Mortality Patterns in the Modernized Pacific Island Nation of Nauru

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Abstract: Nauru is a small phosphate-rich independent island country situated in the Central Pacific. The population is Micronesian and was estimated to be 4,680 in mid-1981. An analysis of mortality data for the years 1976–81 indicates a high adult male mortality due to accidents, injuries, cardiovascular disease, and diabetes. The life expectancy estimate at birth for men was 49 years, and for women 62 years. The male life expectancy is among the lowest in the region. The considerable adult male mortality appears to be related to the rapidly acquired affluence and the ready availability of motorcycles, cars, imported foods, tobacco, and alcohol. The data suggest that modernization of the economy in Pacific Island nations can lead to new and serious public health problems. (*Am J Public Health* 1985: 75:149–155.)

Introduction

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. 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.

The Nauruan population (estimated 4,680 in mid-1981) is part of the Micronesian ethnic group, but their geographic isolation has rendered cultural and linguistic connections tenuous. Nauru was controlled by the Germans (1888) and from 1914 to 1968 by the British, although administered mainly by Australia. The country became an independent Republic in 1968 with a President elected by the members of the legislature. There is a large but shifting expatriate population in Nauru, mainly from other Pacific islands (especially Kiribati), who work the phosphate deposits. These have been excluded from this study and the data presented are restricted to Nauruans only.

Phosphate mining began in 1906 and continued under the aegis of a consortium of the various colonial powers. 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, and part is invested by the government in various enterprises designed to provide Nauru with an income after exhaustion of the phosphate reserves; what remains is paid in royalties to the owners of the land that is being mined.[1] 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 moneys to be expended 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.[2,3]

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 epidemiologic surveys to determine the magnitude of the problem, identify those affected, and define causative factors. These studies revealed a very high prevalence and incidence of non-insulin dependent diabetes in the adult population compared to other Pacific Islanders or Caucasians.[4–8] It was also found that obesity was very common in the Nauru population, and that mean blood pressure levels and the prevalence of documented hypertension were higher than those of other populations in the Pacific (Funafuti, Tuvalu) and Australia (Busselton, W.A.)[9]

Hyperuricaemia and gout have also been found to be very prevalent among Nauruans[10]; 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.[11]

This paper reports an analysis of mortality data in Nauru for the period 1976–81.

Methods

The examination of previous mortality in Nauruans is handicapped by the data available and the way in which they were tabulated. Reports on the administration of Nauru to the UN General Assembly contain important information on medical and health matters, and data on population, births, and deaths for the period 1947–48 to 1967–68.[12] Breakdown of deaths and population by age, sex, and ethnic group was not always available, however, and thus exact comparisons with later mortality data are not possible. However, much important information is available in these reports, and the relevant material has been abstracted.

A firm of actuaries was engaged by the Nauru Government in the early 1970s to analyze Nauruan vital statistics from the 1960s and make population projections. Their report contains data on mortality in Nauruans by age group and sex for the period 1960-61–1969-70[13]; this information can be directly compared to the all-cause mortality rates found in the present study (1976–81). During the early to mid-1970s, a Health Department report was produced which included mortality data[14]; age and sex specific numbers of deaths for 1972, 1973, and 1974 are presented in the report.

In the present study, all available information on deaths from 1976–81, inclusive, was obtained. The analysis started with 1976 since it was the first year for which completed

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TABLE 1—Sources of Data Available on Mortality in Nauruans 1976–81

Year	Total Deaths Enumerated†	Number of Death Certificates	Number of Case-notes reviewed	Number of Postmortem 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**

Proportion of enumerated deaths without death certificates = 6%.
Proportion of deceased case notes reviewed = 79%.
Proportion of postmortem examinations performed on deceased = 15%.
Proportions of enumerated deaths registered (1976–78) = 83%.
†All deaths whether from certificates or case notes.
*From records of the Registrar.
**1976–78 only.
Civil death registration in Nauru was discontinued after 1978 since the medical system was recording this data and it was considered that registration involved duplication.

death certificates were available. All patient medical records which could be found were examined, as well as postmortem reports, results of supplementary tests or biopsies sent elsewhere, and summaries of hospital admissions and investigations from Melbourne. In some instances, death certificates were available but case notes were not, and in others the reverse was true. The proportion of deaths enumerated without death certificates during the period under study was 6 per cent (Table 1).

Details of age, sex, ethnic group, and cause of death were cross-checked between the various documents examined. The underlying cause of death was assigned after examination of all available evidence and following discussion between the South Pacific Commission (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.[15]

As a validation exercise, the Catholic Church burial register for the years 1976–81 was examined. A total of 67 Nauruan deaths was recorded in the register. The age structure of those who received Catholic burials was found to be similar to that of the total enumerated deaths, particularly for males in which group the numbers are adequate for comparison purposes. Furthermore, the higher number of deaths among males relative to females observed in the total sample was also found among Catholic burials.

The Nauruan population in the various age and sex brackets was estimated from calculations based on the 1977 Census (January 22, 1977). The stratified population was first corrected for 6.9 per cent under-enumeration. 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 bracket; and 3) deducting the population which "aged" out of this bracket into the next bracket during the year. Mid-year populations were obtained by averaging the calculated end-year estimates. The 1981 mid-year population was estimated to be 4,860.

In December 1980, a small Census was taken of those ≥20 years for the purpose of establishing a voters' roll for the election. The total Nauruans aged 20 years or over was found to be 2,095 at this Census. The predicted number in this age group at that time, according to the calculations mentioned above, was 2,049. Thus our calculations may be a slight underestimate of the population, but seem to be reasonable.

Abridged life tables were assembled from the death rate according to the method described by Barclay.[16]

To estimate total diabetes mortality, we reallocated to the diabetes category 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. These deaths were added to those in which diabetes was the assigned cause of death to produce an estimate of diabetes mortality. Assignment was based on review of medical case notes as well as death certificates and involved approximately 42 per cent of the deaths in known diabetics in which diabetes was not assigned the primary cause of death from the death certificate.

Calculation of years of life lost by Nauruans aged ≥15 years through premature death from various causes was made by deducting the age of death of each case from an assumed life expectancy of 65 years and summing for the various cause of death groups.

Results

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 adult deaths between 1976 and 1981, only 36 were female. These figures yield mortality rates per 1,000 of 17.4 in males and 5.3 in females (male:female ratio of 3.3).

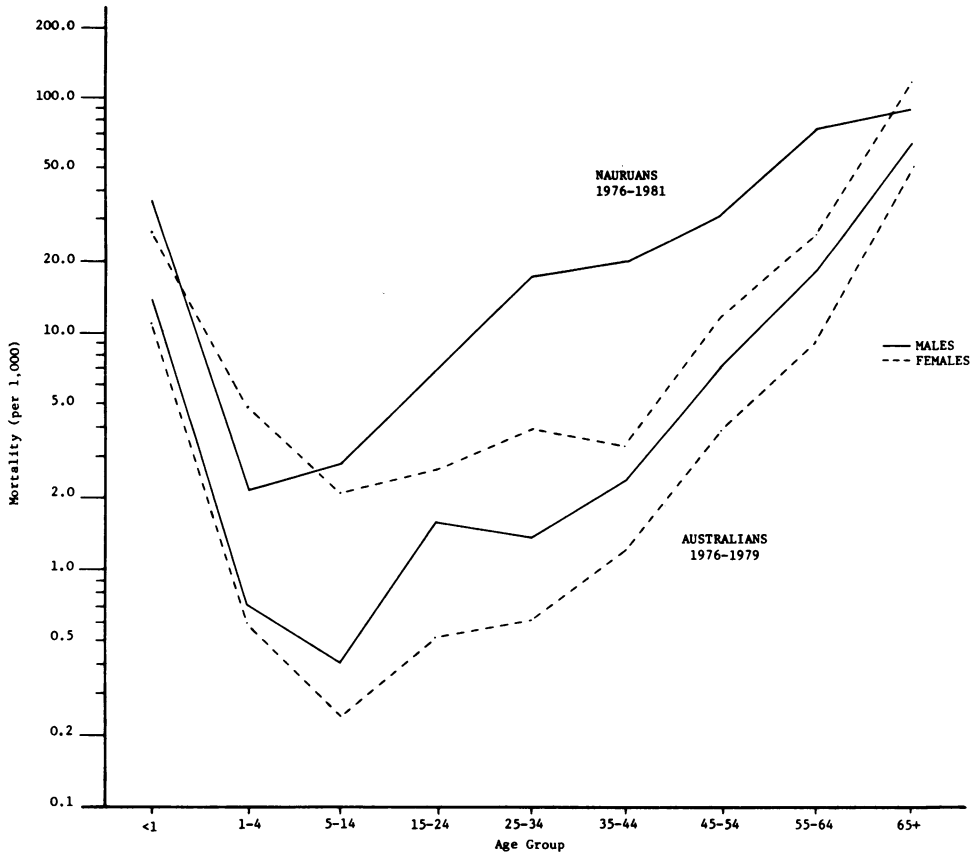
The age- and sex-specific Nauruan mortality rates for 1976–81 are presented in Figure 1. There was a much higher mortality rate in young and middle-aged males, compared to females. The ratio of male:female mortality rates was greatest in the 35–44 year old age group, in which the mortality rate in men is almost six times that of women. Although numbers are not large, these male/female differences are consistent through each of the years 1976–81, and in all adult age groups less than 65 years.

Comparison of Nauruan age- and sex-specific all-cause mortality for 1976–81 with Australian rates for 1976–79 is made in Figure 1. Nauruan rates were higher than those in the Australian population—particularly for males and for the young adult and middle age groups. In the 25–34 year age group, the Nauruan male mortality rate was 12 times the Australian male rate.

Age- and sex-specific Nauruan mortality rates in 1976–81 are compared to 1960-61–1969-70 in Figures 2 and 3. Male mortality was twice as high 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. Overall female mortality in the adult age groups in 1976–81 was less than that in 1960-61–1969-70 period.

Life tables have been constructed from the Nauruan death rates for the period 1976–81 (Table 2). Life expectancy at birth was estimated at 49 years for Nauruans males and 62 years for Nauruan females—a difference of 13 years.

A comparison of life expectancy of Nauruans with other Pacific populations is illustrated in Table 3. Nauruan males have one of the lowest life expectancy (at birth) in the Pacific, comparable to Kiribati and Papua New Guinea. The life expectancy of 37 years for Nauruan males at 15 years is



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 1—Age-Specific Mortality in Nauru and Australia

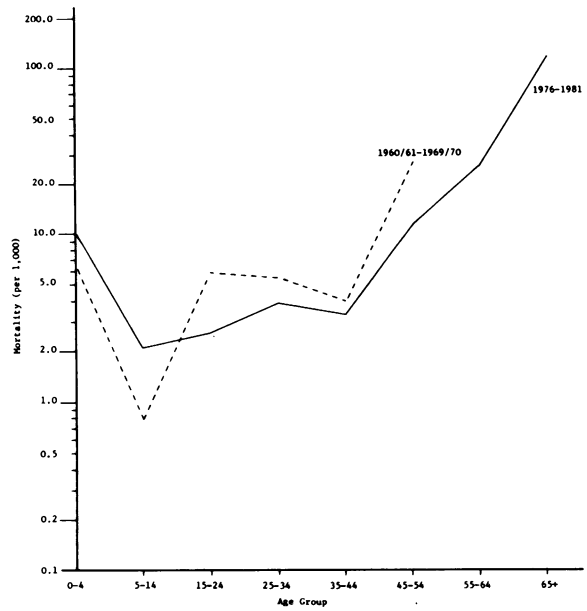
the lowest recorded in the region, and is a consequence of the heavy adult mortality. Female life expectancy in Nauru, both at birth and at age 15 years, is similar to many other Pacific populations.

The infant mortality rate during 1976–81 was 31 per 1,000 live births. Perinatal conditions (47 per cent) and infections (30 per cent) were the main causes of death in infants. Gastroenteritis was responsible for half of the deaths from infection.

One-third of the childhood (age 1–14 years) mortality in Nauru (1976–81) was due to accidents, and another third attributable to infection. Viral hepatitis accounted for half of the infectious deaths. Injuries from motor vehicles were the most common cause of accidents.

Analysis of deaths by cause in adults (aged 15–64 years) indicates that in males accidents were the main cause of mortality (28 per cent) followed by diseases of the circulatory system (21 per cent), cancer (12 per cent), diseases of the digestive system (9 per cent), and acute liver failure (8 per cent). In females, accidents were again the major cause of death (20 per cent), followed by diabetes (14 per cent), and diseases of the circulatory system (10 per cent). 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.

Calculations have been made of the years lost by adult Nauruans aged ≥15 years through premature death, assuming a life expectancy of 65 years. These calculations reveal that almost 40 per cent of the years lost in males were 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 were due to accidents and injuries, and 30 per cent due to cardiovascular disease and diabetes.



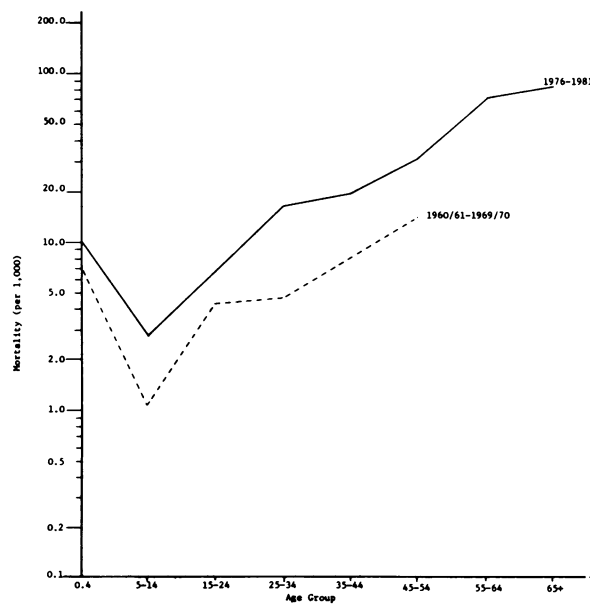
Mortality Ratios								
1976-81:1961-70	1.59	2.47	0.43	0.71	0.81	0.42	-	-

FIGURE 2—Age-Specific Nauruan Female Mortality, 1960–61 to 1969–70 and 1976–81

The majority of accidental deaths involved motor vehicles (60 per cent) and excluding pedestrian deaths, 65 per cent of total accidents involved motorcycles. Deaths from road accidents were more common on the weekend, particularly Friday. Only 10 per cent of non-pedestrian deaths involved collision with another vehicle. 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 standardized mortality ratio of 510. The second most common cause of death in the accident group was drowning.

Discussion

The most striking finding of this report is the high mortality among Nauruan male adults for the period 1976–81. The life expectancy at birth of Nauruan males was only 49 years, and at age 15 it is the lowest recorded in the Pacific



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

FIGURE 3—Age-Specific Nauruan Male Mortality, 1960–61 to 1969–70 and 1976–81

TABLE 2—Abridged Life Tables for Nauruans: Expectation of Life at Various Ages and Probability of Dying During Various Intervals (estimated from 1976–81 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	≥65	1.0000	1.0000

region. Comparison of mortality during 1976–81 with data from the 1960s indicates that adult male mortality has risen while adult female mortality has declined over this period.

Nauru has relatively modern and accessible medical facilities. There are two hospitals (one mainly for the expatriate labor force which works the phosphate mines) and sufficient medical staff so that serious cases are not denied treatment. Specialists visit from Australia, and serious cases can be evacuated by air to Melbourne if necessary. Medications and equipment are adequate, and renal dialysis is available. There is no suggestion that the high levels of mortality are primarily due to lack of essential therapeutic services.

Accidents and injuries were the most important cause of death in children and adults, and the most significant contributor to years of life lost in adults from premature death. It was not possible to undertake a detailed study of motor vehicle accidents, although it is known that road accident deaths were clustered around the weekend, especially Friday. Perhaps this clustering would have been more marked if day of accident rather than day of death had been available for analysis. Another interesting finding was that very few road accident deaths involved collision with another vehicle. Most were a result of loss of control and/or collision with a stationary object.

The above findings support the anecdotal evidence that alcohol is a major factor in road accident mortality in Nauru. Recommendations have been made for a further study of the problem, including blood and urine alcohol estimations on accident victims and drivers. Changes in the law and increased enforcement of existing laws in relation to motor vehicles use have also been recommended.

Alcohol may also play a role in deaths from other accidents and from drowning. Again, anecdotal evidence was forthcoming on the role of alcohol in many of these deaths when they were examined individually, but no statistics are available. Casual observation indicates that alcohol consumption in Nauruan males is considerable, and this is supported by a nutrient intake survey.[11]

The second most common cause of death in Nauruan adults was cardiovascular disease and diabetes. A detailed review of previous morbidity and mortality data on the Nauru population[17] revealed no evidence of significant problems from hypertension, diabetes, or coronary heart disease until after the World War II. Even during the 1950s, infection (especially tuberculosis) was the major cause of death.

As a result of the phosphate mining, and consequent industrial development, imported food has been available for a considerable time in Nauru. Historical evidence suggests that the move from the traditional diet of coconut products and fish to a reliance on store foods (particularly polished rice, sugar, condensed milk, and canned meat and fish) became significant by the mid-1920s.[17] Such changes in diet are usually associated with increased salt intake, both from purchased salt and from highly salted foods (especially canned goods).

While it is probable that Nauruans have a genetic susceptibility to diabetes (non-insulin dependent), it is also likely that the current diet and the high prevalence of obesity make a significant contribution to the considerable diabetes-related morbidity and mortality in this population.[4–6,11] Obesity and the presumed high salt intake probably contribute to hypertension, heart disease, and stroke.

Mortality in the Nauruan population over the last 100 years has been linked to important political and economic factors, and in particular to the development of the phosphate industry. In the early years of the century, indentured laborers for the phosphate mines introduced infectious diseases, 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.[17]

Mortality patterns in other parts of Micronesia also reflect the level of socioeconomic development. Although the data are incomplete, the available evidence suggests that infectious disease is still the major mortality problem in the relatively underdeveloped Republic of Kiribati (formerly Gilbert Islands colony).[18] Mortality data from the main hospital in Kiribati during 1977 reveal that 38 per cent of deaths were due to infection, respiratory disease contributed 14 per cent, and cardiovascular disease 11 per cent. On the other hand, non-communicable diseases are the leading causes of death in the former US Trust Territory of the Pacific Islands (TTPI)—now Marshall Islands, Federated States of Micronesia, Palau, and the Northern Marianas[19]—and also Guam.[20] The aggregated mortality data for the former US TTPI for 1981 indicate that cardiovascular disease contributed 15 per cent of deaths, respiratory disease 13 per cent, infections 11 per cent, and neoplasms 10 per cent. In Guam in 1980, cardiovascular disease contributed 30 per cent of deaths, neoplasms 15 per cent, and accidents 11 per cent.

Much of the present premature mortality in Nauru is

TABLE 3—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			
	Year of estimate	Male	Female	Both sexes	Year of estimate	Male	Female	Both sexes
Polynesia								
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
Melanesia								
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	—	—	—	—
Micronesia								
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	—	—	—	—
Metropolitan Nations								
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	—
United States	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).

potentially preventable, particularly accidents in adults males. The difference between male and female death rates indicates that current level of mortality in males is not inevitable. Preventive activities will need to be on a community as well as an individual level, and specific actions have been outlined in the report to the Nauru Government.[17] These recommendations include increased attention to preventive services with additions to staff if possible, various suggestions for improved road safety and control of alcohol consumption, and recommendations concerning nutrition, control of obesity, and tobacco smoking for the prevention of non-communicable disease.

The mortality patterns in Nauru are of general significance for the Pacific region because of the pace of development and the increasing availability of cash and dependence on important goods. Although Nauru represents an example at one end of the spectrum, it demonstrates how modernization of the economy and way of life in Pacific Island nations can lead to new and serious public health problems.

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