of cause of death. In some years between 1947 and 1968, only deaths in hospital are given by cause. In this case the proportionate mortality is calculated excluding non-hospital deaths. However, the total number of deaths (and crude death rates) for the periods between 1947 and 1968 are based on total number of reported Nauruan deaths, and are considered to be accurate and complete (Table 2, Figure 3A).

There have been significant changes in the system of classification of deaths during the period since the end of the Second World War. In the annual reports to the UN (1947-1968) deaths were classified according to the organ system involved, although if the aetiologic organism was known it was classified under infection. Neoplastic disease was classified according to the organ system in which it arose. Stroke was classified under diseases of the nervous system, and enteritis and dysentery were classified under diseases of the stomach and intestines during this period. In the latter period (1972-74 and 1976-81) deaths were classified according to the International Classification of Diseases. Stroke was included in cardiovascular disease and neoplasms classified separately. Dysentery and enteritis were classified under infection.

In the period 1947/48-1957/58 infection was the overwhelmingly major cause of death, and examination of the early records (Annual Reports, 1947/48) reveals that much of this was due to tuberculosis. Accidents and injuries were a minor cause of death. By the 1960s circulatory diseases were the major cause of death, and would have accounted for an even greater proportion if stroke had not been classified with diseases of the nervous system (ranked third). Diseases of the stomach and intestines were the second-most common cause of death and included many cases of gastroenteritis and dysentery. Accidents and injuries ranked fifth after diseases of the respiratory system (fourth). For the period 1972-74 cardiovascular disease, which now included stroke, was the most common cause of death, followed by accidents and injuries.

Preventive measures against communicable diseases. During the late 1940s and 1950s extensive public health campaigns were conducted against tuberculosis, filariasis and leprosy. Total population surveys for case detection, with isolation and chemotherapy where appropriate, were undertaken. Immunisation against tuberculosis, smallpox, diphtheria, pertussis and polio was carried out. Sanitary measures for the control of mosquito breeding sites, and larvae-eating fish were employed. Attention was given to the water supply and the disposal of wastes (Annual Reports, 1947/48-1959/60). Reading between the lines, one gathers the impression that much greater stress was laid on case detection and treatment, than on preventive measures involving environmental improvement or health education. Nevertheless, it is evident that much of this activity was successful, and mortality from infectious disease was considerably reduced during this period.

Nutrition. Dietary factors and nutrition are hardly mentioned in the Annual Reports during most of the 1950s, but the report of 1958/59 notes: "A recent dietary survey showed that the majority of Nauruans obtain the bulk of

their food from stores, that the consumption of fresh foods and home-grown foods such as coconut, pawpaw, bananas, etc., is small, and that fresh fish does not occupy an important place in their diet. The result is that the average Nauruan diet is of high carbohydrate content containing moderate amounts of protein and fat, and although the total caloric intake is adequate, there is a low intake of vitamins A & C". A short report of this survey can be found in the Journal of the (Australian) Commonwealth Department of Health (Kirk, 1958).

A joint dietary committee (which included Head Chief Hammer de Roburt) was established to deal with the problem by "... introducing to the Nauruan community improved dietary habits, and more suitable foods ...". The next report mentions the sale of only vitamin-fortified rice in the stores, and the issue of seven ounces of canned full-cream milk daily to school children. It seems that there was anxiety concerning the possibility of inadequate amounts of protein and vitamins.

Annual reports during the 1960s record further activity in the nutrition area, including dietary instruction in schools, and in adult education classes, and the introduction in nurses' training. Training in home economics and domestic science became available for girls. Presumably most of this activity was directed towards ensuring a balanced diet, and the prevention of deficiency diseases. During 1963/64 "... a series of weekly articles on nutrition was published in English and Nauruan language newspapers. These articles were written by the Government Medical Officer and were designed to present the principles of nutrition, with special emphasis on the problems faced by a highly urbanised island community" (Annual Report, 1963/64).

It was repeatedly stated in the Annual Reports of the mid-to-late 1960s that although rice remained the staple of the Nauruan diet, and the population relied heavily on imported food, a wide range of this food was available "... including refrigerated goods such as fresh meat, fruit and vegetables". It was also claimed that the Nauruan diet had shown "considerable improvement over recent years", and this was attributed to: "the greater diversity of food available, the general advancement in social and economic conditions and the effects of health education". On the other hand it has been observed by Nauruans that, whilst fresh food may have been available during this period, the quantities were always insufficient, the supply irregular, and the price beyond the capacity of many. Although the administration in Nauru undoubtedly made some efforts in the area of nutrition in the wake of the adverse report of 1958, it is likely that the impact of these programmes was not great, and the rather exaggerated reports were designed primarily for consumption at UN headquarters in New York.

The Annual Report of 1965/66 noted that "... a weight reduction clinic was started by the (hospital) matron; the clinic has an enthusiastic following". Local evidence is that such a clinic involved no more than ten people, and lasted approximately one month.

Alcohol. The prohibition of the consumption and possession of intoxicating liquor by the indigenous inhabitants, and certain other people, was imposed by the Arms, Liquor and Opium Prohibition Ordinance of 1936. The prohibition against consumption of alcohol by Nauruans "... has the support of the local Government Council (and) is designed to guard the social and economic welfare of the Nauru community" (UN Visiting Mission, 1959). However, there were complaints that discrimination existed, and that "... Nauruans were denied the privilege of drinking alcohol; this was particularly embarrassing when Europeans and Nauruans mixed together at social gatherings" (UN Visiting Mission, 1959).

The Liquor Ordinance was varied in 1967, less than a year prior to independence, and provision was made for the regulated sale, supply and consumption of alcohol (Annual Report, 1967/68).

Although the reports to the UN Trusteeship Council by the Australian administration over this period 1948/68 contain glowing accounts of their achievements in health matters (and indeed sufficient hyperbole to make even the more naive reader sceptical), visiting UN missions did not find everything to their liking. In particular, it appears that they saw an imbalance between medical services and preventive programmes. In 1956 a visiting UN delegation had to remind the administration that "... preventive measures are no less important than curative measures". And advised: "Health education, emphasising the importance of environmental hygiene, needs to be intensified, and the collaboration of the population, indigenous and immigrant, must be enlisted" (UN Visiting Mission, 1959).

It can be observed that this imbalance between resources allocated to medical services and those allocated to prevention has persisted to the present day, and that there is no lesser need for health education and preventive measures now than there was in 1956.

(e) Recent mortality data and results of medical surveys in Nauru (from 1975)

In the present analysis, which covers the years 1976-1981, accidents and injuries were the major cause of death amongst Nauruans, followed by cardiovascular disease (including stroke), and then neoplastic disease (cancer) - this will be discussed in detail in Part II. The rise of accidents and injuries, from a trivial cause of death in the period 1947/48-1957/58 to the major cause of death in 1976-1981 (Figure 4), is a truly remarkable phenomenon, and has virtually negated improvements in mortality due to reduction in other diseases, particularly tuberculosis and other infections.

By the mid 1970s, it had become obvious that certain non-communicable diseases were prevalent in Nauru, particularly diabetes and cardiovascular disease, and the Government of Nauru sponsored several surveys in order to determine the magnitude of the problem, identify those affected, and define causative factors.

Cross-sectional surveys of Nauruans have revealed a very high prevalence and incidence of non-insulin dependent diabetes (adult-onset type) in the adult population compared to other Pacific Islanders or Caucasians (Zimmet, Taft, et al., 1977; Zimmet, Arblaster, Thoma, 1978; Zimmet, Pinkstone et al., 1982; Zimmet, Taylor, Whitehouse, 1982; Zimmet, King, et al., 1982). The most recent survey in Nauru (1982) revealed a diabetes prevalence of 24 per cent in the adult population (> 20 yrs), and the prevalence of impaired glucose tolerance was 18 per cent - according to the new (1980) World Health Organisation criteria. This is by far the highest prevalence of diabetes recorded in the Pacific region.

These epidemiological studies have also revealed that obesity was very common in the Nauru population, and it is considered that an interaction between this and other environmental influences (such as diet and exercise) and hereditary factors ("diabetic genotype") is responsible for the high prevalence of diabetes.

The same studies also documented raised mean blood pressure levels and a high prevalence of hypertension compared with other populations in the Pacific (Funafuti, Tuvalu) and Australia (Busselton, W.A) (Zimmet, Jackson, Whitehouse,

1980). Both systolic and diastolic blood pressure rose with age - a finding typical of industrialised countries - and there was a strong correlation between the degree of obesity and blood pressure within the Nauruan population. Hyperuricaemia and gout have also been found to be very prevalent amongst Nauruans (Zimmet, Whitehouse, et al., 1978). Nutrient intake studies in Nauru have revealed a considerable intake of imported calories by adults of both sexes, and high alcohol usage in the men (Ringrose, Zimmet, 1979).

Part II

MORTALITY ANALYSIS 1976-1981

2.1 METHODS

(a) Enumeration of deaths

All available information on deaths, from 1976-1981 inclusive, was obtained. The analysis started with 1976, since this is the first year for which completed death certificates are available. Although deaths were officially registered for part of this period, it was thought advisable to go to the primary source rather than use data produced by the registrar. It was found that there was a discrepancy between the number of deaths registered in 1976-78 and the number of deaths enumerated during the mortality investigation, such that only 83 per cent of actual deaths were registered (Table 3). Death registration ceased in 1978, as it was considered that these were being recorded by the Medical Department and registration involved duplication of work.

Deaths were enumerated for this mortality investigation by examining all available death certificates and other relevant documents during this period, with particular attention to Nauruans. Most Nauruan deaths occurred in the Nauru General Hospital (NGH), or the body was brought to the hospital after death. A few deaths of Nauruans occurred in the Nauru Phosphate Commission Hospital (NPCH), and these were located and included in the analysis. Some Nauruan deaths occurred outside of Nauru, particularly in hospitals in Melbourne. However, the body was generally returned to Nauru for burial and a death certificate was made out at the NGH. Moreover, it was apparent from the case-notes of the deceased if they had been transferred to Melbourne and died there, even if a death certificate was not completed in Nauru.

All available patient records were examined, as well as post-mortem reports, results of supplementary tests or biopsies sent elsewhere, and summaries of hospital admissions and investigations from Melbourne. Furthermore, all medico-legal documents were examined; these included accident reports and post-mortem examinations performed on the order of the coroner. Table 4 sets out the original material from which the mortality information was obtained. In some instances death certificates were available, but case-notes were not, and the reverse. The proportion of deaths enumerated without death certificates during the period under study was 6 per cent. Errors in the counting of deaths, if they occurred, would be all on the side of under-enumeration, and therefore there may be a slight underestimate in the mortality findings.

Details of age, sex, ethnic group and cause of death were cross-checked between the various documents available. The underlying cause of death was assigned after examination of all the evidence available, and following discussion between the SPC Epidemiologist and the Director of Medical Services, who knew most of the cases personally. Each death was assigned a three-digit International Classification of Diseases (ICD) number using the ninth revision (WHO 1977). All deceased who were known diabetics were tagged, irrespective of the assigned cause of death.

Most of the non-Nauruan deaths took place in the Nauru Phosphate Corporation Hospital. It was not possible to obtain details of age or sex on many of these deaths. Furthermore, this group consisted of an ethnic mixture of I-Kiribati, Tuvaluans, Chinese and Europeans, most of whom are resident in Nauru for a maximum of six years. There is a constant turnover in this population and many who are ill and unfit for work return home prematurely. Only a cursory mortality analysis has been undertaken on this group, with no attempt to construct death rates by age groups. Proportional mortality from the various causes will be presented.

Ethnic group is usually not indicated on death certificates in Nauru and non-Nauruan deaths at the Nauru General Hospital were picked out on the basis of their names by the staff, and Nauruan deaths at the Nauru Phosphate Corporation Hospital were likewise singled out on the basis of name.

(b) Enumeration of births

Enumeration of births for the purposes of this study was also via the hospital records. Most Nauruan births take place in the Nauru General Hospital; however, during part of 1978 and 1979 the maternity ward was closed for renovation. During this period all births in Nauru took place in the Nauru Phosphate Corporation Hospital; this is reflected in the figures presented in Table 5 which sets out Nauruan births 1976-81 by sex and hospital of birth. It is apparent that there is under-registration of births, and between 1976 and 1980 only 87 per cent of live births enumerated through the hospital system were registered (Table 6). Although it is possible that some births and early infant deaths occurred outside of the hospital system, these numbers must be very small. Information on the number of births per year by sex was used for the calculation of infant mortality rates, and for population projections.

(c) Validation of death

An attempt was made to validate the information abstracted from death certificates and medical records by examining graves or burial records. The graveyards were spread out around the island, and often the graves were unmarked, or contained little information, and therefore it was decided not to follow this line of investigation further.

The Catholic Church had complete burial records, and the years 1976-1981 were examined. A total of 67 Nauruan deaths were recorded in the Catholic burial register (Table 7). According to the 1977 Census, Catholics comprise 32.6 per cent of the Nauruan population, and so the expected number of Catholic Nauruan deaths for 1976-1981 would be 89 if this proportion was applied to the total number of deaths (273). We can conclude that either Catholics have a lower death rate than the rest of the population, Catholics were over-enumerated or other denominations under-enumerated in the 1977 Census, there is a difference in those who nominate themselves as Catholic in the Census and the religion chosen by the family for burial rites after death, or the Catholic burial records were incomplete. At least it is not evident that the mortality investigation under-enumerated deaths, since the predicted number of total Nauruan deaths for 1976-81 using the figures for Catholics would be only 206.

The age structure of those who received Catholic burials is roughly similar to that of the total enumerated deaths, particularly in the males, in which group the numbers are adequate for comparison purposes (Table 7). Furthermore, the higher number of deaths amongst males relative to females observed in the total sample was found in the Catholic burials as well. In fact, the male:female ratio amongst Catholic burials is even higher than that in the total sample.

From this validation exercise we can conclude that it does not appear that we under-enumerated deaths, or that the sex ratio (with a marked preponderance of males) found in the total enumerated deaths is spurious.

There does not appear to be any particular reason for preferential recording of male deaths, and since Nauruan society is nominally matrilineal this would not necessarily be expected.

(d) Calculation of Nauruan population in age and sex brackets for each year 1976-81

The Nauruan population in the various age and sex brackets was estimated from calculations based on the 1977 Census (22 January 1977). The stratified population was first corrected for 6.9 per cent under-enumeration (the proportion of Census forms not filled out correctly) assuming that this under-estimation was distributed according to the age/sex distribution of the Census. This formed the base (end-1976) population from which subsequent estimations were made.

Populations for subsequent years were constructed by: (1) adding on to the numbers in each age bracket the annual population growth (or births), (2) deducting the yearly deaths in that age/sex bracket, and (3) deducting the population which "aged" out of this bracket into the next bracket during the year. For the purposes of calculating the numbers "ageing" in and out of the age brackets, the distribution of the population within each age bracket was considered to be even. Estimation of the end-1976 population was accomplished in the reverse fashion.

Mid-year populations were then estimated for each age/sex bracket by averaging the end-year populations (Table 8). The numbers at risk over the six-year period, which is the appropriate denominator for calculating death rates based on the 1976-81 aggregated deaths, were calculated as the sum of each mid-year population for each age/sex bracket. The denominator for the calculation of the infant mortality rate 1976-81 was the aggregated births for the same period.

Although the population estimates involved certain assumptions (which are obviously not entirely valid), and certain approximations, it is considered that the results are likely to be reasonably close to the actual situation. In any case, since the numerators used for the calculation of rates are small in comparison to the denominators, minor variation in the population estimates will not have a marked effect on the resulting proportion.

In December 1980, a small Census was taken of those ≥ 20 years for the purpose of establishing a voter's role for the election. The total number of Nauruans aged 20 or over was found to be 2095 at this Census. The predicted number in this age group at that time, according to the calculations mentioned above, was 2049 (assuming that half the 15-24 year-old age group was ≥ 20 years). Thus our calculations may be a slight underestimate of the population, but seem to be reasonable.

(e) Data analysis and statistics

Information on age group, sex, ethnic group, cause of death (ICD three-digit code), year of death, place of death (NGH or NPCH) and known diabetes status of each case was recorded on individual cards with marginal perforations which were subsequently punched according to a set code. The punching was checked for errors. Cases could then be sorted in various ways for tabulation, and subsequent calculation of rates in various subgroups.

Some of the results are presented as age-standardised rates. These rates are age-standardised using the direct method, and 10-year mid-decade age

brackets, to the 1976-81 Nauruan population structure. The standard error of the rates and the chi square for the difference between directly age-standardised rates were calculated according to the method described by Armitage (1971). It could be argued that statistical tests are unnecessary since we are dealing with the universe of Nauruan deaths over the period 1976-81, and not a sample. However, they have been included to highlight the possible significance of comparisons based on small numbers.

Abridged life tables were assembled from the death rate data according to the method described by Barclay (1958). The probability of dying within certain age intervals, and the expectation of life at various exact ages are presented.

2.2 ALL-CAUSE MORTALITY AND LIFE EXPECTANCY

The deaths enumerated by age group by sex by year are displayed in Table 9. There were 273 Nauruan deaths in the period 1976-81. The most striking feature is the difference between the number of male and female deaths in the adult age range (15-64 years). Of the 162 deaths in adults between 1976 and 1981, only 36 were female. The difference between male and female mortality, which is the most important finding of this report, will be discussed in more detail when death rates are presented, since the complement of females is a little less than the male population.

There were 33 infant deaths in the period under study - 45 per cent occurred in those aged one week or less, 18 per cent in those aged between one week and one month, and the balance (77%) in those over one month of age (Table 10).

The all-cause Nauruan mortality rate for 1976-1981 by age group and sex is presented in Table 11 and Figure 5. The most striking feature is the much higher mortality rate in young and middle-aged males, compared to females. The ratio of male:female mortality rates is greatest in the 35-44 year-old age group, in which the mortality rate in men is almost six times that of females. In the other adult age groups (except the \geq 65 years bracket) male mortality rate is approximately 3 to 4 times that of the female rate. Although numbers are not large, these male/female differences are consistent through each of the years 1976-81 (Table 12), and in all adult age groups less than 65 years. The ratio of male to female mortality rates by age group is set out graphically in Figure 6.

Comparison of Nauruan age- and sex-specific all-cause mortality for 1976-81 with Australian rates for 1976-79 is made in Figure 5. It can be seen that Nauruan mortality rates are higher than those in the Australian population - particularly for males and particularly in the young adult and middle age groups. In the 25-34 year age group the Nauruan male mortality rate is 12 times that of the Australian male rate.

The age-standardised mortality rates for all ages, and adults (aged 15-64) in Nauru and Australia by sex are set out in Table 13 and Figure 7. When mortality rates are averaged in this fashion it can be seen that adult male Nauruan mortality is 3.3 times as high as in female Nauruans, and 5.5 times as high as in Australian males. Mortality in adult Nauruan females is also higher than in Australian females (mortality ratio is 3.5).

It is possible to compare age- and sex-specific all-cause Nauruan mortality in 1976-81 to that of the period 1960/61-1969/70 using the data of Palmer et al., (1972). This comparison is set out in Figures 8 and 9. Male mor-

tality was considerably higher in 1976-81 compared to the 1960s, with a maximum difference in the 25-34 year age group, where the 1976-81 mortality rate was 3.6 times that of the previous period. Female mortality in the adult age groups in 1976-81 was less than that in 1960/61-1969/70 period.

A comparison of age-standardised mortality in Nauruan adults aged 15-54 in 1960/61-1969/70 and 1976-81 is presented in Table 14 and Figure 10. It can be seen that, while adult female mortality has declined (halved) during this period, adult male mortality has increased (doubled).

The changes in Nauruan mortality between 1960/61-1968/70 and 1976-81 are dramatic, and the first question to ask is : are they real? While we can be reasonably confident about the 1976-1981 mortality rates and the reality of the sex differential, one has to be less confident concerning the information from the 1960s - if only because the data were collected and processed by others 10 to 20 years ago. While we know that during part of the 1970s there was under-registration of deaths (an average of 83% of deaths were registered), this would not explain the 1960s mortality figures, even if under-registration of this degree had occurred during this period. It is reasonable to assume that under-registration of deaths was less of a problem prior to independence (1968), when the administration during this period had to present annual reports to the Trusteeship Council of the UN General Assembly. It is also worthy of note that under-registration of deaths during the 1970s was equal for males and females, and therefore it is unlikely that differential under-registration has caused the reversal in male/female mortality ratios observed between the two decades.

Both the mortality data contained in the report of Palmer et al. (1972) and the annual reports to the UN General Assembly (although probably derived ultimately from the same source) indicate a low mortality rate in Nauruans during the 1960s. It is concluded that the differences in the pattern of mortality between the 1960s and 1976-81 are most likely real and significant.

Mortality rates of each year within the 1976-1981 period were examined in certain age/sex subgroups. Because the numbers are small the rates are unstable, but no obvious trends over time were observable (Table 12).

Life tables have been constructed from the Nauruan death rates for the period 1976-1981 and the average expectation of life at various ages is set out in Table 15. The life expectancy at birth is 49 years for Nauruan males and 62 years for Nauruan females - a difference of 13 years in life expectancy.

A comparison of life expectancy of Nauruans with other Pacific populations is set out in the Appendix. It can be seen from these data that Nauruan males have one of the lowest life expectancies (at birth) in the Pacific, comparable to Kiribati and Papua New Guinea. The life expectancy of 37 years for Nauruan males at age 15 years is the lowest recorded in the region, and is a consequence of the heavy adult mortality. Female life expectancy in Nauru, both at birth and at age 15 years, is similar to many other Pacific populations.

2.3 MORTALITY BY CAUSE IN THE VARIOUS MAIN AGE GROUPS

To make sense of cause-specific mortality data, it is preferable to examine certain age ranges and sex groups separately, so that the aggregations (which are necessary to ensure sufficient numbers in the various subgroups) have more meaning. The period of life to be examined will be:

- (a) infancy (less than age 1 year)
- (b) childhood 1-14 years

- (c) adulthood 15-64 years
- (d) old age \geq 65 years

(a) Infant mortality by cause

The infant mortality rate during 1976-81 was 31 per 1000 live births (Table 10). The rate was 35 in males and 27 in females (Table 11). It appears that infant mortality rates have not changed very much since 1960-67 (see Figure 11). Of all the infant deaths, 46 per cent occurred in the first week, 64 per cent occurred in the first month, and the balance (36%) was recorded later in the first year (Table 10). It is generally considered that early deaths are related to maternal factors and conditions and complications of pregnancy and childbirth, and are amenable to improved obstetric care. Later infant deaths are considered to be related to external factors, and should respond to improvement of the environment and improved medical and child care. Conditions of the perinatal period (48%) and infections (30%) were the main cause of death in infants (Table 16). Gastroenteritis was responsible for half of the deaths from infection. While these infant mortality rates are higher than those in Australia, they are in line with those in many reasonably developed Pacific countries. At least half of the infant deaths should be preventable.

(b) Childhood mortality by cause

There is little difference in mortality between Nauruan males and females in the age group 1-14 years. The mortality in the 0-14 year age group was higher in the 1976-1981 period compared with the 1960s, though the numbers involved are small. Mortality was higher in childhood in Nauru compared to Australia in both sexes.

One-third of the childhood mortality in Nauru (1976-81) was due to accidents, and another third attributable to infection (Table 17). Viral hepatitis accounted for half of the infectious deaths. Injuries from motor vehicle accidents were the most common cause of death, and control of these and hepatitis are the most urgent preventive measures in this age group.

(c) Adult mortality by cause (age 15-64 years)

Mortality in the adult age group is considerably higher in males compared to females, and mortality is higher in Nauruans of both sexes compared to Australians. The Nauruan male adult mortality has increased since the 1960s, and female mortality has declined.

Analysis of deaths by cause (Table 18) indicates that in males accidents were the main cause of mortality and responsible for 28 per cent of deaths, followed by diseases of the circulatory system (21%), cancer (12%), diseases of the digestive system (9%) and acute liver failure (8%). In females, accidents were again the major cause of death (20%), followed by diabetes (14%) and diseases of the circulatory system (10%).

It should be noted that the relative importance of the various causes of death depends to a large extent on how they are aggregated and the system used for assigning the underlying cause of death. Thus, if diabetes and diabetes-related deaths are lumped with deaths from cardiovascular disease, then this group would account for approximately 30 per cent in males (similar to accidents) and 25 per cent in females. If all cases of acute liver failure are labelled as hepatitis and included with infection, then this cause of death would account for about 10 per cent of deaths in both sexes.

Estimations are made in subsequent sections of the likely contribution of diabetes-related and alcohol-related deaths to overall adult mortality by reassigning cause of death in some or all cases in the various diagnostic subgroups. The contribution of high blood pressure to mortality is also more obvious when similar calculations are made for hypertension-related deaths.

Calculations have been made of the years lost by adult Nauruans aged 15 years through premature death, assuming a life expectancy of 65 years - which should not be an unreasonable expectation in a country like Nauru. These calculations reveal that almost 40 per cent of the years lost in males are due to accidents and injuries and 20 per cent due to cardiovascular disease and diabetes; while in females 34 per cent of the years lost are due to accidents and injuries and 30 per cent due to cardiovascular disease and diabetes (Table 19, Figure 12). The greater prominence of accidents and injuries when the results are expressed in this way, is due to the fact that death from these causes generally occurs at a younger age, and thus the years of life lost are greater for each death than is the case for cardiovascular disease, diabetes or cancer.

It is instructive to look at the excess deaths by cause in adult males compared to females (Table 20, Figure 13). Accidents accounted for 30 per cent of the excess male deaths, cancer and diseases of the circulatory system (including heart disease and stroke) accounted for 16 per cent each, and diseases of the digestive system including cirrhosis and acute liver failure, accounted for 20 per cent of the excess male deaths.

(d) Mortality in the aged by cause (> 65 years)

Mortality in this age group was similar in males and females. The major cause of death was diseases of the circulatory system (M 35%, F 39%), followed by diseases of the respiratory system (M 12%, F 22%), ill-defined conditions, including senility, (M 19%, F 17%) and cancer (M 8%, F 9%). There were no accidental deaths in this age group (Table 21).

2.4 MORTALITY FROM ACCIDENTS AND INJURIES

The major cause of death in Nauruans in the period 1976-1981 was accidents and injuries. Accidents were equal to infection as a cause of death in children, were the most frequent cause of death in adult Nauruans (aged 15-64 years), and were the major contributor to years of life lost by premature mortality in both sexes and to the excess of adult male deaths over females. In both children and adults 60 per cent of accidental deaths involved motor vehicles. Drowning was the second most common form of accidental death.

An analysis of accidents involving motor vehicles reveals that collisions with another vehicle were an uncommon reason for death. Pedestrians accounted for a quarter of road accident fatalities (Table 22). Loss of control, running off the road or collision on the road, but not involving another vehicle or pedestrian, accounted for 65 per cent of the non-pedestrian road deaths. Again, excluding pedestrian deaths, 65 per cent of fatal accidents involved motorcycles. Adult male mortality from motor vehicle accidents is much higher amongst Nauruans than Australians - the ratio of mortality rates varies from 3.5 to 12.0 in the various age groups (Table 23). On the basis of the age-specific mortality from road accidents in Australian males one would have expected 4.2 deaths in the Nauru male population (1976-81); there were, however, 21 - an indirect standardised mortality ratio of 5.1. The age-adjusted mortality rate in

Nauruan males in the adult age group is also five times that of Australian males (for motor vehicle accidents).

The day of the week that deaths due to motor vehicle accidents occurred was examined. Not all fatal accidents resulted in death on the same day as the accident, but date of the accident was often not readily available. The analysis reveals that the average fatalities from motor vehicle accidents on Monday through to Thursday was 3 per day, while the average fatalities for Friday through Sunday were 6 per day (aggregated for the period 1976-81). More deaths from motor vehicle accidents occurred on a Friday than any other day. It is clear that weekends are a high risk period for mortality from motor vehicle accidents.

The exact contribution of alcohol to death from motor vehicle accidents and other accidents and injuries could not be determined with any accuracy from the material available. However, alcohol was known to be an important contributing factor in many of these deaths. In a later section an estimation will be made of the probable contribution of alcohol-related deaths to total adult mortality.

Accidental deaths are largely preventable through a combination of public education, physical protective measures such as seat belts or pedestrian crossings, and restrictive legislation to control irresponsible or drunk driving.

2.5 MORTALITY FROM CARDIOVASCULAR DISEASE

Cardiovascular disease is the second major cause of death in Nauruans overall, the second major cause of death in adults aged 15-64, and the primary cause of death in the elderly. Two adult deaths in each sex were attributed to chronic rheumatic valvular heart disease.

Stroke accounted for almost half of the premature adult deaths from non-rheumatic disease, and the rest were ascribed to cardiac infarction, heart failure or hypertensive disease. The same pattern was evident in the elderly. Since many of the strokes were probably associated with hypertension, and since hypertension contributes to cardiac infarction and failure, it can be concluded that this condition is a major cause of cardiovascular death. Mortality from stroke was much higher in Nauru than Australia, particularly in the middle age range 45-64 years (Table 24). Inadequately controlled hypertension is probably a major contributor to this difference.

Diabetes also contributes to cardiovascular death by its association with arterial disease, which leads to stroke and cardiac infarction.

Acute myocardial infarction (heart attack) was given as a cause of death much more frequently in men than in women, which is consistent with the known predisposition of males to coronary heart disease.

Many of these cardiovascular deaths are preventable by proper nutrition, maintenance of normal weight, physical fitness and the treatment of hypertension and diabetes if they occur.

2.6 MORTALITY FROM LIVER DISEASE

Mortality from diseases of the liver is a cause of considerable concern in Nauru. There appear to be two reasonably distinct categories:

- (a) Acute liver failure in those who are known to have pre-existing liver disease (hepatitis);
- (b) Chronic liver failure and complications due to cirrhosis.

(a) Acute liver failure (hepatitis)

Deaths from acute liver failure by age and sex are tabulated in Table 25. It can be seen from this table that mortality from this cause is twice as common in males than in females overall, and that this male:female differential is most marked in the 15-34 year age group (9 male deaths to 2 female deaths).

Each of the 18 deaths due to acute liver failure were reviewed in detail. There were 4 in 1976, one in both 1977 and 1978, 4 in 1979, 3 in 1980, and 5 deaths in 1981. From the information available it was considered that the diagnosis was a little suspect in four cases, particularly an elderly woman who had an E. coli urinary tract infection and considerable leukocytosis (20,000 per cu.mm), and who may have had septicaemia and secondary toxic liver damage.

All the cases were jaundiced and developed delerium or coma during their illness. Most were febrile at some stage. In some cases abdominal pain and tenderness, anorexia, nausea and vomiting or weakness were recorded. Bilirubin and serum enzyme (SGOT, SGPT, Alkaline phosphatase) levels were available in 15 cases out of the 18. However, in some instances the information was incomplete, or the enzyme tests had been performed without dilution, and the actual degree of elevation was not known. In some cases liver function tests did not appear to have been very abnormal, but it was not clear when these tests were taken during the course of the illness. Hepatitis B Antigen was present in 8 out of the 11 cases tested. A post-mortem biopsy in one case revealed "necrosis".

In the 15-34 year age group, recent heavy alcohol intake was mentioned in 6 of the 9 male deaths, and in neither of the two female deaths. There was a strong familial tendency, with 4 of the deaths from one extended family, and 3 of the deaths from another.

It is probable that these deaths were due to viral hepatitis, but the sex distribution is puzzling. The numbers are relatively small, and perhaps the difference is fortuitous. On the other hand, the possibility that this sex difference is due to the effect of alcohol intake cannot be dismissed.

(b) Cirrhosis

Cirrhosis was responsible for 8 deaths, 7 of which were in males (Table 26). Although cirrhosis can result from several conditions, chronic infection with Hepatitis B being one, the connection of this disease with excessive alcohol consumption is well known. It was recorded in the case-notes that all those who died from cirrhosis were heavy drinkers, and the male:female ratio is consistent with this cause.

Using the age-specific death rate from cirrhosis in Australian males aged 15-64, it can be estimated that less than one death from cirrhosis would be expected in the Nauru population over the period 1976-81. However, there were 7 male deaths from cirrhosis, which yields an indirect age-standardised mortality ratio of 11:3.

Overall diseases of the liver are a significant cause of death in Nauruans, especially males. It appears that both viral hepatitis and alcohol are involved. Further investigation of the hepatitis deaths is required.

2.7 MORTALITY FROM AND WITH DIABETES

Diabetes is recognised to be a common medical problem amongst adult Nauruans. Recent surveys have revealed a prevalence of 25-30 per cent of the population aged $>$ 20 years (Zimmet et al., 1977-1982). Because of the system used for recording cause of death, the actual contribution of diabetes to mortality is underestimated. Although death from uncontrolled metabolic states or specific complications of diabetes (e.g. kidney failure) will be recorded as a diabetic death, diabetes may contribute to mortality from cardiovascular disease or infection, and in these instances diabetes will not be assigned as the main cause of death. To obviate this problem to some extent, data on mortality from and with diabetes will be presented.

It can be seen from Table 27 that many of the deaths in known diabetics were probably attributable in part to diabetes, even though this was not coded as the main cause of death. The two cases of septicaemia and the cases of meningitis due to mastoiditis, and cholecystitis due to gallstones, were probably partly a result of increased susceptibility to infection due to diabetes. It is likely that diabetes contributed to the arterial disease (atheroma) which led to coronary heart disease and stroke. Furthermore, some of the seven cases of renal failure in males were probably due to diabetes, even though a definitive diagnosis of diabetic renal disease was not made.

The role of diabetes in the cause of infection, stroke and renal failure (cause not designated) is obvious from Table 28. Although this table does not take into account differences in age distribution between diabetic and non-diabetic deaths, there appears to be an excess of mortality attributable to infection, renal failure (cause undetermined) and stroke amongst diabetic deaths compared to non-diabetic deaths.

To estimate total diabetes-related mortality we can allocate all the deaths in diabetics assigned to renal failure (cause undetermined) and infection (excluding hepatitis but including meningitis, peritonitis, pneumonia and cholecystitis), and half the deaths from stroke and coronary heart disease, to the diabetes category. The total adult ($>$ 15 years) deaths due to diabetes are then: males 26 (17%), and females 11 (19%). This is perhaps a more realistic figure for the contribution of diabetes to mortality in adult Nauruans.

2.8 ALCOHOL-RELATED MORTALITY

The contribution of excessive consumption of alcohol to mortality is even more difficult to determine than that of diabetes. It was noted that all those who died from cirrhosis were heavy drinkers, and two of the three fatal cases of pancreatitis were "alcoholic". Both of these conditions are known to be alcohol-related in many instances. There was one case of "poisoning" due to alcohol, and there was circumstantial evidence that some deaths from ill-defined conditions in males may have been alcohol-related.

In Australia, it has been determined that 50 per cent of motor vehicle accident fatalities are related to drunkenness (House of Representatives Standing Committee on Road Safety, 1980) and this is probably the case in Nauru - although the proportion may be higher. Furthermore, it is likely that some cases of mortality from drowning and falls were alcohol-related.

It is difficult to determine the contribution of alcohol to the deaths from acute liver failure (hepatitis). However, the predominance of male deaths, and the history of recent heavy alcohol intake in some cases, indicate the probable role of alcohol.

A calculation has been made of the possible number of alcohol-related deaths by making assumptions as to the role of alcohol in the various cause of death categories. These assumptions are based on (a) knowledge of individual circumstances from the medical record, and (b) assumptions used in Australia for making similar calculations (Commonwealth Department of Health, 1979). It is estimated that 20 per cent of adult (age \geq 15 years) male deaths and 9 per cent of adult female deaths may be alcohol-related. In the age range 15-64 years the estimates of the proportion of alcohol-related deaths are 23 per cent for males and 14 per cent for females (Table 29). This may be an underestimate if it is the case that a higher proportion of accidental deaths are alcohol-related than the assumptions used for these calculations.

2.9 CANCER MORTALITY

Deaths from cancer comprised 12 per cent of adult male deaths between the age of 15-64 years, but deaths from this cause were infrequent in females. One third of male cancer deaths were from lung cancer. If an Australian lung cancer age-specific death rate had applied in Nauru, the expected number of deaths from this cause would have been 1.1 in adults (15-64 years) during the period 1976-81. There were, in fact, 5 Nauruan male deaths from lung cancer, which yields a standardised mortality ratio of 4.5. It is likely that cigarette smoking is a major contributing factor in these deaths.

2.10 DEATH FROM AND WITH KIDNEY FAILURE

Kidney failure is commonly associated with mortality in Nauruan adults. Deaths with renal failure are displayed in Table 30. It appears that most of the chronic renal failure is associated with systemic disease such as diabetes and hypertension, rather than with intrinsic kidney disease such as chronic nephritis. The acute renal failure may also be associated mainly with systemic disease rather than intrinsic renal disease, although this is less clear.

2.11 MORTALITY IN NON-NAURUANS

Because of the mixed and unstable nature of the non-Nauruan community in Nauru, no attempt will be made to construct death rates for this segment of the population. Furthermore, difficulty was experienced in obtaining the age and sex of the deceased in many instances. Proportionate mortality by cause for both sexes and all ages and ethnic groups combined is presented in Table 31. There were 73 non-Nauruan deaths enumerated for the period 1976-81.

Diseases of the circulatory system were the most common cause of death (29%). Ischaemic heart disease contributed half of these deaths, and stroke was the other major cause in this group. The second major cause of death was conditions of the perinatal period (21%), and this was followed by accidents and injuries (18%). It is worthy of note that approximately one third of the deaths in the accident and injury group were due to motor vehicle accidents, and one third due to suicide.

PART III

CONCLUSIONS AND RECOMMENDATIONS

3.1 CONCLUSIONS

The most striking finding of this report is the high mortality amongst Nauruan male adults for the period 1976-81. Nauruan male mortality in the 15-64 year age group was three times higher than in females, and over five times higher than the mortality rate in Australian males. In certain age groups mortality ratios are even higher. The life expectancy at birth of Nauruan males is 49 years, and the life expectancy for females is 62 years. The life expectancy for male at age 15 is the lowest recorded in the Pacific region. Comparison of mortality during 1976-81 with data from the 1960s indicates that adult male mortality has risen (doubled), and adult female mortality fallen (halved) over this period.

Analysis of deaths by cause has revealed that accidents and injuries are the most important cause of death in children and adults, are the most significant contributor to years of life lost in adults from premature death and account for a large proportion of the difference between adult male and female mortality. Motor vehicle accidents are the most common reason for accident and injury, and alcohol appears to be involved in many cases. Mortality from motor vehicle accidents in Nauruan male adults (aged 15-64 years) was five times higher than for Australian males. Mortality from accidents and injuries is largely preventable.

Cardiovascular disease and diabetes are the second most important cause of premature death in Nauruan adults. Separate calculations of diabetes-related deaths reveal that diabetes is a significant contributor to premature mortality in adults. A significant proportion of mortality from cardiovascular disease and diabetes should be preventable.

Hepatitis is an important cause of mortality in both children and young adults - particularly males. Further investigation of this problem is warranted in order that preventive measures (such as immunisation) can be formulated and implemented.

It can be seen from our review that mortality in the Nauruan population over the last 100 years has been linked to important political and economic factors, and in particular the development of the phosphate industry. In the early years of the century, indentured labourers for the phosphate mines brought infectious disease, epidemics of which decimated the Nauruan population. Since independence, increased affluence - in the absence of sufficient cultural, social or legal protective mechanisms - has led to epidemics of accidents and diseases associated with the changed way of life.

Much of the present premature mortality in Nauru is preventable, particularly accidents in adult males. Preventive activity will need to be on a community as well as an individual level, and specific actions have been outlined in the section on recommendations. The difference between male and female death rates indicates that current level of mortality in males is not inevitable.

3.2 RECOMMENDATIONS

(a) Increased emphasis on prevention

Since a large proportion of premature mortality in Nauruans is preventable, a section in the health department responsible for prevention, and a person designated to initiate and co-ordinate activities, are required. A

doctor and a health educator should be involved in organising preventive campaigns.

(b) Reduction of mortality from accidents and injuries

The most urgent health priority in Nauru is reducing the death rate in adult males, which is of alarming proportions. The most important cause of premature mortality in adults (and children) is accidents and injuries. A large proportion of these accidents is associated with motor vehicles, and many are alcohol-related.

Measures to be considered for reducing mortality from motor vehicle accidents include:

- (i) A speed limit of 40 kph (approx. 25 mph) on all roads on the island. This should be enforced by appropriate monitoring - including radar devices if necessary. Speed limit sign posts should be erected at suitable intervals.
- (ii) The size of motor cycles should be limited to 90 cc.
- (iii) All adult road accident victims (drivers and pedestrians) should be screened by breathalyser testing, and those found to be positive should supply a specimen of blood for alcohol determination. Facilities for blood alcohol measurement should be developed at the laboratory of the Nauru General Hospital. Driving or riding a motor vehicle with more than 0.05 per cent of alcohol in the blood should be an offence.
- (iv) Consideration should be given to random breathalyser testing during certain periods to detect those driving under the influence of alcohol (e.g. weekends - particularly in the evening).
- (v) A public education campaign concerning road safety and the dangers of driving under the influence of alcohol should be started. Road signs urging careful driving should be erected. School children should be included in the road safety campaign.
- (vi) More training for the police in road safety techniques and the detection and prevention of dangerous driving should be provided.
- (vii) The use of seat belts by drivers and passengers in cars, and the wearing of crash helmets for motor cyclists should be made compulsory.
- (viii) Road signposting should be improved with: marked pedestrian crossings; warning signs near schools, churches, shops; STOP and GIVE WAY signs at intersections; traffic lights; etc.

Reducing mortality from accidents and injuries, other than those related to motor vehicles, should be tackled by a public education campaign concerning the need for safety, particularly in respect of children. Schools should be included in this campaign.

(c) Prevention and control of cardiovascular disease and diabetes

Cardiovascular disease and diabetes are prominent causes of premature mortality in Nauruan adults, and appropriate prevention and control measures should be instituted.

The environmental and behavioural factors implicated in the cause of hypertension, diabetes, and coronary heart disease are:

- . obesity
- . diet high in animal fats and cholesterol, sucrose, calories and salt; and low in complex carbohydrate and fibre
- . insufficient physical exercise
- . tobacco smoking
- . excessive alcohol consumption.

Prevention and control measures involve:

- . primary prevention: designed to prevent the occurrence of these diseases. This involves good nutrition (diet low in animal fat, calories, salt and sucrose, and high in complex carbohydrate and fibre), the prevention of obesity, maintenance of physical fitness, and cessation of smoking.
- . secondary prevention: designed to prevent the development of complications - particularly from hypertension and diabetes. This involves detection and treatment of those affected.

More detail on the control of non-communicable diseases will be provided in a separate report.

(d) Further investigation of the hepatitis problem

Before definite recommendations for the prevention and control of hepatitis can be made, further investigation is required. However, measures to improve standards of hygiene, both personal and in food preparation, as well as attention to water supply and sanitation, will contribute to the control of this disease.

It is recommended that a register be kept of all cases of hepatitis and blood specimens from all cases and contacts should be sent to Dr Ian Gust, Fairfield Hospital of Infectious Diseases, Melbourne, Australia. Furthermore, a post-mortem examination (or a post-mortem liver biopsy) should be performed on all fatal cases of hepatitis.

Consideration should be given to immunisation of the population against Hepatitis B.

3.3 CONSTRAINTS

It is necessary to mention two factors which may be important impediments to preventive action in Nauru. Firstly, there appears to be some loose talk of "human rights" in the Republic, the implication being that people should be free to behave how they like, without interference from government. This attitude appears to be interfering with the protection of human rights of others - particularly the right of pedestrians (including children) and other road users to be protected from those who drive in a dangerous way, or under the influence of alcohol.

The second factor which may mitigate against preventive action is the commercial pressure which results from a high level of consumption expenditure in Nauru. There are influential pressure groups that are involved in the marketing of motorcycles, alcohol, cigarettes and other potentially health damaging products, and these groups may resist measures that are designed to decrease consumer expenditure in these areas.

It is necessary to be explicit concerning these impediments to prevention, because they will need to be overcome by those whose task is to protect the public health.

POSTSCRIPT: NAURUAN DEATHS 1982

Nauruan deaths for the period January to August (inclusive) 1982 were analysed to determine if the trends documented in the 1976-81 analysis were continuing.

A total of 29 Nauruan deaths were enumerated through hospital records and death certificates for the eight-month period. All except two of the deaths occurred at the Nauru General Hospital or received a death certificate from this source. The other two deaths were located at the Nauru Phosphate Corporation Hospital. The estimated total for the year 1982, based on the numbers in the first 8 months, is 44 deaths. This is in line with previous years.

Of the Nauruan deaths enumerated, 21 were male and 8 female; a ratio of 2.6:1. Accidents and injury accounted for 34 per cent of all deaths, 24 per cent were due to cardiovascular disease or diabetes, and 14 per cent were due to acute liver failure (hepatitis). There were 2 deaths from "alcoholic poisoning".

From this cursory analysis it appears that the same trends documented in the 1976-81 mortality analysis are continuing.

BIBLIOGRAPHY

- Annual Reports 1947/48 to 1967/68 to the General Assembly of the United Nations on the administration of the Territory of Nauru. Commonwealth of Australia, Government Printer.
- Armitage, P. (1971). Statistical methods in medical research. Oxford: Blackwell Scientific Publications.
- Austin, C. (1952). Leprosy on the Island of Nauru. South Pacific Commission Technical Paper, 24. Noumea: South Pacific Commission.
- Barclay, G.W. (1958). Techniques of population analysis. New York: John Wiley & Sons.
- Bray, G. (1930). The story of leprosy at Nauru. Proceedings of the Royal Society of Medicine 23: 26-30.
- Census 1977 in the Republic of Nauru, preliminary report. Republic of Nauru: Department of Island Development and Industry.
- Commonwealth Department of Health (1979). Alcohol in Australia. A summary of related statistics. Canberra: Australian Government Publishing Service.
- Commonwealth of Australia. Causes of death 1976 to 1979. Canberra: Australian Bureau of Statistics (ABS).
- Connell, J. (1983). (In press). Nauru, In Migration, employment and development in the South Pacific. Noumea: South Pacific Commission and International Labour Organization.
- Fearn, Capt. J. (1816). Remarks on a voyage from New Zealand to the China Seas. Oriental navigator In Annual Report 1947/48.
- Grant, A. (1933). A medical survey of the Island of Nauru. Medical Journal of Australia 1(4): 113-118.
- Guinea, A. (1975). Morbidity, mortality and epidemiological statistics. Republic of Nauru: Department of Health.
- Hambruch, P. (1914-1915). Nauru In Thilenius G. Ergebnisse der Sudsee Expedition 1908-1910, II B Band 1, 2 parts. pp.458, 314.
- Holmes, M. (1976). This is the world's richest nation - all of it. National Geographic 150(3): 344-353.
- Howells, W. (1981). The good fortune of Nauru. Harvard Magazine, November-December 1981: 40-48.
- Kirk, N. (1958). Nutrition in native peoples. Some observations on the food habits of Nauruans. Health 8(3): 79-82.
- Marshall, M., Marshall, L. (1975). Opening Pandora's bottle: reconstructing Micronesians' early contacts with alcoholic beverages. Journal of the Polynesian Society 84(4): 441-465.

- McQuade, W. (1975). The smallest richest republic in the world. Fortune, December 1975: 132-140.
- Morgan, F. (1923). Leprosy in Nauru. Proceedings of the Pan Pacific Science Congress (Australia) 1419-1429.
- Palmer, R., Trahair, G., Owen, W., Whittle, B. (1972). Report to the Chief Secretary on vital statistics of Nauru population. Melbourne: Palmer, Trahair, Owen and Whittle.
- Pope, H. (1920-21). Nauru and Ocean Island (their phosphate deposits and workings). Journal of the Department of Agriculture of Victoria 19(8): 3-16. Also published as Command Paper 148 Parliament of Australia, 13 October 1922.
- Report of the House of Representatives Standing Committee on Road Safety (1980). Alcohol drugs and road safety. Canberra: Australian Government Publishing Service.
- Ringrose, H., Zimmet, P. (1979). Nutrient intakes in an urban Micronesian population with a high diabetes prevalence. American Journal of Clinical Nutrition 32: 1334-1341.
- Skinner, C. (1976). Nauru. The remarkable community. Journal de la Société des Océanistes XXXII: 105-109.
- Stephen, E., (1936). Notes on Nauru. Oceania 8(1): 34-63.
- United Nations Visiting Mission to the trust territories of Nauru, New Guinea and the Pacific Islands (1959). United Nations Trusteeship Council Official records, Twenty-fourth session. Supplement No.4. New York.
- Viviani, N. (1970). Nauru: phosphate and political progress. Canberra: Australian National University Press.
- Wedgewood, C. (1936a). Report on research work in Nauru Island, Central Pacific (Part D. Oceania 6(4): 359-391.
- Wedgewood, C. (1936b). Report on research work in Nauru Island (Part II). Oceania 7(1): 1-33.
- WHO (1977). Manual of the international statistical classification of diseases, injuries and causes of death. Ninth revision (1975). Geneva: World Health Organization.
- WHO (1980). World Health Organization Expert Committee on Diabetes Mellitus (second report). WHO Technical report, 646. Geneva: World Health Organization.
- Zimmet, P., Taft, P., Guinea, A., Guthrie, W., Thoma, K. (1977). The high prevalence of diabetes mellitus on a Central Pacific Island. Diabetologia 13: 111-115.
- Zimmet, P., Arblaster, M., Thoma, K. (1978). The effects of westernization on native populations: Studies of a Micronesian community with high diabetes prevalence. Australian and New Zealand Journal of Medicine 8:141-146.

- Zimmet, P., Pinkstone, G., Whitehouse, S., Thoma, K. (1982). The high incidence of diabetes mellitus in the Micronesians of Nauru. Acta diabetologica latina 19: 65-74.
- Zimmet, P., Taylor, R., Whitehouse, S., (1982). Prevalence rates of impaired glucose tolerance and diabetes mellitus in various Pacific populations according to the new WHO criteria. Bulletin of the World Health Organization, 60: 279-282. Geneva: World Health Organization.
- Zimmet, P., King, H., Taylor, R., Balkau, B., Raper, L., Borger, J., Heriot, W. (1982). The exceptionally high prevalence of abnormal glucose tolerance and diabetic retinopathy in the Micronesian population of Nauru. Sydney and Palmerston: Australian Diabetes Society and New Zealand Society for the Study of Diabetes.
- Zimmet, P., Jackson, L., Whitehouse, S. (1980). Blood pressure studies in two Pacific populations with varying degrees of modernization. New Zealand Medical Journal 91: 249-252.
- Zimmet, P., Whitehouse, J., Whitehouse, S., Thoma, K. (1978). High prevalence of hyperuricaemia and gout in an urbanised Micronesian population. British Medical Journal 1:1237-1239.

T A B L E S

NAURUAN MORTALITY 1976 - 1981

Table 1MORTALITY FROM TUBERCULOSIS IN NAURUANS 1924-1958

PERIOD	Number of deaths	Mean deaths/year	Crude death rate (per 1000 population)
1924-1929	24	4.0	3.1
1930-1934	36	7.2	5.1
1935-1940	44	7.3	4.4
WW II	n.a.	n.a.	n.a.
1948-1953	35	5.8	3.6
1954-1958	3	0.6	0.3

All ages, both sexes

n.a. = not available

Table 2

CRUDE DEATH RATE IN NAURUANS 1947-1981

PERIOD	MALES		FEMALES		BOTH SEXES	
	Deaths	Rate	Deaths	Rate	Deaths	Rate
1947/48 - 1957/58	-	-	-	-	207 (18.8)	11.0
1958/59 - 1967/68	-	-	-	-	144 (14.4)	6.0
1961 - 1970	106 (10.6)	7.1	87 (8.7)	6.4	193 (19.3)	6.8
1960/61 - 1969/70	113 (22.6)	12.4	75 (15.0)	8.9	178 (35.6)	10.2
1976-1981	185 (30.8)	13.8	88 (14.7)	7.0	273 (45.5)	10.5

Rate : per 1000 population

() Mean number of deaths per year during the period

From Annual Reports 1947/48-1966/68
Palmer et al 1972
Guinea 1975

Table 3

COMPARISON OF DEATHS REGISTERED AND DEATHS ENUMERATED*, NAURUANS 1976/78
 (all ages)

YEAR	Death registration			Mortality investigation		
	Male	Female	M + F	Male	Female	M + F
1976	20	16	36	22	18	40
1977	29	12	41	31	15	46
1978	26	7	33	37	10	47
Total 76-78	75	35	110	90	43	133

* Enumerated deaths obtained by examination of all available death certificates and hospital case-notes during mortality investigation.

Proportion of enumerated deaths registered 1976-78:

Male 83%
 Female 81%
 Male+Female 83%

A
 +
 *

Table 4

SOURCES OF DATA AVAILABLE ON MORTALITY IN NAURUANS 1976-81

	Total deaths enumerated +	Number of death certificates	Number of case-notes reviewed	Number of post-mortem reports	Number of deaths registered*
1976	40	37	21	2	36
1977	46	46	34	9	41
1978	47	44	45	9	33
1979	31	25	30	1	-
1980	50	46	44	14	-
1981	59	59	43	5	-
Total 1976-81	273	257	217	40	110 Δ

Proportion of enumerated deaths without death certificate = 6%

Proportion of deceased case-notes reviewed = 79%

Proportion of post-mortem examinations performed on deceased = 15%

Proportion of enumerated deaths registered (1976-78) = 83%

Δ 1976-78.

+ All death certificates or case-notes.

* From records of the Registrar.

Table 5

NAURUANS LIVE BIRTHS IN HOSPITAL 1976-1981

YEAR	NAURU GENERAL HOSPITAL		NAURU PHOSPHATE CORPORATION HOSPITAL		TOTAL
	MALE	FEMALE	MALE	FEMALE	BOTH SEXES
1976	61	62	14	8	145
1977	73	80	7	6	166
1978	47	39	49	38	173
1979	85	64	25	23	197
1980	74	87	16	14	191
1981	73	91	13	15	192

From hospital records.

Table 6

ENUMERATED NAURUAN LIVE BIRTHS IN HOSPITAL^{*} AND REGISTERED NAURUAN LIVE BIRTHS 1976-1981

Year	Total enumerated hospital live births	Registered births ⁺	Proportion (%) of enumerated births registered
1976	145	116	80
1977	166	137	83
1978	173	158	91
1979	197	182	92
1980	191	166	87
1981	192	NA	-
1976-1980	872	759	87

NA = Not available.

^{*} From hospital records.

⁺ From records of Registrar.

Table 7

COMPARISON OF TOTAL ENUMERATED NAURUAN DEATHS AND NAURUAN CATHOLIC BURIALS 1976-1981

Age group	Males				Females			
	Enumerated deaths		Catholic burials		Enumerated deaths		Catholic burials	
	No.	%	No.	%	No.	%	No.	%
< 1	19	10	2	4	14	16	2	14
1-14	14	8	4	8	15	17	1	7
15-34	49	26	14	26	14	16	2	14
35-54	52	28	14	26	12	14	1	7
55+	51	28	18	34	33	38	8	57
Unknown age	-	-	1	2	-	-	-	-
Total	185	100	53	100	88	100	14	100

Male:Female ratio

Age group	Enumerated deaths	Catholic burials
All ages	2.1	3.8
Adults ≥15 years	2.6	4.2

Table 8
 ESTIMATED MID-YEAR NAURUAN POPULATION 1976-1981
 BASED ON EXTRAPOLATIONS FROM THE 1977 CENSUS USING BIRTHS AND DEATHS ENUMERATED THROUGH HOSPITAL RECORDS AND ASSUMPTIONS REGARDING AGEING

Year	0 - 4		5 - 14		15 - 24		25 - 34		35 - 44		45 - 54		55 - 64		65 +		Total 0-65 +		Total 15-64		1 - 4	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
mid-1976	335	320	569	541	528	516	208	190	189	130	156	130	43	53	46	26	2074	1906	1124	1019	268	256
mid-1977	360	329	581	552	528	518	235	218	190	137	156	129	51	58	48	27	2149	1968	1160	1060	288	263
mid-1978	370	340	593	563	529	519	261	247	191	146	154	129	55	62	49	31	2202	2037	1190	1103	296	272
mid-1979	394	351	606	574	535	522	285	274	194	155	153	130	59	68	51	34	2277	2108	1226	1149	315	281
mid-1980	413	371	623	585	541	526	304	297	200	166	152	133	64	73	54	38	2331	2189	1261	1195	330	297
mid-1981	415	396	642	599	545	530	319	321	207	179	150	134	69	78	54	42	2401	2279	1290	1242	332	317
Total 1976-1981	2287	2107	3614	3414	3206	3131	6121	1547	1171	913	921	785	341	392	302	198	13454	12487	7251	6768	1829	1686
(mid-year population)	4394		7028		6337		3159		2084		1706		733		500		25941		14019		3515	

Table 9
NAURUAN DEATHS BY AGE GROUP AND SEX 1976-1981, ALL CAUSES

	1-4		5-14		15-24		25-34		35-44		45-54		55-64		65+		15-64 (Total adults)		0-65+ (Total)	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1976	2	3	1	1	5	1	3	2	3	-	1	2	2	1	3	8	14	6	22	18
1977	2	3	-	-	7	2	2	1	5	1	4	3	4	3	4	3	23	8	31	15
1978	8	2	1	1	2	1	3	-	4	-	6	1	8	3	4	1	23	5	37	10
1979	2	1	-	2	-	-	2	1	5	1	4	-	4	-	2	4	15	2	21	10
1980	2	2	1	2	3	3	10	2	1	1	6	-	6	2	5	2	26	8	35	15
1981	3	3	1	2	5	1	7	-	5	-	7	5	1	1	8	5	25	7	39	20
TOTAL 1976-81	19	14	4	8	22	8	27	6	23	3	29	9	25	10	26	23	126	36	185	88

Table 10

DISTRIBUTION OF NAURUAN INFANT DEATHS BY AGE
1976-1981

Year	Neonatal deaths				Other infant deaths		Total infant deaths
	0-1 week		>1 week <1 month		>1 month- <1 year		
	M	F	M	F	M	F	
1976	2	1	-	-	-	2	5
1977	1	-	1	2	-	1	5
1978	5	1	1	-	2	1	10
1979	2	-	-	-	-	1	3
1980	-	-	-	1	2	1	5
1981	-	3	1	-	2	-	6
Total 1976-1981	10	5	3	3	6	6	33
	15		6		12		
Proportion (%)	46		18		36		100

Table 11
NAURIAN DEATHS AND DEATH RATE BY AGE GROUP AND SEX, 1976-1981

	<1*		0-4		5-14		15-24		25-34		35-44		45-54		55-64		65+		Total 0-65+		15-64 Total adults		1-4		15-54		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
Deaths 1976-1981	19	14	23	22	10	7	22	8	6	27	6	23	3	9	25	10	26	23	185	88	126	36	4	8	101	26	
Population or Births* 1976-1981	537	527	2287	2107	3614	3414	3206	3131	1547	1612	1547	913	1171	785	341	392	302	198	13454	12487	7251	6768	1829	1686	6910	6376	
Mortality Rate per 1000	35.38	26.57																									
	31.02		10.06	10.44	2.77	2.05	6.86	2.56	3.88	16.75	3.29	19.64	31.49	11.46	73.30	25.51	86.09	116.16	13.75	7.05	17.38	5.32	2.19	4.74	14.62	4.08	
Ratio of M:F mortality rates	1.33		0.96		1.35		2.68		4.32		5.97		2.75		2.87		0.74		1.95		3.37		0.46		3.58		

* Births are used as the denominator for the calculation of infant mortality rates.

Table 12

ALL-CAUSE NAURUAN MORTALITY RATES (PER 1000) FOR EACH YEAR 1976-81

	< 1 ^a	0 - 4		0 - 14		15 - 44		45 - 64		15 - 64		0 - 65	
		M + F	M + F	M + F	M	F	M	F	M	F	M	F	
1976	34.48	10.68	1.84	11.89	3.59	15.08	16.39	11.57	5.89	10.6	9.4		
1977	30.12	8.71	1.78	14.69	4.58	43.48	21.39	19.83	7.55	14.4	7.6		
1978	57.80	16.90	2.32	9.17	1.10	67.00	20.94	19.33	4.53	16.8	4.9		
1979	15.23	6.71	2.82	6.90	2.10	37.74	0.00	12.23	1.74	9.2	4.7		
1980	20.94	7.65	2.72	13.40	6.07	55.56	9.71	20.62	6.69	14.9	6.9		
1981	31.25	11.10	4.23	16.33	6.07	36.53	28.30	19.38	5.64	16.2	8.8		

Deaths per 1000 live births.

Table 13

AGE STANDARDIZED MORTALITY RATES IN NAURU AND AUSTRALIA

National/sex group	All ages		Age 15-64	
	Rate (per 1000)	SE	Rate (per 1000)	SE
<u>Nauruans</u>				
Male	13.55	0.98	17.46	1.53
Female	7.40	0.77	5.25	0.87
<u>Australians</u>				
Male	3.55	0.01	3.17	0.01
Female	2.26	0.01	1.15	0.01

Age-standardized to the total 1976-1981 Nauruan population using 10 year mid-decile age brackets (except the 0-4 range), by the direct method.

SE: Standard Error.

Rate: per 1000.

All differences between the various groups are significant to $p < 0.001$.

Table 14

AGE-STANDARDIZED MORTALITY RATES IN NAURUAN ADULTS
(AGED 15-54 YRS) IN 1961-1970 AND 1976-1981

Years	Male		Female	
	Rate	SE	Rate	SE
1961-1970	6.40	1.09	8.16	1.32
1976-1981	14.38	1.42	4.13	0.81

Rate: per 1000 .

Table 15

ABRIDGED LIFE TABLES FOR NAURUANS

EXPECTATION OF LIFE AT VARIOUS AGES AND PROBABILITY OF DYING DURING VARIOUS INTERVALS (estimated from 1976-1981 death rates)

Expectation of life (years) at various ages			Probability of dying during certain age intervals		
Exact age	Males	Females	Age intervals	Males	Females
0	48.9	62.1	0 - <1	0.0348	0.0262
1	49.6	62.8	1 - 5	0.0087	0.0188
5	46.1	59.9	5 - 14	0.0273	0.0202
15	37.2	51.1	15 - 24	0.0666	0.0253
25	29.5	42.3	25 - 34	0.1560	0.0382
35	23.9	32.5	35 - 44	0.1807	0.0324
45	18.0	23.4	45 - 54	0.2757	0.1092
55	12.7	15.6	55 - 64	0.5404	0.2290
65	11.6	8.6	\geq 65	1.0000	1.0000

Table 16

CAUSES OF DEATH, NAURUAN INFANTS (AGE < 1 YEAR) 1976-1981

ICD code	Cause of death	Number of deaths	Proportion of total (%)
001-139	<u>Infections</u>		
	Intestinal infections	5	
	Septicaemia	1	
	Toxoplasmosis	1	
	Bacterial meningitis	1	
	Pneumonia	<u>2</u>	
	Total	10	30
760-799	<u>Perinatal conditions</u>		
	Short gestation and low birth weight	9	
	Intrauterine hypoxia and birth asphyxia	5	
	Other respiratory perinatal conditions	<u>2</u>	
	Total	16	48
	<u>Other causes</u>		
	Marasmus	1	
	Congenital anomalies	2	
	Suffocation	3	
	Unknown	<u>1</u>	
	Total	7	21
	<u>All causes</u>	33	100

Table 17

MORTALITY BY CAUSE IN NAURUAN CHILDREN (AGES 1-14), 1976-1981

ICD code	Cause of death	Number of deaths	Proportion of total (%)
001-139	<u>Infection</u> (10)		35
	Gastroenteritis	1	
	Septicaemia	2	
	Viral hepatitis	5	
	Intestinal helminths	2	
140-239	<u>Neoplasm</u> (1)		3
	Lymphoma or leukaemia	1	
320-389	<u>Diseases of the Nervous System</u> (2)		7
	Encephalitis and myelitis	1	
	Infantile cerebral palsy	1	
390-459	<u>Diseases of the circulatory system</u> (2)		7
	Chronic rheumatic valvular heart disease	1	
	Diseases of pulmonary circulation	1	
780-799	<u>Ill-defined conditions</u> (4)	4	14
E800-E999	<u>Accidents</u> (10)		35
	Motor vehicle accidents	6	
	Drowning	4	
	<u>All causes</u>	29	100

C
a
1

16

24

25

32

390

393

401

Table 18

MORTALITY BY CAUSE IN NAURUAN ADULTS (AGED 15-64) 1976-1981

ICD code	Cause of death	Numbers of deaths and proportion (%) of total	
		Males	Females
001-139	<u>Infections</u> (M3, F2. Ratio = 1.5)	(2.3%)	(5.6%)
	Pulmonary tuberculosis	1	-
	Septicaemia	1	1
	Varicella (chickenpox)	1	1
070 and 570	<u>Acute liver failure</u> (hepatitis) (M10, F2. Ratio = 5.0)	10 (7.9%)	2 (5.6%)
140-239	<u>Cancer</u> (M15, F1. Ratio = 15.0)	(11.9%)	(2.8%)
	Lip, tongue, mouth, pharynx	2	-
	Oesophagus	1	-
	Stomach	1	-
	Colon, rectum, anus	1	-
	Liver	1	-
	Pancreas	2	-
162	Bronchus and lung	5	1
	Kidney	1	-
	Leukaemia and lymphoma	1	-
240-279	<u>Endocrine and metabolic</u> (M6, F5. Ratio = 1.2)	(4.7%)	(13.9%)
250	Diabetes mellitus	6	5
320-389	<u>Nervous system and sense organs</u> (M4, F0)	(3.2%)	-
	Bacterial meningitis	1	-
	Infantile cerebral palsy	1	-
	Epilepsy	1	-
	Mastoiditis	1	-
390-459	<u>Circulatory system</u> (M26, F12. Ratio = 2.2)	(20.6%)	(9.5%)
393-398	Chronic rheumatic valvular heart disease	2	2
401-405	Hypertensive heart and/or renal disease	3	-

Table 18
page 2

ICD code	Cause of death	Numbers of deaths and proportion (%) of total	
		Males	Females
410	Acute myocardial infarction	6	1
415	Acute pulmonary heart disease	2	-
426 and 428	Heart failure and conduction disorders	3	3
430-438	Acute cerebrovascular disease	10	6
460-519	<u>Respiratory system</u> (M5, F2. Ratio = 2.5)	(4.0%)	(5.6%)
416 and 490-496	Cor pulmonale/chronic obstructive lung disease	2	1
480-487	Pneumonia	3	1
520-579	<u>Digestive system</u> (M11, F1. Ratio = 11.0)	(8.7%)	(2.8%)
	Peptic ulcer	1	-
	Peritonitis	1	-
571	Cirrhosis	7	1
	Pancreatitis	2	-
580-629	<u>Genito-urinary system</u> (M5, F2. Ratio = 2.5)	(4.0%)	(5.6%)
584	Acute renal failure	3	-
585	Chronic renal failure	2	1
590	Renal infection	-	1
780-799	<u>Ill-defined conditions</u> (M6, F2. Ratio = 3.0)	(4.8%)	(5.6%)
798	Sudden death	2	1
799	Unknown cause	4	1
E800-E999	<u>Accidents</u> (M35, F7. Ratio = 5.0)	(27.8%)	(19.4%)
E810-E825	Motor vehicle accidents	21	4
	Poisoning	1	-
	Misadventures during medical care	2	1
	Falls	3	2

Table 18
Page 3

ICD code	Cause of death	Numbers of deaths and proportion (%) of total	
		Males	Females
E910	Drowning	5	-
	Suicide	1	-
	Brawl	1	-
	Electrocution	1	-
	All causes	126 (100%)	36 (100%)

Table 19

YEARS OF LIFE LOST BY ADULT NAURUANS (AGE \geq 15 YRS) FROM VARIOUS CAUSES
CALCULATED FROM THE AGE DISTRIBUTION OF 1976-81 DEATHS, ASSUMING A LIFE
EXPECTANCY OF 65 YEARS

ICD code	Cause of death	Years of life lost			
		Males		Females	
		No.	%	No.	%
E810-E825	Motor vehicle accident	715	23	160	19
E826-E999	Other accidents and injury	450	15	125	15
E800-E999	All accidents and injuries	1165	38	285	34
390-459 and 250	Cardiovascular disease and diabetes	575	19	250	30
070 and 570	Acute liver failure (hepatitis)	360	12	90	11
520-579	Disease of digestive system (incl. cirrhosis)	205	7	15	2
140-239	Cancer	140	5	20	2
	Others	625	20	170	20
	Total	3070	100	830	100

Table 20

EXCESS DEATHS BY CAUSE IN NAURUAN ADULT MALES COMPARED TO FEMALES (AGE 15-64)

ICD code	Cause of death	Number of excess deaths	Proportion of all excess deaths (%)
001-139	Infection (excluding hepatitis)	1	1.1
070 and 570	Acute liver failure (hepatitis)	8	8.9
140-239	Neoplasms (cancer)	14	15.5
250	Diabetes mellitus	1	1.1
320-389	Nervous system	4	4.4
390-459	Circulatory system	14	15.6
460-519	Respiratory system	3	3.3
520-579	Digestive system (including cirrhosis but excluding acute liver failure)	10	11.1
580-629	Genito-urinary system	3	3.3
780-799	Ill-defined conditions	4	4.4
E800-E999	Accidents	28	31.1
	All causes	90	100

Table 21

MORTALITY BY CAUSE IN THE NAURUAN AGED (≥ 65 YEARS) 1976-1981

ICD code	Cause of death	Numbers of deaths and proportion % of total	
		Males	Females
001-139	<u>Infections</u> (M2, F1. Ratio = 2.0)	(7.5%)	(4.5%)
	Gastroenteritis	1	-
	Varicella	-	1
	Filariasis	1	-
140-239	<u>Neoplasms</u> (M2, F2. Ratio = 1.0)	(7.7%)	(8.8%)
	Colon, rectum, anus	-	2
	Pancreas	1	-
	Brain	1	-
240-279	<u>Endocrine and metabolic</u> (M2, F0)	(7.7%)	-
250	Diabetes mellitus	2	-
320-389	<u>Nervous system</u> (M0, F1)	-	(4.3%)
	Disease of the spinal cord	-	1
390-459	<u>Circulatory system</u> (M9, F9. Ratio = 1.0)	(34.6%)	(39.1%)
410	Acute myocardial infarction	2	-
415	Acute pulmonary heart disease	-	1
	Heart failure and conduction disorders	4	3
436	Acute cerebrovascular disease	3	5
460-519	<u>Respiratory disease</u> (M3, F5. Ratio = 0.6)	(11.5%)	(21.7%)
416 and 496	Cor pulmonale/chronic obstructive lung disease	1	2
480-487	Pneumonia	2	3
520-597	<u>Digestive system</u> (M1, F1. Ratio = 1.0)	(3.8%)	(4.3%)
	Pancreatitis	1	-
	Cholelithiasis (gall stones)	-	1

Table 21
Page 2

ICD code	Cause of death	Numbers of deaths and proportion (%) of total	
		Males	Females
580-629	<u>Genito-urinary system</u> (M2, F0)	(7.7%)	-
584	Acute renal failure	2	-
580-799	<u>Ill-defined conditions</u> (M5, F4. Ratio = 1.3)	(19.2%)	(17.4%)
797	Senility	4	3
799	Unknown	1	1
	All causes	26 (100%)	23 (100%)

Table 22

MORTALITY FROM MOTOR VEHICLE ACCIDENT (ICD E810-E825)
NAURUANS 1976-81, BY TYPE OF ACCIDENT

Type of accident	Deaths	Proportion of total (%)
Collision with another vehicle	2 (2)	6.5
Collision with a pedestrian	8 (0)	25.8
Collision on the road, but not with another vehicle or pedestrian	7 (5)	22.6
Loss of control, or ran off road	8 (5)	25.8
Unspecified	6 (3)	19.4
Total	31 (15)	100.0

Figures in brackets () refer to deaths in which motor cycles were involved. However, the vehicle was not always identified, and therefore the number of motor cycle-associated deaths may be an underestimate.

Table 23

COMPARISON BETWEEN MALE MORTALITY FROM MOTOR VEHICLE ACCIDENTS⁺
IN NAURU AND AUSTRALIA

Age group	Nauru (1976-81)		Australia (1976-79)	Ratio Nauru: Australia
	Deaths	Rate (per 1000)	Rate (per 1000)	
15 - 24	10	3.12	0.88	3.5
25 - 34	4	2.48	0.40	6.2
35 - 44	3	2.56	0.27	9.5
45 - 54	3	3.25	0.27	12.0
55 - 64	1	2.93	0.35	8.4 (NS)
Age standardized* rate (15 - 64)		2.90	0.58	5.0
Indirect age standardized mortality ratio(15-64)		-	-	5.1

+ Motor vehicle traffic and non-traffic accidents (ICD E810-825).

* Standardized by the direct method to the total Nauruan age structure 1976-81.

All differences between Nauruans and Australians are significant at $p < 0.001$, except in the 55-64 age group (NS).

Table 24

MORTALITY FROM CEREBROVASCULAR DISEASE (STROKE)[‡]
IN NAURU AND AUSTRALIA (MALES AND FEMALES COMBINED)

Age group	1976-81 Nauru		1976-79 Australia Rate (per 1000)	Mortality ratio Nauru: Australia
	Deaths	Rate (per 1000)		
35 - 44	1	0.48	0.13	3.7 NS
45 - 54	7	4.10	0.39	10.5
55 - 64	8	10.91	1.13	9.7
65+	8	16.00	8.94	1.8
Age standardized* rate 35 - 65+		4.78	1.2	4.0
Indirect age standardized** Mortality ratio 35 - 65+		-	-	3.9

* Age standardized by the direct method to the total Nauruan population 1976-81 age 35 - 64+.

** Expected number of cases in Nauruan population if Australian age-specific rates prevailed would be 6.2.

All differences in rates between Nauru and Australia are statistically significant at $p < 0.001$, except for the age group 35 - 44 years.

‡ ICD codes 430-438.

Table 25

DEATHS DUE TO ACUTE LIVER FAILURE (HEPATITIS)*
NAURUANS 1976-81

AGE GROUP	NUMBER OF DEATHS	
	MALES	FEMALES
1 - 4	-	1
5 - 14	2	2
15 - 24	4	2
25 - 34	5	-
35 - 44	-	-
45 - 54	-	-
55 - 64	1	-
65+	-	1
TOTAL	12	6

* ICD Code 070 (viral hepatitis) and 570
(acute and subacute necrosis of the liver).

Table 26

DEATHS FROM CIRRHOSIS OF THE LIVER*
NAURUANS 1976-81

AGE GROUP	NUMBER OF DEATHS	
	MALES	FEMALES
25 - 34	3	-
35 - 44	4	-
45 - 54	-	1
TOTAL	7	1

Expected number of male cirrhosis deaths in Nauruan males aged 15-64 if the age-specific death rate in Australia was applied = 0.62.

Since the actual number was 7 the standardized mortality ratio is 11.3.

* ICD Code 571 (Chronic liver disease and cirrhosis).

Table 27

CAUSES OF DEATH IN NAURUANS WHO WERE KNOWN DIABETICS, 1976 - 1981

Cause of death	Number of deaths	
	Male	Female
Diabetes (combinations of renal failure, hyperglycaemia & infection)	8	5
Septicaemia	1	1
Tuberculosis	1	-
Filariasis	1	-
Enteritis	1	-
Cancer (3 lung, 1 kidney, 1 tongue)	5	-
Meningitis due to mastoiditis	1	-
Hypertensive disease	3	-
Ischaemic heart disease	2	-
Pulmonary embolism	2	-
Heart failure	1	-
Cerebrovascular disease (stroke)	5	9
Peptic ulcer	1	-
Peritonitis	1	-
Cirrhosis	1	2
Cholelithiasis (gall stones)	-	1
Chronic pancreatitis	2	-
Acute renal failure	5	-
Chronic renal failure	2	-
Chronic bronchitis/Cor pulmonale	-	1
Pneumonia	1	-
Accidents	1	2
Acute liver failure (hepatitis)	2	-
Total	47	23

Table 28

COMPARISON OF VARIOUS CAUSES OF DEATH IN KNOWN DIABETIC AND NON-DIABETIC ADULTS ≥ 15 YRS

ICD code	Cause of death	Known Diabetics	Non-Diabetics
250	Diabetes	13	-
001-139 and 320-326	Infection (including meningitis, excluding hepatitis)	6 (11)	2 (1)
140-239	Cancer	5 (9)	15 (11)
401-429	Non-Rheumatic cardiovascular disease (excluding stroke)	8 (14)	20 (14)
430-438	Stroke	14 (26)	10 (7)
584 & 585	Acute & chronic renal failure (without identifiable cause)	7 (12)	1 (1)
070 & 570	Acute liver failure (Hepatitis)	2 (4)	10 (7)
E800-E999	Accidents	3 (5)	39 (28)
	Others	12 (21)	44 (31)
	Total deaths not assigned directly to diabetes	57 (100)	141 (100)

() proportion %.

Table 29

POSSIBLE ALCOHOL-RELATED DEATHS, NAURUANS ADULTS (AGE \geq 15 YRS)
1976 - 1981

ICD Code	Cause of Death	Males	Females
571	Cirrhosis (100%)	7	1
070 & 570	Acute liver failure/ hepatitis (50%)	5	1
577	Pancreatitis (100%)	3	-
E810-E825	Motor vehicle accident (50%)	10.5	2
E860	Alcohol poisoning (100%)	1	-
	Other accidents, excluding misadventures during medical care (20%)	2.2	0.4
428	Heart disease, not labeled as to cause (10%)	0.7	0.6
798 & 799	Ill-defined cause (25%)	1.3	0.5
	Total	30.7	5.5

The proportion of deaths which may be attributed to alcohol is given in brackets.

These deaths comprise 20% of deaths in adult males and 9% of deaths in adult females (age \geq 15 years).

In the 15-64 year age bracket it is estimated that 29.5 deaths related to alcohol occurred in males (23%), and in females 5 occurred within this age range (14%).

Table 30

DEATHS IN ASSOCIATION WITH KIDNEY FAILURE IN NAURUANS ADULTS AGE \geq 15 YEARS
1976 - 1981

ICD code	Cause of death	Male	Female
	<u>Deaths assigned to renal failure</u>		
584	Acute renal failure (all diabetic)	5	-
585	Chronic renal failure (all diabetic)	2	-
586	Renal failure unspecified	-	1
	<u>Deaths assigned to diabetes</u>		
250	diabetic nephropathy	1	0
	<u>Deaths assigned to hypertension</u>		
403 or 404	Hypertensive renal disease	2	-
	Totals	16	6

Table 31

DEATHS BY CAUSE: NON-NAURUANS (1976 - 1981)

ICD code	Cause of death	Deaths	
		Number	Proportion %
001-139	<u>Infections</u>	(4)	5
	Septicaemia	2	
	Enteritis	1	
070	Hepatitis	1	
140-239	<u>Neoplasms</u>	(2)	3
	Cancer of bone	1	
	Unknown primary site	1	
240-279	<u>Metabolic & Endocrine disease</u>	(2)	3
250	Diabetes	2	
320-389	<u>Disease of the nervous system & sense organs</u>	(3)	4
	Menigits	2	
	Ear infection and septicaemia	1	
390-459	<u>Disease of circulatory system</u>	(21)	29
393-398	Chronic rheumatic heart disease	1	
410-414	Ischaemic heart disease	10	
	Acute pulmonary heart disease	1	
	Heart failure	1	
430-438	Cerebrovascular disease	8	
460-519	<u>Diseases of the respiratory system</u>	(3)	4
480-487	Pneumonia	3	
	<u>Diseases of the digestive system</u>	(3)	4
571	Liver failure	3	
740-795	<u>Congenital anomalies</u>	(2)	3

Table 31 (Cont.)

ICD Code	Cause of Death	Deaths	
		Number	Proportion %
760-779	<u>Conditions originating in the perinatal period</u>	(15)	21
780-799	<u>Ill-defined conditions</u>	(5)	7
E800-E999	<u>Accidents and violence</u>	(13)	18
E810-E825	Motor vehicle accident	4	
	Asphyxiation	2	
	Electrocution	1	
	Suicide	4	
	Assault	1	
	Drowning	1	
	Total	73	100

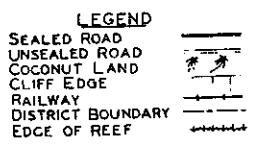
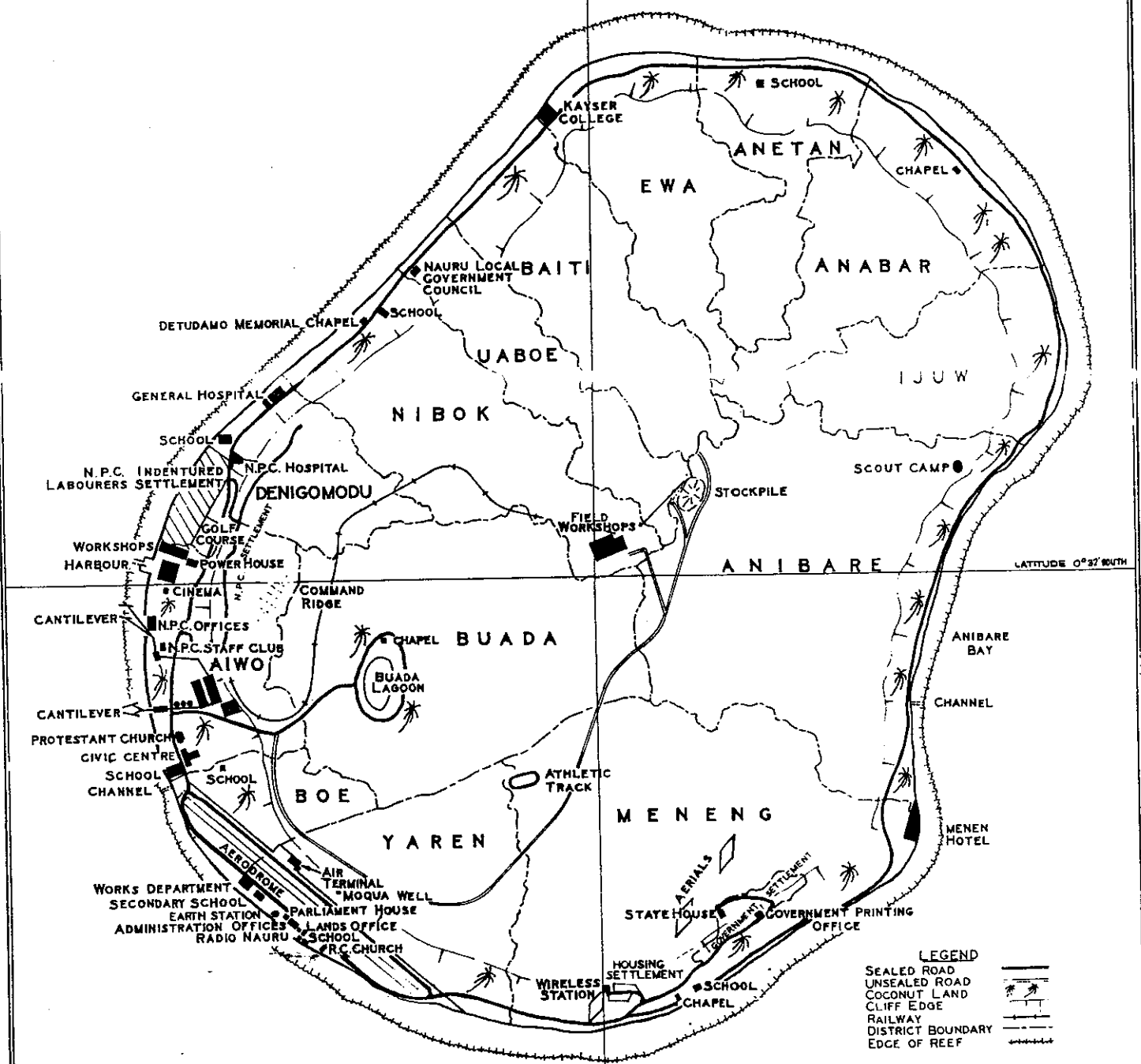
() = total for the group.

FIGURES

NAURUAN MORTALITY 1976-1981

Figure 1: REPUBLIC OF NAURU

REPUBLIC OF NAURU

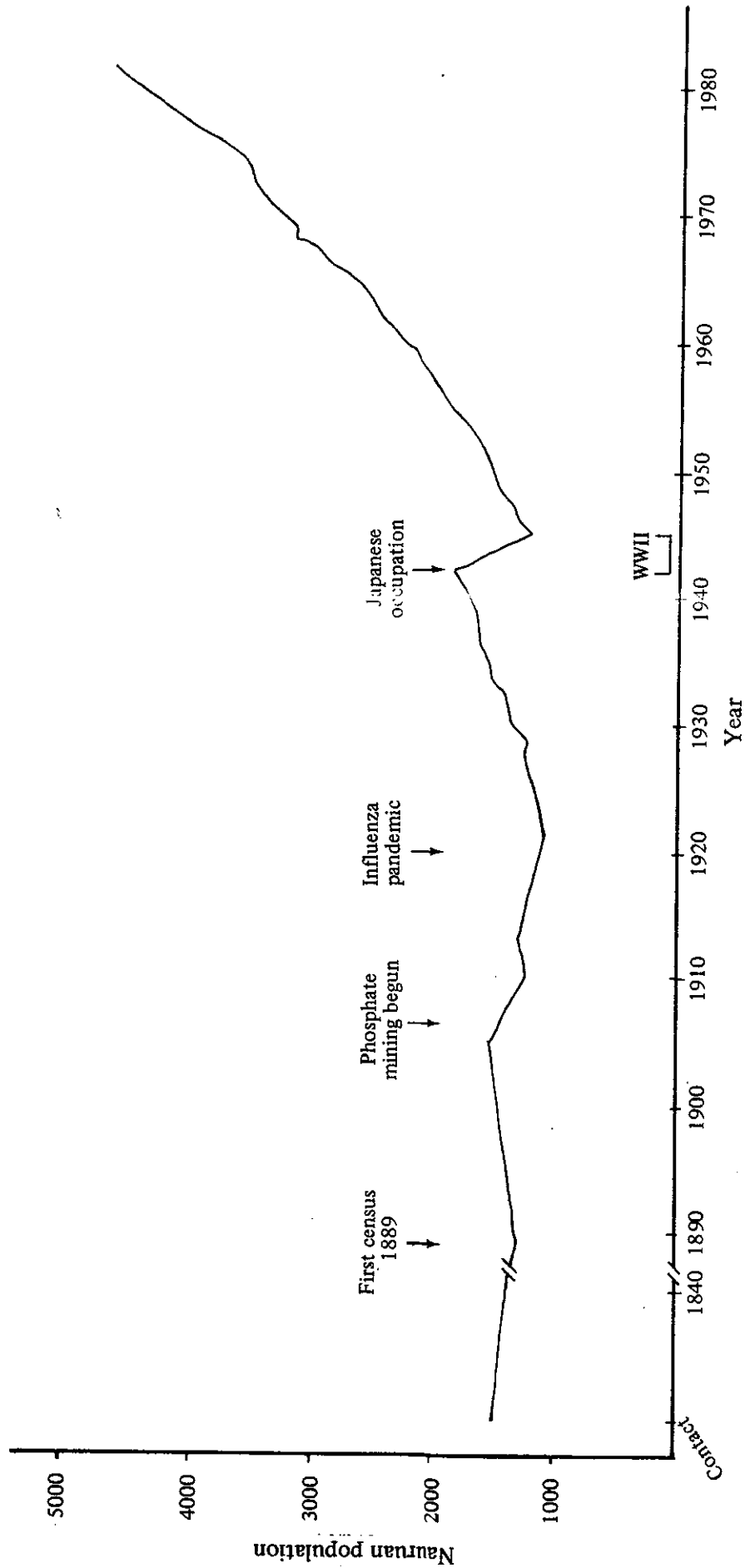


SOUTH PACIFIC OCEAN

LONGITUDE 168° 54' EAST

PRODUCED BY THE DIRECTORATE OF LANDS AND SURVEY REPUBLIC OF NAURU

Figure 2: NAURUAN POPULATION FROM 1830-1981



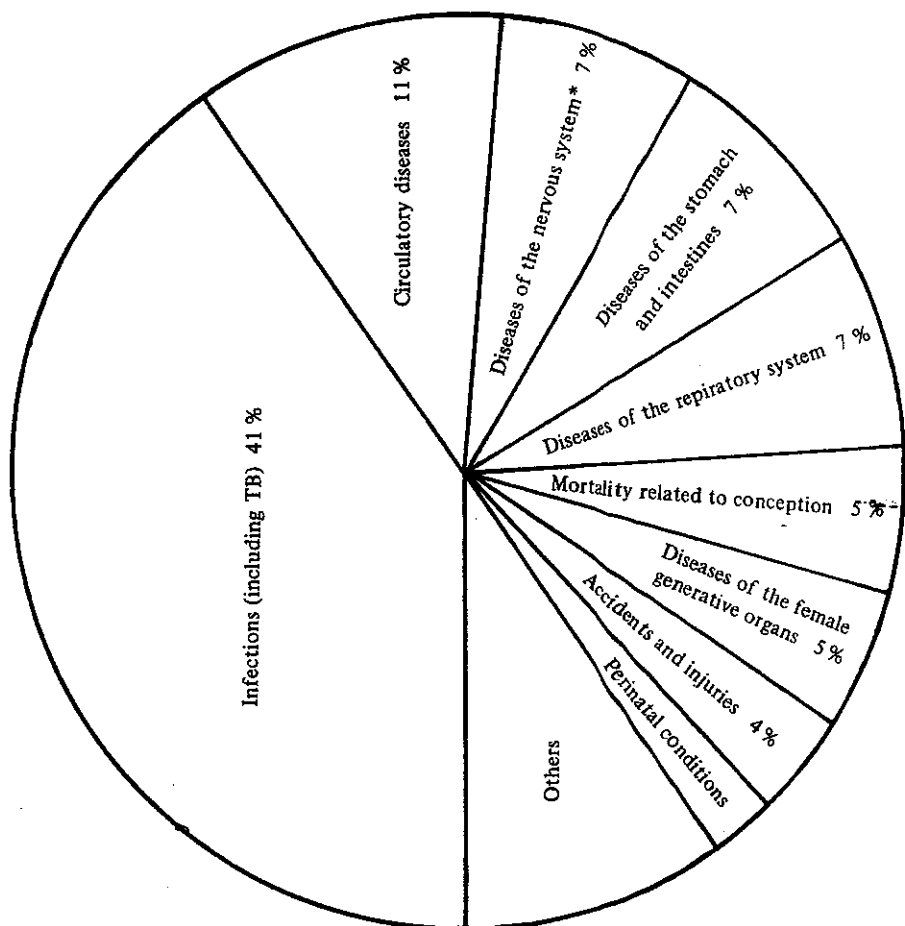
From: Viviani 1970, *Annual Reports 1947/48-1967/68*, Palmer *et al* 1972, Guinea 1975, Census 1977. Estimates calculated from 1977 census.

DIRECTORATE
VLF
4U

0°32' SOUTH

Figure 3A: NAURUAN PROPORTIONATE MORTALITY BY CAUSE, 1947/48-1967/68

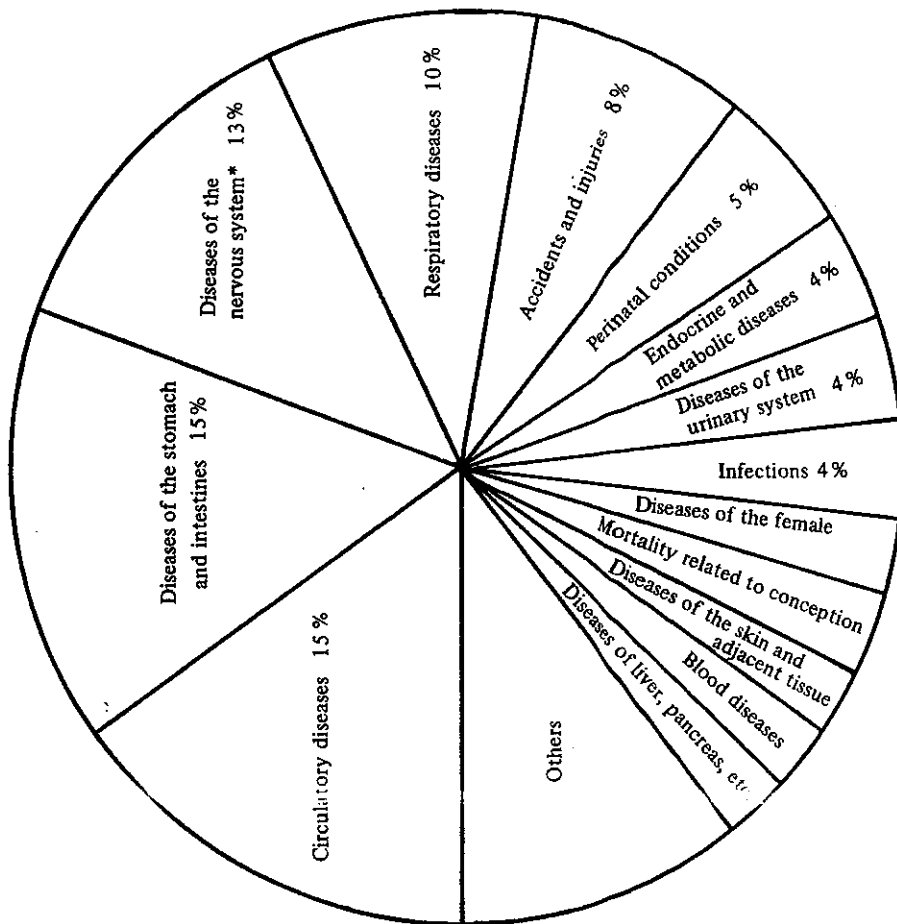
1947/48 - 1957/58



Deaths = 207
 Crude death rate = 11.0 (per 1,000)
 (From Annual Reports 1947/48-1957/58)

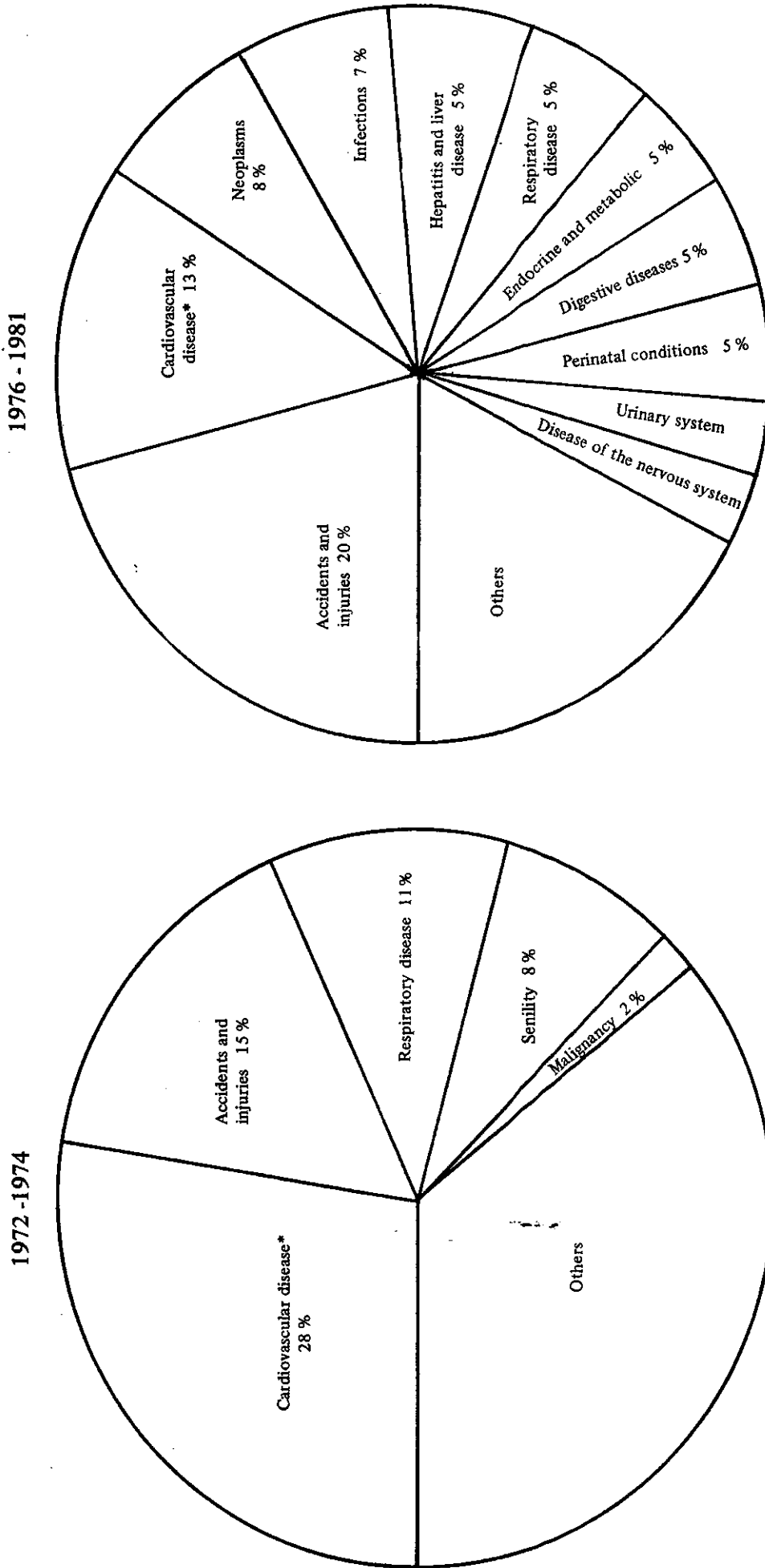
* includes stroke

1958/59 - 1967/68



Deaths = 144
 Crude death rate = 6.0 (per 1,000)
 (From Annual Reports 1958/59-1967/68)

Figure 3B: NAURUAN PROPORTIONATE MORTALITY BY CAUSE, 1972-1981

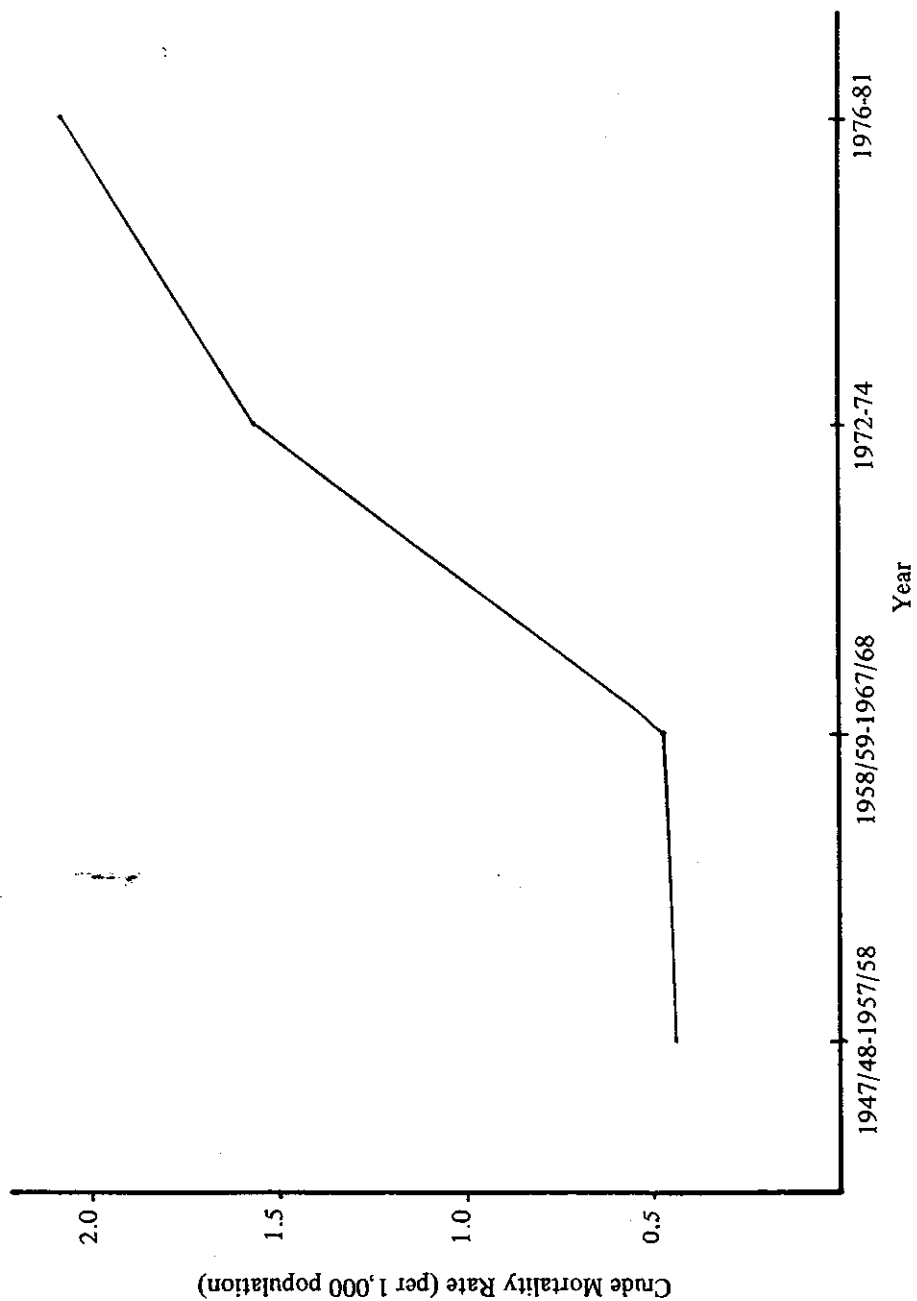


Deaths = 114
 Crude death rate = 10.6 (per 1,000)
 (From Guinea 1975)

Total deaths = 273
 Crude death rate = 10.5 (per 1,000)

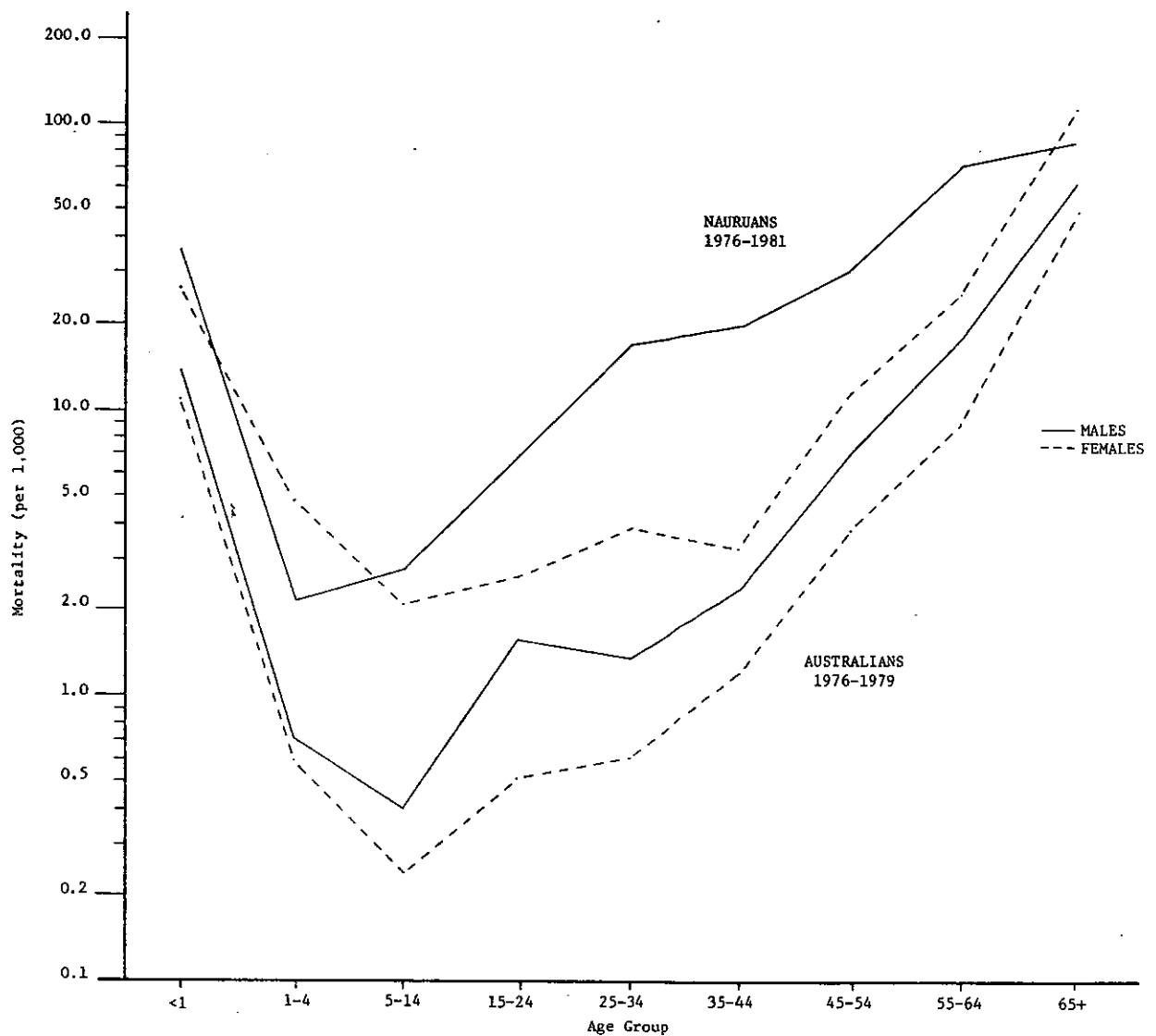
* includes stroke

Figure 4: CRUDE MORTALITY RATE FROM ACCIDENTS AND INJURIES, NAURUANS, 1947-1981



From: *Annual Reports 1947/48-1967/68, Guinea 1975 and present investigation.*

Figure 5: AGE-SPECIFIC MORTALITY IN NAURU AND AUSTRALIA



Mortality Ratios

Nauru M : F	1.3	0.5	1.4	2.7	4.3	6.0	2.8	2.9	0.7
Males Nauru: Australia	2.6	3.1	7.5	4.3	12.4	8.1	4.5	4.1	1.4
Females Nauru Australia	2.4	8.6	8.5	4.9	6.4	2.3	3.0	2.9	2.3
Australia M : F	1.3	1.3	1.5	3.1	2.2	1.7	1.8	2.0	1.2

Figure 6: RATIO OF MORTALITY RATES (MALE:FEMALE) BY AGE GROUP, NAURUANS, 1976-1981

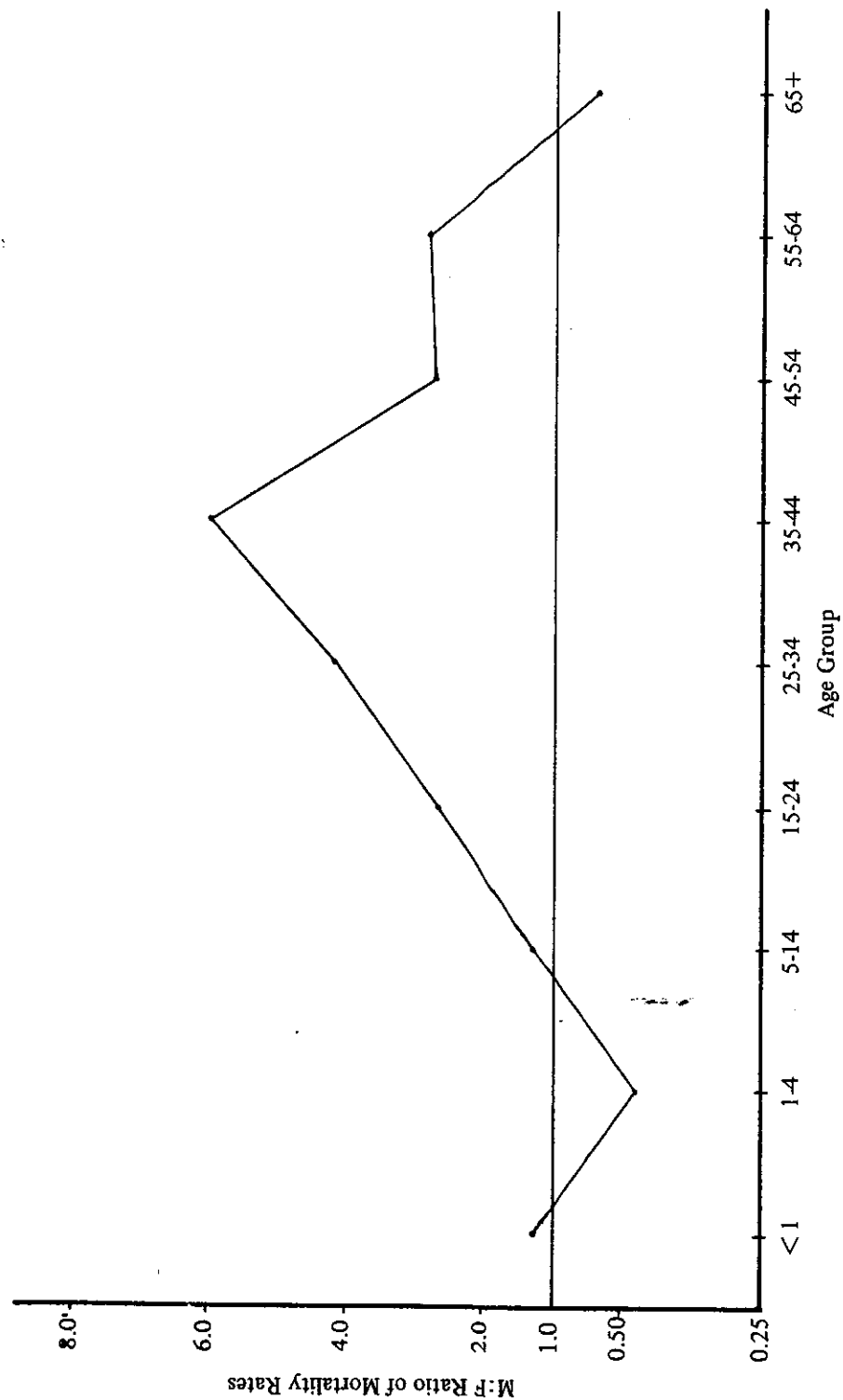
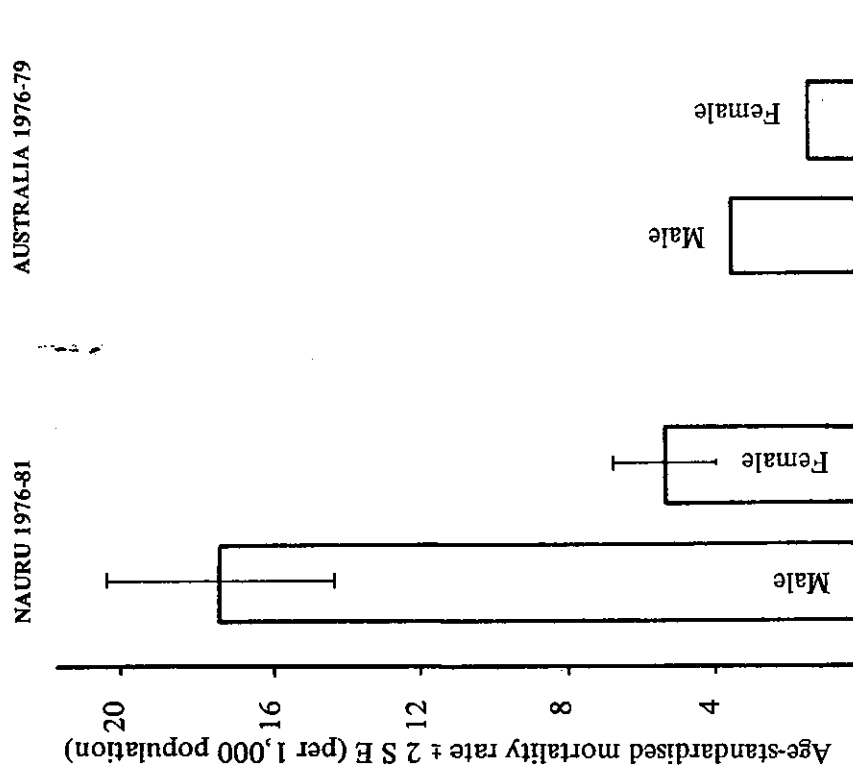


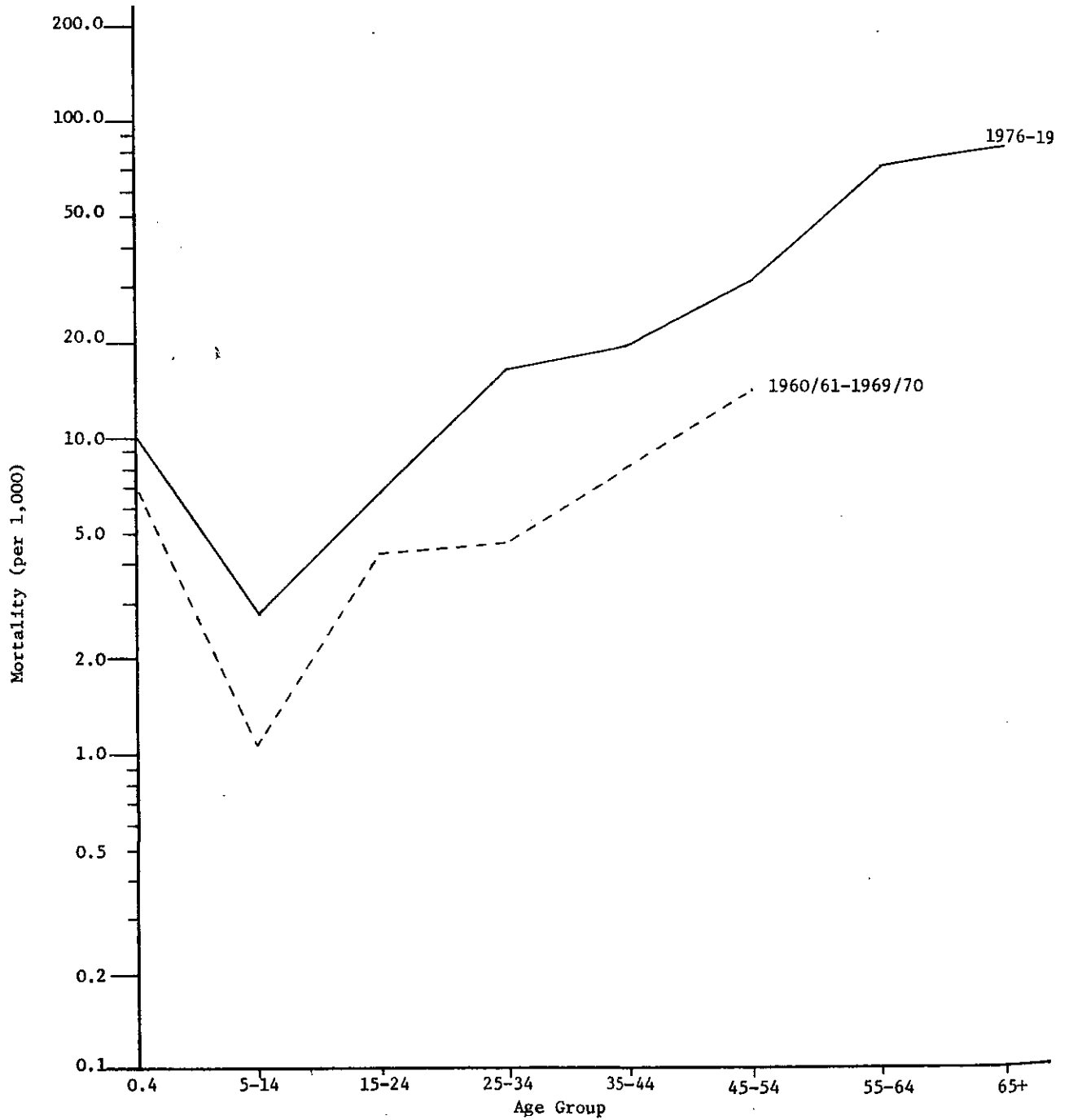
Figure 7: AGE-STANDARDISED MORTALITY RATES OF ADULTS (AGED 15-64) IN NAURU AND AUSTRALIA



Ratios of age-standardised mortality rates	Male:Female		Nauru:Australia	
	Nauru	Australia	Male	Female
	3.3	2.1	5.5	3.5

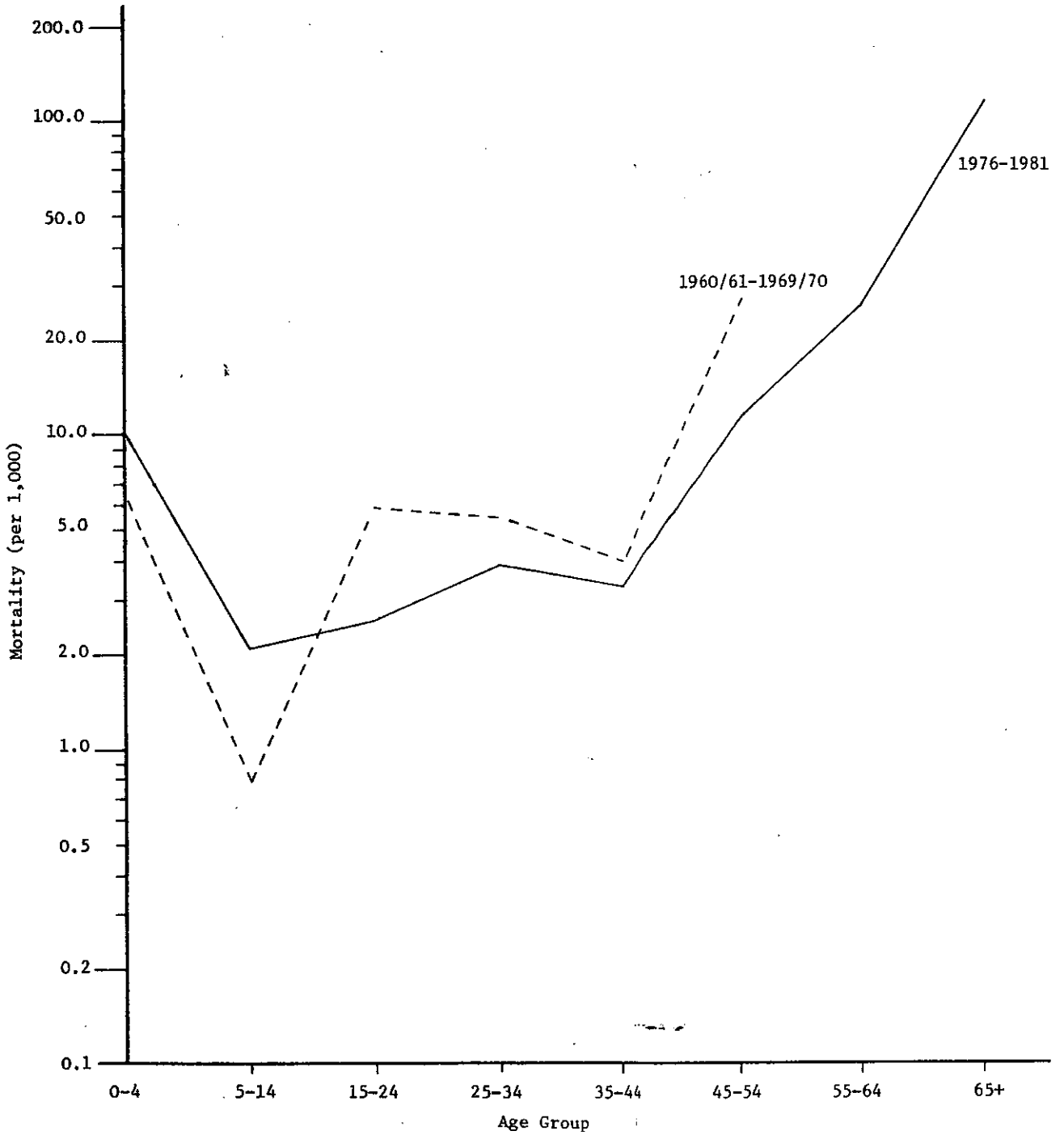
All differences and ratios are significant at $p < 0.001$.
Age-standardised to the total (M + F) Nauruan population 1976-81

Figure 8: AGE-SPECIFIC NAURUAN MALE MORTALITY, 1960/61-1969/70 AND 1976-1981



Mortality Ratios								brta	
1976-81: 1960/61-1969/70	1.3	2.6	1.6	3.6	2.4	2.2	-	-	976-

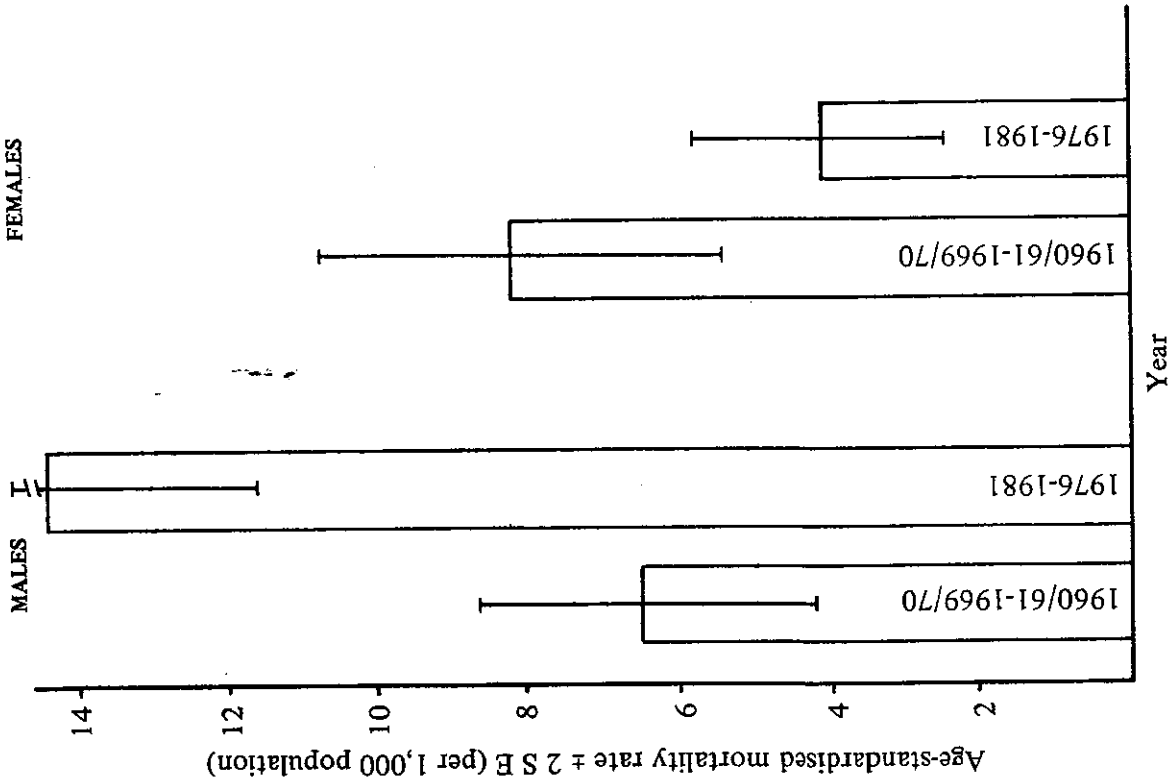
Figure 9: AGE-SPECIFIC NAURUAN FEMALE MORTALITY, 1960/61-1969/70 AND 1976-1981



Mortality Ratios

1976-81:1961-70	1.59	2.47	0.43	0.71	0.81	0.42	-	-
-----------------	------	------	------	------	------	------	---	---

Figure 10: AGE-STANDARDISED MORTALITY RATES IN NAURUAN ADULTS (AGED 15-54), 1960/61-1969/70 AND 1976-1981



Ratios of age-standardised mortality rates
 * p < 0.01
 ☆ p < 0.001

1976-81:1960/61-1969/70		Male : Female	
Male	Female	1960/61-1969/70	1976-1981
2.2 ☆	0.5 *	0.78	3.48

Age-standardised to the total (M + F) Nauruan population 1976-81

Figure 12: YEARS OF LIFE LOST BY ADULT NAURUANS (AGE ≥ 15 YEARS) FROM PREMATURE DEATH FROM VARIOUS CAUSES

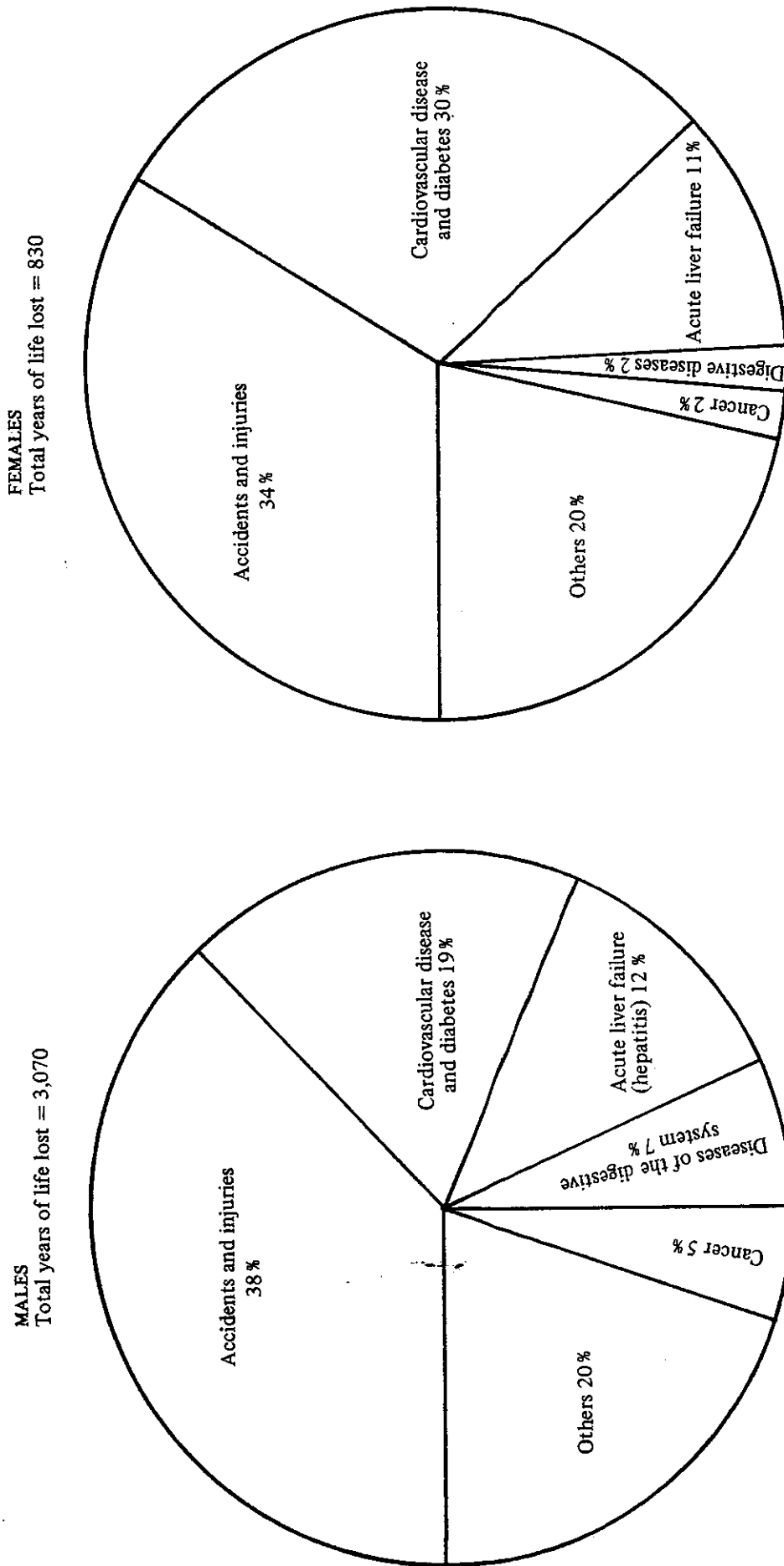
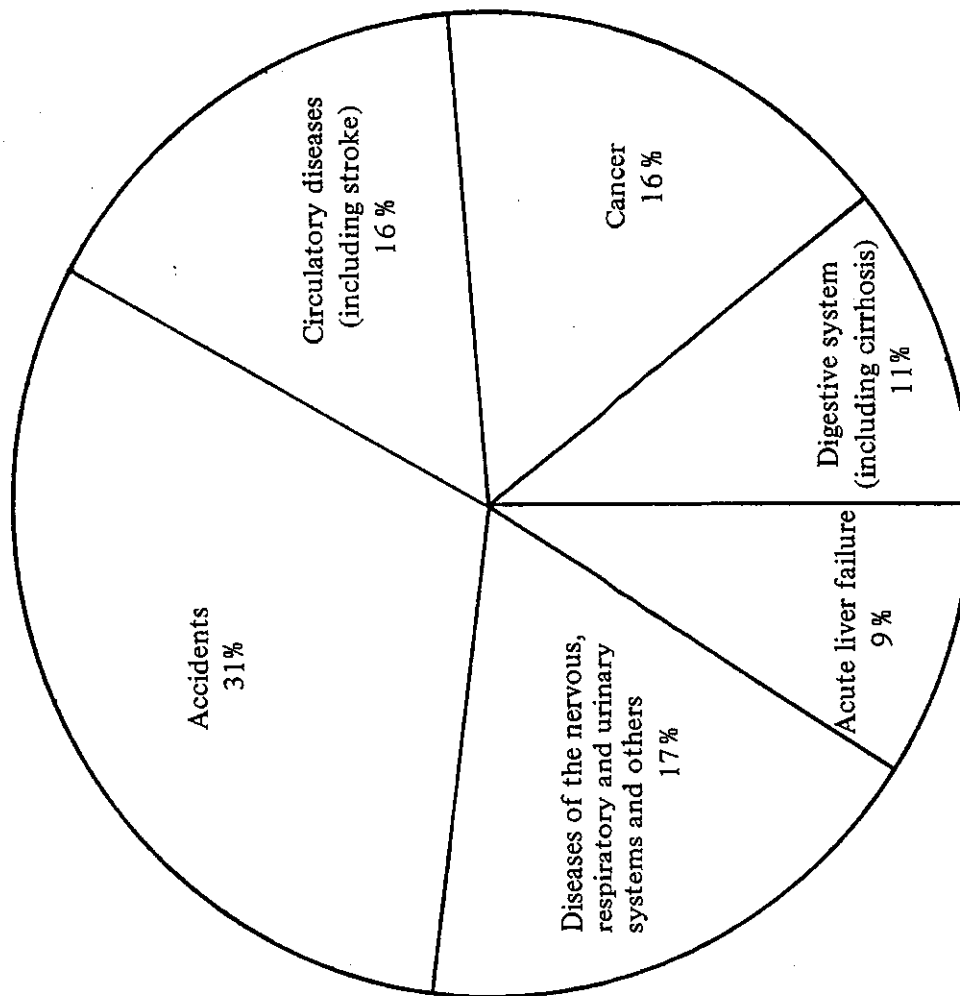


Figure 13: DISTRIBUTION BY CAUSE OF EXCESS DEATHS IN NAURUAN ADULT (AGED 15-64 YEARS) MALES COMPARED TO FEMALES, 1976-1981



APPENDIX

Life expectancy at birth and at age 15 in Pacific Island countries and metropolitan nations of the South Pacific Commission

COUNTRY	Life expectancy at birth			Life expectancy at age 15 yrs				
	Year of estimate	Male	Female	Both sexes	Year of estimate	Male	Female	Both sexes
<u>POLYNESIA</u>								
American Samoa	1969-71	65	70	67	1960-70	53	58	56
Cook Islands	1975-81	65	69	67	1975-81	54	58	56
French Polynesia	1971-76	60	63	61	-	-	-	-
Niue	1971-76	60	64	62	1971-76	51	53	52
Tokelau	-	-	-	-	-	-	-	-
Tonga	1976	-	-	59	1976	-	-	50
Tuvalu	1979	57	60	58	1979	48	50	49
Wallis & Futuna	1974-78	61	63	62	1974-78	51	52	52
Western Samoa	1971-76	61	64	63	1971-76	51	54	52
<u>MELANESIA</u>								
Fiji	1976 F	61	64	62	1976 F	51	53	52
	I	60	62	61	I	50	52	51
New Caledonia	1976 M	-	-	64	1969-76M	45	49	47
Papua New Guinea	1971	49	50	49	1971	46	48	48
Solomon Islands	1976	54	54	54	1976	46	45	45
Vanuatu	1961-63	-	-	50-60	-	-	-	-
<u>MICRONESIA</u>								
Guam	1976-78	70	79	74	1976-78	56	65	60
Kiribati	1978	50	54	52	1978	46	48	47
Nauru	1976-81	49	62	-	1976-81	37	51	-
TTPI *	1973	-	-	61	-	-	-	-
<u>METROPOLITAN NATIONS</u>								
Australia	1979	71	78	-	1979	56	60	-
France	1977	70	79	-	1977	57	65	-
England and Wales	1979	70	76	-	1979	57	63	-
New Zealand	1978	70	76	-	1978	56	63	-
USA	1978	70	77	-	1978	56	64	-

F: Fijian

I: Indian

M: Melanesian

Life expectancy data supplied by the demographic section of the South Pacific Commission.

* TTPI : Trust Territory of the Pacific Islands
(now consists of Marshall Islands, Federated States of Micronesia, Palau and Northern Mariana Islands).