Trends in Neonatal and Infant Mortality for Pacific Island States

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Trends in Neonatal and Infant Mortality for Pacific Island States

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EXECUTIVE SUMMARY

Significant investments have been made in child health in Pacific Island Countries and Territories (PICTs) over previous decades in the pursuit of achieving Millennium Development Goal (MDG) 4, to reduce under-five mortality by two-thirds between 1990 and 2015. Neonatal mortality (deaths between birth and <28 days), post-neonatal mortality (deaths between 28 days and <1 year) and infant mortality (deaths between birth and <1 year) are all components of under-five mortality; however the policies, health services and interventions required to reduce mortality in these age groups are significantly different.

Substantial declines in infant mortality have been achieved in many PICTs over the past decades, and levels have remained relatively low in others. There are instances however where infant mortality remains unacceptably high: with Papua New Guinea and Kiribati experiencing an infant mortality rate (IMR) of >40 deaths per 1000 live births, despite a consistent downward trend; and Nauru experiencing an IMR of >30 deaths per 1000 live births, with a trend that appears to have plateaued at this rate. A greater understanding of the components of infant mortality (neonatal and post neonatal mortality) is necessary to better target future interventions and monitor their outcomes.

While it is expected that infant mortality will be constituted by a greater proportion of neonatal deaths as overall infant mortality declines, due to the greater impacts that can be achieved in the survival of post-neonatal infants at the population level through sanitation, nutrition and community health interventions, this does not explain any increase in the actual neonatal mortality rate (NMR). It is difficult however in some PICTs to establish the levels and trends in NMR because routine death registration is significantly incomplete or not available as published data, and the only source of estimates are often demographic analyses from surveys which rely on retrospective data collection.

Although there is a paucity of data on neonatal mortality in many PICTs, until recently it has largely been assumed that NMR has been decling or stable in most PICTs, in line with trends in IMR. Estimates published in recent Demographic and Health Surveys (DHS) however, indicated that NMR in some PICTs had increased significantly in the most recent retrospective periods of the survey. Detailed analysis of the weaknesses associated with many of these estimates derived from retrospective birth histories indicate that they need to be interpreted with a great deal of caution, which is explicitly stated in many of the published DHS reports. Increased NMR in the most recent retrospective periods of the surveys (deaths which occurred in the 0-4 and 5-9 year periods prior to the survey) is also likely due in part to underreporting of deaths in the earliest retrospective period (deaths which occurred in the 10-14 year period prior to the survey). This is evident in Papua New Guinea, the only PICT to have undertaken two DHS surveys, where the number of reported neonatal and infant deaths for the same overlapping time point were higher when women were recalling deaths that had occurred in the previous 0-4 years rather than 10-14 years before the survey. As a result, the increasing trends noted in the DHS are largely inconsistent with other sources for most PICTs, and the need for better data and reporting remains.

With the 2015 MDG deadline upon us, there is discussion regarding what the post-2015 development framework will look like, and what global targets will be set. The World Health Organisation is advocating for a global neonatal mortality target of <10 deaths per 1000 live births by 2035 in all countries. If the post-2015 development framework includes global targets for reducing neonatal mortality there are several PICTs that currently lack the capacity to monitor, assess and report their progress using reliable data of neonatal deaths from civil registration and vital statistics (CRVS), or demographic data from more than one survey. Investment in improving national CRVS systems in these PICTs should be a priority, not only to enable reporting on progress towards global neonatal mortality targets but because a lack of high-quality data on births and child deaths results in an absence of crucial information for policy-making, planning and evaluation for improved child survival.

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Introduction

This report presents estimates of neonatal, postneonatal and infant mortality from all the countries and territories of Melanesia, Micronesia and Polynesia which are members of the Secretariat for the Pacific Community (SPC). In this report the term Pacific Island Countries and Territories (PICTs) will be used to refer to the 14 countries, and 7 territories (American, French and New Zealand) located in this region of the Pacific. These dispersed Island nations and territories have great variation in their history, geographical characteristics, population size and culture. There is also great variation in access to health services, which is reflected in important health status indicators such as early childhood mortality.

The early childhood mortality indicators in this report are;

> *Neonatal Mortality Rate (NMR):* the probability of dying between birth and less than 28 days, per 1000 live births.
>
> *Postneonatal Mortality Rate (PNMR):* the probability of dying between 28 days and less than one year, per 1000 live births.
>
> *Infant Mortality Rate (IMR):* the probability of dying between birth and less than 1 year, per 1000 live births.

Although stillbirths and perinatal mortality are also important indictors for child survival; reliable data for these are as yet generally not available for most PICTs (or indeed many countries globally) and as such these have not been included in this report.

The Healthy Islands concept, which forms the basis of health priorities in the Pacific and which was initially outlined in the Yanuca Declaration of 1995, highlights the importance of Child health (and survival) as an important development objective in the Pacific. The concept is built on a series of central beliefs including that “children should be nurtured in body and mind” [WHO 1995]. Improving childhood survival is also a core focus of both the Millennium Development Goals and the proposed 2015 Sustainable Development agenda.

Methods

Data sources

Estimates of NMR, PNMR and IMR in this report have been: (1) extracted from published or publically available primary sources such as Census Reports, Statistical Yearbooks, etc.; or (2) directly calculated by the authors based on published and unpublished civil registration and vital statistics (CRVS) data of neonatal and infant deaths, and live births for the same period. For each mortality estimate the original source of data and the analytic method of calculation are recorded in the summary table for each PICT in Appendix 1.

The preferred method for obtaining estimates of neonatal and infant mortality is from CRVS data, which involves the ongoing, national recording of vital events (births, deaths) in a population through a civil registration system (civil vital registration), and/or through the national health system. In some countries routine vital registration may also involve other sources such as local governments and churches, although these systems are not usually nationally representative.

In countries where CRVS data are considered to be fairly complete this is typically the sole source of child mortality estimates. In countries where mortality estimates cannot be obtained from CRVS, data on infant deaths are collected intermittently through censuses and/or population sample surveys such as Demographic and Health Surveys (DHS), using direct or indirect methods. Direct methods involve asking questions on deaths in the household in a defined retrospective period (usually 12 months), or a complete retrospective maternal history. The number of reported deaths is then divided by the number of reported births in the same period to calculate the mortality rate. Indirect methods include the children ever born and children surviving (CEBCS) technique where women of childbearing age are asked how many children they have ever given birth to, and how many of those children are still alive. The child deaths are then distributed in time according to the age of the mother, and provide the probability of dying between birth and various childhood ages [Ekanem 1981].

Table 1 provides an outline of which PICTs have data available on levels and trends in IMR and/or NMR, and the year of the most recent estimates (as at the time of publication). There are three PICTs with no data available on NMR (Federated States of Micronesia, Palau; Tokelau); one PICT with only a single year estimate of NMR (Niue); and seven PICTs where the only source of data on NMR is from Demographic and Health Surveys (Kiribati; Nauru; Papua New Guinea; Samoa; Solomon Islands; Tuvalu; Vanuatu). The availability of IMR data is much greater, with only one PICT (Tokelau) with no data available, and all other PICTs having IMR data from more than one source.

Table 1: Availability of neonatal and infant mortality data in Pacific Islands

Country	Mortality Data Available (most recent estimate)		Type	Trends in NMR* 1990-2013
	Neonatal	Infant		
American Samoa	Yes (2012)	Yes (2012)	CRVS	Yes
Cook Islands	Yes (2013)	Yes (2013)	CRVS and survey	Yes
Fiji	Yes (2013)	Yes (2013)	CRVS and survey	Yes
French Polynesia	Yes (2012)	Yes (2012)	CRVS	Yes
Guam	Yes (2011)	Yes (2011)	CRVS	Yes
Kiribati	Yes (2009)^	Yes (2010)	Survey	No
Marshall Islands, Republic of the	Yes (2011)	Yes (2011)	CRVS and survey	Yes
Micronesia, Federated States of	No	Yes (2010)	CRVS and survey	No
Nauru	Yes (2007)^	Yes (2011)	CRVS and survey	No
New Caledonia	Yes (2012)	Yes (2012)	CRVS	Yes
Niue	Yes (2011)	Yes (2011)	CRVS and survey	No
Northern Mariana Islands, Commonwealth	Yes (2004)	Yes (2009)	CRVS	No
Palau	No	Yes (2013)	CRVS	No
Papua New Guinea	Yes (2007)^	Yes (2007)	Survey	Yes
Samoa	Yes (2009)^	Yes (2011)	Survey	No
Solomon Islands	Yes (2007)^	Yes (2009)	Survey	No
Tokelau	No	No	N/A	N/A
Tonga	Yes (2012)	Yes (2012)	CRVS and survey	Yes
Tuvalu	Yes (2007)^	Yes (2007)	CRVS and survey	No
Vanuatu	Yes (2013)^	Yes (2013)	Survey	No
Wallis and Futuna	Yes (2012)	Yes (2012)	CRVS	Yes

CRVS (civil registration and vital statistics); N/A (not applicable); *Sufficient data (≥3 data points; and from more sources than a single DHS) to assess trends in neonatal mortality; ^Demographic and Health Surveys are the only source of neonatal mortality estimates.

Mortality analysis

Neonatal, postneonatal and infant mortality estimates were plotted by period from 1990 to 2013 (where available) and trend lines fitted to data points. Rather than using a linear function ($y = a + bx$) to describe trends, the most suitable function was found to be exponential ($y = ae^{bx}$).

Y = NMR, PNMR or IMR; x = period (year); a = intercept; b, c = coefficients (slope);
e = base of the natural logarithm

To avoid overinterpretation of small numbers, trends showing an overall difference of less than 4 deaths per 1000 live births over the 24 years plotted are interpreted as a plateau (with no apparent increase or decrease) given the slow rate of change. Estimates that were significantly inconsistent and of questionable plausibility were not included in the calculation of the trendline, and have been presented on the country-specific graphs in Appendix 1 for illustrative purposes only. Instances where this exclusion has occurred have been noted in the country-specific text of the results and under the graphs in Appendix 1. Trendlines were not fitted where there were less than 3 data points or where there was no obvious trend over time. Additionally, as there are recognised problems with recall and reporting bias the further back in time the reference period is from the time of interview [DoS 2014] and the potential to exacerbate these errors in a sample taken from an initially small population, trend lines have also not been fitted where the only source of data is a single DHS.

Results

Levels and trends in neonatal mortality rate (NMR), postneonatal mortality rate (PNMR) and infant mortality rate (IMR) for 21 Pacific Island Countries and Territories (PICTs) analysed in this report are outlined in Table 2 and 3. Countries are divided into 3 categories based on the level of IMR in the most recent period for which estimates are available.

1. Low infant mortality (IMR <10);
2. Moderate infant mortality (IMR 10-30);
3. High infant mortality (IMR 30-60);

& No infant mortality data

The trend is assessed as being in decline, plateauing or increasing based on the direction of the exponential trend line. Trend lines have not been fitted where only a single DHS is available as a source of NMR estimates.

Table 2: Recent levels and trends in neonatal, postneonatal and infant mortality

Country	Neonatal Mortality		Postneonatal Mortality		Infant Mortality	
	Trend	Rate*	Trend	Rate*	Trend	Rate*
1. Low infant mortality (IMR <10)						
American Samoa	Decline	<10	Plateau	<10	Plateau	<10
Cook Islands	Decline	<10	Plateau	<10	Decline	<10
French Polynesia	Plateau	<10	Plateau	<10	Decline	<10
New Caledonia	Plateau	<10	Plateau	<10	Decline	<10
Niue	No trend∞	<10	No data	-	Decline	<10
Northern Mariana Islands, Commonwealth of the	No trend∞	<10	No trend∞	<10	Decline	<10
Wallis and Futuna	Plateau	<10	No data	-	Plateau	<10
2. Moderate infant mortality (IMR 10-30)						
Fiji	Decline	<10	Plateau	<10	Decline	10-20
Guam	Plateau	<10	Plateau	<10	Plateau	10-20
Marshall Islands, Republic of the	Decline	10-20	Plateau	10-20	Decline	20-30
Micronesia, Federated States of	No data	-	No data	-	Decline	10-30
Palau	No data	-	No data	-	Decline	10-20
Samoa	No trend^∞	<10	No trend^∞	<10	Decline	10-20
Solomon Islands	No trend^∞	10-20	No trend^∞	<10	Plateau	20-30
Tonga	Increasing	<10	Plateau	<10	Plateau	10-20
Vanuatu	No trend^∞	10-20	No trend^∞	10-20	Plateau	20-30
3. High neonatal and/or high infant mortality (IMR 30-60)						
Kiribati	No trend^∞	20-30	No trend^∞	10-20	Decline	40-50
Papua New Guinea	Plateau^	20-30	Plateau^	20-30	Decline	50-60
Nauru	No trend^∞	20-30	No trend^∞	10-20	No trend	30-60
Tuvalu	No trend^∞	20-30	No trend^∞	<10	Decline	20-30
No infant mortality data available						
Tokelau	No data	-	No data	-	No data	-

*Average mortality rate in the most recent period. ^ Demographic and Health Surveys are the only source of neonatal/postneonatal mortality estimates. ∞Insufficient data points (<3, or 3 points from a single DHS) to determine a trend. Note data may be internally inconsistent due to different sources – i.e. 2 plateaus equal a decline.

Table 3: Risk categories for recent levels and trends in neonatal and infant mortality

	Levels and trends in Neonatal Mortality Rate (NMR)			
	Decline	Plateau	Increasing	Insufficient data∞
Low (NMR <10)	American Samoa Cook Islands Fiji	French Polynesia New Caledonia Guam Samoa^ Wallis and Futuna	Tonga*	CNMI Niue
Moderate (NMR 10-20)	RMI			Solomon Islands^ Vanuatu^
High (NMR 20-30)		PNG^		Kiribati^ Nauru^ Tuvalu^
No data	FSM; Palau; Tokelau			

	Levels and trends in Infant Mortality Rate (IMR)			
	Decline	Plateau	Increasing	Insufficient data or no clear trend∞
Low (IMR <10)	Cook Islands French Polynesia New Caledonia Niue CNMI	American Samoa Wallis and Futuna		
Moderate (IMR 10-30)	FSM Fiji RMI Palau Samoa Tuvalu	Guam Solomon Islands Tonga Vanuatu		
High (IMR 30-60)	Kiribati PNG			Nauru
No data	Tokelau			

CNMI (Commonwealth of the Northern Mariana Islands); FSM (Federated States of Micronesia); RMI (Republic of the Marshall Islands); PNG (Papua New Guinea). ^ Demographic and Health Surveys are the only source of NMR estimates. ∞Insufficient data points (<3, or 3 points from a single DHS) to determine a trend; * see country data for Tonga.

1. LOW INFANT MORTALITY (IMR <10)

Estimates of IMR in the most recent period in these PICTs are <10 deaths per 1000 live births. These mortality estimates are primarily derived from fairly complete civil registration and vital statistics (CRVS) systems. Several PICTs included in this category which are able to consistently report IMR do not have published NMR data, but should be able to generate this through the existing CRVS and health systems. Although low IMR and NMR in these PICTs are consistent with local conditions and health services, some of the reported values may be artificially low due to referral of high risk pregnancies off-island. A notable exception is New Caledonia which both refers high risk cases off-island, but which also may receives referrals from other French Territories due to the higher level of care available.

1.1. Declining/plateaued trends in IMR and NMR

Trends in IMR and NMR in these PICTs indicate a decline or plateau, with both indicators in the most recent period less than 10 deaths per 1000 live births. Once IMR and NMR has been reduced to below 10 deaths per 1000 live births, continued decline is harder to achieve then when the level is higher. For this reason, a trend that demonstrates a plateau at a rate <10/1000 is not of equal concern as a plateau at a higher rate.

- American Samoa

Annual CRVS data of births and infant/neonatal deaths are available for 1990-2012. Estimates of IMR fluctuated between 9-15/1000 throughout 1990-2010, with the most recent estimate for 2011-2012 declining to 6.9/1000. NMR remained <10/1000 throughout 1990-2012, with evidence of continued decline.

- Cook Islands

Annual CRVS data of births and infant deaths are available for 1990-2013, and neonatal deaths for 2000-2013. Estimates of IMR predominantly fluctuated between 10-20/1000 until 2008, after which the rate declined to <10/1000. Estimates of NMR declined from around 15-20/1000 in 2000-2005, to 3.8/1000 in 2010-2013.

- French Polynesia

Annual CRVS data of births and infant/neonatal deaths are available for 1990-2012. Estimates of IMR were around 10/1000 in 1990 and declined to between 5-7/1000 since 2000. Estimates of NMR remained <6/1000 throughout 1990-2012.

- New Caledonia

Annual CRVS data of births and infant/neonatal deaths are available for 1990-2012. Estimates of IMR remained <10/1000 throughout 1990-2007 and <5/1000 since 2008. Estimates of NMR remained <6/1000 throughout 1990-2005, and declined to <3/1000 since 2005.

- Wallis and Futuna

Annual CRVS data of births and infant deaths are available for 1990-2012; and neonatal deaths for 2004-12. Estimates of IMR remained <10/1000 throughout 1990-2004 and <4/1000 since 2005. Estimates of NMR remained 0/1000 throughout 2004-2012. There is CRVS data of neonatal deaths for 1996-2003, however, stillbirths and infant deaths have been combined and are not currently available as separate mortality indicators. As with other PICTs in this category, these rates may be affected by off-island referrals for high risk events, and very small population size.

1.2. Declining/plateaued trend in IMR; insufficient data for NMR trend

Estimates of NMR are available for these PICTs, however there are insufficient data points to apply a trendline (<3, or 3 points from a single DHS). Evaluation of the level of NMR should be interpreted with caution.

- Northern Mariana Islands, Commonwealth of the (CNMI)

Annual CRVS data of births and infant deaths are available for 1990-2009, and neonatal deaths for 2000-04. Estimates of IMR declined from around 10/1000 in the early 1990s to <5/1000 since 2005. The two data points available for NMR indicate the level was around 5/1000 during 2000-04.

1.3. Declining/plateaued trend in IMR; no data for NMR

Estimates of NMR are not available / published for these PICTs, predominantly due to the small populations which make rates for this age group unstable. As data in these PICTs is generally derived from complete national civil registration however, such information should be available. As with the previous category, it is likely that these figures are affected by referrals off-island, and stochastic variation due to small population sizes.

- Niue

Estimates of IMR are available from CRVS data (for some periods) and censuses, which also derive estimates from CRVS data. One estimate of NMR is available for 2011 (single year estimate) from the Niue Ministry of Health. Due to the very small population and number of deaths there is large variation between estimates. For example, even when working with multi-year averages the census estimate of IMR for 2001-2006 is based on one infant death during this period. The large 95% confidence intervals around IMR estimates based on CRVS data produced by the Statistics Office are further evidence of this large variation and the difficulty in trying to determine a statistically significant trend. IMR reached the highest level at around 30/1000 in 1997-2001 and declined to around 10/1000 by 2007-11. NMR

for 2011 was reported as 0/1000[1]. Niue has reported 100 percent skilled birth attendance in recent years and high immunisation coverage in children [PIFS 2013].

2. MODERATE INFANT MORTALITY (IMR 10-30)

Estimates of IMR in the most recent period in these PICTs are between 10-30 deaths per 1000 live births. Estimates of NMR in the most recent period in these PICTs are <10 or between 10-20 deaths per 1000 live births. Child mortality estimates in these PICTs are derived from civil registration and vital statistics (CRVS) systems of varying completeness, and through censuses and/or population sample surveys, commonly Demographic and Health Surveys, using direct or indirect methods.

2.1. Declining trends in IMR and NMR

Trends in IMR and NMR in these PICTs indicate decline in both mortality indicators and suggest that continuation and strengthening of current interventions in maternal and child health may achieve further declines in mortality to IMR <10/1000.

- Fiji

Estimates of IMR and NMR are available from CRVS data (for some periods) and census (IMR only). Estimates of IMR indicate a plateau around 15-17/1000 throughout 1990-2013, with two periods during the 1990s and 2000s when it rose above 20/1000. Estimates of NMR indicate decline to <10/1000 since 2010. Fiji has recently reported 100 per cent skilled birth attendance and very high antenatal coverage rates [PIFS 2013], which is consistent with the low level of NMR at <10/1000. Potential reasons attributed to the sustained level of IMR around 15-20/1000 may include a drop in the immunisation coverage which has been highlighted as an area of concern [PIFS 2013], as well as a greater focus on improved reporting systems which may have offset apparent gains over the last several years.

- Marshall Islands, Republic of the (RMI)

Estimates of IMR are available from CRVS data (for some periods), censuses and the 2007 DHS. Estimates of NMR are available from CRVS data (for some periods) and the 2007 DHS. Estimates of IMR and NMR from the last period (10-14 years prior to the survey) of the 2007 DHS (1993-1997) were excluded from calculation of the trendlines as they are significantly lower than other estimates and of questionable plausibility. Estimates of IMR indicate significant variation around the year 2000 from 24-46/1000, however since 2005 the variation has decreased with estimates ranging between 20-25/1000. Estimates of NMR indicate a plateau between 12-17/1000 from 2003-11, with the DHS estimate of 32/1000 for 1998-2002 producing an overall declining trend. Although this decline should

[1] There is an estimate of NMR for 2005 of 0/1000 published in the 2011 revision of the WHO Country Health Information Profiles (CHIPS) report [WHO 2011]. As this estimate could not be confirmed/obtained from the primary source it has been excluded from analysis.

be interpreted with caution as the trend is driven by this single data point, the overall trend is consistent with the decline in IMR for which there is more evidence. RMI has recently reported increased immunisation coverage; strengthening of its pre- and postnatal programs; and increased levels of skilled birth attendance, which is consistent with the declining trends in IMR and NMR [PIFS 2013].

2.2. Plateaued trends in IMR and NMR

Trends in IMR and NMR in these PICTs indicate a plateau in both mortality indicators and suggest that further interventions in maternal and child health might be needed in order to achieve further declines in IMR to <10/1000.

- Guam

Annual CRVS data of births and infant/neonatal deaths are available for 1990-2011. IMR plateaued between 8-10/1000 from 1990-2004 and then between 11-12 from 2005-2011. NMR plateaued between 4-7/1000 throughout 1990-2011;

2.3. Plateaued trend in IMR; increasing trend in NMR

Trends in IMR and NMR in these PICTs indicate an increase in one or both mortality indicators. Further investigation into the reliability of estimates should be a priority to determine if these trends represent a true increase.

- Tonga

Estimates of IMR are available from CRVS data (for some periods), censuses and the 2012 DHS. Estimates of NMR are available from CRVS data for 2009 (single year estimate) and the 2012 DHS. Estimates of IMR show large variation, with DHS estimates half the level of census estimates for some comparative periods. The overall IMR trend from all sources combined indicates that IMR plateaued around 15/1000 since 2000. While there are more than three data points available allowing a trend line to be fitted, trends in NMR are driven by census and survey data only, and must be interpreted with extreme caution. NMR estimates indicate an increasing trend over 1998-2012 from around 6/1000 to 10/1000. However this rate is still low at <10/1000, and there is a lack of CRVS data for earlier periods to provide a valuable comparator to assess the reliability of DHS estimates which may be under-enumerated, as appears to be the case for IMR. The Tonga 2012 DHS Report states that a clear trend in the levels of childhood mortality indicators (NMR and IMR) during the 15-year period prior to the survey cannot be determined with confidence because of the wide 95% confidence intervals which overlap from one period to another [TDoS 2014]. Tonga is currently working on reconciling estimates of neonatal mortality from CRVS data – and these estimates will be valuable in confirming neonatal mortality trends in Tonga. There are 34 maternal and child health clinics scattered throughout the four island groups providing free health services including access to skilled birth attendants, antenatal care, and immunisations [PIFS 2013].

2.4. Declining/plateaued trend in IMR; insufficient data for NMR trend

Estimates of NMR are available for these PICTs, however there are insufficient data points to apply a trendline (<3, or 3 points from a single DHS). Evaluation of the level of NMR in these PICTs should be interpreted with caution.

- Samoa

Estimates of IMR are available from censuses and the 1999[2] and 2009 DHS. Estimates of NMR are available from the 2009 DHS. Estimates of IMR from the 2009 DHS are around 10/1000 for 1995-2009, while the census estimates are almost twice as high between 15-20/1000 for an overlapping period from 2001-11. The 1999[2] estimate for 1998 was also higher at 25/1000. Comparison with CRVS data indicates that the survey estimates are likely under-enumerated and the overall trend in IMR from all sources combined indicates a plateau at around 15/1000 since the late 1990s. NMR estimates from the 2009 DHS indicate a plateau at a low rate between 4-6/1000 from 1995-2009, although as estimates are only available from the DHS, these are likely to be under-enumerated. The Samoa DHS Report highlights that due to significant under-reporting of births and deaths, the estimates of neonatal, postneonatal and infant mortality published in the report are very likely underestimates of the true mortality in the country, and therefore should not be treated as reliable [SBOS, 2010, p.104]. There are concerns in Samoa regarding the level of access to skilled birth attendants in the rural areas [PIFS 2013], and the level of immunisation coverage, with reports that Government is now working closely with non-government organisations and development partners to try and raise the child immunisation rate [PIFS 2013].

- Solomon Islands

Estimates of IMR are available from censuses and the 2006-07 DHS; estimates of NMR are available from the 2006-07 DHS. The NMR estimate from the earliest period (10-14 years prior to the survey) in the DHS (1993-1997) is significantly lower than other estimates and of questionable plausibility. The 2006-07 Solomon Islands DHS Report highlights that caution must be exercised in using the mortality measures as indicators of early age mortality levels because of the possible under coverage of eligible DHS respondents, evidenced by an 87% response rate of all eligible women selected in the DHS sample [SINSO, 2009, p. 127]. Estimates of IMR from censuses and the DHS fluctuated between 22-28/1000, with the overall trend indicating a small decline. Estimates of NMR indicate the level was around 15-17/1000 during 1998-2007. It is noted that the Solomon Islands have less than full coverage of skilled birth attendants, antenatal care and childhood immunisation, and there is significant room for improving infant and neonatal health [PIFS 2013].

[2] Although it is titled a DHS survey, the 1999 Samoa DHS was not undertaken using the standardised DHS methodology and is not recognised on the DHS Program website. It is not considered comparable with the other DHS surveys in this report.

- Vanuatu

Estimates of IMR are available from censuses, the 2007 Multiple Indicator Cluster survey (MICS) and the 2013 DHS. Estimates of NMR are available from the 2013 DHS. Trends in IMR indicated a plateau around 25/1000 between 1995-2013 with some variation in estimates ranging between 20-30/1000. Trends in NMR indicated a plateau between 11-16/1000 between 1999-2013.

2.5. Declining trend in IMR; no data for NMR

These PICTs do not have data available of NMR and as such it is not possible to determine levels or trends. Both PICTs collect data through health system reporting, and as such should have some data available.

- Micronesia, Federated States of (FSM)

Estimates of IMR are available from CRVS data (for some periods) and censuses. Routine reporting of deaths is known to be under-registered in FSM and it is unclear if CRVS data used in the current analysis were adjusted for under-registration. Therefore, it is possible these figures are an underestimate of the true IMR. Census estimates indicate decline in IMR from 46/1000 in 1990 to 29/1000 in 2010. Estimates based on CRVS data indicate a plateau at a lower rate around 18/1000 between 1998-2009. There is a lack of data on the level and coverage of antenatal care and skilled birth attendance in FSM, but it is recognised they are both likely to be at low levels of concern [PIFS 2013]. The lack of NMR data means the potential effect of these interventions on trends in neonatal survival cannot be assessed[3].

- Palau

Annual CRVS data of births and infant deaths are available for 1990-2013[4]. There is moderate variation between estimates of IMR due to the small number of births and deaths in Palau. Estimates ranged between 12-20/1000 throughout 1990-2009, with a trend indicating a plateau since the late 1990s. A high level of antenatal care, skilled birth attendance and child immunisation is reported in Palau, with 95-98 percent of children fully immunised according to the US immunisation protocols [PIFS 2013].

[3] There is one estimate of NMR for 2009 (single year estimate) of 9.3/1000 that is published in the 2011 revision of the WHO Country Health Information Profiles (CHIPS) report, which states the FSM Health Information and Planning Unit, Department of Health and Social Affairs is the primary source [WHO 2011]. As this estimate could not be confirmed/obtained from the primary source it has been excluded from the current analysis.

[4] There is one estimate of NMR in Palau for 2010 (single year estimate) of 4/1000 that is published in the 2011 revision of the WHO Country Health Information Profiles (CHIPS) report, which states the Public Health Data and Statistics of the Palau Ministry of Health is the primary source [WHO 2011]. As this estimate could not be confirmed/obtained from the primary source it has been excluded from the current analysis.

3. HIGH INFANT MORTALITY (IMR 30-60)

Estimates of IMR in the most recent period are between 30-60 deaths per 1000 live births. Estimates of NMR in the most recent period in these PICTs are between 10-30 deaths per 1000 live births. Child mortality estimates in these PICTs are primarily derived from censuses and/or population sample surveys, commonly Demographic and Health Surveys, using direct or indirect methods.

3.1. Declining/plateaued trends in IMR and NMR

Trends in IMR and NMR in these PICTs indicate a plateau in one or both mortality indicators and suggest that further interventions in neonatal and infant health are needed to achieve a further decline.

- Papua New Guinea (PNG)

Estimates of IMR and NMR are available from the 1996 and 2006 DHS and censuses (IMR only). Estimates of IMR estimates indicate a declining trend from around 70-80 during the early 1990's to around 60 from 2000. Estimates of NMR indicate a plateau between 1992-2007 at around 30/1000. The high level of IMR and NMR in PNG is consistent with the low level of antenatal care and skilled birth attendants, low immunisation coverage, lack of proper sanitation and safe drinking water, and inadequate delivery of basic health services, especially to the rural areas [PIFS 2013]. PNG is facing significant challenges in allocating sufficient funding and resources to decrease infant and neonatal mortality to an acceptable level.

3.2. Declining/plateaued trend in IMR; insufficient data for NMR trend

Estimates of NMR are available for these PICTs, however there are insufficient data points to apply a trendline (<3, or 3 points from a single DHS). Evaluation of the level of NMR in these PICTs should be interpreted with caution.

- Kiribati

Estimates of IMR are available from censuses and the 2009 DHS; estimates of NMR are available from the 2009 DHS. Estimates of IMR indicate a decline from 50-70/1000 during the 1990's to between 40-50/1000 from 2005. Estimates of NMR indicate a decline from 31.2/1000 in 1995-99 to 25.6/1000 in 2005-09. Gaps still exist in the delivery of infant and neonatal health interventions in Kiribati, especially in the dispersed outer islands. The declining trend in IMR may reflect the increasing immunisation coverage in children; however the predominance of diarrhoeal diseases and respiratory infections as a major cause of childhood deaths highlights the importance of improving access to clean water and sanitation [PIFS 2013]. The high level of NMR reflects the variable access to antenatal care and skilled birth attendants, although there are reports that access to these services are increasing [PIFS 2013].

- Tuvalu

Estimates of IMR are available from CRVS data (for some periods) censuses and the 2007 DHS; estimates of NMR are available from the 2007 DHS. Estimates of IMR indicate large variation in the early 1990s, with the census estimate 40/1000 and the Ministry of Health estimate 62/1000 for 1990-92. The variation decreased over time as mortality declined. The overall trend in IMR from all sources combined shows substantial decline from a level around 50/1000 in the early 1990s to around 25/1000 in 2005. Estimates of NMR from the 2007 DHS indicate a plateau between 15-30/1000 during 1993-2007, with large variation during this period. There is a lack of CRVS data for NMR to provide a valuable comparator to assess the reliability of DHS estimates. An indication of the statistical significance of the DHS estimates of NMR cannot be assessed as standard errors and 95% statistical confidence intervals were not published with the estimates. Tuvalu is currently working on reconciling estimates of NMR from CRVS data, and these estimates will be valuable in determining trends in neonatal mortality in Tuvalu. The high level of antenatal care, skilled birth attendants and immunisation coverage reported in Tuvalu in recent years indicates that the Government is taking action to decrease neonatal and infant mortality [PIFS 2013].

3.3. Insufficient data for trend in IMR and NMR

Estimates of IMR are available for these PICTs, however the level of variation between estimates prevents application of a trend line. Estimates of NMR are available for these PICTs, however there are insufficient data points to apply a trendline (<3, or 3 points from a single DHS). Evaluation of the level of IMR and NMR in these PICTs should be interpreted with caution.

- Nauru

Estimates of IMR are available from CRVS data (for some periods), censuses and the 2007 DHS; estimates of NMR are available from the 2007 DHS. Estimates from the last period (10-14 years prior to the survey) of the DHS (1993-97) for IMR and NMR are significantly lower than other estimates and are of questionable plausibility. Estimates of IMR from CRVS data for 1993-98 are also significantly lower than other estimates and are of questionable plausibility. There is a wide variation in the remaining IMR data points between 30-60/1000 which prevents the application of a trendline. Estimates indicate that NMR was around 27/1000 during 1998-2007. The level of IMR and NMR in Nauru remains high. It has been reported in recent years that Nauru has 97% skilled birth attendance and high antenatal care coverage, easy access to health services and safe motherhood programs. A drug shortage affected measles coverage a few years ago, however as supplies recovered unvaccinated children were targeted [PIFS 2013]. Further investigation is needed to identify where the gaps in neonatal and infant health interventions are and prioritise resources.

4. NO INFANT MORTALITY DATA

- Tokelau

No data on neonatal or infant mortality is available for Tokelau, although zero child deaths were reported by the Ministry of Health in 2011 (NMDI).

Discussion

Childhood mortality is a key development indicator and essential component in monitoring and improving health outcomes under the Pacific Healthy Islands initiative. As shown in this report, the results across the Pacific, both in terms of the overall gains made in child survival and the availability of reliable data, are mixed. Significant investments have been made in child health in PICTs over previous decades in the pursuit of achieving Millennium Development Goal (MDG) 4, to reduce under-five mortality by two-thirds between 1990 and 2015. Substantial declines in infant mortality have been achieved in many PICTs over the past decades, and levels have remained relatively low in others [MoH Meeting 2011]. There are instances however where infant mortality remains unacceptably high: with Papua New Guinea and Kiribati experiencing an infant mortality rate (IMR) of >40 deaths per 1000 live births despite a consistent downward trend; and Nauru experiencing an IMR of >30 deaths per 1000 live births with a trend that appears to have plateaued at this rate. A greater understanding of the components of infant mortality (neonatal and post neonatal mortality) is necessary to better target future interventions and monitor their outcomes.

Neonatal and post-neonatal mortality

Neonatal and post-neonatal mortality are both components of infant mortality; however the policies, health services and interventions required to reduce mortality in these two age groups are substantially different. It is expected that infant mortality will be constituted by a greater proportion of neonatal deaths as overall infant mortality declines, due to the greater impacts that can be achieved in the survival of post-neonatal infants at the population level through improvements in water supply and sanitation, nutrition and community health interventions. In previous decades neonatal care has often been perceived as too technical, expensive and lacking in cost-effective interventions in order to be implemented in low- and middle-income countries to improve neonatal outcomes. More recently evidence has been generated and disseminated showing that cost-effective interventions at the community level do exist and are effective [Darmstadt et al. 2005]. One of the first studies to provide this evidence was a home-based package of maternal and newborn health interventions delivered by community health workers in rural India that reported reduction in neonatal mortality by 62% [Bang et al. 1999]. As previously outlined in the Results section above, many of these community level newborn health interventions have been implemented over the past two decades in PICTs, with subsequent mortality declines achieved in some PICTs, and further intervention required in others.

The importance of early childhood mortality data in the Pacific Islands

It is difficult to establish the levels and trends in infant and neonatal mortality in some PICTs because routine death registration is significantly incomplete or not available as published data, and the only source of estimates are demographic analyses from surveys which rely on

retrospective data collection. Under-reporting, particularly for early neonatal deaths which occur in the community away from health facililites, is known to be a potential issue with both routine and retrospective data collections due to the sensitivity of the topic and cultural practices, and has been noted as a concern in the draft CRVS assessments of several PICTs over the last several years.

Table 4 provides an estimate of the percentage of infant mortality that is attributable to neonatal deaths, based on the average of neonatal and infant mortality estimates available in each country since 2000. This may provide some guidance for better targeting policies, health services and interventions towards neonatal and/or postneonatal care, dependent on the contribution they make to overall infant mortality. It is important to remember that the reliability of the proportional mortality estimates in Table 4 is dependent on the reliability of the estimates from which they have been calculated. As previously discussed, there is large variation in the reliability of mortality estimates in PICTS, especially for neonatal mortality. Particular caution should be exercised when estimates of levels and trends in neonatal mortality are based on retrospective data collected in one survey only – as indicated by a ^ next to the country.

Table 4: Percentage of infant mortality attributable to neonatal mortality since 2000*

Percentage	Country
40-50%	American Samoa;
50-60%	Fiji; French Polynesia; Guam; Kiribati^; Marshall Islands, Republic of the; New Caledonia; Papua New Guinea; Samoa^; Tonga^; Vanuatu^
60-70%	Nauru^; Northern Mariana Islands, Commonwealth of the; Solomon Islands^;
70-80%	Tuvalu;
80-90%	Cook Islands;
Insufficient data	Micronesia, Federated States of; Niue; Palau; Tokelau; Wallis and Futuna

*calculated as the average of neonatal deaths divided by average of infant deaths since 2000. ^ Based exclusively on Demographic and Health Survey estimates of neonatal and infant mortality

Further, although late foetal deaths or stillbirths and perinatal mortality (late foetal deaths from 22 weeks gestation through and early neonatal mortality within the first 7 days of life [WHO 2014b]) are also important measures of child survival, these have not been included in this report as they are difficult to capture accurately and there is significant variation in the definition of these indicators globally [Richardus et al. 1998].

Perinatal mortality was more commonly used in the past when the etiologic causes of death in stillbirths and newborns were thought to be closely related, however in recent years the etiologic determinants have diverged sharply and the reporting of still births and neonatal deaths as separate mortality indicators is encouraged wherever possible [Kramer et al 2002]. Making this differentiation between a stillbirth and a neonatal death (preceeded by a live birth) however can be difficult, especially where the level of skilled birth attendance is low [Richardus et al. 1998; Kramer et al. 2002]. In PICTs lacking complete coverage of skilled birth attendance, there is a high likelihood of some misclassification between still births and neonatal deaths, and that this will

continue until further investments are made to improve coverage to 100 percent. There are other instances where stillbirths and infant deaths reported to the CRVS system have been combined, and are not published as separate mortality indicators, as is the case for earlier data in Wallis and Futuna.

There are also many additional cultural and religious factors that influence whether a birth is registered as a live birth or a still birth – if it is registered at all [Kramer et al. 2002]. Local practices may lead to a preference in reporting an early neonatal deaths as "stillborn", as has been anecdotally noted in some PICTs through work conducted under the Pacific Vital Statistics Action Plan. Despite difficulties in measurement, these indicators are therefore important in obtaining a complete picture of child survival and monitoring health status around the time of birth, and should be included in routine collections through national health information systems.

Trends in early childhood mortality in the Pacific Islands

Although some concerns have been raised across the region that neonatal mortality may be increasing based on DHS reports including those for Nauru, the Republic of the Marshall Islands (RMI), the Solomon Islands, Tonga and Tuvalu [NBoS 2009; SBoS 2010; SNSO 2009; TDoS 2014], the data presented here does not support this, with all countries where sufficient data is available demonstrating declines or plateaus in NMR, except in Tonga where data must be interpreted with caution and trends are unclear. Detailed analyses of the weaknesses associated with many of the DHS estimates indicate that they need to be interpreted with a great deal of caution, which is explicitly stated in all published DHS reports [NBoS 2009; SBoS 2010; SNSO 2009; TDoS 2014].

Increased neonatal mortality in the most recent periods of the DHS is likely due in part to underreporting of deaths in the earlier periods, as it is recognised that a neonatal death that occurred 10 years before a survey is more likely to be omitted by a mother than a neonatal death that occurred two years before a survey [DoS 2014]. Evidence of this can be seen in Papua New Guinea, the only PICT to have undertaken two DHS surveys, where rates of NMR and IMR for the same overlapping time point were higher when women were recalling deaths which occurred 0-4 years prior to the survey in comparison to 10-14 years prior to the survey (Appendix 1). It is likely that a similar situation has occurred in the Solomon Islands, Nauru and RMI where the DHS estimate of NMR 10-14 years prior to the survey was extremely low at <10/1000, and then increased in the period 5-9 years prior to the survey by 1.8-fold in the Solomon Islands to 17/1000; 3.4-fold in Nauru to 27/1000; and 4.6-fold in RMI to 32/1000 (Appendix 1). Considerable caution is therefore essential whenever using estimates of childhood mortality for periods more than 10 years prior to a survey [Curtis 1995]. If all retrospective estimates of neonatal mortality from the DHS are used to calculate the overall trend in Nauru, RMI and the Solomon Islands, the trend indicates that NMR is increasing in each country. By excluding the last estimate (10-14 years prior to the survey), due to substantial inconsistency and questionable plausibility, the trend in all three countries changes and indicates that in Nauru NMR has plateaued, while in the Solomon Islands

and RMI it is declining. Identical trends are seen in IMR in these countries when the earliest (10-14 years prior to the survey) estimate of IMR is censored.

The increasing neonatal mortality trend in Tonga indicated by DHS data is different to the trends in Nauru, RMI and the Solomon Islands described above. In Tonga there was an increase in the number of reported neonatal deaths between the two most recent periods of the survey (0-4 and 5-9 years), and censoring the last estimate (10-14 years prior to the survey) would make the trend line indicate an even greater increase. In the case of Tonga there are a few things that need to be considered. The estimate of NMR in the most recent period is low at <10/1000. There is also a lack of civil registration and vital statistics (CRVS) data for earlier periods which would provide a valuable comparator to assess if neonatal mortality in Tonga is increasing, or if DHS estimates for earlier periods were under enumerated, as appears to be the case for IMR when compared with CRVS estimates for similar periods (Appendix 1). The Tonga 2012 DHS Report also states that a clear trend in the levels of NMR and IMR during the 15-year period prior to the survey cannot be determined with confidence because of the wide 95% confidence intervals which overlap from one period to another [TDoS 2014]. Tonga is currently working on reconciling estimates of neonatal mortality from CRVS data, and these estimates will be valuable in confirming if neonatal mortality is increasing, or if DHS estimates for earlier periods were under-enumerated. Previous detailed evaluations of the quality of DHS mortality data have strongly recommended that data from more than one source be used for trend analyses whenever possible [Curtis 1995].

Future directions and global targets for reducing neonatal mortality

Inclusion of a target to reduce child mortality in the Millennium Development Goals (MDGs) is reported to have been a key component in the significant decline in global under-five mortality by almost 50% from 90 deaths per 1000 live births in 1990 to 48 deaths per 1000 live births in 2012 [WHO 2014a; UNICEF 2013]. This decline has been attributed to increased political commitment and investment in child health as a result of the MDGs common global agenda of outcome-focused targets [Mason et al 2014]. The decline in under-five mortality however has not been equal, with less decline in neonatal mortality at 37% during 1990-2012, despite deaths in the neonatal period representing 44% of deaths in children aged under-five years in 2012 [UNICEF 2013].

With the 2015 MDG deadline approaching there is increasing discussion regarding what the post-2015 development framework will look like, and what global targets will be set. The World Health Organisations (WHO) recently released 'Every Newborn Action Plan' and the Lancet series 'Every Newborn' published in May 2014 both advocate for global neonatal mortality goals of <10 deaths per 1000 live births by 2035 in all countries [WHO 2014a; Lawn et al. 2014; Mason et al. 2014]. These documents state that newborn deaths were largely invisible in the MDGs [Mason et al. 2014] and it is both realistic and timely that neonatal mortality goals be recognised in the post-2015 development framework in order to receive the same increased policy attention and investment of under-five mortality following its inclusion in the MDGs [Mason et al 2014;

Darmstadt et al. 2014]. It is worth noting that, to date however, there has been no mention of neonatal mortality in the post-2015 development documents including the Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda [United Nations 2013].

Setting a global target for neonatal mortality reduction for all countries is reliant on countries having the ability to measure and report levels and trends. It is acknowledged that many countries lack this capacity and increased investment in improving national birth and death registration systems is urgently needed in order to improve the quantity, consistency and frequency of child mortality estimations [WHO 2014a; Lawn et al 2014]. If the post-2015 development framework includes global targets for reducing neonatal mortality, there are several PICTs that currently lack the capacity to monitor, assess and report their progress using civil registration and vital statistics (CRVS) data of births and neonatal deaths. In the absence of CRVS data several PICTs rely solely on Demographic and Health Surveys (DHS) to estimate neonatal mortality. While this can provide a valuable estimate of mortality levels, at best the DHS is performed at 5 year intervals which means there is a significant time lag between evaluation of level and trends, which impedes the ability to implement timely programmatic action [Lawn et al 2014].

A reason put forward for the timeliness of including neonatal mortality goals in the post-2015 development framework is that the quality, frequency and visibility of data on newborn health has notably improved and neonatal mortality trend estimates are now produced annually by more than one group, namely the United Nations Inter-agency Group for Child Mortality Estimation (UNIGME) and Institute for Health Metrics and Evaluation (IHME) [Darmstadt et al 2014]. In many Pacific Island countries however (Cook Islands, Federated States of Micronesia, Niue, Palau, Solomon Islands, Tonga, Tuvalu and Vanuatu), these annual estimates are produced using statistical models that use under-five mortality as an input to produce estimates of neonatal mortality [UNIGME 2013; 2014]. In other Pacific Island countries (Kiribati, Republic of the Marshall Islands, Nauru, Papua New Guinea, Samoa) the only source of neonatal mortality data used in the production of these annual estimates is from Demographic and Health Surveys (DHS) [UNIGME 2014].

While modelled neonatal mortality estimates (derived from under-five mortality) or data collected through retrospective maternal histories provide valuable information in the absence of CRVS data on neonatal deaths, it is worth highlighting that such estimates should not be regarded as adequate substitutes for real time data derived from a national CRVS system. PICTs have committed to improving their CRVS systems through a United Nations Regional Action Framework for CRVS (2014) and commitments through both the Pacific Ministers of Health Meetings (2011 and 2013) and the Regional Heads of Planning and Statistics meeting (2013). Support for this work has been provided through the Brisbane Accord Group[5] and the Pacific Vital Statistics Action Plan since 2011. This investment should be prioritised not only to enable reporting on progress towards

[5] The Brisbane Accord Group currently includes the following agencies: Secretariat of the Pacific Community (SPC), University of Queensland (UQ), UNFPA, World Health Organization (WHO), UNICEF, Pacific Health Information Network (PHIN), Australian Bureau of Statistics (ABS), Queensland University of Technology (QUT), University of New South Wales (UNSW), Fiji National University (FNU), and the Pacific Civil Registrars Network.

global neonatal mortality targets, but because a lack of high-quality data on registration of births and child deaths results in an absence of crucial real-time information for policy-making, planning and evaluation. Significant investments have been made in recent decades in improving neonatal and infant survival in many PICTs through increased access and coverage of pre- and postnatal care, skilled birth attendants and child immunisations. Without regular access to quality data on neonatal and infant mortality, the success or failure of these interventions cannot be assessed, and evidence-based recommendations of the effectiveness of future interventions cannot be made.

Finally, while significant data gaps remain, for nearly all PICTs where data is available (excluding American Samoa), it is clear that neonatal mortality now accounts for more than half of all infant deaths. While improved data is essential to monitor and respond to trends in neonatal mortality, this alone highlights a critical need for targeted interventions for this age group, and to build on existing programs for maternal and child health in the region.

References

[Bang et al. 1999] Bang AT, Bang RA, Baitule SB, Reddy MH, Deshmukh MD. Effect of home-based neonatal care and management of sepsis on neonatal mortality: field trial in rural India. Lancet. 354:1955–61;1999.

[Curtis 1995] Curtis SL. Assessment of the quality of data used for direct estimation of infant and child mortality in DHS-II surveys. Calverton, Maryland: Macro International Inc.; 1995 Mar.

[Darmstadt et al. 2014] Darmstadt GL, Kinney MV, Chopra M, Cousens S, Kak L, Paul VK et al. Who has been caring for the baby? The Lancet. Published online May 20, 2014. Available from: http://dx.doi.org/10.1016/S0140-6736(14)60458-X

[Darmstadt et al. 2005] Darmstadt GL, Bhutta ZA, Cousens S, Adam T, Walker N, de Bernis L, and the Lancet Neonatal Survival Steering Team. Evidence-based, cost-effective interventions: how many newborn babies can we save? Lancet. 365:977–88;2005.

[DoS 2014] Tonga Department of Statistics and Tonga Ministry of Health, Secretariat of the Pacific Community, and UNFPA. Tonga Demographic and Health Survey, 2012. Noumea: SPC; 2014.

[Ekanem 1981] Estimation of early childhood mortality from children ever born and surviving. Canadian Studies in Population. 8:41-48;1981.

[Lawn et al. 2014] Lawn JE, Blencowe H, Oza S, You D, Lee ACC, Waiswa P et al. Every Newborn 2. Progress, priorities, and potential beyond survival. The Lancet. Published online May 20, 2014. Available from: http://dx.doi.org/10.1016/S0140-6736(14)60496-7

[Mason et al. 2014] Mason E, McDougall L, Lawn JE, Gupta A, Claeson M et al. Every Newborn 5. From evidence to action to deliver a healthy start for the next generation. The Lancet. Published online May 20, 2014. Available from: http://dx.doi.org/10.1016/S0140-6736(14)60750-9

[MoH Meeting 2011] Ninth meeting of Ministers of Health for the Pacific Island countries. Achieving MDGs 4 and 5: scaling-up programmes for women's and children's health. Honiara, Solomon Islands. 28 June–1 July 2011 [Internet]. 2011 Jun [accessed 2014, July 20]. Available from: http://www.wpro.who.int/southpacific/pic_meeting/2011/documents/PIC98AchievingMDGS4and5.pdf

[NBoS 2009] Nauru Bureau of Statistics, the Secretariat of the Pacific Community, and Macro International Inc. Republic of Nauru Demographic and Health Survey 2007. Noumea: SPC; 2009 Apr.

[PIFS 2013] Pacific Islands Forum Secretariat. 2013 Pacific Regional MDGs tracking Report. Suva, Fiji: Pacific Islands Forum Secretariat; 2013.

[Richardus et al 1998] Richardus JH, Graafmans WC, Verloove-Vanhorick SP, Mackenbach JP. The perinatal mortality rate as an indicator of quality of care in international comparisons. Medical Care. 36(1):54–66;1998. doi:10.1097/00005650-199801000-00007. PMID 9431331.

[SBoS 2010] Samoa Bureau of Statistics, Ministry of Health, ICF Macro. Samoa Demographic and Health Survey 2009. Apia, Samoa: Ministry of Health; 2010.

[SNSO 2009] Solomon Islands National Statistics Office, The Secretariat of the Pacific Community, and Macro International Inc. Solomon Islands Demographic and Health Survey 2006-2007. Noumea: SPC; 2009 May.

[TDoS 2014] Tonga Department of Statistics and Tonga Ministry of Health, Secretariat of the Pacific Community, and UNFPA. Tonga Demographic and Health Survey, 2012. Noumea: SPC; 2014.

[UNIGME 2014] United Nations Inter-agency Group for Child Mortality Estimation (UNIGME). Child mortality estimates CME Info [Internet]. 2014 [accessed 2014, July 23]. Available from: http://www.childmortality.org

[UNIGME 2013] United Nations Inter-agency Group for Child Mortality Estimation (UNIGME). Levels and trends in child mortality: report 2013. New York: UNICEF; 2013.

[United Nations 2013] United Nations. A new global partnership: eradicate poverty and transform economies through sustainable development. The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda. New York: United Nations; 2013.

[WHO 2014a] World Health Organisation. Sixty-seventh World Health Assembly. Newborn health: draft action plan. Every newborn: and action plan to end preventable deaths. Report by the Secretariat. A67/21. 2014 May 2.

[WHO 2014b] World Health Organisation. Maternal, newborn, child and adolescent health [Internet]. 2014 [accessed 2014, July 20]. Available from: http://www.who.int/maternal_child_adolescent/topics/maternal/maternal_perinatal/en/

[WHO 2011] World Health Organisation. Western Pacific country health information profiles. 2011 revision. 2011 [accessed 2015, January 24]. Available from: http://www.wpro.who.int/health_information_evidence/documents/CHIPS/en/

[WHO 1995] World Health Organisation. Yanuca Island Declaration. Adopted at the Conference of the Ministers of Health of the Pacific Islands. Yanuca Island, Fiji 10 March 1995. Available from: http://whqlibdoc.who.int/wpro/1994-99/WPR_RC46_INF_DOC1.pdf

[WHO 1993] World Health Organization. International statistical classification of diseases and related health problems. Tenth Revision. Vol 2. Geneva, Switzerland: World Health Organization, 1993: 129.

Appendix 1. Country profiles

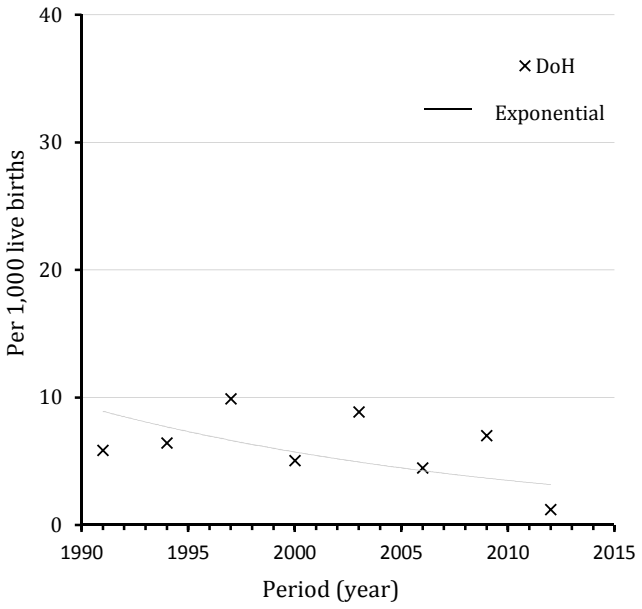
1. American Samoa
2. Cook Islands
3. Fiji
4. French Polynesia
5. Guam
6. Kiribati
7. Marshall Islands, Republic of the
8. Micronesia, Federated States of
9. Nauru
10. New Caledonia
11. Niue
12. Northern Mariana Islands, Commonwealth of the
13. Palau
14. Papua New Guinea
15. Samoa
16. Solomon Islands
17. Tokelau
18. Tonga
19. Tuvalu
20. Vanuatu
21. Wallis and Futuna

1. American Samoa

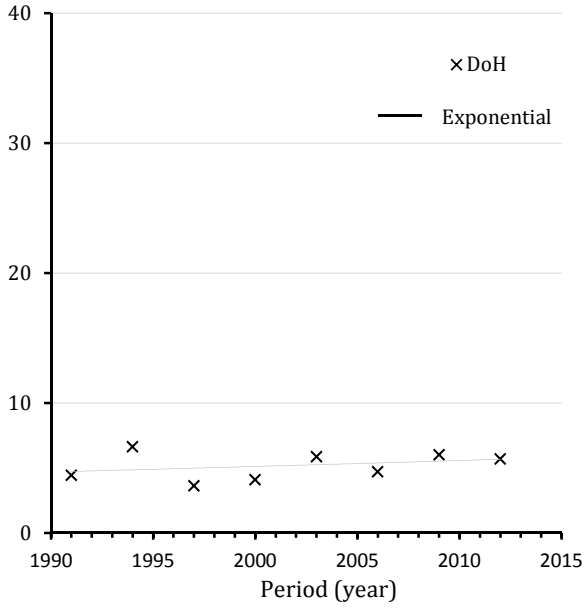
Land area (Km^2)	199
2013-mid-year population estimate	56,500
Population growth rate (%)	-0.3
Crude birth rate (per 1000 population)	25.9
Total fertility rate (year)	3.1 (2010)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

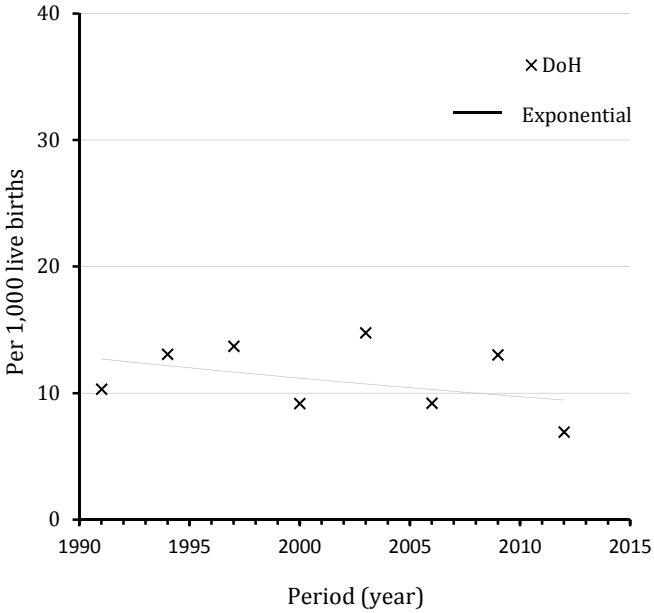
Neonatal Mortality



Postneonatal Mortality



Infant Mortality



Key

DoH: Department of Health

Source	Year	Rate	Data	Analysis	Ref
Neonatal Mortality					
DoH	2011-2012 (2012)	1.2	Vital registration	Direct calculation	1,2
	2008-2010 (2009)	7.0			2
	2005-2007 (2006)	4.5			
	2002-2004 (2003)	8.9			
	1999-2001 (2000)	5.1			2,3
	1996-1998 (1997)	9.9			3
	1993-1995 (1994)	6.4			
	1990-1992 (1991)	5.9			
Post-Neonatal Mortality					
DoH	2011-2012 (2012)	5.7	Vital registration	Direct calculation	1,2
	2008-2010 (2009)	6.0			2
	2005-2007 (2006)	4.7			
	2002-2004 (2003)	5.9			
	1999-2001 (2000)	4.1			2,3
	1996-1998 (1997)	3.6			3
	1993-1995 (1994)	6.6			
	1990-1992 (1991)	4.4			
Infant Mortality					
DoH	2011-2012 (2012)	6.9	Vital registration	Direct calculation	1,2
	2008-2010 (2009)	13.0			2
	2005-2007 (2006)	9.2			
	2002-2004 (2003)	14.7			
	1999-2001 (2000)	9.2			2,3
	1996-1998 (1997)	13.7			3
	1993-1995 (1994)	13.1			
	1990-1992 (1991)	10.3			

References

1. Health Information Systems Office, Department of Health, Government of American Samoa. Data cited in; Department of Commerce, Statistics Division. American Samoa Statistical Yearbook 2012 [Internet]. No date [cited 2014 Apr 30]. Available from: http://doc.as.gov/statistics/statistical-yearbook/
2. Health Information Systems Office, Department of Health, Government of American Samoa. Data cited in; Department of Commerce, Statistics Division. American Samoa Statistical Yearbook 2011 [Internet]. No date [cited 2014 Apr 30]. Available from: http://www.spc.int/prism/americansamoa/index.php/document-library
3. Health Information Systems Office, Department of Health, Government of American Samoa. Data cited in; Department of Commerce, Statistics Division. American Samoa Statistical Yearbook 2000 [Internet]. No date [cited 2014 Apr 30]. Available from: http://www.pacificweb.org/DOCS/amsamoa/2000%20Yearbook/2000yrbk.pdf

Comments:

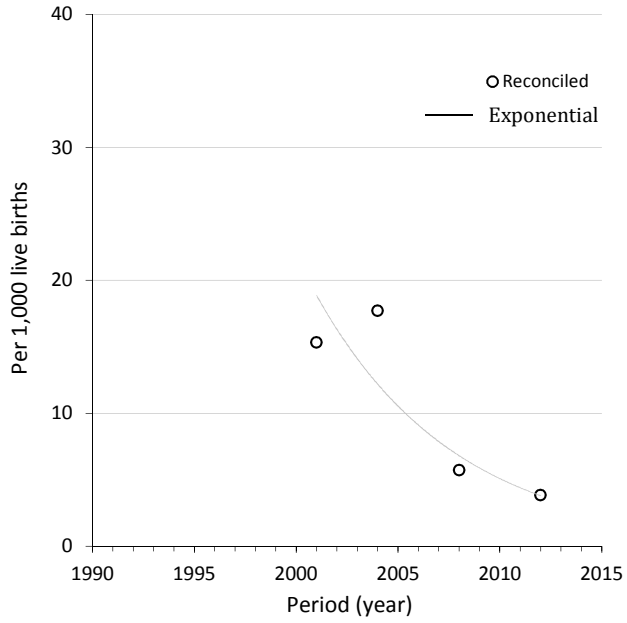
- The vital registration system in American Samoa is reported to be fairly complete since 1930 with respect to deaths.
- Figures may be affected by off island deaths not captured by the routine recording system.

2. Cook Islands

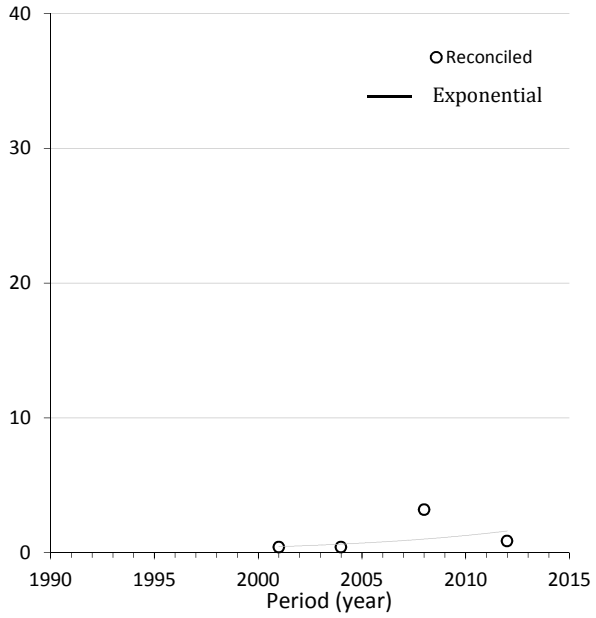
Land area (Km^2)	237
2013-mid-year population estimate	15,200
Population growth rate (%)	-0.5
Crude birth rate (per 1000 population)	18.1
Total fertility rate (year)	2.8 (2011)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

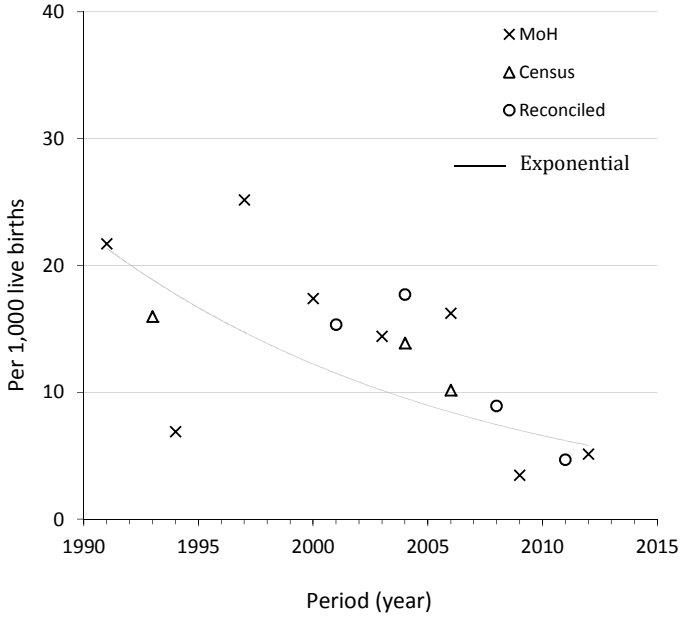
Neonatal Mortality



Postneonatal Mortality



Infant Mortality



Key
MoH: Ministry of Health
Reconciled: reconciled data

Source	Year	Rate	Data	Analysis	Ref
Neonatal Mortality					
Reconciled	2010-2013 (2012)	3.8	Vital registration	Direct calculation	1
	2006-2009 (2008)	5.7			
	2003-2005 (2004)	17.7			
	2000-2002 (2001)	15.3			
Post-Neonatal Mortality					
Reconciled	2010-2013 (2012)	0.9	Vital registration	Direct calculation	1
	2006-2009 (2008)	3.2			
	2003-2005 (2004)	0			
	2000-2002 (2001)	0			
Infant Mortality					
MoH	2011-2012 (2012)	5.8	Vital registration	Direct calculation	2
	2008-2010 (2009)	5.8			3
	2005-2007 (2006)	15.2			
	2002-2004 (2003)	12.2			
	1999-2001 (2000)	15.4			
	1996-1998 (1997)	25.2			
	1993-1995 (1994)	6.9			
	1990-1992 (1991)	21.7			
Census	2001-2012 (2006)	10.2	Vital registration and Census	Life tables based on vital registration and CEBCS data using software package PAS, procedure LTPOPDTH, of the US Census Bureau	4
	2001-2006 (2004)	13.9	Vital registration	Life table based on vital registration data using software package PAS, procedure LTPOPDTH, of the US Census Bureau	5
	1991-1996 (1993)	16	Vital registration	Direct calculation	6
Reconciled	2010-2013 (2012)	4.7	Vital registration	Direct calculation	1
	2006-2009 (2008)	8.9			
	2003-2005 (2004)	17.7			
	2000-2002 (2001)	15.3			

References

1. Calculated by representatives from the Cook Islands Statistics Office and the Ministry of Health during a civil registration and vital statistics workshop held at the Secretariat of the Pacific Community, Noumea, in April 2014.
2. Ministry of Finance and Economic Management, Government of the Cook Islands. Vital statistics and population estimates June Quarter 2013 [Internet]. 2013 [cited 2014 Apr 15]. Available from: http://www.mfem.gov.ck/population-and-social-statistics/vital-stats-pop-est
3. Cook Islands Ministry of Health. Health Statistics Tables 2008-2010. Medical Records Unit Rarotonga Hospital. Rarotonga: Ministry of Health; July 2011.
4. Secretariat for the Pacific Community. Population Profile of the Cook Islands 2006-2011 [provisional report].
5. Statistics Department Cook Islands, Statistics and Demography Programme Secretariat of the Pacific Community. Cook Islands 2006 Census of Population and Housing, Analytical Report [Internet]. 2007 [cited 2012 Oct 10]. Available from: http://www.spc.int/prism/country/ck/stats/Statistics/CensusSurveys/censurvnav.htm
6. Secretariat of the pacific Community. Cook Islands population profile based on 1996 Census. A guide for planners and policy-makers. Noumea: SPC; 1999.
7. Statistics Cook Islands. Cook Islands annual statistical bulletin 2011. Statistics Cook Islands; 2011 Jul.

Comments:

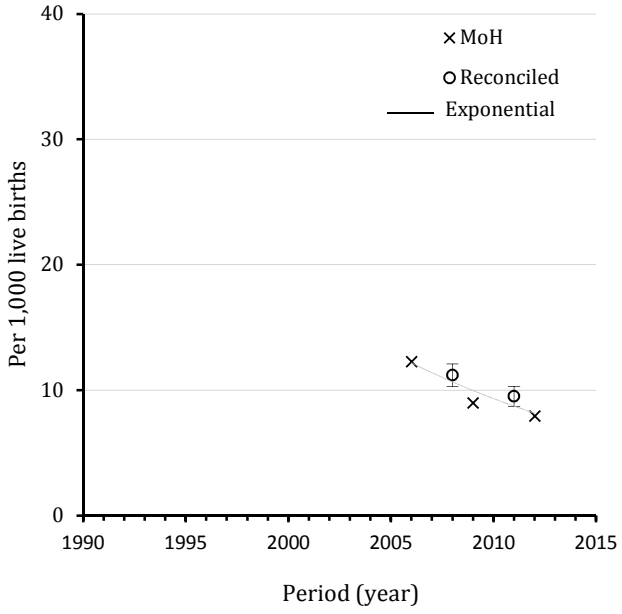
- Civil registration in the Cook Islands is regarded as essentially 99% complete.
- Figures of live births and infant deaths for 1990-2010 differ slightly between tabulations published by the Cook Islands Ministry of Health[3] and the Cook Islands Annual Statistical Bulletin 2011[7], with the MoH reporting higher births and infant deaths in many years, but only by a small number.

3. Fiji

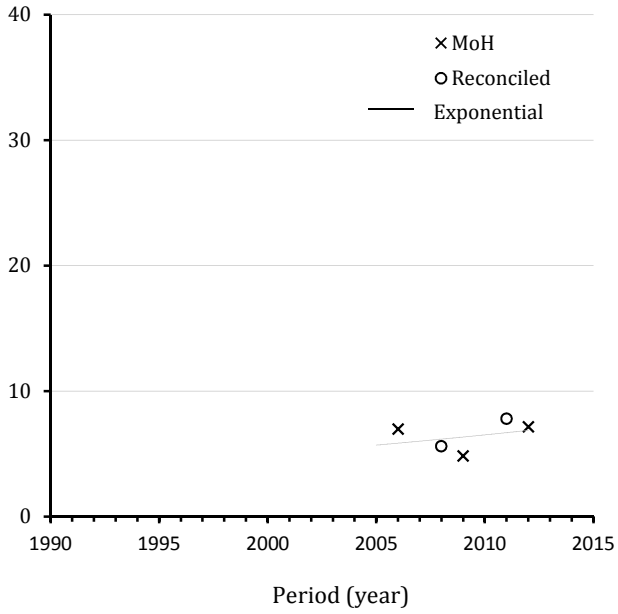
Land area (Km^2)	18,333
2013-mid-year population estimate	859,200
Population growth rate (%)	0.8
Crude birth rate (per 1000 population)	19.1
Total fertility rate (year)	2.5 (2007)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

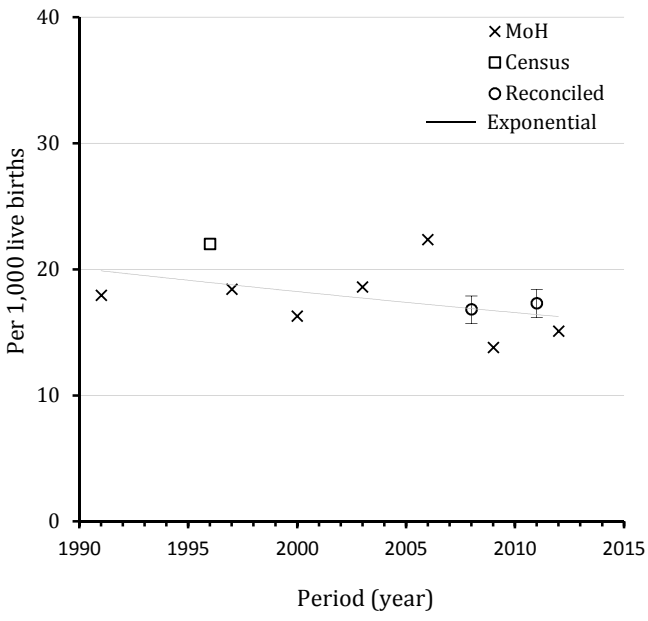
Neonatal Mortality



Postneonatal Mortality



Infant Mortality



Key
MoH: Ministry of Health
Reconciled: reconciled data

Source	Year	Rate	95% CI	Data	Analysis	Ref
Neonatal Mortality						
MoH	2011-2013 (2012)	7.9	-	Vital registration	Direct calculation	1,2
	2008-2010 (2009)	9.0	-			3,4
	2004-2007 (2006)	12.3	-			4
Reconciled	2010-2012 (2011)	9.5	8.7-10.3	Vital registration	Direct calculation	5
	2007-2009 (2008)	11.2	10.4-12.1			
Post-Neonatal Mortality						
MoH	2011-2013 (2012)	7.2	-	Vital registration	Direct calculation	1,2
	2008-2010 (2009)	4.8	-			3,4
	2004-2007 (2006)	7.0	-			4
Reconciled	2010-2012 (2011)	7.8	-	Vital registration	Direct calculation	5
	2007-2009 (2008)	5.6	-			
Infant Mortality						
MoH	2011-2013 (2012)	15.1	-	Vital registration	Direct calculation	1,2
	2008-2010 (2009)	13.8	-			3,4
	2005-2007 (2006)	22.3	-			6
	2002-2004 (2003)	18.6	-			
	1999-2001 (2000)	16.3	-			
	1996-1998 (1997)	18.4	-			
	1990-1991 (1991)	17.9	-			7
Census	1995-1997 (1996)	22	-	Vital registration and Census	Vital registration and Census data used to impute a model life table (UN Far Eastern 2 parameter model)	8
Reconciled	2010-2012 (2011)	17.3	16.2-18.4	Vital registration	Direct calculation	5
	2007-2009 (2008)	16.8	15.8-17.9			

References

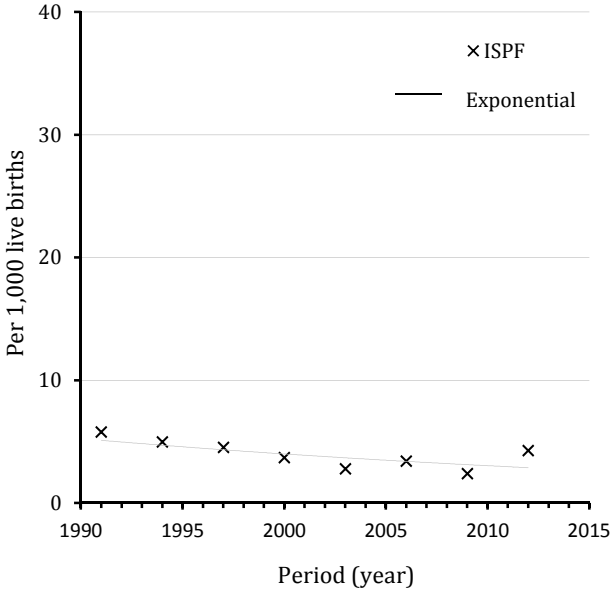
1. Fiji Ministry of Health. Obtained directly from Fiji MoH by the Secretariat of the Pacific Community, 2014 May.
2. Fiji MoH Annual Report 2012 [Internet]. 2013 Jul [cited 2014 May 15]. Available from: http://www.health.gov.fj
3. Fiji Ministry of Health. Fiji Annual Report 2010. Suva: Ministry of Health; 2011 Sep.
4. Fiji Bureau of Statistics. Key Statistics June 2012. Table 1.17 Vital and health statistics [Internet]. 2012 June [cited 2014 Jan 15]. Available from: http://www.statsfiji.gov.fj
5. Calculated by representatives from the Fiji Bureau of Statistics and the Ministry of Health during a civil registration and vital statistics workshop held at the Secretariat of the Pacific Community, Noumea, in April 2014.
6. Fiji Bureau of Statistics. Key Statistics December 2012. Table 1.15 Births, deaths and marriages by major ethnic group [Internet]. 2012 Dec [cited 2014 Jan 15]. Available from: http://www.statsfiji.gov.fj
7. Ministry of Health. Annual Report 1991-1992. Fiji: paper number 59; 1993.
8. Fiji Islands Bureau of Statistics. 1996 Fiji Census of population and housing. Analytic report part 1 demographic characteristics. Suva: Parliament of Fiji; 1998.

4. French Polynesia

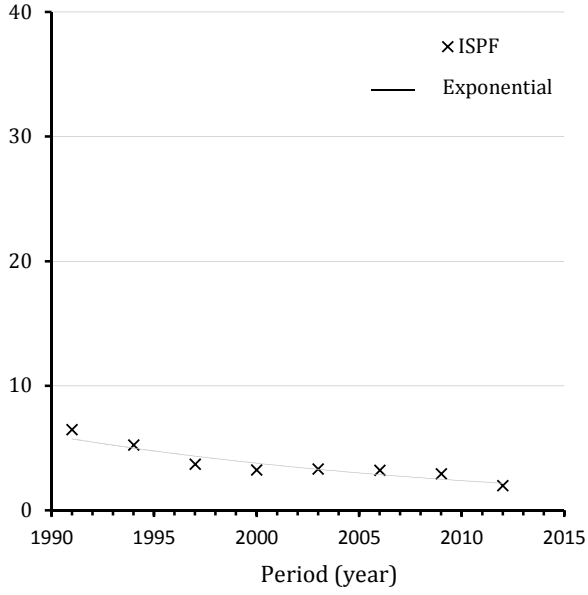
Land area (Km^2)	3,521
2013-mid-year population estimate	261,400
Population growth rate (%)	1.8
Crude birth rate (per 1000 population)	16.6
Total fertility rate (year)	2.1 (2010)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

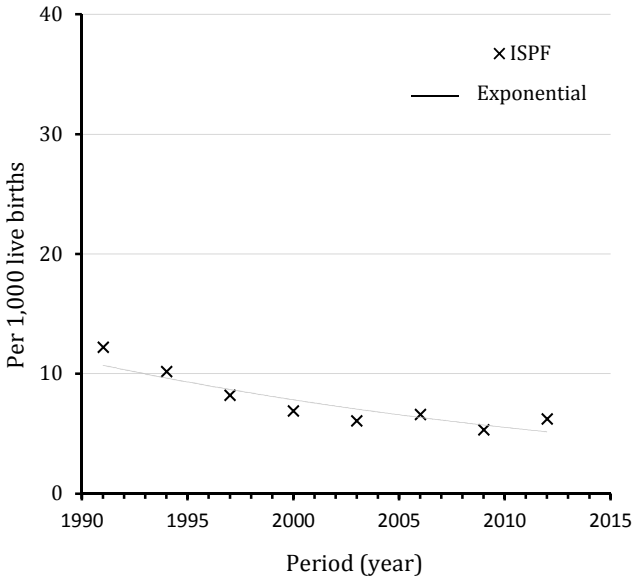
Neonatal Mortality



Postneonatal Mortality



Infant Mortality



Key

ISPF: Institut de la Statistique de la Polynésie Française

Source	Year	Rate	Data	Analysis	Ref
Neonatal Mortality					
ISPF	2011-2012 (2012)	4.3	Vital registration	Direct Calculation	1
	2008-2010 (2009)	2.4			
	2005-2007 (2006)	3.4			
	2002-2004 (2003)	2.8			
	1999-2001 (2000)	3.7			
	1996-1998 (1997)	4.5			
	1993-1995 (1994)	5.0			
	1990-1992 (1991)	5.8			
Post-Neonatal Mortality					
ISPF	2011-2012 (2012)	2.0	Vital registration	Direct Calculation	1
	2008-2010 (2009)	2.9			
	2005-2007 (2006)	3.2			
	2002-2004 (2003)	3.3			
	1999-2001 (2000)	3.2			
	1996-1998 (1997)	3.7			
	1993-1995 (1994)	5.2			
	1990-1992 (1991)	6.4			
Infant Mortality					
ISPF	2011-2012 (2012)	6.2	Vital registration	Direct Calculation	1
	2008-2010 (2009)	5.3			
	2005-2007 (2006)	6.6			
	2002-2004 (2003)	6.1			
	1999-2001 (2000)	6.9			
	1996-1998 (1997)	8.2			
	1993-1995 (1994)	10.2			
	1990-1992 (1991)	12.2			

References

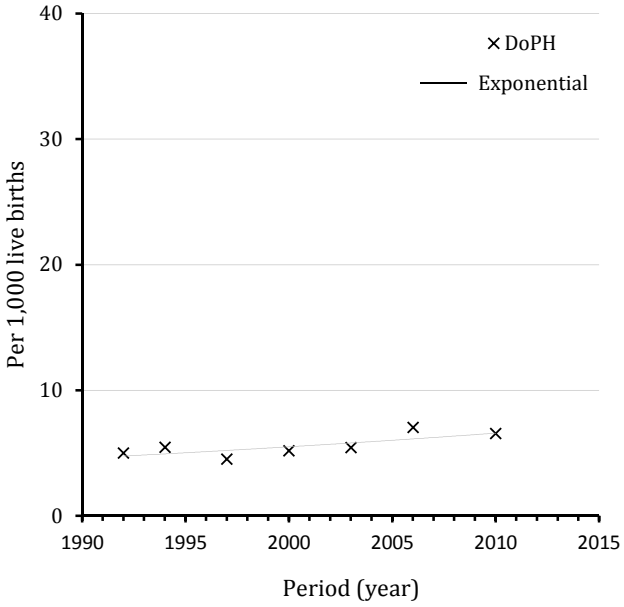
1. Institut de la Statistique de la Polynésie Française. Obtained directly from INSEE by the Secretariat of the Pacific Community.

5. Guam

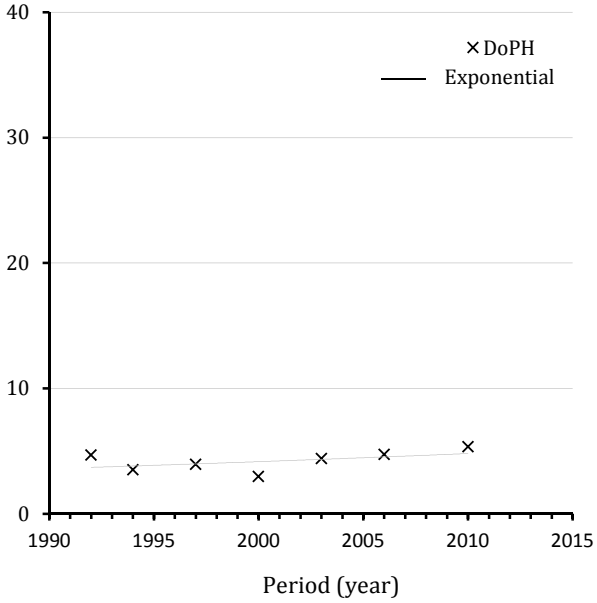
Land area (Km^2)	541
2013-mid-year population estimate	174,900
Population growth rate (%)	0.3
Crude birth rate (per 1000 population)	18.7
Total fertility rate (year)	3.0 (2010)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

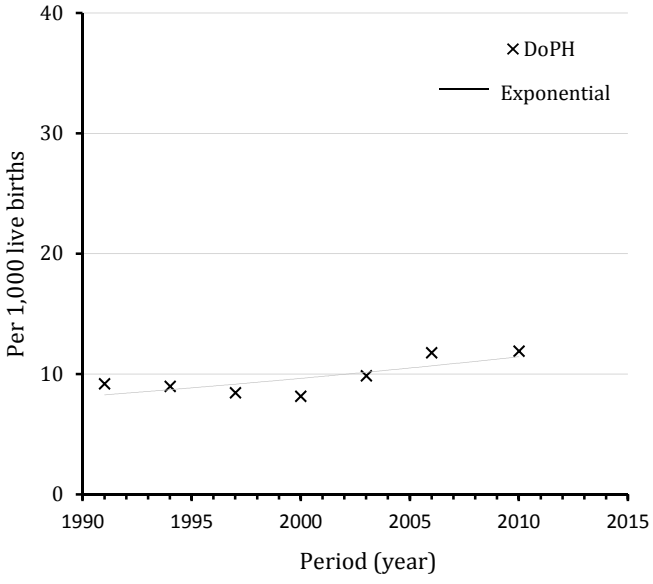
Neonatal Mortality



Postneonatal Mortality



Infant Mortality



Key

DoPH: Department of Public Health and Social Services

Source	Year	Rate	Data	Analysis	Ref
Neonatal Mortality					
DoPH	2008-2011 (2010)	6.5	Vital registration	Direct calculation	1
	2005-2007 (2006)	7.0			
	2002-2004 (2003)	5.4			
	1999-2001 (2000)	5.2			1,2
	1996-1998 (1997)	4.5			2
	1993-1995 (1994)	5.5			
	1991-1992 (1992)	5.0			3
Post-Neonatal Mortality					
DoPH	2008-2011 (2010)	5.4	Vital registration	Direct calculation	1
	2005-2007 (2006)	4.7			
	2002-2004 (2003)	4.4			
	1999-2001 (2000)	3.0			1,2
	1996-1998 (1997)	4.0			2
	1993-1995 (1994)	3.5			
	1991-1992 (1992)	4.7			3
Infant Mortality					
DoPH	2008-2011 (2010)	11.9	Vital registration	Direct calculation	1
	2005-2007 (2006)	11.8			
	2002-2004 (2003)	9.9			
	1999-2001 (2000)	8.2			1,3
	1996-1998 (1997)	8.4			3
	1993-1995 (1994)	9.0			
	1990-1992 (1991)	9.2			

References

1. Office of Vital Statistics, Department of Public Health and Social Services, Government of Guam. Estimate cited in; Bureau of Statistics and Plans. Guam Statistical Yearbook 2011. Hagatna, Guam; 2012.
2. Department of Public Health and Social Services, Government of Guam. Estimate cited in; Secretariat of the Pacific Community. Table SO1. Vital Statistics Summary, 1993 to 2003 Guam [Internet]. No date [cited Apr 30, 2014]. Available from: http://www.spc.int/prism/country/gu/stats/Social/Social.htm
3. Office of Vital Statistics, Department of Public Health and Social Services, Government of Guam. Estimate cited in; Bureau of Statistics and Plans. 2004 Guam Statistical Yearbook. Hagatna, Guam; 2005.

Comments

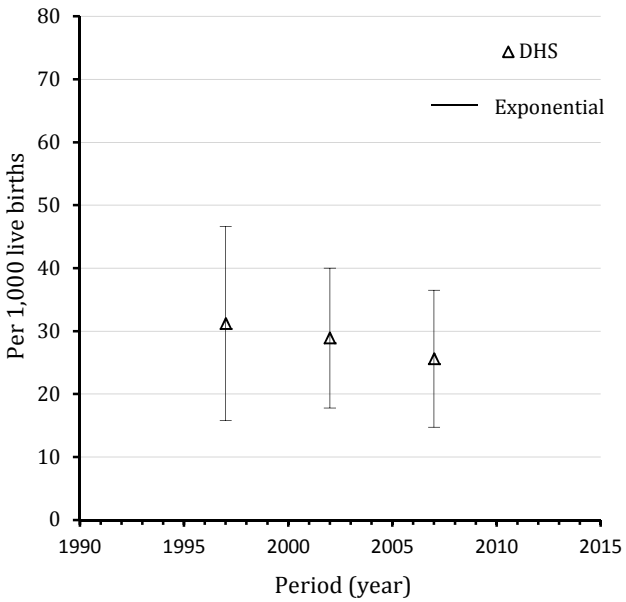
- Censuses undertaken in Guam during 1990-2013 are not a primary source of mortality estimates due to the completeness of the vital registration system.

6. Kiribati

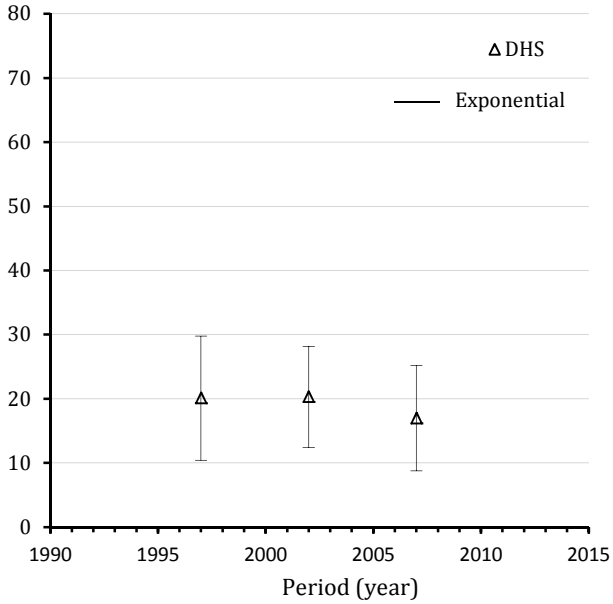
Land area (Km^2)	811
2013-mid-year population estimate	108,800
Population growth rate (%)	2.2
Crude birth rate (per 1000 population)	29.9
Total fertility rate (year)	3.9 (2010)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

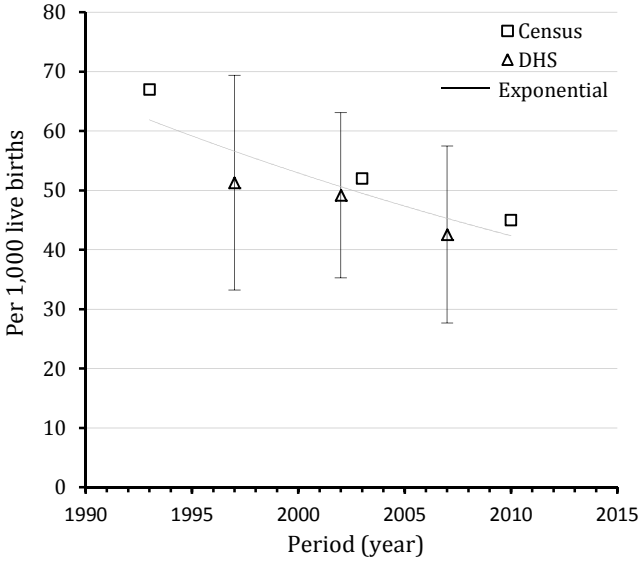


Postneonatal Mortality



No trendlines applied to NMR or PNMR graphs due to all data points coming from a single DHS.

Infant Mortality



Key

DHS: Demographic and Health Survey

Source	Year	Rate	95% CI	RSE	Data	Analysis	Ref
Neonatal Mortality							
DHS	2005-2009 (2007)	25.6	14.7-36.5	21%	Survey	Retrospective maternal history	1
	2000-2004 (2002)	28.9	17.8-40.0	19%			
	1995-1999 (1997)	31.2	15.8-46.7	25%			
Post-Neonatal Mortality							
DHS	2005-2009 (2007)	17.0	8.9-25.2	24%	Survey	Retrospective maternal history	1
	2000-2004 (2002)	20.3	12.4-28.2	19%			
	1995-1999 (1997)	20.1	10.3-29.8	25%			
Infant Mortality							
DHS	2005-2009 (2007)	42.6	27.8-57.5	17%	Survey	Retrospective maternal history	1
	2000-2004 (2002)	49.2	35.4-63.1	14%			
	1995-1999 (1997)	51.3	33.1-69.4	18%			
Census	2010	45	-	-	Census	CEBCS used to impute a model life table (UN Far East Asian) using MORTPAK4.1	2
	2003	52	-	-	Census	CEBCS used to impute a model life table (UN Far East Asian) using MORTPAK4.1	3
	1995	67	-	-	Census	CEBCS using MORTPAK3.0	4

RSE – relative standard error (standard error/rate). The DHS advises that generally speaking, estimates with an RSE above 10% are considered useable, but should be used with caution; estimates with an RSE above 25% should not be considered reliable [5].

References

1. Kiribati National Statistics Office and the Secretariat of the Pacific Community. Kiribati Demographic and Health Survey 2009. Noumea; Secretariat of the Pacific Community: 2010 Dec.
2. Kiribati National Statistics Office. & the SPC Statistics for Development Programme. Kiribati 2010 Census. Volume 2: Analytic Report. Noumea; 2012.
3. Demmke A, Haberkorn G, Rakaseta VL, Lepers C, Beccalossi G. Kiribati Population Profile based on the 1995 Census. Noumea; Secretariat of the Pacific Community: 1998.
4. Secretariat of the Pacific Community. Kiribati 2005 Census, volume 2: analytic report. SPC; 2007 Jan.
5. Solomon Islands National Statistics Office, The Secretariat of the Pacific Community, and Macro International Inc. Solomon Islands Demographic and Health Survey 2006-2007. Noumea: SPC; 2009 May.

Comments

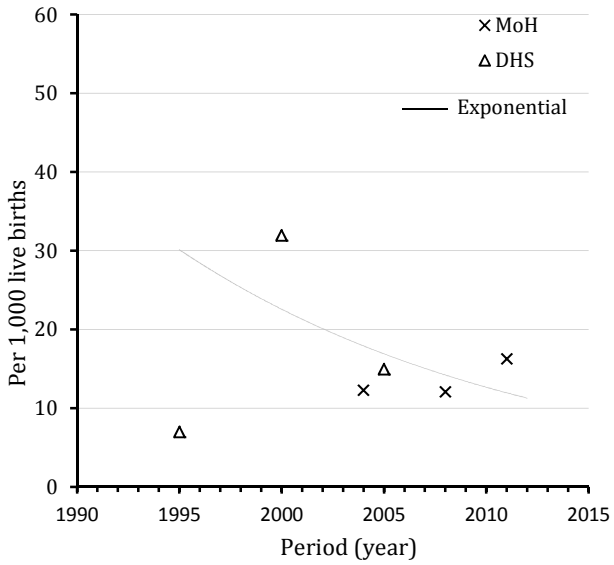
Kiribati 2009 DHS: Estimates of NMR, PNMR and IMR from the Kiribati 2009 DHS are based on interviews with 1,978 eligible women aged 15-49 years, with a response rate of 90%. Tabulation of reported births by year indicates no obvious age shifting or heaping [KNSO, 2010, p.281]. Tabulation of reported child deaths by days, months and years showed no obvious age heaping in deaths less than one month, however, there was substantial heaping at 12 months which might have had an impact on estimates of IMR [KNSO, 2010, p.281]. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 60%; the rate varied within a narrow range of 59-61%. Estimates of NMR, PNMR and IMR during the 15 years preceding the survey have overlapping 95% statistical confidence intervals and therefore are unable to show a statistically significant change (increase or decrease) in mortality during the 15 years preceding the survey [KNSO 2010].

7. Marshall Islands, Republic of the

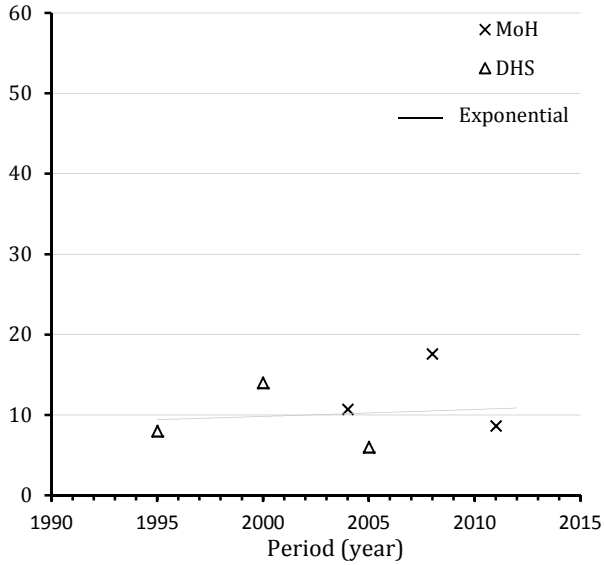
Land area (Km^2)	181
2013-mid-year population estimate	54,200
Population growth rate (%)	0.4
Crude birth rate (per 1000 population)	29.6
Total fertility rate (year)	4.1 (2011)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

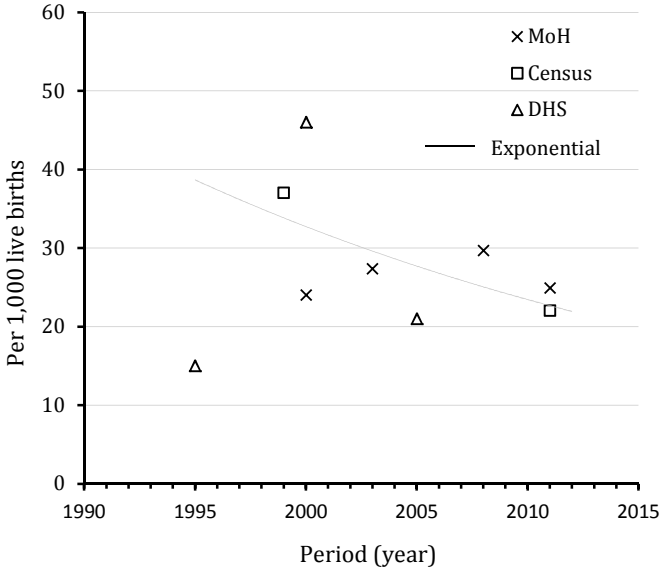


Postneonatal Mortality



The DHS estimate of NMR for 1993-97 is not included in the calculation of the trendline because it is inconsistent and is presented on the graph for illustrative purposes only.

Infant Mortality



Key
MoH: Ministry of Health
DHS: Demographic and Health Survey

The DHS estimate of IMR for 1993-97 is not included in the calculation of the trendline because it is inconsistent and is presented on the graph for illustrative purposes only.

Source	Year	Rate	Data	Analysis	Ref
Neonatal Mortality					
MoH	2010-2011 (2011)	16.3	Vital registration	Direct Calculation	1
	2007-2009 (2008)	12.1			
	2004*	12.3			2
DHS	2003-2007 (2005)	15	Survey	Retrospective maternal history	3
	1998-2002 (2000)	32			
	1993-1997 (1995)	7			
Post-Neonatal Mortality					
MoH	2010-2011 (2011)	8.6	Vital registration	Direct Calculation	1
	2007-2009 (2008)	17.6			
	2004*	10.7			2
DHS	2003-2007 (2005)	6	Survey	Retrospective maternal history	3
	1998-2002 (2000)	14			
	1993-1997 (1995)	8			
Infant Mortality					
MoH	2010-2011 (2011)	24.9	Vital registration	Direct Calculation	1
	2007-2009 (2008)	29.7			
	2002-2004 (2003)	27.3			2
	1999-2001 (2000)	24.0			
Census	2011	22	Census	<2 mortality CEBCS data used to impute model life tables (Coale/Demeny West)	4
	1999	37	Census	Interpolated from CEBCS data used to impute a model life table (Coale/Demeny West)	5
DHS	2003-2007 (2005)	21	Survey	Retrospective maternal history	3
	1998-2002 (2000)	46			
	1993-1997 (1995)	15			

*this is a single year estimate and should be interpreted with caution due to large fluctuation that can occur in small populations

References

1. Ministry of Health, Republic of the Marshall Islands. Annual Report FY 2011 [Internet]. No date [cited 2014 Jan 10]. Available from: http://www.spc.int/nmdi/nmdi_documents/RMIFY2011AnnualHealthDataReportFinal.pdf
2. Ministry of Health. Annual Report 2004 [Internet]. No date [cited 2012 Oct 5]. Available from: http://www.rmiembassyus.org/Health/RMI%20MOH%20Annual%20Report%20FY%202004.pdf
3. Economic Policy, Planning and Statistics Office (EPPSO) Marshall Islands, Secretariat of the Pacific Community and Macro International Inc. Republic of the Marshall Islands Demographic and Health Survey 2007. Noumea: SPC; 2008.
4. Economic Policy, Planning and Statistics Office, Republic of the Marshall Islands, and the Secretariat of the Pacific Community (SPC) Statistics for Development Programme. Report of the Marshall Islands 2011 Census Report. Noumea: SPC; 2012.
5. Office of Planning and Statistics. Republic of the Marshall Islands. Census of Population and Housing 1998 Final Report. Majuro, Marshall Islands: Office of Planning and Statistics.

Comments

RMI 2007 DHS: Estimates of NMR, PNMR and IMR from the RMI 2007 DHS are based on interviews with 1,625 eligible women aged 15-49 years, with a response rate of 93.3%. Standard errors and 95% confidence intervals for mortality indicators are not published in the report to allow evaluation of the statistical signicifance of trends. Tabulation of the reported births by year indicates no substantial age shifting or heaping occurred. Tabulation of reported child deaths by days, months and years showed no obvious age heaping in deaths [RMISO, 2008, p.113]. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 63%; the rate varied within a large range of 47-71%.

8. Micronesia, Federated States of

Land area (Km^2)	701
2013-mid-year population estimate	103,000
Population growth rate (%)	0.3
Crude birth rate (per 1000 population)	23.8
Total fertility rate (year)	3.5 [provisional] (2010)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

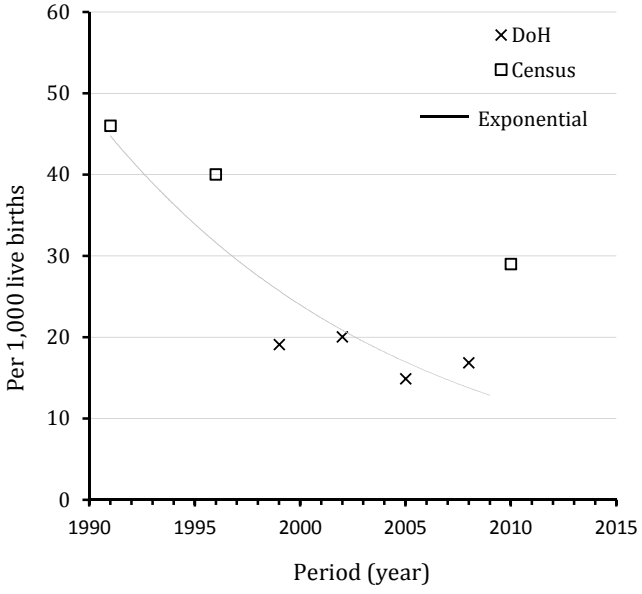
Neonatal Mortality

No data available

Postneonatal Mortality

No data available

Infant Mortality



Key
DoH: Department of Health

Source	Year	Rate	Data	Analysis	Ref
Infant Mortality					
DoH	2007-2009 (2008)	16.9	Vital registration	Direct calculation	1
	2004-2006 (2005)	14.9			
	2001-2003 (2002)	20.1			
	1998-2000 (1999)	19.1			
Census	2010	29	Census	CEBCS data used to impute a model life table (Coale/Demeny West)	2
	1996	40	Census	CEBCS data used to impute a model life table (Coale/Demeny West)	3
	1990	46	Census	CEBCS data used to impute a model life table (Coale/Demeny West)	4

References

1. Department of Health and Social Affairs. Estimate cited in; Office of Statistics, Budget & Economic Management, Overseas Development Assistance & Compact Management (SBOC). Millennium Development Goals & the Federated States of Micronesia Status Report 2010. Pohnpei; National Government FSM: 2010 Dec.
2. Division of Statistics, FSM Office of Statistics, Budget, Overseas Development Assistance and Compact Management. FSM 2010 Census of Population and Housing. [provisional report].
3. Division of Statistics, Department of Economic Affairs, FSM National Government. Federated States of Micronesia 2000 population and housing Census report. Pohnpei: FSM National Government; 2002 May.
4. Division of Statistics, Department of Economic Affairs, FSM National Government. Federated States of Micronesia 1994 population and housing Census report. Pohnpei: FSM National Government; 1996 June.

Comments References

5. Secretariat of the Pacific Community. National Minimum Development Indicators (NMDI). Vital statistics indicators [Internet] 2014. [cited 2014, Jul 24].
6. World Health Organisation. Western Pacific country health information profiles. 2011 revision. 2011 [accessed 2015, January 24]. Available from: http://www.wpro.who.int/health_information_evidence/documents/CHIPS/en/

Comments

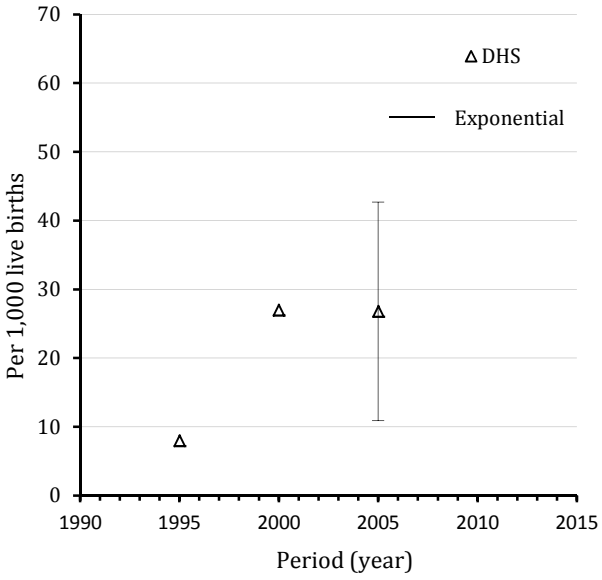
- The most recent FSM Statistical Yearbook published was for 2008.
- The SPC National Minimum Development Indicators (NMDI) website states that deaths are under-reported in the civil registration and health vital statistics reporting in FSM, and the IMR estimate of 13/1000 for 2009 published on the website is unadjusted for undercount and will therefore under-estimate the true mortality rate.[5] This estimate was not included in the current analysis.
- There is one estimate of NMR for 2009 (single year estimate) of 9.3/1000 that is published in the 2011 revision of the WHO Country Health Information Profiles (CHIPS) report, which states the FSM Health Information and Planning Unit, Department of Health and Social Affairs is the primary source.[6] As this estimate could not be confirmed/obtained from the primary source it has been excluded from the current analysis.

9. Nauru

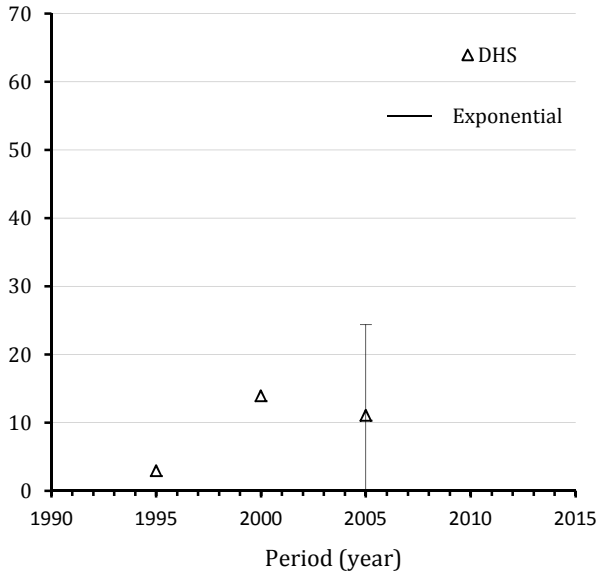
Land area (Km^2)	21
2013-mid-year population estimate	10,500
Population growth rate (%)	1.8
Crude birth rate (per 1000 population)	34.5
Total fertility rate (year)	4.3 (2009-11)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

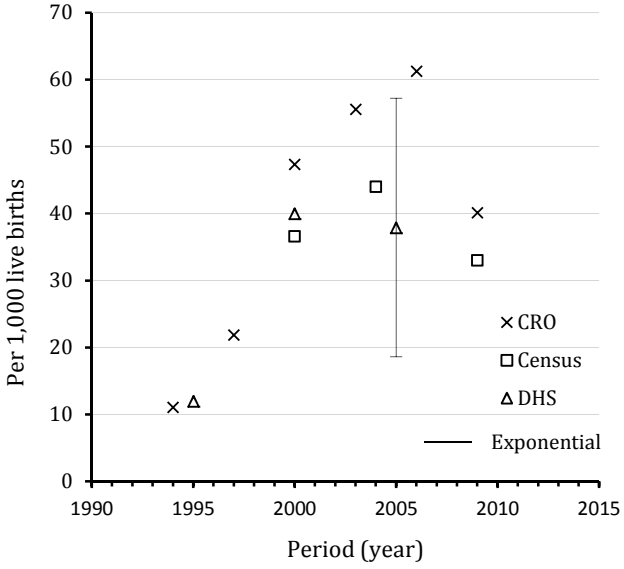


Postneonatal Mortality



No trendlines applied to NMR or PNMR graphs due to all data points coming from a single DHS.

Infant Mortality



Key

CRO: Nauru Civil Registration Office

DHS: Demographic and Health Survey

No trend line fitted due to substantail variation between estimates, no clear pattern, and different sources trending in different directions

Source	Year	Rate	95% CI	RSE	Data	Analysis	Ref
Neonatal Mortality							
DHS	2003-2007 (2005)	27	10.9-42.8	29.7%	Survey	Retrospective maternal history	1
	1998-2002 (2000)	27	NA	NA			
	1993-1997 (1995)	8	NA	NA			
Post-Neonatal Mortality							
DHS	2003-2007 (2005)	11	0.0-24.4	60.2%	Survey	Retrospective maternal history	1
	1998-2002 (2000)	14	NA	NA			
	1993-1997 (1995)	3	NA	NA			
Infant Mortality							
CRO	2008-2011(2010)	40.1	-	-	Vital registration	Direct calculation	2
	2005-2007 (2006)	61.3	-	-			
	2002-2004 (2003)	55.6	-	-			
	1999-2001 (2000)	47.4	-	-			3
	1996-1998 (1997)	21.9	-	-			
	1993-1995 (1994)	11.1	-	-			
Census	2007-2011(2009)	33	-	-	Vital registration	Direct calculation adjusted for underreporting	2
	2002-2006(2004)	44	-	-	Vital registration	Direct calculation adjusted for underreporting	
	1997-2002(2000)	36.6	-	-	Vital registration	Direct calculation	3
DHS	2003-2007 (2005)	38	18.7-57.2	25.4%	Survey	Retrospective maternal history	1
	1998-2002 (2000)	40	NA	NA			
	1993-1997 (1995)	12	NA	NA			

RSE – relative standard error (standard error/rate). The DHS advises that generally speaking, estimates with an RSE above 10% are considered useable, but should be used with caution; whilst estimates with an RSE above 25% should not be considered reliable. The Nauru 2007 DHS report strongly suggests that early childhood mortality estimates be used with great care due to their large RSE's [1].

References

1. Nauru Bureau of Statistics, the Secretariat of the Pacific Community, and Macro International Inc. Republic of Nauru Demographic and Health Survey 2007. Noumea: SPC; 2009 Apr.
2. Nauru Civil Registration Office. Estimates cited in; UNFPA, Secretariat of the Pacific Community, Australian Government. Republic of Nauru National Report on Population and Housing Census 2011 [Internet]. No date [cited 2014 Jan 15]. Available from: http://www.spc.int/nmdi/nmdi_documents/2011_NAURU_CENSUS_REPORT.pdf
3. Nauru Civil Registration Office. Estimates cited in; Secretariat of the Pacific Community Demography/Population Programme and Nauru Bureau of Statistics. Part 2: Demographic profile of the Republic of Nauru, 1992-2002. Noumea: Secretariat of the Pacific Community.

Comments

- There is instability in estimates due to small numbers producing stochastic variation.

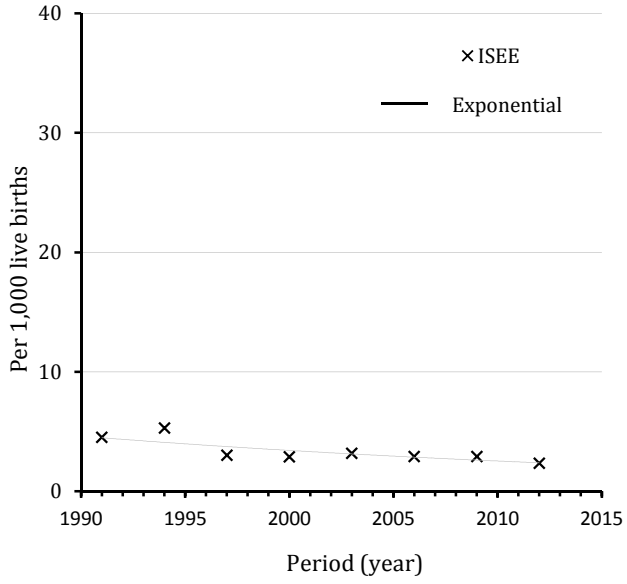
Nauru 2007 DHS: Estimates of NMR, PNMR and IMR from the Nauru 2007 DHS are based on interviews with 618 eligible women aged 15-49 years, with a response rate of 94.4%. The published report strongly suggests that the estimates of NMR, PNMR and IMR are used with great care as their relative standard errors (RSE) indicate that the estimates cannot be considered reliable [NBOS, 2009, p.94]. Tabulation of the reported births by year indicates no substantial age shifting or heaping occurred. Tabulation of reported child deaths by days, months and years showed no obvious age heaping in deaths [NBOS, 2009, p.93]. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 68%; the rate varied within a narrow range of 67-71%. The published report advises that caution must be exercised in using the mortality measures as indicators of levels of early age mortality because of the very small number of cases [NBOS, 2009, p.93].

10. New Caledonia

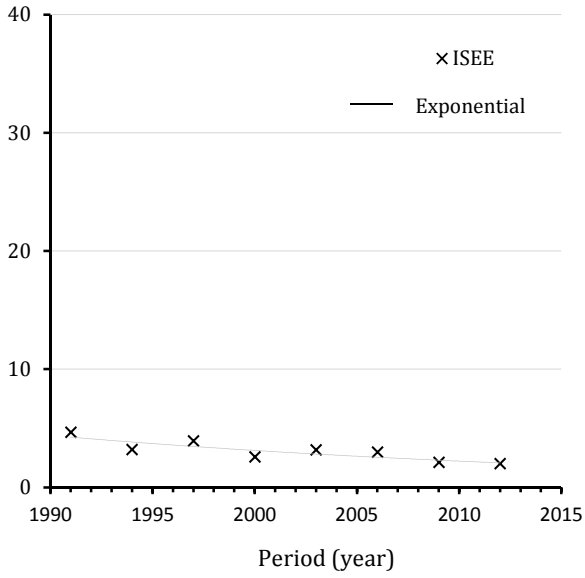
Land area (Km^2)	18,576
2013-mid-year population estimate	259,000
Population growth rate (%)	1.9
Crude birth rate (per 1000 population)	15.1
Total fertility rate (year)	2.2 (2007)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

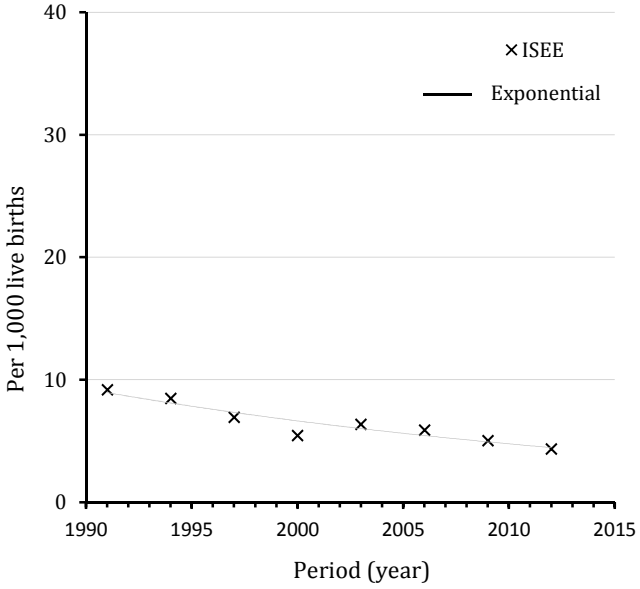
Neonatal Mortality



Postneonatal Mortality



Infant Mortality



Key

ISEE: Institut de la Statistique et des Etudes Economiques

Source	Year	Rate	Data	Analysis	Ref
Neonatal Mortality					
ISEE	2011-2012 (2012)	2.4	Vital registration	Direct calculation	1
	2008-2010 (2009)	2.9			
	2005-2007 (2006)	2.9			
	2002-2004 (2003)	3.2			
	1999-2001 (2000)	2.9			
	1996-1998 (1997)	3.0			
	1993-1995 (1994)	5.3			
	1990-1992 (1991)	4.5			
Post-Neonatal Mortality					
ISEE	2011-2012 (2012)	2.0	Vital registration	Direct calculation	1
	2008-2010 (2009)	2.1			
	2005-2007 (2006)	3.0			
	2002-2004 (2003)	3.2			
	1999-2001 (2000)	2.6			
	1996-1998 (1997)	3.9			
	1993-1995 (1994)	3.2			
	1990-1992 (1991)	4.7			
Infant Mortality					
ISEE	2011-2012 (2012)	4.3	Vital registration	Direct calculation	1
	2008-2010 (2009)	5.0			
	2005-2007 (2006)	5.9			
	2002-2004 (2003)	6.4			
	1999-2001 (2000)	5.5			
	1996-1998 (1997)	6.9			
	1993-1995 (1994)	8.5			
	1990-1992 (1991)	9.2			

References

1. Institut de la Statistique et des Etudes Economiques (ISEE). Obtained directly from ISEE by the Secretariat of the Pacific Community.

Comments

- The civil vital registration system in New Caledonia is considered to be complete.

11. Niue

Land area (Km^2)	259
2013-mid-year population estimate	1,500
Population growth rate (%)	-0.2
Crude birth rate (per 1000 population)	13.2
Total fertility rate (year)	2.2 (2006-11)

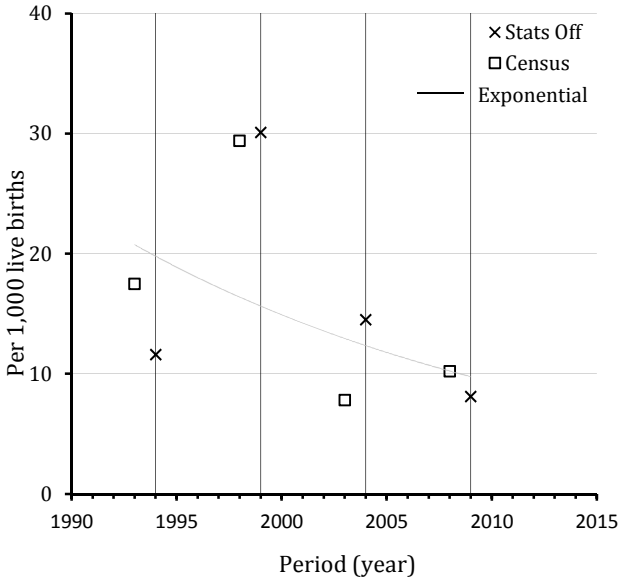
[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

One estimate of NMR for 2011 (single year estimate) is available from the Niue Ministry of Health. The NMR was 0/1000, and highlights the small number of deaths. As only one estimate was available it has not been displayed on a graph.

Postneonatal Mortality

Infant Mortality



Full 95% CIs not shown on graph. Please see table below for complete figures

Key

Stat Off: Niue Statistics Office

Source	Year	Rate	95% CI	Data	Analysis	Ref
Infant Mortality						
Stats Off	2007-2011 (2009)	8.1	0-148.8	Vital registration	Direct calculation	1
	2002-2006 (2004)	14.5	0-133.7			
	1997-2001 (1999)	30.1	0-138.7			
	1992-1996 (1994)	11.6	0-107.2			
Census	2006-2011 (2008)	10.2	-	Vital registration	Direct calculation	2
	2001-2006 (2003)	7.8	-	Vital registration	Direct calculation	3
	1997-2001 (1998)	29.4	-	Vital registration	Direct calculation	4
	1991-1997 (1993)	17.5	-	Vital registration	Direct calculation	5

References

1. Niue Statistics Unit & Statistics for Development, Secretariat of the Pacific Community. Niue Vital Statistics Report: 1987-2011 [Internet]. No date [cited Jan 14 2014]. Available from: www.spc.int/prism/niue/index.php/niue.../120-vital-a-health-statistics
2. Statistics Niue, Government of Niue. Niue Census of Population and Households 2011 [Internet]. 2012 [cited 2014 Jan 10]. Available from: http://www.spc.int/prism/niue/index.php/niue-documents/cat_view/12-surveys/13-census/14-census-2011
3. Secretariat of the Pacific Community. Niue population profile based on 2006 Census of population and housing. A guide for planners and policy makers. Noumea; 2008.
4. Economic, Planning, Development and Statistics Unit Premiers Department. Niue 2001 Census of Population and Housing.
5. Secretariat of the Pacific Community. Niue population profile based on 1997 Census – a guide for planners and policy-makers. Noumea; 1999.

Comments References

6. World Health Organisation. Western Pacific country health information profiles. 2011 revision. 2011 [accessed 2015, January 24]. Available from: http://www.wpro.who.int/health_information_evidence/documents/CHIPS/en/

Comments

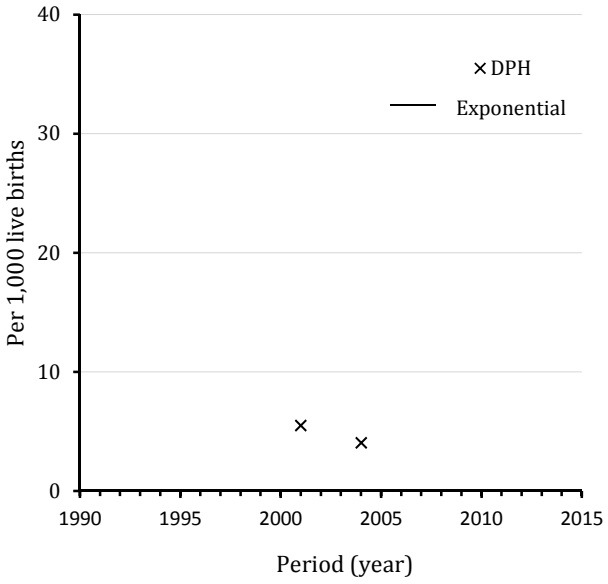
- Mortality estimates for Niue are affected by small numbers of deaths and the small population.
- Infant mortality rates from the Niue Statistics Division are based on the vital registration system, which is considered fairly complete. However, some mothers travel to New Zealand to give birth.
- Some of the differences in reported infant mortality rates between Census reports and the Statistics Division is due to the use of different denominators; the Statistics Division use births to resident mothers, whereas Census reports use all registered births.
- Estimates of infant mortality in recent periods of around 10 deaths per 1000 live births should be interpreted with caution as only one infant death reported in the 5 years (2006-2011) was used for the calculation of this estimate.[2] While this figure may be plausible, 10 years ago Niue's infant mortality was 29.4/1000 (4 infant deaths recorded over 1997-2001).[2]
- Generally sitting below 15 deaths per 1000 live births (except in 1997-2001), IMR in Niue is fairly low. This is consistent with high standard of living and good quality medical care. The Niue Vital Statistics Report: 1987-2011 states that "Further reductions in IMR are likely to require significant (and possibly unwarranted) investments in specialised care."[1]
- There is an estimate of NMR for 2005 of 0/1000 published in the 2011 revision of the WHO Country Health Information Profiles (CHIPS) report.[6] As this estimate could not be confirmed/obtained from the primary source it has been excluded from analysis.

12. Northern Mariana Islands, Commonwealth of the

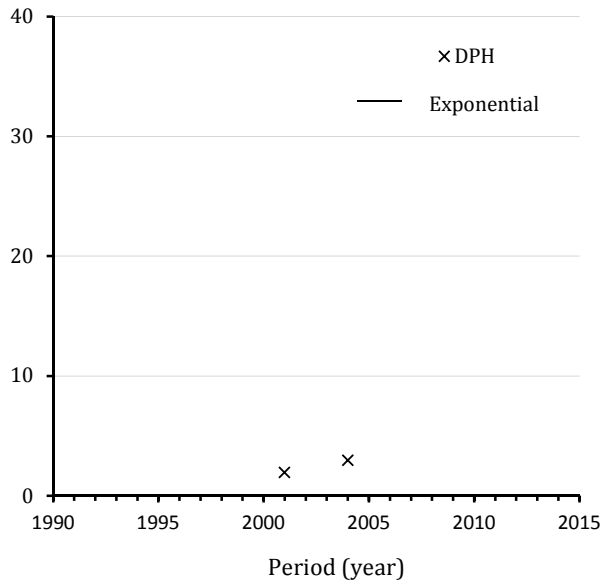
Land area (Km^2)	457
2013-mid-year population estimate	55,600
Population growth rate (%)	-2.5
Crude birth rate (per 1000 population)	14.8
Total fertility rate (year)	2.2 (2010)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

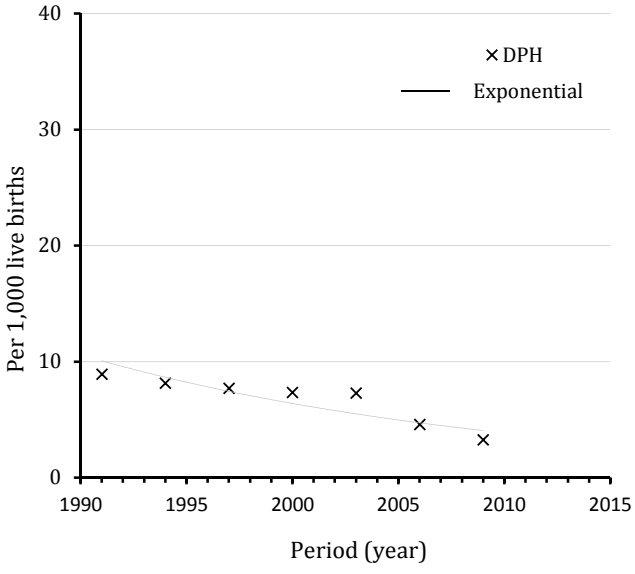


Postneonatal Mortality



No trendlines applied to NMR or PNMR graphs due to insufficient data points (<3).

Infant Mortality



Key

DPH: Department of Public Health

Source	Year	Rate	Data	Analysis	Ref
Neonatal Mortality					
DPH	2003-2004 (2004)	4.1	Vital registration	Direct calculation	1
	2000-2002 (2001)	5.5			
Post-Neonatal Mortality					
DPH	2003-2004 (2004)	3.0	Vital registration	Direct calculation	1
	2000-2002 (2001)	1.9			
Infant Mortality					
DPH	2008-2009(2009)	3.3	Vital registration	Direct calculation	2
	2005-2007 (2006)	4.6			
	2002-2004 (2003)	7.3			1
	1999-2001 (2000)	7.3			
	1996-1998 (1997)	7.7			
	1993-1995 (1994)	8.1			1,3
	1990-1992 (1991)	8.9			3

References

1. Department of Public Health. Maternal and Child Health Needs Assessment Summary. Commonwealth of the Northern Mariana Islands. 2005 Jul.
2. Department of Public Health, Health and Vital Statistics Office. Estimate cited in; Division of Public Health Maternal and Child Health program. Commonwealth of the Northern Mariana Islands, Department of Public Health, Maternal and Child Health 2010 Needs Assessment [Internet]. No date [cited 2014 May 5]. Available from: https://mchdata.hrsa.gov/tvisreports/Documents/NeedsAssessments/2011/MP-NeedsAssessment.pdf
3. Department of Public Health and Central Statistics Division, Department of Commerce. Commonwealth of the Northern Mariana Islands Statistical Yearbook 2002 [Internet]. No date [cited 2012 Oct 5]. Available from: http://commerce.gov.mp/wp-content/uploads/2010/08/CNMI-Yearbook-2002.pdf

Comments

- The most recent Statistical Yearbook published in CNMI was for 2002.

13. Palau

Land area (Km^2)	444
2013-mid-year population estimate	17,800
Population growth rate (%)	-1.9
Crude birth rate (per 1000 population)	13.6
Total fertility rate (year)	1.7 (2010)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

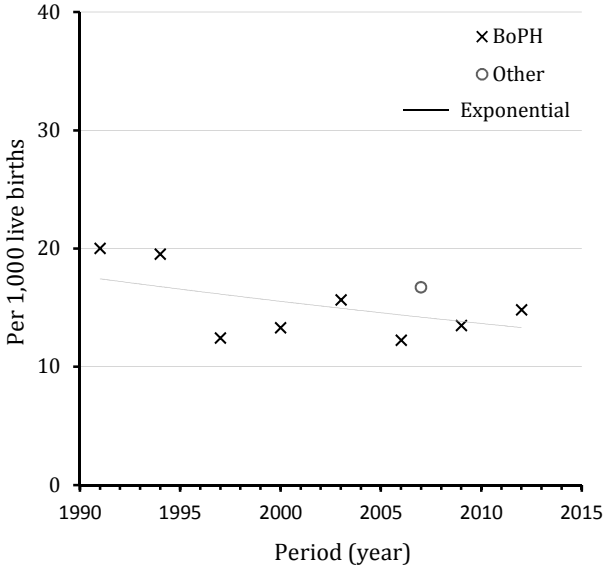
Neonatal Mortality

No data avaliable

Postneonatal Mortality

No data avaliable

Infant Mortality



Key

BoPH: Bureau of Public Health

Other: other source noted in reference list

Source	Year	Rate	Data	Analysis	Ref
Infant Mortality					
BoPH	2011-2013 (2012)	14.8	Vital registration	Direct calculation	1
	2008-2010 (2009)	13.5			
	2005-2007 (2006)	12.2			
	2002-2004 (2003)	15.7			
	1999-2001 (2000)	13.3			
	1996-1998 (1997)	12.4			
	1993-1995 (1994)	19.5			
	1990-1992 (1991)	20.0			
Other	2004-09(2006)	16.7	Vital registration	Direct calculation using population mortality rate (population <1 year) and converted to a probability using life table methods.	2

References

1. Palau Ministry of Health. Obtained directly from Palau MoH by the Secretariat of the Pacific Community, 2014 Jun.
2. Karen Carter. 2013. Mortality and cause of death in the Pacific [Doctoral Thesis]. University of Queensland. Brisbane. Available from: http://espace.library.uq.edu.au/view/UQ:309197

Comments References

3. World Health Organisation. Western Pacific country health information profiles. 2011 revision. 2011 [accessed 2015, January 24]. Available from: http://www.wpro.who.int/health_information_evidence/documents/CHIPS/en/

Comments

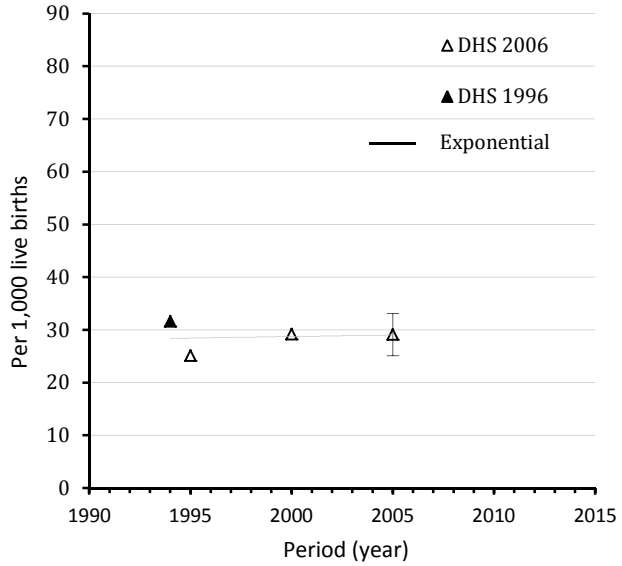
- There is one estimate of NMR in Palau for 2010 (single year estimate) of 4/1000 that is published in the 2011 revision of the WHO Country Health Information Profiles (CHIPS) report, which states the Public Health Data and Statistics of the Palau Ministry of Health is the primary source.[3] As this estimate could not be confirmed/obtained from the primary source it has been excluded from the current analysis.

14. Papua New Guinea

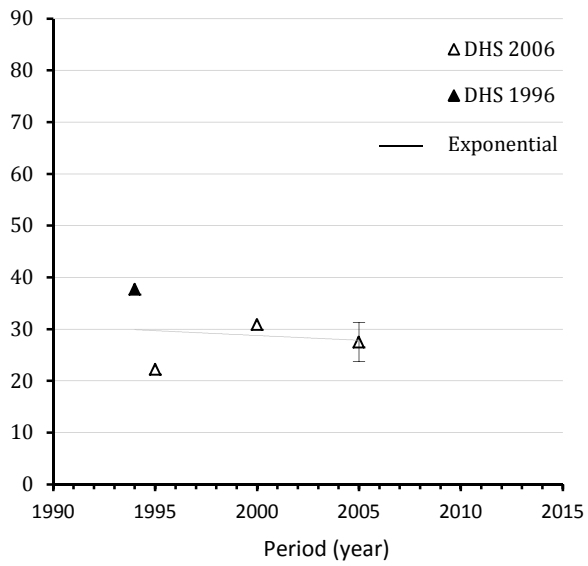
Land area (Km^2)	462,840
2013-mid-year population estimate	7,398,500
Population growth rate (%)	2.3
Crude birth rate (per 1000 population)	32.5
Total fertility rate (year)	4.4 (2002-06)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

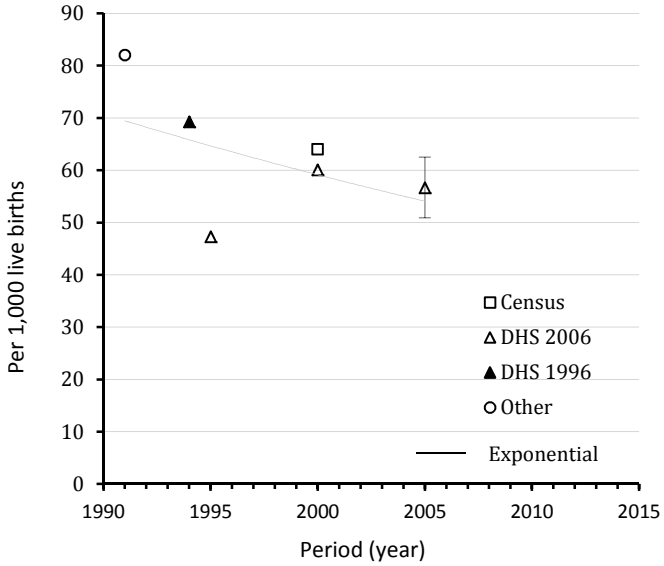
Neonatal Mortality



Postneonatal Mortality



Infant Mortality



Key

DHS: Demographic and Health Survey

Other: other source noted in reference list

Source	Year	Rate	95% CI	RSE	Data	Analysis	Ref
Neonatal Mortality							
DHS 2006	2003-2007 (2005)	29.1	24.9-32.8	6.8%	Survey	Retrospective maternal history	1
	1998-2002 (2000)	29.2	-	-			
	1993-1997 (1995)	25.1	-	-			
DHS 1996	1992-1996 (1994)	31.6	-	-	Survey	Retrospective maternal history	2
Post-Neonatal Mortality							
DHS 2006	2003-2007 (2005)	27.5	24.8-32.4	6.6%	Survey	Retrospective maternal history	1
	1998-2002 (2000)	30.9	-	-			
	1993-1997 (1995)	22.2	-	-			
DHS 1996	1992-1996 (1994)	37.7	-	-	Survey	Retrospective maternal history	2
Infant Mortality							
Census	2000	64			Census	CEBCS used to impute a model life table (Coale/Demeny West)	3
DHS 2006	2003-2007 (2005)	56.7	51.7-63.2	5.0%	Survey	Retrospective maternal history	1
	1998-2002 (2000)	60.1	-	-			
	1993-1997 (1995)	47.3	-	-			
DHS 1996	1992-1996 (1994)	69.3	-	-	Survey	Retrospective maternal history	2
Other	1991	82	-	-	Survey	CEBCS used to impute a model life table (Coale/Demeny Far East)	4

RSE – relative standard error (standard error/rate). The DHS advises that generally speaking, estimates with an RSE above 10% are considered useable, but should be used with caution; estimates with an RSE above 25% should not be considered reliable [5].

References

1. National Statistics Office. Papua New Guinea Demographic and Health Survey 2006. National Report. Port Moresby: National Statistics Office; 2009.
2. National Statistics Office. Papua New Guinea Demographic and Health Survey 1996. National Report. Port Moresby: National Statistics Office; 1997.
3. National Statistical Office. Recent fertility and mortality indices and trends in Papua New Guinea. A report based on the analysis of 2000 Census data. National Statistics Office: Port Moresby; 2003 April.
4. Hayes G. Estimates of mortality in Papua New Guinea based on the 1990 Census and the 1991 Demographic and Health Survey. UNFPA/ILO Project PNG/94/P01: Port Moresby; 1996 July.
5. Solomon Islands National Statistics Office, The Secretariat of the Pacific Community, and Macro International Inc. Solomon Islands Demographic and Health Survey 2006-2007. Noumea: SPC; 2009 May.

Comments

PNG 2006 DHS: Estimates of NMR, PNMR and IMR from the PNG 2006 DHS are based on interviews with 10,353 eligible women aged 15-49 years, with a response rate of 90.4%. The relative standard errors (RSE) associated with NMR, PNMR and IMR estimates for the most recent period in the PNG DHS Report are small, however 95% confidence intervals can only be calculated for the most recent estimates so the statistical significance of trends over time cannot be assessed. Tabulation of reported births by year indicates a significant heaping of births in the year 2000, probably due to transference of births by interviewers and digit preference (see Appendix 2). The likely result is an understatement of IMR in the period 0-4 years preceding the survey and a corresponding overstatement for the period 5-9 years preceding the survey [PNGNSO 2009]. Tabulation of reported child deaths by days, months and years shows evidence of age heaping at 6 and 11 months, with the age heaping at 11 months tending to overestimate the IMR. Age heaping was less pronounced in the five years preceding the survey, for which the most recent rates are calculated. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 51%; the rate varied within a narrow range of 49-53%.

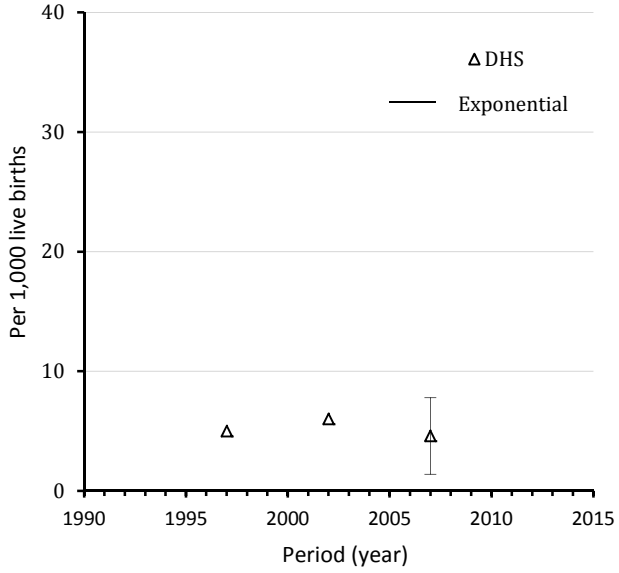
PNG 1996 DHS: Estimates of NMR, PNMR and IMR from the PNG 1996 DHS are based on interviews with 4,917 eligible women aged 15-49 years, with a response rate of 88.6%. The standard errors and 95% confidence intervals for mortality indicators are not published in the report so the statistical significance of trends cannot be assessed. Tabulation of reported births by year indicates some age shifting to the year outside the cut-off for administering the lengthy birth-history related questions. Tabulation of reported child deaths by days, months and years shows some heaping of deaths at 12 months, although it is stated that the pattern of this heaping would downwardly bias the IMR by no more than 1% [PNGNSO, 1997, p.77]. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 45%; the rate varied within a narrow range of 44-46%.

15. Samoa

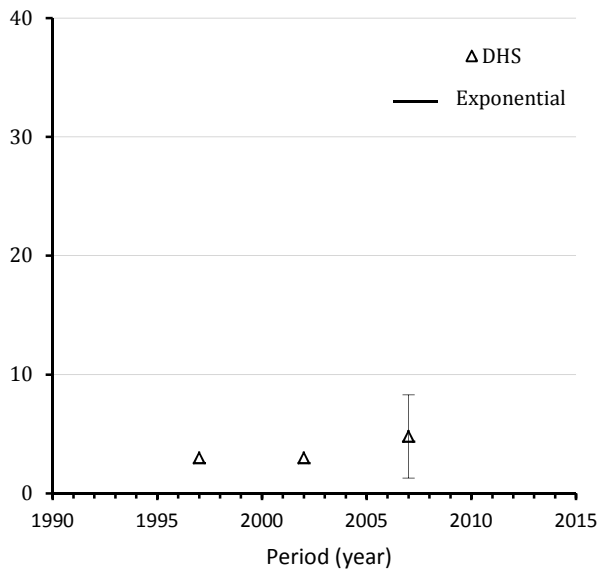
Land area (Km^2)	2,934
2013-mid-year population estimate	187,400
Population growth rate (%)	0.8
Crude birth rate (per 1000 population)	29.1
Total fertility rate (year)	4.7 (2011)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

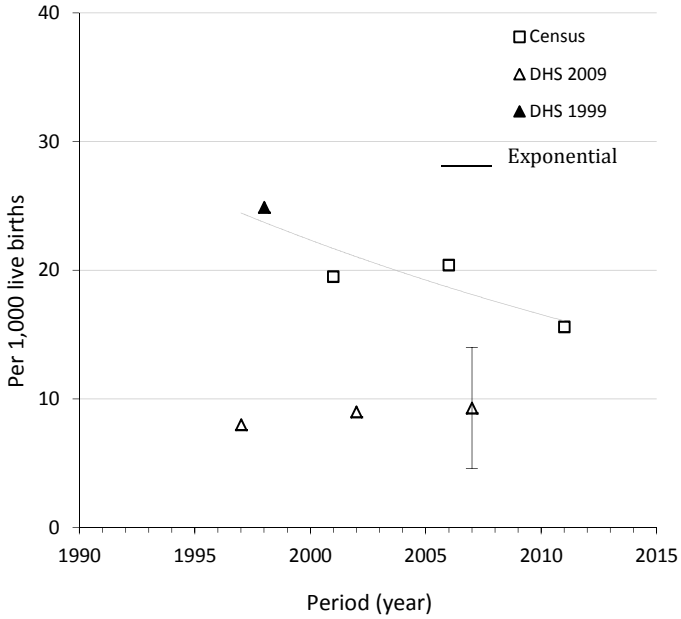


Postneonatal Mortality



No trendlines applied to NMR or PNMR graphs due to all data points coming from a single DHS.

Infant Mortality



Key

DHS: Demographic and Health Survey

The Samoa 2009 DHS report indicates that the sample size was too small to reliably calculate childhood mortality and is inconsistent with other data presented. Therefore it is displayed on the graph for illustrative purposes only and has not been used in calculation of the trendline.

Source	Year	Rate	95% CI	RSE	Data	Analysis	Ref
Neonatal Mortality							
DHS 2009	2005-2009 (2007)	4.6	1.4-7.8	35.1%	Survey	Retrospective maternal history	1
	2000-2004 (2002)	6	NA	NA			
	1995-1999 (1997)	5	NA	NA			
Post-Neonatal Mortality							
DHS 2009	2005-2009 (2007)	4.8	1.3-8.3	36.6%	Survey	Retrospective maternal history	1
	2000-2004 (2002)	3	NA	NA			
	1995-1999 (1997)	3	NA	NA			
Infant Mortality							
Census	2011	15.6			Census	Direct calculation based on retrospective reporting of births and deaths in the household	2
	2006	20.4			Census	Direct calculation based on retrospective reporting of births and deaths in the household	3
	2001	19.5			Census	CEBCS using MORTPAK software	4
DHS 2009	2005-2009 (2007)	9.3	4.7-14.0	24.8%	Survey	Retrospective maternal history	1
	2000-2004 (2002)	9	NA	NA			
	1995-1999 (1997)	8	NA	NA			
DHS 1999	1998	24.9	NA	NA	Survey	Reported infant deaths divided by estimated live births	5

RSE – relative standard error (standard error/rate). The DHS advises that generally speaking, estimates with an RSE above 10% are considered useable, but should be used with caution; estimates with an RSE above 25% should not be considered reliable [6].

References

1. Samoa Bureau of Statistics, Ministry of Health, ICF Macro. Samoa Demographic and Health Survey 2009. Apia, Samoa: Ministry of Health; 2010.
2. Samoa Bureau of Statistics. Population and Housing Census 2011 Analytic Report. Apia, Samoa: Bureau of Statistics; 2012.
3. Samoa Bureau of Statistics. Samoa Population and Housing Census Report 2006. Apia, Samoa: Government of Samoa; 2008 Jul.
4. Government of Samoa, Ministry of Finance, Statistical Services Division. Report of the Census of Population and Housing Samoa 2001. Apia, Samoa; 2001.
5. Government of Samoa, Department of Statistics and Secretariat of the Pacific Community. Samoa Demographic and Health Survey 1999 Analytic Report. Noumea; SPC.
6. Solomon Islands National Statistics Office, The Secretariat of the Pacific Community, and Macro International Inc. Solomon Islands Demographic and Health Survey 2006-2007. Noumea: SPC; 2009 May.

Comments

- Although it is titled a DHS survey, the 1999 Samoa DHS was not undertaken using the DHS methodology and is not recognised on the DHS Program website. It is not considered comparable with the other DHS surveys in this report.

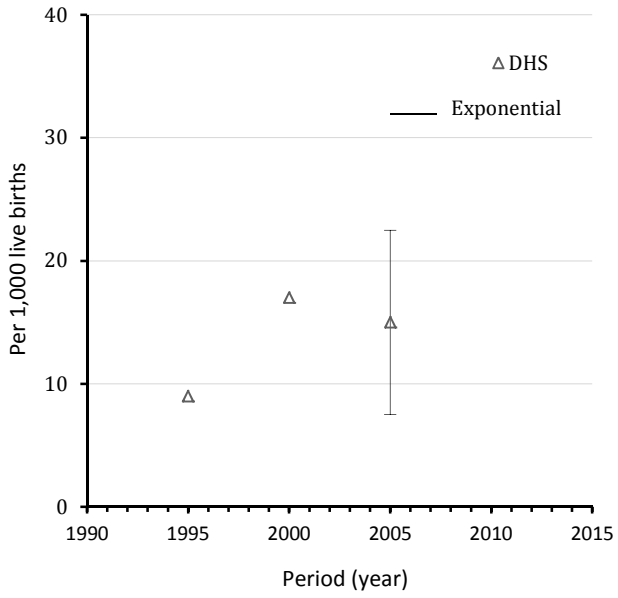
Samoa 2009 DHS: Estimates of NMR, PNMR and IMR from the Samoa 2009 DHS are based on interviews with 2,657 eligible women aged 15-49 years, with a response rate of 88%. The published report states that the number of households visited and individual interviews conducted during the survey was low, resulting in broad confidence intervals around mortality estimates and no statistically significant change (increase or decrease) in mortality during the three time periods of the survey [SBOS, 2010, p.103]. Tabulation of reported births by year indicates no obvious age shifting or heaping. Tabulation of reported child deaths by days, months and years shows no obvious age heaping in deaths [SBOS, 2010, p.222]. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 60%; the rate varied within a range of 49-67%. The report highlights that due to significant under-reporting of births and deaths the estimates of NMR, PNMR and IMR published in the report are very likely underestimates of the true mortality in the country, and therefore should not be treated as reliable [SBOS, 2010, p.104].

16. Solomon Islands

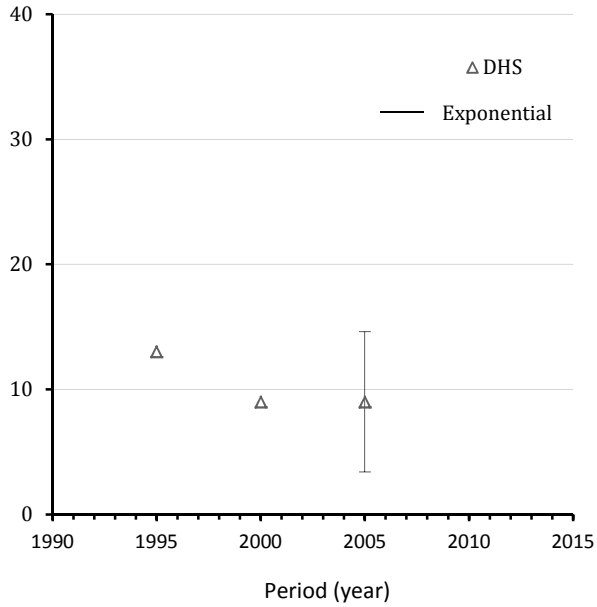
Land area (Km^2)	28,000
2013-mid-year population estimate	610,800
Population growth rate (%)	2.8
Crude birth rate (per 1000 population)	30.0
Total fertility rate (year)	4.1 [provisional] (2007-09)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

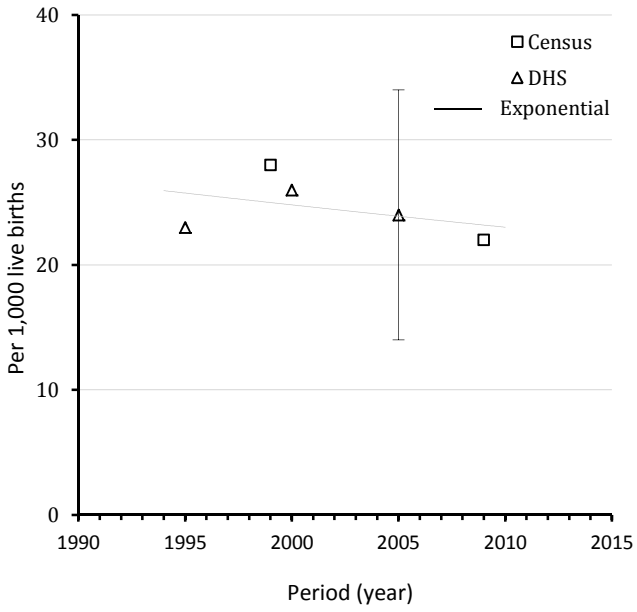


Postneonatal Mortality



No trendlines applied to NMR or PNMR graphs due to all data points coming from a single DHS.

Infant Mortality



Key

DHS: Demographic and Health Survey

Source	Year	Rate	95% CI	RSE	Data	Analysis	Ref
Neonatal Mortality							
DHS	2003-2007 (2005)	15	7.7-22.6	24.5%	Survey	Retrospective maternal history	1
	1998-2002 (2000)	17	N/A	N/A			
	1993-1997 (1995)	9	N/A	N/A			
Post-Neonatal Mortality							
DHS	2003-2007 (2005)	9	7.7-22.6	24.5%	Survey	Retrospective maternal history	1
	1998-2002 (2000)	9	N/A	N/A			
	1993-1997 (1995)	13	N/A	N/A			
Infant Mortality							
Census	2009	22			Census	CEBCS data and adult survivorship data used to impute a model life table (Coale/Demeny North)	2
	1999	28			Census	CEBCS data and adult survivorship data used to impute a model life table (Coale/Demeny North)	
DHS	2003-2007 (2005)	24	14.4-34.2	20.3%	Survey	Retrospective maternal history	1
	1998-2002 (2000)	26	N/A	N/A			
	1993-1997 (1995)	23	N/A	N/A			

RSE – relative standard error (standard error/rate). The DHS advises that generally speaking, estimates with an RSE above 10% are considered useable, but should be used with caution; estimates with an RSE above 25% should not be considered reliable [1].

References

1. Solomon Islands National Statistics Office, The Secretariat of the Pacific Community, and Macro International Inc. Solomon Islands Demographic and Health Survey 2006-2007. Noumea: SPC; 2009 May.
2. Solomon Islands National Statistics Office. 2009 Population & Housing Census National Report (Volume 2). Honiara; Solomon Islands Government

Comments

Solomon Islands 2006-07 DHS: Estimates of NMR, PNMR and IMR from the Solomon Islands 2006-07 DHS are based on interviews with 3,823 eligible women aged 15-49 years, with a response rate of 87%. The published report strongly suggested that estimates of IMR, NMR and PNMR in the report are used with great care as their relative standard errors (RSE) indicate that the estimates cannot be considered reliable [SINSO, 2009, p.128]. tabulation of reported births by year indicates no obvious age shifting or heaping occurred [SI DHS p.127]. Tabulation of reported child deaths by days, months and years shows no obvious age heaping in deaths less than one month, however, there is evidence of some heaping at 12 months which might have had an impact on estimates of IMR [SINSO, 2009, p.127]. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 56%; the rate varied within a wide range of 39-65%. The published report stresses that caution must be exercised in using the mortality measures as indicators of early age mortality levels because of the possible under coverage of eligible DHS respondents, evidenced by an 87% response rate of all eligible women selected in the DHS sample. The large discrepancy between estimates in the 2006-07 Solomon Islands DHS and the 1999 Census are noted, with the DHS Report highlighting that further investigation is needed as to whether the significantly lower estimates in the DHS Report are a direct result of interventions or a result of data errors [SINSO, 2009, p. 127].

17. Tokelau

Land area (Km^2)	12
2013-mid-year population estimate	1,200
Population growth rate (%)	0.9
Crude birth rate (per 1000 population)	15.3
Total fertility rate (year)	2.1 (2006-11)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Comments

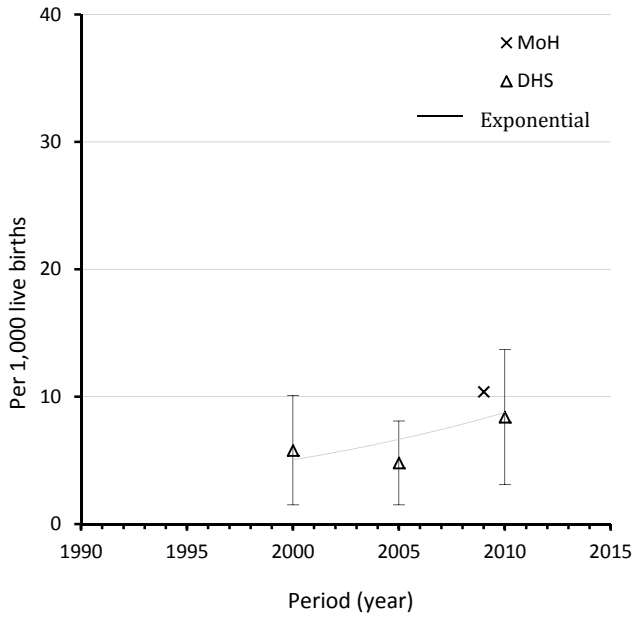
- High risk pregnancies are referred to either Samoa or New Zealand, and births generally do not occur on island. There are no reliable figures for infant births or deaths off island, although Tokelau is working to implement reporting procedures to capture these.

18. Tonga

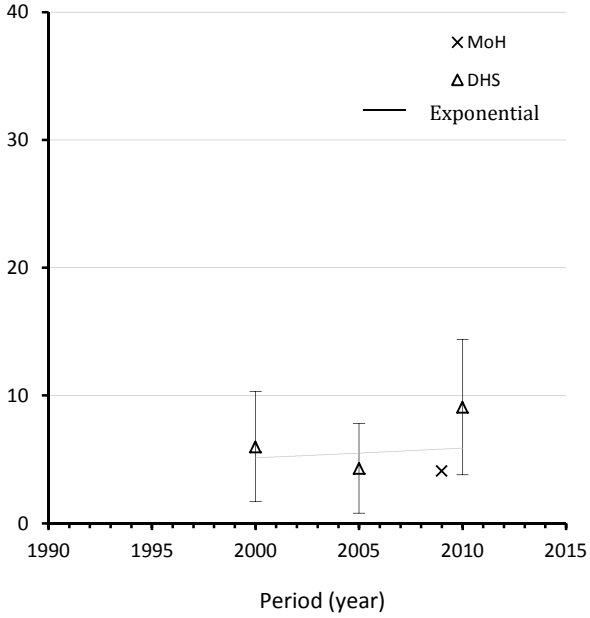
Land area (Km^2)	749
2013-mid-year population estimate	103,300
Population growth rate (%)	0.2
Crude birth rate (per 1000 population)	27.1
Total fertility rate (year)	3.9 (2011)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

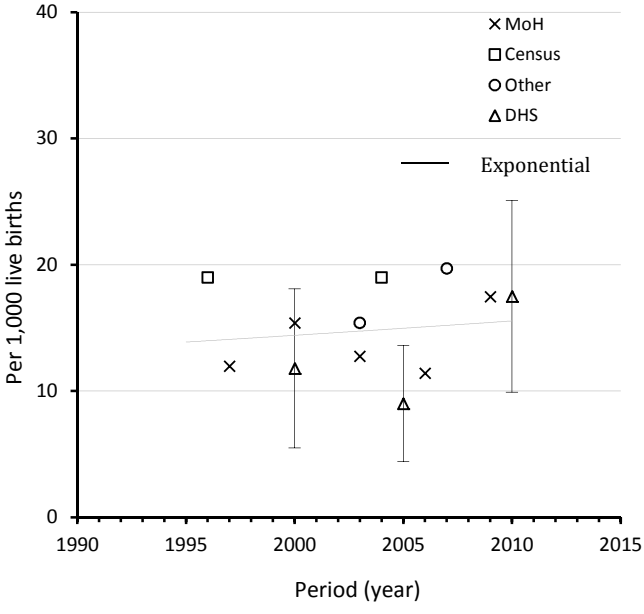
Neonatal Mortality



Postneonatal Mortality



Infant Mortality



Key
MoH: Ministry of Health
DHS: Demographic and Health Survey
Other: other source noted in reference list

Source	Year	Rate	95% CI	RSE	Data	Analysis	Ref
Neonatal Mortality							
MoH	2009*	10.4	-	-	Vital registration	Direct calculation	1
DHS	2008-2012 (2010)	8.4	3.1-13.8	30%	Survey	Retrospective maternal history	2
	2003-2007 (2005)	4.8	1.5-8.0	30%			
	1998-2002 (2000)	5.8	1.5-10.0	40%			
Post-Neonatal Mortality							
MoH	2009*	4.1	-	-	Vital registration	Direct calculation	1
DHS	2008-2012 (2010)	9.1	3.8-14.4	30%	Survey	Retrospective maternal history	2
	2003-2007 (2005)	4.3	0.8-7.8	40%			
	1998-2002 (2000)	6.0	1.7-10.4	40%			
Infant Mortality							
MoH	2008-2010 (2009)	17.5	-	-	Vital registration	Direct calculation	1
	2005-2007 (2006)	11.4	-	-			1,3
	2002-2004 (2003)	12.8	-	-			3
	1999-2001 (2000)	15.4	-	-			3,4
	1995-1998 (1997)	12.0	-	-			4
Census	2006	19	-	-	Survey	<5 mortality from CEBCS data imputed into a model life table (using MORTPAK4.1) to generate IMR	5
	1996	19	-	-	Survey	<5 mortality from CEBCS used to generate IMR	6
DHS	2008-2012 (2010)	17.5	9.9-25.1	20%	Survey	Retrospective maternal history	2
	2003-2007 (2005)	9.0	4.5-13.6	20%			
	1998-2002 (2000)	11.8	5.6-18.1	30%			
Other	2005-09(2007)	19.7	-	-	Vital registration and Census data	Reconciliation of multiple source vital registration and capture-recapture analysis, for deaths.	7
	2001-04(2003)	15.4	-	-	Vital registration and Census data	Reconciliation of multiple source vital registration and capture-recapture analysis, for deaths.	7

*this is a single year estimate and should be interpreted with caution due to large fluctuation that can occur in small populations; RSE – relative standard error (standard error/rate). The DHS advises that generally speaking, estimates with an RSE above 10% are considered useable, but should be used with caution; estimates with an RSE above 25% should not be considered reliable [8].

References

1. Government of Tonga. Report of the Minister for Health for the year 2010 [Internet]. No date [cited 2014 April 5]. Available from: http://health.gov.to/Annualreport_Public
2. Tonga Department of Statistics and Tonga Ministry of Health, Secretariat of the Pacific Community, and UNFPA. Tonga Demographic and Health Survey, 2012. Noumea: SPC; 2014.
3. Government of Tonga. Report of the Minister for Health for the year 2005 [Internet]. No date [cited 2014 April 5]. Available from: http://www.mic.gov.to
4. Government of Tonga. Report of the Minister for Health for the year 2000 [Internet]. No date [cited 2014 April 5]. Available from: http://www.mic.gov.to
5. Tonga Statistics Department and the Secretariat of the Pacific Community. Tonga 2006 Census of population and housing, volume 2: analytic report. Noumea: SPC; 2008.
6. Statistics Department. Tonga population Census 1996 demographic analysis. Nuku'alofa: Statistics Dep; 1999.
7. Hufanga S, Carter K, Rao C, Lopez A, Taylor R. Mortality trends in Tonga: an assessment based on a synthesis of local data. Population Health Metrics. 2012;10(14): doi:10.1186/1478-7954-10-14
8. Solomon Islands National Statistics Office, The Secretariat of the Pacific Community, and Macro International Inc. Solomon Islands Demographic and Health Survey 2006-2007. Noumea: SPC; 2009 May.

Comments:

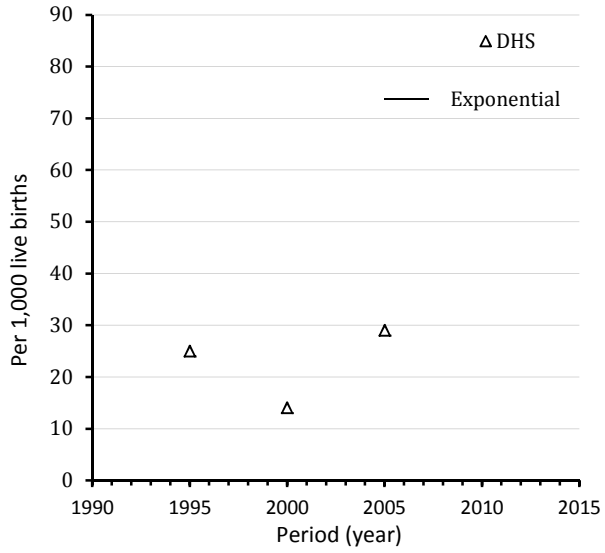
Tonga 2012 DHS: Estimates of NMR, PNMR and IMR from Tonga 2013 DHS are based on interviews with 4,617 eligible women aged 15-49 years, with a response rate of 96.7%. The report states that a clear trend in the levels of childhood mortality indicators, including NMR/PNMR/IMR, during the 15-year period before the survey cannot be determined with confidence because of the wide 95% confidence intervals which overlap from one period to another. Tabulation of reported births by year indicates no obvious age shifting or heaping occurred [TDOS, 2014, p.230]. Tabulation of reported child deaths by days, months and years shows no obvious age heaping of deaths [TDOS, 2014, p.213]. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 50%; the rate varied within a small range of 42-54.5% [TDOS, 2014, p.231].

19. Tuvalu

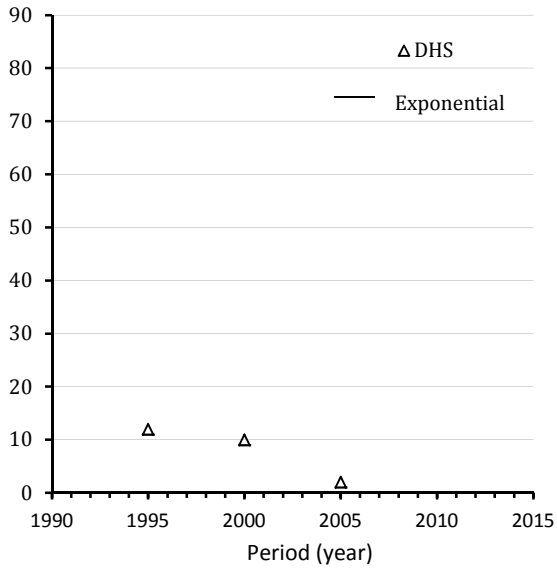
Land area (Km^2)	26
2013-mid-year population estimate	10,900
Population growth rate (%)	1.1
Crude birth rate (per 1000 population)	24.7
Total fertility rate (year)	3.7 [provisional] (2012)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

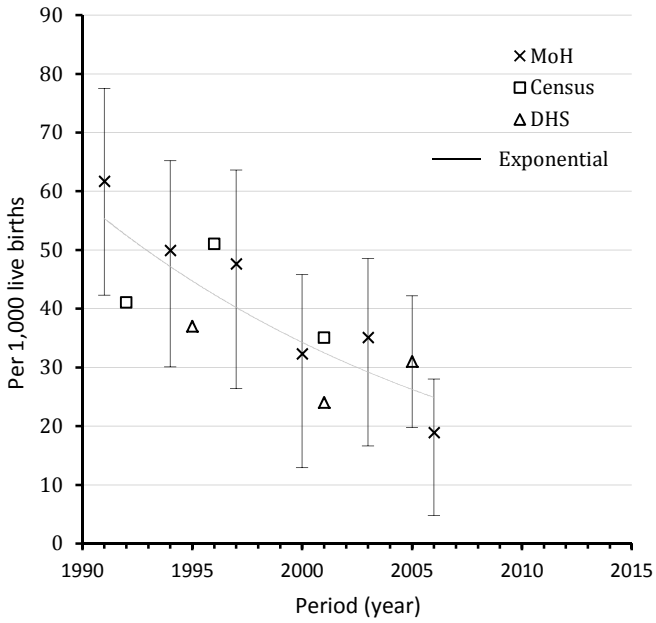


Postneonatal Mortality



No trendlines applied to NMR or PNMR graphs due to all data points coming from a single DHS.

Infant Mortality



Key
MoH: Ministry of Health
DHS: Demographic and Health Survey

Source	Year	Rate	Data	Analysis	Ref
Neonatal Mortality					
DHS	2003-2007 (2005)	29	Survey	Retrospective maternal history	1
	1998-2002 (2000)	14			
	1993-1997 (1995)	25			
Post-Neonatal Mortality					
DHS	2003-2007 (2005)	2	Survey	Retrospective maternal history	1
	1998-2002 (2000)	10			
	1993-1997 (1995)	12			
Infant Mortality					
MoH	2005-2007 (2006)	18.9	Vital registration	Direct calculation	2
	2002-2004 (2003)	35.1			
	1999-2001 (2000)	32.3			
	1996-1998 (1997)	47.6			
	1993-1995 (1994)	49.9			
	1990-1992 (1991)	61.7			
Census	1997-2002(2000)	35	Vital registration	Direct calculation	3
	1992-1997 (1995)	51	Vital registration	Direct calculation	
	1990-1991 (1991)	41	Census	<5 mortality from CEBCS and adult survivorship data from paternal orphanhood method used to impute a model life table to generate IMR	4
DHS	2003-2007 (2005)	31	Survey	Retrospective maternal history	1
	1998-2002 (2000)	24			
	1993-1997 (1995)	37			

References

1. Central Statistics Division (TCSD), SPC and Macro International Inc. Tuvalu Demographic and Health Survey 2007. Noumea: SPC; 2009.
2. Taylor R, Linhart C, Homasi S, Hayes G. Measuring progress towards achieving Millennium Development Goals in small populations: is under-five mortality in Tuvalu declining? ANZJPH; 2014 Apr 22, doi: 10.1111/1753-6405.12169.
3. Secretariat of the Pacific Community. Tuvalu 2002 population and housing Census, volume 2 demographic profile, 1991-2002. Noumea, New Caledonia: SPC; 2005.
4. Central Statistics Division. Tuvalu 1991 Population and Housing Census, Volume 2: Analytical Report. Funafuti: Government of Tuvalu, 1992.

Comments

- The Poisson method was employed to calculate 95%CIs for MoH data.[2]

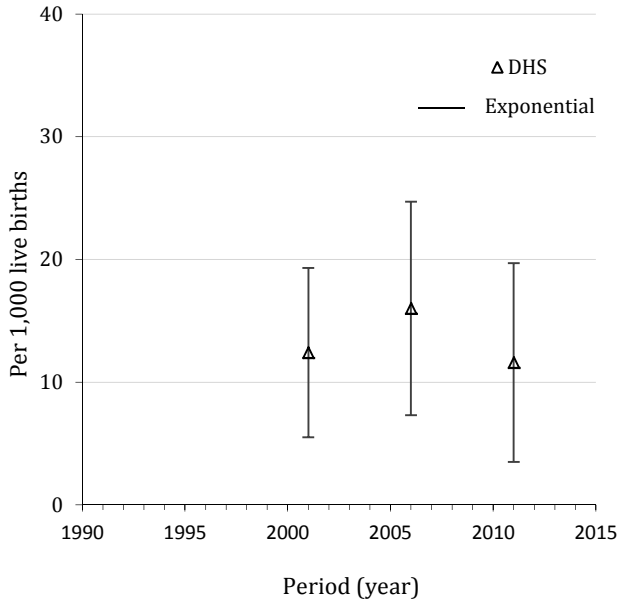
Tuvalu 2007 DHS: Estimates of NMR, PNMR and IMR from the Tuvalu 2007 DHS are based on interviews with 852 eligible women aged 15-49 years, with a response rate of 95%. The report does not provide information on the sampling error or 95% confidence intervals around mortality estimates so the statistical significance of trends cannot be assessed [TCSD 2009]. Tabulation of the reported births by year are not discussed or provided, so the occurrence of age shifting or heaping cannot be assessed. Tabulation of reported child deaths by days, months and years are not discussed or provided, so possible heaping of deaths cannot be assessed. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 73%; the rate varied within a wide range of 58-94%. The 95% confidence interval for the most recent IMR estimate was published in a recent journal article which found that tests for linear trend and 95% confidence intervals indicate there is no statistically significant change (increase or decrease) in IMR during the three time periods of the 2007 Tuvalu DHS.[2]

20. Vanuatu

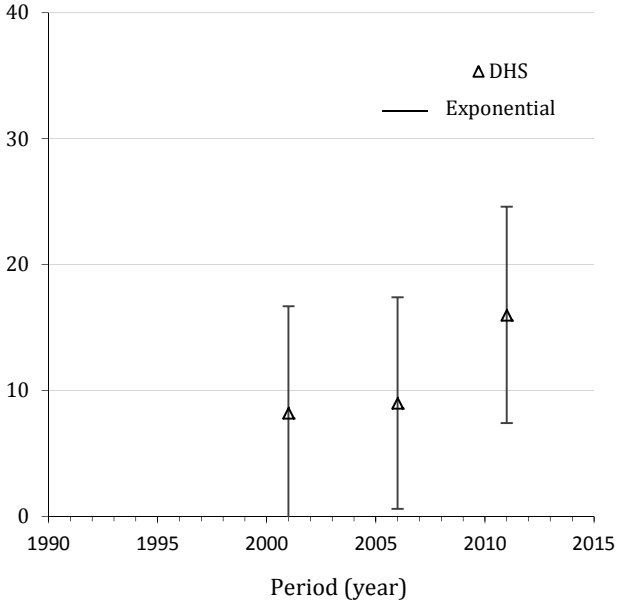
Land area (Km^2)	12,281
2013-mid-year population estimate	264,700
Population growth rate (%)	2.5
Crude birth rate (per 1000 population)	29.4
Total fertility rate (year)	4.4 (2009)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

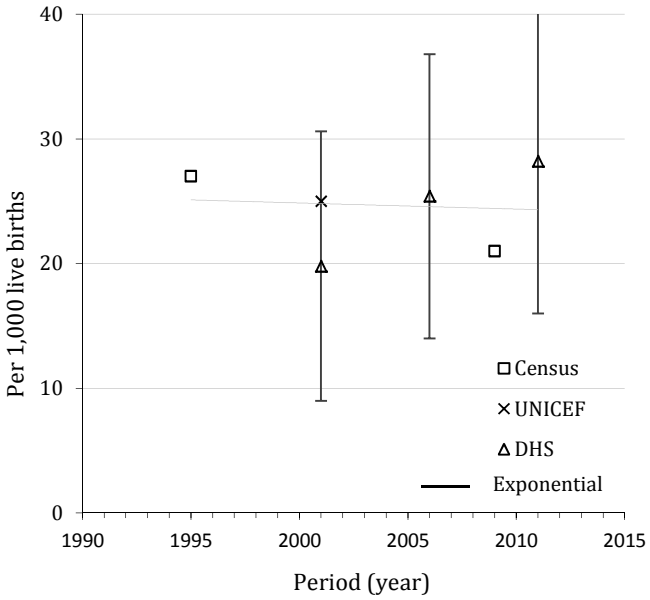


Postneonatal Mortality



No trendlines applied to NMR or PNMR graphs due to all data points coming from a single DHS.

Infant Mortality



Key

DHS: Demographis and Health Survey

UNICEF: United Nations International Emergency Children's Fund

Source	Year	Rate	95%CI	RSE	Data	Analysis	Ref
Neonatal Mortality							
DHS	2009-2013 (2011)	12.4	5.5-19.3	10%	Survey	Retrospective maternal history	1
	2004-2008 (2006)	16.0	7.3-24.7	30%			
	1999-2003 (2001)	11.6	3.5-19.7	30%			
Post-Neonatal Mortality							
DHS	2009-2013 (2011)	15.8	7.0-24.6	30%	Survey	Retrospective maternal history	1
	2004-2008 (2006)	9.5	1.6-17.4	40%			
	1999-2003 (2001)	8.2	0.0-16.7	50%			
Infant Mortality							
DHS	2009-2013 (2011)	28.2	16.0-40.4	20%	Survey	Retrospective maternal history	1
	2004-2008 (2006)	25.4	14.0-36.9	20%			
	1999-2003 (2001)	19.8	9.0-30.6	30%			
Census	2009	21	-	-	Census	CEBCS used to impute a model life table (Coale/Demeny West)	2
	1995	27	-	-	Census	CEBCS using MORTPAK	3
UNICEF	2001	25	-	-	Survey	CEBCS data used to impute a model life table (Coale/Demeny West)	4

RSE – relative standard error (standard error/rate). The DHS advises that generally speaking, estimates with an RSE above 10% are considered useable, but should be used with caution; estimates with an RSE above 25% should not be considered reliable [5].

References

1. Vanuatu Ministry of Health, Vanuatu National Statistics Office, the Secretariat of the Pacific Community. Vanuatu Demographic and Health Survey – MICS. Noumea: Secretariat of the Pacific Community; 2014 Nov.
2. Vanuatu National Statistics Office. 2009 National Population and Housing Census. Analytic Report Volume 2. [provisional report].
3. Vanuatu National Statistics Office. Vanuatu National population Census 1999. Demographic analysis report. Port Vila: National Statistics Office; 2001.
4. United Nations Children's Fund, Ministry of Health Government of Vanuatu. Vanuatu multiple indicator cluster survey (MICS) 2007 Final Report. Port Vila, Vanuatu: 2008.
5. Solomon Islands National Statistics Office, The Secretariat of the Pacific Community, and Macro International Inc. Solomon Islands Demographic and Health Survey 2006-2007. Noumea: SPC; 2009 May.

Comments

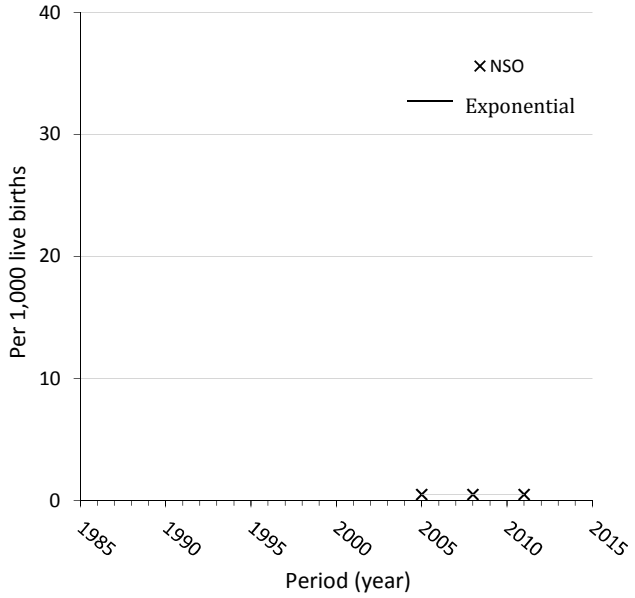
Vanuatu 2013 DHS: Estimates of NMR, PNMR and IMR from the Vanuatu 2007 DHS are based on interviews with 4,063 eligible women aged 15-49 years, with a response rate of 94.6%. The report states that whilst the estimated mortality values of each indicator differ, their associated confidence intervals overlap and, therefore, the true trend could theoretically be the opposite of what the mortality values suggest [VanMoH, 2014, p.107]. Tabulation of reported births by year indicates no obvious age shifting or heaping occurred [VanMoH, 2014, p.262]. Tabulation of reported child deaths by days, months and years shows no obvious age heaping of deaths [VanMoH, 2014, p.263]. The percentage of all infant deaths constituted by neonatal deaths during the 15 year period prior to the survey was 54.6%; the rate varied within a wide range of 47.6-63.6%.

21. Wallis and Futuna

Land area (Km^2)	142
2013-mid-year population estimate	12,100
Population growth rate (%)	-2.1
Crude birth rate (per 1000 population)	12.0
Total fertility rate (year)	2.0 (2008)

[Source: Secretariat of the Pacific Community Pocket Summary 2013]

Neonatal Mortality

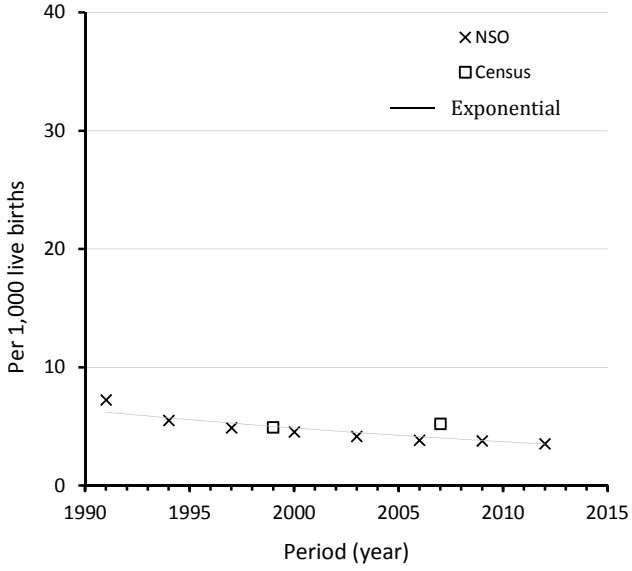


Postneonatal Mortality

There were 0 neonatal deaths reported during the period 2004-12. Therefore postneonatal mortality for this period is equal to infant mortality displayed on the graph below.

* see comments on the following page.

Infant Mortality



Key
NSO: National Statistics Office

Source	Year	Rate	Data	Analysis	Ref
Neonatal Mortality					
NSO	2010-2012 (2011)	0	Vital registration	Direct calculation	1
	2007-2009 (2008)	0			
	2004-2006 (2005)	0			
Post-Neonatal Mortality					
NSO	2010-2012 (2011)	3.5	Vital registration	Direct calculation	1
	2007-2009 (2008)	3.8			
	2004-2006 (2005)	3.8			
Infant Mortality					
NSO	2011-2012 (2012)	3.5	Vital registration	Direct calculation	1
	2008-2010 (2009)	3.8			
	2005-2007 (2006)	3.8			
	2002-2004 (2003)	4.1			
	1999-2001 (2000)	4.5			
	1996-1998 (1997)	4.9			
	1993-1995 (1994)	5.5			
	1990-1992 (1991)	7.2			
Census	2005-2008 (2007)	5.2	Vital registration	Direct calculation	2
	1996-2003 (1999)	4.9	Vital registration	Direct calculation	3

References

1. National Statistics Office. Obtained directly by the Secretariat of the Pacific Community.
2. Institut National de la Statistique et des Etudes Economiques. Wallis and Futuna: Census of population 2008. [Internet]. 2009 [cited 2014 Jan 15. Available from: http://www.spc.int/prism/wf/index.php/documents/cat_view/63-recensements-et-enquetes/64-recensements-generaux-de-population-rgp-/69-rgp-2008
3. Secretariat of the Pacific Community. Demographic profile of Wallis and Futuna based on the Census of 2003. Noumea: SPC; 2007.

Comments

Prior to 2004 stillbirths were reported with neonatal mortality and it is therefore not possible to determine NMR. Since 2004 Wallis and Futuna have reported no neonatal deaths. As neonatal mortality usually makes up a significant component of IMR, this is likely to reflect the very small population size, heath referral patterns for high-risk pregnancies and possibly incomplete reporting of age in the infant mortality data.

Appendix 2: Outline of mortality calculation methods and terms

Direct calculation: in relation to calculating neonatal or infant mortality rates this method involves dividing the number of deaths that occur between birth and less than 28 days (NMR), or birth and less than one year (IMR), by the number of live births in the same period.

Children Ever Born / Children Surviving (CEBCS): is a method of collecting a partial birth history for use in indirect estimation of child mortality indicators. Women of childbearing age are asked during a survey to answer how many children they have ever given birth to, and how many of those children are still alive. The proportion of children dead classified by the mother's five-year age group can then provide estimates of the probabilities of dying between birth and various childhood ages [Ekanem 1981].

Confidence Interval (95%): for any statistic calculated from a sample survey, the value of that statistic will fall within a range of plus or minus two times the standard error of that statistic in 95% percent of all possible samples of identical size and design (the larger this range, the less reliable the estimate) [SINSO, 2009 p.128].

Reconciliation: a process whereby two or more data sets (such as from Health Department reporting and Civil Registration) are compared and combined to arrive at a single list of unique events, which can then be used for direct calculation of mortality indices (or further adjusted for under-count, if required).

Relative Standard Error (RSE) (%): this is simply the standard error expressed as a percentage of the estimate (the larger this value, the less reliable the estimate). The Demographic and Health Survey (DHS) advises that estimates with an RSE above 10% are considered useable, but should be used with caution; estimates with an RSE above 25% should not be considered reliable [SINSO, 2009 p.128].

Retrospective maternal history: the accuracy of the childhood mortality estimates from this method depends on the completeness of reporting of all births by respondents, especially those who have died, and the extent to which the date of birth and age at death of children are accurately reported and recorded.

Appendix 3: Details of Demographic and Health Surveys

Demographic and Health Surveys (DHS) are nationally-representative household surveys that seek to provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition. Since 1984 more than 300 surveys have been completed in over 90 countries [ICF International 2014].

Methodology for collecting neonatal and infant mortality data: eligible women aged 15-49 years are interviewed and asked detailed histories of all pregnancies in chronological order starting with the first pregnancy. Women were asked whether a pregnancy was single or multiple; the sex of the child; the date of birth (month and year); survival status; age of the child on the date of the interview if alive; and if not alive, the age at death of each child born alive [Rutstein & Guillermo 2003].

Weaknesses associated with DHS methodology: the reliability of DHS childhood mortality estimates depends on the sampling variability of the estimates and the completeness and accuracy of reporting of all births and deaths by respondents. Weaknesses associated with the mortality estimates include;

1. **Selection bias:** only surviving women aged 15-49 years are interviewed, therefore, no data is gathered on children whose mothers have died. Bias could occur if the mortality rates differ significantly between surviving and non-surviving women [DoS 2014].
2. **Under-reporting:** the accuracy of mortality estimates is dependent on the accuracy of birth and death reporting by women interviewed in the survey. If women omit information on births and deaths the resulting estimates will be under-estimations of the actual situation of the country. It is believed that underreporting of early infant deaths may increase with the length of time since a child's death, for example an early infant death that occurred 10 years before the survey may be more likely to be omitted than an early infant death two years before the survey [DoS 2014]. Identifying under-reporting in the DHS would be relatively easy if reliable civil registration and vital statistics data was available for comparison – however in the majority of PICTs where a DHS has been undertaken this is not possible.
3. **Misreporting of age at death:** misreporting of age at death will bias mortality estimates if it results in transference of deaths from one age bracket to another [Sullivan 2007]. In general, this issue is more common for periods in the more distant past (10-14 years ago) than the recent past (0-4 years ago) [Pullum & Thomas 2006]. To minimise errors in the reporting of age at death interviewers in recent surveys are instructed to record the age at death in days if the death took place within one month after birth, in months if the child died within 24 months, and in years if the child was two years or older. This allows the distribution of deaths to be tabulated and assessed for age-heaping.
4. **Transference of births by interviewers:** an additional maternal and child health questionnaire is asked of respondents who report having a birth within a specified time

preceding the survey. Many DHS reports worldwide have documented evidence of age shifting or heaping to years outside the required cut-off year to avoid administering these lengthy birth-history related questions [SINSO 2009; Curtis & Sian 1995]. Birth transference is also more pronounced for deceased rather than surviving children as interviewers appear to particularly avoid asking detailed questions about dead children [Sullivan 2007; Curtis & Sian 1995]. The 2006 DHS in Papua New Guinea reported that significant heaping of births around the year 2000 occurred and was likely due in part to transference of births from the year 2001 to the year 2000 by interviewers to avoid the maternal and health section of the questionnaire [PNGNSO 2009].

5. **Digit preference.** The 2006 DHS in Papua New Guinea reported the existence of a digit preference, that is, preference for digit 0 or a number ending in 0, hence for year 2000. Substantial heaping of births in a particular year due to digit preference, and an intentional displacement of year of birth, result in a calendar ratio which differs substantially from 100 percent. In the Papua New Guinea DHS the avoidance of year 2001 and preference for year 2000 was reflected in a calendar year ratio of 74 per cent for the year 2001 and 135 per cent for year 2000 [PNGNSO 2009].

References for Appendices

[Curtis & Sian 1995] Curtis, L. Sian, Assessment of the Quality of the Data Used for the Direct Estimation of Infant and Child Mortality in the DHS-II Surveys, Occasional paper 3, Macro International Inc. Calverton, Maryland, March 1995.

[DoS 2014] Tonga Department of Statistics and Tonga Ministry of Health, Secretariat of the Pacific Community, and UNFPA. Tonga Demographic and Health Survey, 2012. Noumea: SPC; 2014.

[Ekanem 1981] Estimation of early childhood mortality from children ever born and surviving. Canadian Studies in Population. 8:41-48;1981.

[ICF International 2014] ICF International. The Demographic and Health Surveys Program [Internet]. 2014 [cited 2014, Jul 21]. Available from: http://www.dhsprogram.com

[PNGNSO 2009] National Statistics Office. Papua New Guinea Demographic and Health Survey 2006. National Report. Port Moresby: National Statistics Office; 2009.

[Pullum 2006] Pullum TW. An assessment of age and date reporting in the DHS Surveys, 1985-2003. Methodological Reports No.5, Calverton, Maryland: Macro International Inc., 2006.

[Rutstein & Guillermo 2003] Rutstein S and Guillermo R. Guide to DHS Statistics. Calverton, Maryland: Demographic and Health Surveys, ORC Macro; September 2003.

[SINSO 2009] Solomon Islands National Statistics Office, The Secretariat of the Pacific Community, and Macro International Inc. Solomon Islands Demographic and Health Survey 2006-2007. Noumea: SPC; 2009 May.

[Sullivan 2007] Sullivan J M. An assessment of the credibility of child mortality declines estimated from DHS mortality rates (working draft). A report submitted to UNICEF in fulfilment of Contract DPP/2007/SI/55. 2007.