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Contemporary patterns of Pacific Island mortality

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Background The Pacific Island countries are at different stages of the demographic and epidemiological transitions. The availability of accurate and current mortality data is of vital importance for priority setting in health. Available mortality data generally underestimate death rates among both children and adults. In many Pacific Island populations, little is reliably known about levels and causes of death, particularly among adults.

Methods The results of two comprehensive approaches to obtaining mortality estimates are reported. First, a systematic review of available life expectancy and infant mortality information reported by countries from 1990 onwards was undertaken and evaluated with respect to quality, and a final 'best estimate' was established. Methods were based on registered deaths and indirect demographic methods. The second approach consisted of a demographic evaluation of vital registration data for completeness, with death rates adjusted accordingly, or where vital registration was not available, the application of new model life table methods to generate life tables from estimates of child mortality, as used by the World Health Organisation (WHO).

Results This analysis reveals substantial uncertainty about mortality conditions in Pacific Island populations. In some countries, life expectancy variations of 10 years or more were recorded in the 1990s, depending on the source. Best approaches suggest that life expectancy (at birth) varied considerably, from levels of around 55–60 years in some Melanesian and Micronesian states to levels above 70 years in low-mortality countries. The principal issues with regard to uncertainty around mortality levels include underenumerated vital registration data; annual stochastic fluctuations in mortality in small populations; errors in the imputation of adult mortality from infant and childhood rates; implausible results from indirect demographic methods; use of possibly inappropriate model life tables to adjust death data or for indirect methods; and inadequately described and implausible projections. The WHO model life table method based on adjusted vital registration generally yielded results similar to those suggested by an evaluation of published data, with some exceptions, which are further discussed.

Conclusions This study indicates the urgent need to improve infrastructure, training, and resources for routine mortality estimation in many Pacific Island countries in order to better inform and evaluate health and public policy.

Keywords Mortality, life expectancy, infant mortality rate, Pacific Island countries, Melanesia, Polynesia, Micronesia, health transition, demographic transition

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Pacific Island countries are at different stages of the demographic transition, with some populations still experiencing relatively high mortality and fertility, while others manifest lower mortality and declining fertility. These countries are also passing through the epidemiological transition, with a progressive increase in proportionate mortality from chronic diseases and widening sex differentials in death rates.[1,2]

The availability of accurate and current data on mortality levels, causes of death, and trends is of vital importance to assist countries to channel public and private resources into priority health-related activities. The consequence of inaccurate (usually low) mortality data is an underestimation of the gravity and urgency of health problems, often leading to under-investment in health development. Many international and aid agencies use infant and childhood mortality rates and life expectancy as part of the decision-making process for the allocation of funds. Trends in mortality can also provide a useful and simple overall assessment of the results of investment in social and economic development and health services.

The purposes of this article are to (i) document levels of uncertainty in mortality estimates in Pacific Island countries, (ii) identify the major quality and analytic problems affecting estimates of mortality in Pacific Island countries, and (iii) provide best estimates from an assessment of published data and the application of demographic techniques. The scope of the current exercise is limited to total mortality levels. A similar assessment of cause of death data and cause of death estimates is essential to help determine the need for priority health programmes.

The study includes Melanesia (Fiji, New Caledonia, Papua New Guinea, Solomon Islands, and Vanuatu), Micronesia (Federated States of Micronesia, Guam, Kiribati, Marshall Islands, Nauru, Northern Marianas, and Palau), and Polynesia [American Samoa, Cook Islands, French Polynesia, Niue, Samoa (formerly Western Samoa), Tokelau, Tonga, Tuvalu, and Wallis and Futuna].

Methods

Review of existing country mortality information

A systematic survey was undertaken of international and regional health and development agencies, and of universities and research institutes known to be involved in the production and dissemination of mortality data for the Pacific Islands. A data collection instrument was sent to the health and statistics ministries/departments of Pacific Island countries through World Health Organisation (WHO) offices and representatives requesting published and unpublished mortality data from 1990 onwards.[3] In total, 167 references to recent mortality information were obtained for the 21 states included in the survey. Mortality data were evaluated with respect to (i) source and methods, (ii) plausibility, and (iii) consistency.

(i) The primary source of mortality data was identified, and the methods used for computation and projections were ascertained as far as possible; these were evaluated with respect to the known strengths and weakness of the sources and methods.[3–5] Empirical data from vital registration that had been assessed for underregistration were preferred to the use of model life tables for imputation of adult mortality from child mortality or as part of indirect methods (the model life tables used may not have been appropriate in several instances). Indirect methods were used extensively, especially the children ever born/children surviving (CEBCS) method, and the widowhood and orphanhood techniques for adult mortality;[4] these methods are capable of providing reasonable estimates of mortality as long as recall of demographic events is accurate and appropriate model life tables are used to translate recorded proportions of children/siblings surviving into estimates of infant and child mortality. Vital registration data covering short periods for small populations are unreliable because of stochastic variation. Projections were examined with regard to methodology and assumptions, where these were available; projections were often based on standard assumptions about mortality decline over time from international rather than local data, and are therefore unreliable.[6] We paid particular attention to comments in reports that were related to data quality and assumptions in analyses.

(ii) Infant and childhood mortality and life expectancy figures were evaluated with respect to plausibility compared with levels in other countries (e.g. infant mortality rates below 10/1000 are usually seen only in developed countries), the cause-structure of mortality, where it is reliably known (e.g. relatively low infant mortality is plausible in countries with relatively low life expectancy if the health transition is characterized by considerable noncommunicable disease mortality in adults), and reported changes in relation to previous estimates (e.g. sudden rises or falls in life expectancy and infant mortality over short periods are improbable without good explanation), of which some may have been of greater validity [in assessing a series over time, greater weight is given to the estimates derived from more appropriate methods, as assessed in (i)].

(iii) Finally, there is greater confidence in mortality estimates that are derived by independent methods requiring different assumptions yet which yield approximately similar results. However, estimates produced by different agencies may be consistently wrong because they derive from each other, or are produced from the same faulty source data or inappropriate methodologies; thus consistency must be judged in relation to (i) and (ii).

The 'best estimates' of life expectancy and infant mortality for each Pacific Island country have been derived from the data and information available, following application of the above considerations. A range of uncertainty is given as the minimum and maximum estimates for life expectancy and infant mortality identified from the available data for each country during the 1990s.

Estimates from reported or estimated age-specific mortality data

For its annual assessment of life tables for Member States, WHO classifies countries, including Pacific Island states, into categories depending on the availability and quality of vital registration data.[5] Death registration data were derived from vital registration and/or health department sources in various countries covering the period 1980–2000. Jurisdictions not included are New Caledonia, Guam, Northern Mariana Islands, American Samoa, French Polynesia, Tokelau, and Wallis and Futuna as they are not WHO Member States. For analytical

purposes, Category I countries, in which vital registration data were considered sufficiently complete (coverage ⩾95%) to compute life tables, included Fiji and Cook Islands. Category II countries were those considered to have incomplete vital statistics, which required the application of indirect demographic methods to assess the completeness of vital registration and to correct for underreporting.[4] Countries in this category included Papua New Guinea, Marshall Islands, Palau, Niue, Samoa, Tonga, and Tuvalu. No Pacific Island countries fell into Category III (countries with nationally representative sample mortality surveillance systems). Category IV includes countries for which child mortality can be estimated from surveys and censuses, and for which there may or may not be any estimate of adult mortality; countries in this category included Solomon Islands, Vanuatu, Federated States of Micronesia, Kiribati, and Nauru.

For countries in Categories I and II, standard life table methods were used. For countries in Category II, demographic techniques were first used to correct for underenumeration of data.[4,5] Next, using the latest available year (or years) as standard, annual values of α and β from the Brass relational model life table system were estimated for each year for which data were available. The appendix shows the years of vital registration data available for use in the WHO method, and the results are shown in Tables 1–3. Brass proposed that the logits of the survival values at each age x (ℓx) from two life tables are linearly related, that is, logit $\ell x = \alpha + \beta$ logit $\ell^s x$, where $\ell^s x$ is the standard (known) life table and logit $\ell x = 0.5 \ln((1.0-\ell x)/\ell x)$.[4]

For Categories I and II, the trend in the two parameters (α, β) generated from the life tables using the basic Brass logit system was used to generate a time-series of life tables to 2000 using standard lagged time-series projection models.[5] For countries with no adult mortality estimates available from vital registration (Category IV), estimates of adult mortality at ages 15–60 years ($_{60}q_{15}$) were derived from corrected estimates of child mortality based on censuses and surveys, using the modified Brass life table system.[7]

Data presented in Tables 1–3 from the WHO life tables have been rounded to the nearest whole year of life expectancy (at birth) and nearest number of deaths (per 1000) for the infant mortality rate (IMR). The IMR shown in Tables 1–3 was calculated by averaging the sex-specific IMR from the WHO life tables.

Results

Uncertainty of mortality estimates

This analysis reveals substantial uncertainty around mortality estimates for Pacific Island countries (Tables 1–3). The ranges for life expectancy and infant mortality are the minimum and maximum estimates identified from the published and unpublished data obtained from the detailed review described in 'Methods'. In some countries, life expectancy variations of 10 years or more were recorded in the 1990s. The review of published mortality estimates suggests that there is considerable use of underenumerated death records or vital registration data, especially within countries, without any attempt to estimate and correct for underenumeration. Both infant and adult mortality data are underestimated in many Pacific Island countries.

In some small Pacific Island states, especially those with populations below 50 000, vital registration or death recording data are frequently used by countries to produce annual mortality estimates. The small number of deaths produces significant fluctuations from year to year, with some mortality estimates being implausibly high (e.g. Cook Islands) and others implausibly low (e.g. Fiji).

In some countries, adult mortality has been imputed directly from infant and under-5 mortality using inappropriate life tables that do not reflect Pacific Island patterns of the relationship between child and adult mortality.[1,2] An additional problem is that the infant and childhood mortality calculated from death registration or indirect methods may not in itself, be accurate. Some estimates of mortality from indirect demographic methods do not produce plausible results (compared with previous estimates and similar countries), and this may be due to uncorrected inaccuracies in the census or survey data or uncritical analysis.

There are indications that projections are frequently employed to produce 'current' mortality estimates (since mortality and life expectancy figures are given for the year of publication of the data), but projection methodology is hardly ever mentioned or described. There is indirect evidence that projections of life expectancy using as an increment a fixed fraction of a year of life expectancy per annum (such as 0.5 years per annum) have been used in some countries since published annual life expectancies increment by such fixed values each year from the last empirical estimate. Such increments are likely to be based on generic models of mortality decline assumed by the United Nations.[6]

Best estimates of Pacific Island mortality around 2000

Based on an evaluation of data and methods, life expectancy across the Pacific appears to vary from 51–58 years in Papua New Guinea to a high in Guam (73–77 years) and New Caledonia (70–76 years) (Table 1). Infant mortality was lowest in Guam and New Caledonia (<10/1000) and relatively high (60–80/1000) in several countries across Melanesia, Micronesia, and Polynesia, although there is substantial uncertainty around these estimates. This mortality range, if true, is at least as great as the variation between Africa and Europe.[5]

Discussion

This study provides a comprehensive critique of available mortality estimates for Pacific Island countries using multiple sources of published and unpublished information, as well as the life tables constructed by WHO based on adjusted age-specific mortality rates. The references acquired on mortality in Pacific Island countries indicate that contradictory and unreliable estimates of the level of mortality in these countries are often published. For this article, ranges of mortality levels are presented from a review of existing published and unpublished information and the 2000 WHO life tables.

In general, there is very poor documentation of data sources and the methodology of mortality estimation in most published reports. The age-specific mortality rates upon which life expectancies are based are frequently not provided. There are significant differences between data published by different

Table 1 Mortality estimates for Pacific Island countries: Melanesia

Country (population '000—year) GDP per capita Aus $000	Best recent available estimate (and range of 1990s estimates)[a]						WHO estimate for 2000[5]			
	Year	Life expectancy at birth (yrs) Male	Female	Year	Infant mortality (per 1000)	Source and method	Life expectancy at birth (yrs) Male	Female	Infant mortality (per 1000)	Mortality data category
Fiji (810—1997) $3.1	1996	65 (61–72)	69 (65–76)	1996	20 (7–25)	Demographic analysis of 1996 census [20–22]	67	71	20	I
New Caledonia (197—1996) $21.0	1999	70 (67–70)	76 (73–77)	1999	6 (5–11)	Accurate vital registration [23]	—	—	—	—
Papua New Guinea (3608—1990) $1.3	1991	52 (52–55)	51 (51–57)	1995	76 (76–82)	Life expectancy 1991 census analysis [24–26] IMR intercensal survey (1995)[27]	55	58	84	II
Solomon Islands (404—1999) $1.1	1999	61 (61–68)	62 (62–73)	1999	66 (38–66)	Demographic analysis of 1999 census [28]	67 (64)[b]	71 (67)[b]	26 (69)[b]	IV
Vanuatu (193—1999) $1.8	1989 1999	62 66 (62–67)	64 69 (64–70)	1989 1999	45 27 (26–45)	Demographic analysis of censuses [21,24,28]	64	68	41	IV

Category I countries are countries considered by WHO to have vital registration data sufficiently complete (95% coverage and above) to compute life tables. Countries in Category II are considered to have incomplete vital statistics and require the application of indirect demographic methods to assess the completeness of vital registration and to correct for underreporting. Category IV includes countries in which child mortality can be estimated from surveys and censuses and for which there may or may not be any estimate of adult mortality. GDP per capita Aus$000: most recent data 1993–2000. Secretariat for the Pacific Community, *Selected Pacific Economies—A Statistical Summary (SPESS)*.[29]

[a] The ranges for life expectancy and infant mortality are the minimum and maximum estimates identified for the 1990s.

[b] Updated estimates from the *World Health Report, 2003. Geneva: WHO*.[8]

agencies for similar periods for many countries. It is usually not clear how such different estimates were derived. It may be the case that, for some countries, published mortality estimates are derived from similar neighbouring countries or regional averages, or imputed from macroeconomic (e.g. GDP per capita) or social data, and this could explain some of the large differences between figures provided by different agencies. It is vital that methodology is accurately recorded to ensure reproducibility of results and to adhere to fundamental scientific principles.

Underenumeration of deaths in vital registration data is common, yet few countries attempt to estimate and correct for underenumeration. Mortality rates derived from these data are often implausibly low in relation to mortality reported from countries at similar levels of social and economic development and are inconsistent with measures of mortality derived from indirect demographic techniques. In some small Pacific Island countries, especially those with populations below 50 000, the small number of deaths produces significant fluctuations from year to year. Averages over 3–5 years, or in some cases 7–10 years, are required to avoid spurious high and low mortality estimates due to stochastic variation.

In some small Pacific Island countries with extensive connections with more developed countries, outmigration of seriously ill people for treatment may lead to underenumeration of deaths. This applies especially to states associated with New Zealand, the USA, and France. Furthermore, sailors, expatriate workers, and military personnel may die overseas and their deaths may not be registered in their country of origin, although they had been counted in the census. The number of such deaths may be considerable for such Pacific Island countries as Kiribati and US-associated Micronesian states.

Indirect demographic methods including the CEBCS technique for infant and child mortality, and the orphanhood and widowhood methods for adult mortality, are used extensively in the census analyses for these populations. Although these methods are valuable in populations without accurate vital registration, the results depend on the quality of the data reported in the census. Moreover, these approaches have their own methodological problems[4,5] and they can be inappropriately or inexpertly applied, thus producing spurious findings.

There are some important differences between the two approaches used in this article to estimate mortality levels in Pacific Island countries. In particular, estimates of the infant mortality rate and life expectancy in 2000 for the Solomon Islands varied substantially between the two approaches; subsequently, however, WHO has revised its estimates based on updated information,[8] and it now indicates lower life expectancy and higher infant mortality, although the latest WHO estimates still claim lower mortality than quoted figures (Table 1). Considering the level of development, endemic disease, and civil disturbance in the Solomon Islands, it is likely

that the higher mortality estimates are more reasonable. There were also differences in the estimates for the Marshall Islands in 2000; but again, the latest WHO estimates[8] now indicate lower life expectancy, commensurate with reported figures, although the WHO infant mortality estimate is lower than quoted sources (Table 2). Differences are also apparent between the two approaches for estimates of life expectancy in Nauru, with the WHO method yielding lower mortality for 2000 than quoted data from the early 1990s (Table 2). However, the WHO estimates are derived from childhood mortality only and may not capture the excessive adult mortality from non-communicable disease and injuries in Nauruan adults. Consequently, the higher mortality estimates may be more accurate. The discrepancies in infant mortality between WHO and quoted sources for Niue and Tuvalu (Table 3) could well be due to stochastic variation over different periods in these very small populations. The approach used by WHO to estimate age-specific mortality rates in these countries relies heavily on judgement about the true level of underreporting of deaths in vital registration, and hence needs to be viewed cautiously. Its main advantage is that it yields smooth model age-specific death rates that are not affected by small population sizes.

Model life tables from the UN or Coale–Demeny systems are used extensively to smooth empirical death data, or are employed at some stage in the variety of indirect methods used in mortality analysis based on census or survey material.[9,10] These model life tables are now well out of date and their ability to capture contemporary age-specific mortality patterns in countries at different stages of the health (epidemiological) transition is questionable.[7] During the health transition many populations experience a plateau in life expectancy at birth (at around 55–65 years) which may last for decades as reductions in infant and childhood mortality from infectious disease and undernutrition are counterbalanced by increases in adult mortality from noncommunicable conditions (especially cardiovascular disease). This was observed in Australia between 1945 and 1970 in males and 1960 and 1970 in females,[11,12] and it is quite likely to be the case in many Pacific Island countries given the documented proportional mortality[1,2] and morbidity from noncommunicable disease and risk-factor

Table 2 Mortality estimates for Pacific Island countries: Micronesia

Country (population '000—year) GDP per capita Aus $000	**Best recent available estimate (and range of 1990s estimates)[a]**						**WHO estimate for 2000[5]**			
	Year	Life expectancy at birth (yrs) Male	Female	Year	Infant mortality (per 1000)	Source and method	Life expectancy at birth (yrs) Male	Female	Infant mortality (per 1000)	Mortality data category
Federated States of Micronesia (118—1997) $3.3	1994	64 (63–65)	67 (65–67)	1994	46 (20–46)	Life tables imputed from childhood mortality by indirect methods[24]	64	68	44	IV
Guam (146—1997) $26.8	1995	73 (70–73)	77 (74–77)	1995	9 (9)	Accurate vital registration[30]	—	—	—	—
Kiribati (81—1999) $0.8	1995	59 (58–59)	65 (62–65)	1995	62 (53–67)	Demographic analysis of 1995 census[31]	60	65	68	IV
Marshall Islands (51—1999) $2.7	1994	60 (60–66)	63 (63–69)	1994	63 (14–63)	Life tables imputed from childhood mortality[24]	63 (61)[b]	68 (65)[b]	38 (33)[b]	II
Nauru (10—1992) $4.3	1991–93	54 (54–55)	61 (61–64)	1991–93	13 (11–25)	Hospital death registration data[21,30]	59	67	10	IV
Northern Mariana Islands (59—1995)	1994–96	67 (67)	73 (73)	1992–96	10 (7–10)	Vital registration data[21,30] Probably accurate	—	—	—	—
Palau (19—1998) $10.9	1995	64 (64–66)	70 (69–74)	1995	20 (19–28)	Vital registration data[24,25] Probably accurate	65	69	20	II

Category I countries are countries considered by WHO to have vital registration data sufficiently complete (95% coverage and above) to compute life tables. Countries in Category II are considered to have incomplete vital statistics and require the application of indirect demographic methods to assess the completeness of vital registration and to correct for underreporting. Category IV includes countries in which child mortality can be estimated from surveys and censuses and for which there may or may not be any estimate of adult mortality. GDP per capita Aus$000: most recent data 1993–2000. Northern Mariana Islands: data not available. Secretariat for the Pacific Community, *Selected Pacific Economies—A Statistical Summary (SPESS)*.[29]

[a] The ranges for life expectancy and infant mortality are the minimum and maximum estimates identified for the 1990s.

[b] Updated estimates from the *World Health Report, 2003. Geneva: WHO*.[8]

Table 3 Mortality estimates for Pacific Island Countries: Polynesia

Country (population '000—year) GDP per capita Aus $000	Best recent available estimate (and range of 1990s estimates)[a]						WHO estimate for 2000[5]			
		Life expectancy at birth (yrs)			Infant mortality	Source and	Life expectancy at birth (yrs)		Infant mortality	Mortality data
	Year	Male	Female	Year	(per 1000)	method	Male	Female	(per 1000)	category
American Samoa (63—1999)	1995	68 (67–68)	76 (71–76)	1991–95	13 (10–16)	Sources and methods unclear[24]	—	—	—	—
Cook Islands (17—1999) $7.2	1995–97	68 (51–71)	72 (57–74)	1991–96	16 (4–36)	Vital registration data[21,30,32]	69	72	18	I
French Polynesia (220—1996) $23.9	1996	69 (68–69)	74 (71–74)	1996	10 (7–13)	Accurate vital registration data[21,30]	—	—	—	—
Niue (2—1997) $6.9	1991–97	70 (63–74)		1991–96	18 (18–22)	Probably accurate vital registration data[21,33]	70	73	29	II
Samoa (175—1999) $2.4	1998	65 (65–70)	72 (67–72)	1998	25 (11–25)	Vital statistics sample survey[21,30,34]	67	73	27	II
Tokelau (1.5—1996)	1996	68 (68)	70 (70)	1991–95	32 (32–38)	Vital registration data[24] Probably accurate	—	—	—	—
Tonga (97—1999) $2.5	1996	70 (68–70)	72 (71–74)	1996	19 (9–19)	Demographic analysis of 1996 census[21,35]	67	73	18	II
Tuvalu (11—1999) $1.9	1991	64 (64)	70 (70)	1990–99	27 (16–56)	Life expectancy data from demographic analysis of 1991 census[21,24,36,b]	64	68	37	II
Wallis and Futuna (14—1996)	1990–95	67 (67–70)	71 (71–74)	1990–95	15 (6–18)	Probably accurate vital registration data[24,30]	—	—	—	—

Category I countries are countries considered by WHO to have vital registration data sufficiently complete (95% coverage and above) to compute life tables. Countries in Category II are considered to have incomplete vital statistics and require the application of indirect demographic methods to assess the completeness of vital registration and to correct for underreporting. Category IV includes countries in which child mortality can be estimated from surveys and censuses and for which there may or may not be any estimate of adult mortality. GDP per capita Aus$000: most recent data 1993–2000. Data not available from American Samoa, Tokelau, and Wallis and Futuna. Secretariat for the Pacific Community, *Selected Pacific Economies—A Statistical Summary (SPESS)*.[29]

[a] The ranges for life expectancy and infant mortality are the minimum and maximum estimates identified for the 1990s.

[b] Tuvalu Government, Statistics Office, Excel data file, 2001.

prevalences.[13] This pattern is seen, for example, in Nauru,[14] Australian Aborigines,[15,16] and also Eastern Europe and the former Soviet Union.[17,18] There may well be a variety of age-specific patterns of mortality that yield the same level of life expectancy, and these are not adequately covered by model life tables. The new model life table system proposed by Murray *et al.*[7] should help to overcome some of these problems in incorrect choice of a family of model life tables, but this system presupposes reasonable estimates of adult mortality.

Furthermore, there are problems in life expectancy projections. The average rate of improvement in life expectancy (years per annum) in countries at various levels of life expectancy depends on many factors, including the impact of risk-factor dispersion on levels of mortality from noncommunicable diseases. Projections that incorporate a rate of increase in life expectancy (at birth) derived from past international experience rather than local data may be implausible for countries in the midst of the epidemiological (health) transition with an epidemic of noncommunicable disease. Some Pacific countries have shown a plateau in life expectancy for 1–2 decades, which is likely to be associated, in part, with the emergence of noncommunicable disease (as observed in Australia).[11,12]

Conclusions

Pacific Island countries show highly variable patterns of mortality. Whereas high-mortality populations are affected particularly by infectious diseases and undernutrition (especially in children), low-mortality countries are afflicted with noncommunicable diseases and injuries in adults. However, even the least developed, high-mortality countries show urban–rural differentials, with noncommunicable diseases

emerging as health problems in urban areas.[13] In Nauru, noncommunicable diseases and accidents, particularly for males, are sufficiently problematic to greatly increase adult mortality and reduce life expectancy. This cause-structure of mortality also explains wide sex differentials in death rates, with much higher death rates in males.[1,2,14] Compared with previous studies from around 1980,[1,2] mortality appears to have declined over the past two decades in all Pacific Island countries, with the smallest changes in those states that already had relatively high life expectancy (such as Guam and American Samoa). Nevertheless, important differentials remain.

The community of Pacific Island countries is a neglected category in international comparisons of health development. This review of available data suggests that accurate vital registration systems, the internationally recognized 'gold standard'[19] for assessing levels, patterns, and causes of mortality, are woefully inadequate in most of these countries and seem to have developed very little over the last few decades. Rather, most estimates of mortality are based on indirect methods applied to census and survey data which, although generally reasonable for measuring levels of child mortality, are very poorly understood in most Pacific Island states. Such data as are available, however, suggest that several of these countries, and in particular Nauru, have patterns of mortality that are unique in the sense that levels of adult mortality appear to be substantially higher than might be expected, or than has been observed elsewhere, given probable levels of child mortality. This aberration requires urgent documentation and scientific enquiry to establish the true levels of adult mortality, and where possible from an analysis of vital registration data, the main causes of the observed excess deaths. Correction of mortality levels will lead to an apparent increase in death rates, compared with published values, and this needs to be carefully explained.

Reliable, current data on levels and causes of child and adult mortality are critical for prioritizing health sector interventions and health policy development in the Pacific Islands, and elsewhere. The results highlight substantial uncertainty in mortality estimates and probable wide variation of mortality levels and patterns across the Pacific. The very different stages of the demographic and health transitions suggest that these states should not be grouped together in international health analyses.

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KEY MESSAGES

- There is considerable uncertainty about levels and patterns of mortality in Pacific Island states. Efforts to improve routine vital registration systems are urgently required.
- Best estimates of current mortality levels suggest substantial diversity in mortality rates among Island populations.
- Life expectancy ranges from levels around 55 years to 75 years, reflecting very different progress in disease control among countries.
- There is evidence in some states of markedly higher rates of adult mortality, particularly for males, than would be expected given relatively low levels of child mortality.

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Appendix

Table A1 Years of vital registration data available for the WHO method,[5] held in the WHO database 1980–2000 (as of September 2001)

Country	1980	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000
Category 1: considered to have complete vital statistics (≥95% coverage)																					
Cook Islands	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Fiji	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	
Category II: incomplete vital statistics																					
Marshall Islands							x	x	x	x	x	x	x	x	x	x	x	x			
Niue	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Palau						x		x	x	x	x	x	x	x	x	x	x	x	x	x	
Papua New Guinea			x	x	x			x	x		x	x	x	x	x	x	x	x	x	x	
Samoa	x												x	x							
Tonga																	x	x	x		
Tuvalu												x	x	x	x						