

# Cancer Incidence In Four Pacific Countries: Tonga, Fiji Islands, Cook Islands and Niue

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## **Abstract:**

**Background:** We have established and/or upgraded cancer registries in four Pacific countries, a region where few cancer registries exist. We report age-standardised cancer incidence in Tonga (2000-2005), Fiji (2002-2005), Cook Islands (2000-2005) and Niue (2000-2005), and in Pacific people in New Zealand (2000-2005).

**Methods:** In each country we identified incident cancer cases by reviewing hospital discharge, death registration, cancer registration records, and pathology reports. The primary site and morphology data were coded using ICD-O, and age-standardised incidence rates were calculated.

**Results:** Age-standardised cancer incidence rates for Pacific people in New Zealand (315 per 100,000 person-years in females, 379 in males) were similar to those for New Zealand overall (322 in females, 404 in males); incidence rates were lower in the Pacific, with rates of 195 and 151 per 100,000 person-years for females and males respectively in Tonga, 231 and 126 in Fiji, 165 and 142 in the Cook Islands, and 228 and 131 in Niue. However, some specific cancers were elevated in the Pacific including cervical cancer (16 per 100,000 in Tonga, 51 in Fiji, 17 in Cook Islands, and 26 in Niue compared with 10 in Pacific people in New Zealand, and 8 in New Zealand overall), liver cancer (rates of 8, 5, 19, 0, 7, and 2 respectively) and uterine cancer (rates of 24, 18, 47, 19 and 12 respectively).

**Conclusions:** Cancer incidence in the Pacific is lower than for Pacific people living in New Zealand. Environmental rather than genetic factors are most likely to explain these patterns, and cancer incidence in the Pacific is likely to increase to rates similar to those in New Zealand as the region becomes 'westernised'. The high rates of cervical cancer and liver cancer in the Pacific indicate an important role of infectious disease (human papilloma virus (HPV) and hepatitis B virus (HBV)).



## Introduction

While cancer is a significant and growing problem in the Pacific, as these countries undergo demographic and epidemiological transitions, relatively little is known about the magnitude of the problem, the key risk factors, or the potential for prevention<sup>1-4</sup>. Over the last 25 years a great deal of research on non-communicable disease has been conducted throughout the South Pacific, but there have been few studies of cancer. Despite the existing lack of standardization, diagnostic facilities and a comparable system of data comparisons there are clear indications that the burden of cancer is increasing in the Pacific<sup>5,6</sup>. There are several reasons why cancer is likely to be an increasingly important contributor to morbidity and mortality in developing countries including the small island states of the South Pacific<sup>5</sup>. These include the increases in population and the accompanying aging of the population, better control of infectious diseases and lowering of infant mortality, increased tobacco use, and the general increase in the adoption of 'western' diets and lifestyles. However, determining the cancer burden in the Pacific in terms of morbidity, survival and mortality involves different obstacles than those encountered in more developed countries. In particular, cancer registration and information systems among many Pacific islands countries are often of questionable quality and comprehensiveness.

The first cancer registry in the Pacific was established in Papua New Guinea in 1958<sup>7</sup> followed by Fiji in 1965<sup>8</sup>. The South Pacific Commission (SPC) developed a standardised cancer reporting system in 1977<sup>9</sup>. This was followed by a course for Cancer Registrars from thirteen Pacific island countries and territories in collaboration with the International Agency for Research on Cancer (IARC) in New Caledonia in 1998<sup>2</sup>, and a course on cancer epidemiology held by two of the authors (Sunia Foliaki and Neil Pearce) and IARC in Tonga in 2004. These courses endorsed a standard system for cancer registration in the Pacific using the IARC software, CANREG<sup>10</sup>.

However, until recently, few Pacific countries had established cancer registries, and peer-reviewed publications on cancer in the Pacific were mostly a product of isolated research projects with very little sustained cancer registry activities maintained at the national level. We have previously reported on cancer incidence in Pacific people living in New Zealand.<sup>11</sup> Recently, we have established and/or upgraded cancer registries in four Pacific countries (Tonga, Fiji, Cook Islands, and Niue) using CANREG-4. It is planned to extend these standardised cancer registration systems to other Pacific countries. This report, the first from this project, provides an overview of cancer incidence in Tonga (2000-2005), Fiji (2003-2005), Cook Islands (2000-2005) and Niue (2000-2005), and compares the findings with those for Pacific people in New Zealand.

## Methods

We have visited each of the four countries and conducted intensive reviews of available records, and constructed and/or upgraded the cancer registries using all of the available information in a standardised manner. In each country this involved reviewing hospital discharge, death registration and cancer registration records; in each country death registration is compulsory, and hospital discharge records are considered to be relatively complete. In some countries additional records (e.g. pathology reports) were also available. Each of the four countries is now described in more detail.



## *Tonga*

Tonga consists of four main island groups, with Tongatapu (main island and capital Nuku'alofa) and 'Eua at the southern end, the Ha'apai Group (centrally), the Vava'u Group to the north and the two northernmost groups of Niuatoputabu and Niuafou'u. Tonga's economy is heavily dependent on remittances from Tongans living overseas.

The 2006 census reported Tonga's population to be 101,991 with ethnic Tongans (Polynesians) making up 98% of the population, and the rest being mostly Europeans (569) and an increasing number of Chinese in recent years (395). Two-thirds of the population live on Tongatapu with the rest living throughout 36 other islands. The total land area of 747 km<sup>2</sup>, incorporating 169 islands and islets spread over 800 miles of ocean, is a major challenge to health service delivery.

The Tongan Ministry of Health approved the establishment of a Cancer Registry in 2005, using CANREG-4, with technical assistance from the Centre for Public Health Research of Massey University (CPHR) and IARC. The sources of data were all histology and cyto/haematological reports available from the Ministry of Health records, patient admission/discharge records and death certificates. Most histology testing is done by the single pathologist (Dr Siale 'Akau'ola, who is a co-author of this paper) at the main hospital in Nuku'alofa, but some specimens are sent to New Zealand (Auckland Hospital) for confirmation. Although the Registry was established in 2005, cases from earlier years have also been registered where sufficient information has been available. Due to incomplete data in some years prior to 2000, this report for Tonga focuses on the period 2000 to 2005. The annual population estimates for each year during 2000-2005 published by the Tonga Statistics Department were used for the calculation of age-specific and age-standardised incidence rates.

## *Fiji Islands*

To the west of Tonga, the Fiji Islands consist of 322 islands of which 106 are permanently inhabited by the country's 840,201 inhabitants, with the two main islands of Viti Levu and Vanua Levu accounting for 87% of the population. The British made Fiji a colony in 1874 and also brought Indian labourers for the sugar cane plantations. Indian Fijians now account for 43% of the total population with indigenous Fijians (of mixed ethnicity, partly Tongan and Melanesian ancestry) accounting for just over 50%. Life expectancy is similar for both Indian and indigenous Fijians (64 years in males; 68 years in females). Fiji is one of the more developed of the Pacific economies with forestry, mineral, fish resources, garments and the sugar industry. Tourism is also a significant source of income.

Fiji has had a Cancer Registry with electronic record storage since the mid 1980's. CANREG-3 was introduced as the Fiji Cancer Registry software in 1998. Most histological testing is done at the Colonial War memorial Hospital in Suva, and at the laboratory of Lauktoka Hospital, but some specimens are sent to New Zealand or Australia for confirmation. Since 2002 the Fiji Ministry of Health (Cancer Registry) had been working closely with CPHR, and the data has been imported into CANREG-4. In addition, the cancer registry data was compared with patient admission/discharge and mortality data with the period 2002 to 2005, and updated where appropriate. Population denominator data were obtained from the population numbers at 31st December 2003 as estimated by the Fiji Islands Bureau of Statistics<sup>12</sup>.



## *Cook Islands*

The Cook Islands consists of fifteen major islands spread over a vast area of the South Pacific Ocean as far north as the Tokelau group and as far south as the southern latitudes of Tonga. This covers an area of at least two million square kilometres of ocean. The 2006 census estimated a total population of 19,569 with a life expectancy of 70 and 75 for males and females respectively. Like most small Pacific islands, the Cook Islands face development constraints associated with geographical isolation and the dispersion of small population centres amongst the 15 islands. Tourism is estimated to account for about 40% of the gross domestic product in 2004/2005, which is greater than the earnings from the two largest exports of fishing and pearl farming. Cook Islanders are New Zealand residents/citizens and have access to free medical care in New Zealand.

The Cook Islands Cancer Registry was established in 1981, and by 2005 had registered a total of 410 cancers (184 males and 226 females). CANREG-3 was introduced in 1998, and the Cook Islands Ministry of Health in collaboration with CPHR, and with technical assistance from IARC, began to use CANREG-4 in 2004. All cytology specimens are sent to New Zealand (Auckland Hospital) for testing. The authors visited the Cook Islands on two occasions to review the Cook Islands Cancer Registry records through reviews of logbooks, laboratory reports, medical records and death registers. The cancer registration data was then updated using CANREG-4. The population estimates from the 2001 Cook Islands census were used for the calculation of age-specific and age-standardised incidence rates.

## *Niue*

Niue is located 2,400 kilometres northeast of New Zealand in a triangle between Tonga, Samoa and the Cook Islands. It consists of a single 260 square kilometres raised coral island. Niue's total population, as enumerated in the 2006 Census had decreased to 1,625, down from around 5,000 in the 1960s. At the time of the 2001 New Zealand census, 20,100 Niueans were resident in New Zealand (<http://www.mfat.govt.nz/Countries/Pacific/Niue.php>). Niue is a self-governing state in free association with New Zealand, sharing the New Zealand currency as well as Niueans being New Zealand citizens. Niue's economy is constrained by limited access to reliable air and sea services, limited land and poor soil quality. The government is the main employer, although recently the government has established joint ventures with Auckland's Reef Group in fish processing and noni farming which have assisted with employment and export earnings.

Niue's only hospital was destroyed and washed out to sea by the worst tropical cyclone in the country's history (Cyclone Heta) in the first week of 2004, and most of the hospital records were destroyed, including cancer-related records. The Niue Cancer Registry was established by the authors from CPHR in 2006, using CANREG-4. A further visit by the authors was conducted in early 2009 to restore the registry electronic database which was 'lost'. All cases that could be identified from the patient case notes, cytology and histology reports and letters and from the nursing staff were re-entered. Personnel were also identified and trained for entering and updating cases. All histological specimens from Niue are read in New Zealand, although it was evident that there were many instances where laboratory reports and discharge letters from NZ were not sent to Niue or had not been received at the hospital in Niue. The population estimates from the 2006 census were used for the calculation of age-specific and age-standardised incidence rates.



## *New Zealand*

The New Zealand Cancer Registry was established in 1948 and the Cancer Registry Act came into effect in 1994 making cancer registration mandatory.<sup>13 14</sup> Pathology laboratories are the primary source of cancer data to the NZCR and other collections (Medical Certificates of Causes of Death, Coroners' reports, hospital discharge data on the National Minimum Dataset (NMDS), and private hospital discharge data) as well as extensive data checking are used to validate the cancer diagnoses.<sup>15</sup> The New Zealand Cancer Registry records self-identified ethnicity, where people may record multiple responses, based on the Statistics New Zealand Census ethnicity question.<sup>16</sup> Participants who reported more than one ethnicity were classified into a single ethnicity using a standard system of prioritisation: Māori > Pacific > 'Other'.<sup>17</sup> The current analyses were based on cancer registrations during 2000-2005, and the corresponding population denominator data derived from the 2001 and 2006 national censuses.

## **Data analysis**

For each country, the primary site and morphology data were coded using the International Classification of Diseases for Oncology (ICD-O, 3<sup>rd</sup> ed.)<sup>18</sup>, which are essentially the same as those of ICD-10<sup>19</sup>. Crude cancer incidence and mortality rates were calculated by dividing the total number of cases during the relevant period by the sum of the mean populations for each year of the same period. The estimated values are therefore annual average incidence rates. We estimated these rates for all cancers combined, and for the major site-specific cancers. Rates were directly standardised to the world standard population using five-year age-groups<sup>20</sup>.

## **Results**

### *Tonga*

Table 1 shows the crude incidence rates and numbers of cases for cancer registrations in Tonga during 2000-2005, and Table 2 shows the age-standardised incidence rates and 95% CIs. For the years 2000-2005, there were 759 cases of cancer (432 female, 327 male) (table 1). The leading cancers among males were lung (14.4 % of male cases), prostate (12.8% ), liver (11.3%) and stomach (9.8%). There was a high percentage of cancers where the primary site was unknown (9.2%). Among females, the leading cancer sites were the breast (22.9% of female cases), uterus (12.0%), cervix (7.6%) and ovary (6.3%). Once again, there was a high percentage (8.8 %) of cancers where the primary site was unknown. Of the 761 cases registered, 384 (50.4%) had histological or cytohaematological confirmation. There was a relatively high percentage (30.0%) of cancers diagnosed from death certificates, and 19.3 % were based on clinical investigation/ultrasound.

### *Fiji Islands*

The Fiji Cancer Registry was already in existence before the commencement of this study, but as part of the current project the Registry was reviewed and updated by the authors. In this process, at least 600 cancer cases that were not on the cancer register were identified from the Patient Identification System (PATIS) in a 2006 review by one of the authors (Di Best). Important components of cancer registry information such as



**Table 1: Crude Cancer incidence per 100,000 person-years in Tonga, Fiji Islands, Cook Islands, Niue and Pacific people in New Zealand**

		Tonga (2000-2005)	Fiji Islands (2002-2005)	Cook Island (2000-2005)	Niue	New Zealand (Pacific) (2000-2005)	New Zealand (total) (2000-2005)
	ICD-10	Rate (n)	Rate (n)	Rate (n)	Rate (n)	Rate (n)	Rate (n)
<b>Female</b>							
Breast	C50	33.3 (99)	38.2 (622)	19.1 (10)	85.3 (3)	55.6 (421)	118.6 (14149)
Uterine	C54	17.5 (52)	13.8 (225)	43.9 (23)	21.3 (1)	23.0 (174)	16.1 (1917)
Cervical	C53	11.1 (33)	43.0 (700)	17.2 (9)	21.3 (1)	7.1 (54)	8.9 (1063)
Unknown		12.1 (36)	4.4 (72)	9.5 (5)	21.3 (1)	0 (0)	0 (0)
Lung	C34	7.7 (23)	2.9 (48)	5.7 (3)	0 (0)	16.2 (123)	35.8 (4268)
Liver	C22	6.4 (19)	3.6 (59)	17.2 (9)	0 (0)	3.8 (29)	2.9 (347)
Stomach	C16	7.1 (21)	3.6 (59)	1.9 (1)	0 (0)	7.5 (57)	7.4 (882)
Colon	C18	3.4 (10)	2.8 (45)	0 (0)	21.3 (1)	7.7 (58)	47.9 (5708)
Ovary	C56	9.1 (27)	11.1 (181)	5.7 (3)	0	9.2 (70)	14.7 (1750)
Other		37.6 (112)	67.6 (1101)	32.5 (17)	63.9 (3)	46.3 (351)	139 (16582)
<b>Total</b>		<b>145.1 (432)</b>	<b>191.0 (3112)</b>	<b>152.8 (80)</b>	<b>234.4 (11)</b>	<b>197.3 (1495)</b>	<b>437.1 (52150)</b>
<b>Male</b>							
Lung	C34	15.2 (47)	5.4 (91)	28.7(16)	0 (0)	28.6 (210)	51.8 (5885)
Prostate	C61	13.6 (42)	10.8 (184)	16.1 (9)	88.2 (4)	44.5 (327)	147.3 (16742)
Liver	C22	12.0 (37)	7.8 (133)	16.1 (9)	0 (0)	11.6 (85)	6.2 (702)
Unknown		10.0 (31)	2.3 (39)	7.2 (4)	0 (0)	0 (0)	0 (0)
Stomach	C16	10.3 (32)	4.4 (74)	1.8 (1)	0 (0)	9.7 (71)	12.1 (1376)
Lymphoid and Haematopoietic	C81-96	5.5 (17)	11.0 (186)	3.6 (2)	0 (0)	22.8 (168)	48.8 (5550)
Pancreas	C25	3.9 (12)	2.7 (45)	1.8 (1)	0 (0)	3.1 (23)	9.0 (1028)
Colon	C18	3.9 (12)	3.1 (53)	1.8 (1)	22.0 (1)	5.3 (39)	42.6 (4837)
Other		31.3 (97)	39.5 (671)	37.6 (21)	22.0 (1)	52.1 (383)	195.4 (22206)
<b>Total</b>		<b>105.6 (327)</b>	<b>87.0 (1476)</b>	<b>114.7 (64)</b>	<b>132.3 (6)</b>	<b>178.4 (1312)</b>	<b>514.1 (58426)</b>

recording the extent of disease at diagnosis are currently not recorded on the register. The collaboration has resulted in the compilation of a Procedure/user Manual for the Fiji Cancer Registry, brief training on the use of CanReg4, training for cancer, and recommendations submitted to the Fiji Ministry of Health. Table 1 shows the crude incidence rates and numbers of cases for cancer registrations in the Fiji Islands during 2002-2005, and Table 2 shows the age-standardised incidence rates and 95% CIs. For the years 2002-2005 there were 4,609 cases of cancer (1,485 males and 3,124 females). The leading cancers among males were lymphoid and haematopoietic (12.6% of males cases), prostate (12.5 % of male cases), liver (9.0%), and lung (6.1%). Among females the leading cancer sites were the cervix (22.5% of female cases), breast (20.0%), uterus (7.2%) and ovary (5.8%).



Table 2: Age-standardised cancer incidence per 100,000 person-years in Tonga, Fiji Islands, Cook Islands, Niue and Pacific people in New Zealand

	ICD-10	Tonga (2000-2005)		Fiji Islands (2002-2005)		Cook Island (2000-2005)		Niue		New Zealand (Pacific people) (2000-2005)		New Zealand (total) (2000-2005)	
		Rate (95%CI)	Rate (95%CI)	Rate (95%CI)	Rate (95%CI)	Rate (95%CI)	Rate (95%CI)	Rate (95%CI)	Rate (95%CI)	Rate (95%CI)	Rate (95%CI)		
<b>Female</b>													
Breast	C50	45.5 (44.6 - 46.4)	47.7 (47.3 - 48.1)	22.9 (21.5 - 24.3)	82.7 (74.6 - 90.8)	85.7 (77.5 - 94.6)	92.8 (91.3 - 94.4)						
Uterine	C54	23.9 (23.3 - 24.5)	17.7 (17.5 - 17.9)	47.0 (45.1 - 48.9)	29.4 (23.6 - 35.2)	38.1 (32.5 - 44.3)	12.4 (11.8 - 13.0)						
Cervix	C53	15.7 (15.2 - 16.2)	50.7 (50.3 - 51.1)	17.0 (15.9 - 18.1)	25.9 (20.8 - 31.0)	10.3 (7.7 - 13.6)	7.8 (7.3 - 8.3)						
Unknown		16.9 (16.3 - 17.5)	5.5 (5.4 - 5.6)	11.0 (10.1 - 11.9)	16.6 (13.4 - 19.8)	0	0						
Lung	C34	10.7 (10.3 - 11.1)	3.9 (3.8 - 4.0)	7.0 (6.2 - 7.8)	0	28.8 (23.8 - 34.5)	25.4 (24.7 - 26.2)						
Liver	C22	8.3 (7.9 - 8.7)	4.7 (4.6 - 4.8)	18.8 (17.6 - 20.0)	0	6.8 (4.5 - 9.8)	2.0 (1.8 - 2.3)						
Stomach	C16	9.7 (9.3 - 10.1)	4.7 (4.6 - 4.8)	1.8 (1.5 - 2.1)	0	13.2 (9.9 - 17.2)	4.9 (4.6 - 5.2)						
Colon	C18	4.6 (4.3 - 4.9)	3.9 (3.8 - 4.0)	0	18.9 (15.2 - 22.6)	13.1 (9.8 - 17.0)	31.1 (30.2 - 31.9)						
Ovary	C56	12.1 (11.6 - 12.6)	13.3 (13.1 - 13.5)	5.8 (5.1 - 6.5)	0	13.5 (10.4 - 17.2)	11.2 (10.6 - 11.7)						
Other		48.3 (47.4 - 49.2)	79.0 (78.5 - 79.5)	33.4 (31.8 - 35.0)	54.4 (48.2 - 60.6)	73.2 (65.4 - 81.6)	101.5 (99.9 - 103.1)						
Total		194.9 (193.1 - 196.7)	230.9 (230.1 - 231.7)	164.5 (160.9 - 168.1)	227.8 (214.3 - 241.3)	314.9 (298.6 - 331.9)	321.5 (318.7 - 324.4)						
<b>Male</b>													
Lungs	C34	21.9 (21.3 - 22.5)	8.3 (8.1 - 8.5)	36.8 (35.0 - 38.6)	0	64.3 (55.3 - 74.3)	39.4 (38.4 - 40.4)						
Prostate	C61	20.7 (20.1 - 21.3)	21.1 (20.8 - 21.4)	26.4 (24.6 - 28.1)	84.4 (76.1 - 92.7)	114.6 (101.8 - 128.4)	113.7 (112.0 - 115.5)						
Liver	C22	17.6 (17.0 - 18.2)	11.7 (11.5 - 11.9)	16.9 (15.9 - 17.9)	0	21.5 (17.0 - 26.9)	5.0 (4.6 - 5.3)						
Unknown		14.6 (14.1 - 15.1)	3.6 (3.5 - 3.7)	7.0 (6.3 - 7.7)	0	0	0						
Stomach	C16	15.0 (14.5 - 15.5)	6.2 (6.1 - 6.3)	1.7 (1.4 - 2.0)	0	19.7 (15.1 - 25.2)	9.4 (8.9 - 9.9)						
Lymphoid and Haematopoietic	C81-96	6.6 (6.3 - 6.9)	12.5 (12.3 - 12.7)	5.8 (5.0 - 6.6)	0	39.5 (33 - 46.8)	39.5 (38.4 - 40.5)						
Pancreas	C25	5.5 (5.2 - 5.8)	4.2 (4.1 - 4.3)	3.8 (3.0 - 4.6)	0	7.0 (4.1 - 10.8)	7.0 (6.5 - 7.4)						
Colon	C18	5.4 (5.1 - 5.7)	4.6 (4.5 - 4.7)	1.7 (1.4 - 2.0)	20.5 (16.5 - 24.5)	11.8 (8.0 - 16.5)	32.5 (31.6 - 33.4)						
Other		44.1 (43.2 - 45.0)	54.1 (53.7 - 54.5)	41.6 (39.8 - 43.4)	25.9 (20.8 - 31.0)	99.4 (88.5 - 111.2)	157.1 (155.0 - 59.2)						
Total		151.4 (149.8 - 153)	126.3 (125.7 - 126.9)	141.7 (138.2 - 45.2)	130.7 (120.2 - 41.2)	379.1 (356.9 - 402.2)	404.2 (400.9 - 407.5)						



### *Cook Islands*

Table 1 shows the crude incidence rates and numbers of cases for cancer registrations in the Cook Islands during 2000-2005, and Table 2 shows the age-standardised incidence rates and 95% CIs. For the years 2000-2005 there were 144 cancers registered (64 males and 80 females). The leading cancers among males were lung (26.6 % of male cases), prostate (14.1% ) and liver (12.5%). There was a significant number of cancers of with unknown primary site (6.3%). Among females the leading cancer sites were the uterus (28.8% of female cases), breast (12.5%), cervix (11.3%) and liver (11.3%). For almost a third of cancers, the "basis of diagnosis" could not be ascertained from available records. This may be partly due to missing histology reports as all histology specimens are send to New Zealand, and results are send back to referring doctors with no copies to the cancer registry. Less than half of the diagnoses were based on histology of the primary site.

### *Niue*

Table 1 shows the crude incidence rates and numbers of cases for cancer registrations in Niue during 2000-2005, and Table 2 shows the age-standardised incidence rates and 95% CIs. There were only 17 cancers registered during this period (11 female, 6 male). Among the 6 males with cancer 4 were of the prostate and among the 11 female cancers 4 were of the breast followed equally by 1 cancer each registered for individual sites including the uterus, cervix, an unknown site and the thyroid).

## **Discussions**

This study has provided the first published standardised comparisons of cancer incidence in Tonga, Fiji, the Cook Islands, and Niue, and the first comparisons of cancer incidence in those countries with that in New Zealand in general, and Pacific people in New Zealand in particular. Before we discuss the substantive findings, the limitations of this data should first be considered.

The primary concerns involve the completeness of the data and the validity of the diagnoses. In most countries, the sources of data were histology and cyto/haematological reports available from the Ministry of Health records, patient admission/discharge records and death certificates. There are particular concerns in all four countries about the lack of information on outpatient events, probably under-reporting of cancer on death certificates, and possible under-reporting of cancers in hospital admission records because of the lack of accurate biopsy or histology data. We have therefore visited each of the four countries and conducted intensive review of records and constructed the cancer registries using all of the available information in a standardised manner. We have then restricted our analyses to the time periods for which we were confident that a high proportion of the relevant records were available. This produced, in each country, a large increase in the number of cancer registrations. We therefore have confidence that the estimates presented here do not involve significant under-reporting, but currently no information is available to quantify the extent (or lack of) any under-reporting for the time periods under study.

A further limitation of these data is that Pacific people in New Zealand constitute a heterogeneous group from many Pacific countries, and includes both second- and third- generation New Zealanders as well as more recent migrants. The two populations are therefore not directly comparable.





On the other hand, a strength of the study is the availability of comparable data on Pacific people living in New Zealand, which has enabled us to make comparisons which are relevant to the assessment of whether the high rates observed for some specific cancers in Pacific people in New Zealand<sup>21</sup> are likely to be due to genetic or environmental factors.

Bearing these limitations in mind, the findings of this study are nevertheless of considerable interest. We will first consider the findings for overall cancer incidence, before discussing the data for specific cancer sites.

### **Total cancer**

The overall age-standardised cancer incidence rates for Pacific people in New Zealand (315 per 100,000 person-years in females, 379 in males) were similar to those for New Zealand overall (322 in females, 404 in males). However, cancer incidence was markedly lower for Pacific people living in the Pacific with rates of 195 and 151 for females and males respectively in Tonga, 231 and 126 in Fiji, 165 and 142 in the Cook Islands, and 228 and 131 in Niue. These findings are of considerable interest, since environmental rather than genetic factors are most likely to explain these patterns<sup>21</sup>, and cancer incidence in the Pacific is therefore likely to increase to rates similar to those in New Zealand as Pacific countries become more 'westernised'.

### **Female reproductive cancers**

Breast cancer, uterine cancer and cervical cancer were the three leading causes of cancer incidence in women in all four Pacific countries. This contrasts with the situation of Pacific women in New Zealand for whom lung cancer has become the third leading cause of cancer incidence. Breast cancer was lower than for Pacific women in New Zealand and New Zealand in general, but nevertheless represented the leading cause of cancer in women in the four Pacific countries. Uterine cancer was higher in Pacific women in New Zealand (38 per 100,000) than for New Zealand in general, and was also relatively high in the Pacific with rates of 24 in Tonga, 18 in Fiji Islands, 47 in the Cook Islands, and 29 in Niue. The reasons for this are unknown. Although it would be expected that the relatively high parity of Pacific women would result in a low incidence of these cancers, this does not seem to be the case. It is possible that post-menopausal obesity, a risk factor for both breast and uterine cancers, could be contributing to the high levels of these diseases.

The most striking finding is the high rates of cervical cancer in the Pacific. Despite the likely under-reporting of cases, incidence was higher in Fiji (51 per 100,000), Tonga (16), Cook Islands (17) and Niue (26) than for Pacific women in New Zealand (11) or New Zealand in general (8). Cervical cancer represents an immense cancer burden, especially in Fiji<sup>22</sup>. For the last decade cervical cancer has been the most common cancer, and the leading cause of cancer death, both among women and for the whole Fiji population. The reasons for this are not well-established, and the available data is minimal for the Pacific, but it is possible that these high incidence rates are due to high rates of human papilloma virus (HPV) infection. One possible explanation for this is a relatively low rate of condom use, which had been reported for Tonga<sup>23</sup> and is likely to also be the case in other Pacific countries. The low participation rate in cervical screening programmes (Pap smears) experienced in most Pacific island countries undoubtedly also plays a role<sup>23</sup>.



## Liver cancer

Due to the history of endemicity of Hepatitis B in the Pacific<sup>24-26</sup>, liver cancer merits special attention. The incidence rates were elevated in Tonga (8 in women, 18 in men), Fiji Islands (5 and 12), Cook Islands (19 and 17), and in Pacific people in New Zealand (7 and 26) compared with New Zealand overall (2 and 5). The high rate of hepatitis B carriage in Pacific people and Maori in New Zealand, has been reported as accounting for the high rates of liver cancer compared to the European New Zealand population<sup>25 27</sup>. However, it could be expected that the introduction of hepatitis B vaccination two decades ago, should in future be reflected declining rates of liver cancer in the next few decades<sup>24</sup>.

## Lung cancer

Lung cancer incidence rates in men were elevated in Tonga (22), Fiji Islands (8), and the Cook Islands (37), and in Pacific people in New Zealand (66) compared with New Zealand overall (41). The importance of lung cancer in both men and women is likely to increase in coming years in these four Pacific countries in coming decades as a result of increases in smoking rates in the last few decades<sup>28-32</sup>.

## Conclusions

In summary, cancer incidence in the Pacific is lower than for Pacific people living in New Zealand, with the latter group having similar cancer incidence rates to New Zealand overall. Environmental rather than genetic factors are most likely to explain these patterns, and cancer incidence in the Pacific is therefore likely to increase to rates similar to those in New Zealand as Pacific countries become more 'westernised'. The high rates of cervical cancer and liver cancer in the Pacific indicate an important role of infectious disease (human papilloma virus (HPV) and hepatitis B virus (HBV)) for these cancers in the Pacific. The explanations for the high rates of uterine, and to a lesser extent, ovarian cancer are currently unclear and require further study. Breast cancer rates are lower in the Pacific than for Pacific women in New Zealand, but nevertheless represent the most important cancer burden for women in the four Pacific countries studied. Similarly, lung cancer rates are lower for Pacific men in New Zealand, but nevertheless represent the most important cancer burden for men in the four Pacific countries studied.

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*“Each moment of the year has its own beauty”*

*Ralph Waldo Emerson*

