Mortality trends in Fiji

Abstract

Objectives: Mortality level and cause of death trends are evaluated to chart the epidemiological transition in Fiji. Implications for current health policy are discussed.

Methods: Published data for infant mortality rate (IMR), life expectancy (LE) and causes of death for 1940-2008 were assessed for quality, and compared with mortality indices generated from recent Ministry of Health death recording. Trends in credible mortality estimates are compared with trends in proportional mortality for cause of death.

Results: IMR declined from 60 deaths (per 1,000) in 1945 to below 20 by 2000. IMR for 2006-08 is estimated at 18-20 deaths per 1,000 live births. Excessive LE estimates arise by imputing from the IMR using inappropriate models. LE increased, but has been stable at 64 years for males and 69 years for females since the late 1980s and early 1990s respectively. Proportional mortality from diseases of the circulatory system has increased from around 20% in the 1960s to more than 45%. Extensive variation in published mortality estimates was indentified, including clearly incompatible ranges of IMR and LE.

Conclusions: Mortality decline has stagnated. Relatively low IMR and proportional mortality trends suggest this is largely due to chronic diseases (especially cardiovascular) in adults.

Implications: Reconciliation of mortality data in Fiji to reduce uncertainty is urgently needed. Fiji's health services and donor partners should place continued and increased emphasis on effective control strategies for cardiovascular disease.

Key words: Cardiovascular disease, epidemiological transition, Fiji, mortality

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As countries move through demographic and epidemiological transitions, declines in undernutrition and infectious diseases are reflected in improvements in survival which result in improvements in life expectancy (LE) at birth. However, real increases in adult mortality from non-communicable diseases (NCDs) and injury can slow or even reverse mortality decline, if of sufficient magnitude.[1-3] This requires urgent action to reduce premature adult mortality, such as occurred in Australia and New Zealand.[4,5]

Fiji is a multi-ethnic society (Melanesian 57%, Indian 38%) of 827,900 people (2007).[6] NCDs such as cardiovascular disease and diabetes have been documented as public health concerns since the 1970s.[7,8] Mortality measures for Fiji are published by government sources and a range of international agencies. This paper evaluates mortality levels to chart the progress of the epidemiological transition in Fiji by assessing available information for 1940-2008. Levels of adult mortality are compared with similar measures for Australia and New Zealand. Published data on causes of death are used to explain trends in all-cause mortality, and implications of these findings for current health policy are discussed.

Methods

Data Collection

Measures of level of mortality were obtained from two sources: (1) previously unpublished data on reported deaths aggregated by age group and sex for 1996-2004 from the Fiji

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Ministry of Health (MoH); and (2) published reports on all-cause and cause-specific mortality from 1940-2008 by local and international agencies. Data from published reports[7,9-69] were sought through direct contact and website searches from Fiji government departments, United Nations agencies, the Secretariat of the Pacific Community (SPC), the World Bank (WB), Asian Development Bank (ADB) and non-government organisations. A literature search was undertaken in PubMED and Medline.

For published data on mortality levels, the method of data collection and analysis was rarely available. Limited data on causes of death have been published for Fiji, many of which included only leading causes of death, usually not tabulated by age group or sex, or ill-defined and unknown causes could not be excluded from proportional mortality.

Data Assessment

All-cause mortality

The infant mortality rate (IMR) and life expectancy (LE) were chosen as measures of all-cause mortality due to availability. IMRs from Fiji MoH death registration and published reports were graphed over time by major source of data (Figure 1). Data sources were assessed for reliability and plausibility of estimates on the basis of method of estimation, original source of data, and data consistency. Unreliable sources were censored from further analysis if they met any of the following criteria: (a) data were derived, or were considered likely to have been derived, from models assuming a given improvement by year, as evidenced by a perfectly linear improvement in LE or IMR by year; (b) multiple incompatible estimates were given by the source for a single year or adjacent years; (c) source data included implausible estimates (based on equivalent measures for developed countries); (d) calculations were based on uncorrected vital registration data known to be significantly under-reported or with no assessment of reporting completeness.

An exponential trend was fitted to the average IMRs of each year from data remaining after censoring (Microsoft Excel). Childhood mortality (probability of dying before five years of age) was largely unavailable from published reports. Recent measures were estimated by applying the proportion of childhood mortality accounted for by infant mortality (78%) from credible data sources for which both measures were available (analyses from the 1986[37] and 1996[38] censuses, and MOH data 1996-2004), to credible estimates of IMR for 2006-08.[54]

Age-specific mortality rates and life tables[70] were calculated from the MoH death data and populations from SPC.[71] Data were aggregated by triennia to reduce stochastic variation (1996-98, 1999-2001 and 2002-04). Mortality rates were analysed for completeness using the Brass growth-balance method[70] for age groups 35-74 years, a method that has been recently validated as a way of measuring reporting completeness.[72] No adjustment was made to reported deaths as registration was assessed to be over 85% complete (more than 95% for all except females 2002-04). LE and adult mortality (probability of dying between 15 and 59 years of age inclusive) were calculated (Table 1). Adult mortality for 2002-04 was compared to measures derived from published life tables for Australia and New Zealand for the same period[73-76] (Table 1). LE from all sources were graphed over time by major source of data (Figures 2-3), with unreliable estimates censored from further analysis. A quadratic function was fitted to the remaining life expectancy estimates (Microsoft Excel) (Figures 2-3) to obtain final estimates and overall trend.

Empirical measures of LE derived from MoH data for 1996-2008 were compared with LE predicted by the WHO Model Life Table system[77]. First, LE was predicted using empirical childhood mortality as a single input; and, second, using probabilities of childhood mortality and adult mortality (two parameters).

Causes of death

Available data on cause-specific mortality were examined using a range of measures and cause aggregations. Data are presented as proportional mortality (PM) by International Classification of Disease (ICD) chapter[78] as several sources did not provide total deaths and data are frequently under-enumerated. Cause of death was calculated for the total population as there was insufficient information available to examine by age group, sex, or ethnicity. PM excluding unknown and ill-defined cases was calculated for sources where this was possible. PM, and corrected PM, were graphed over time for each ICD chapter.

Results

All-cause mortality

Extensive variation was found in published estimates of IMR (Figure 1), with several reporting levels below those of developed countries in the region.[74,76] Of 16 IMR sources, 12 were censored from further analysis with a further two partially censored. The trend

Table 1: Probability of dying between ages 15 and 59 years (%) by age group in Fiji, New Zealand and Australia, males and females, 1996-2004.

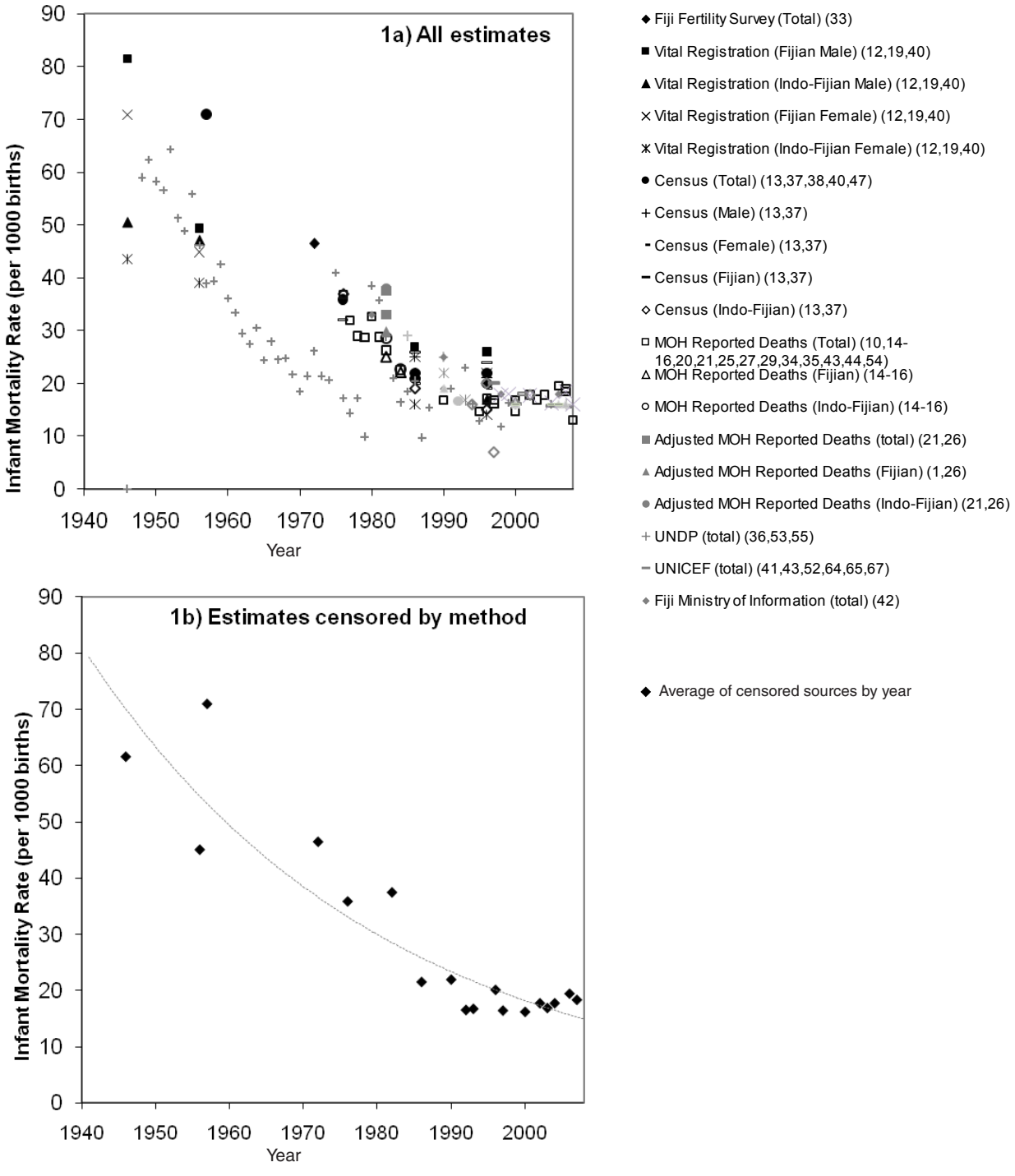
Age group (years)		15-34		35-59		15-59	
Sex		Males	Females	Males	Females	Males	Females
Fiji	1996-1998	3.6	2.5	26.8	18.5	29.5	20.5
	1999-2001	4.1	2.9	27.5	18.4	30.5	20.8
	2002-2004	3.7	2.9	24.9	17.9	27.6	20.3
New Zealand	2002-2004	2.0	0.9	7.9	5.5	9.7	6.4
Australia	2002-2004	1.7	0.7	7.2	4.4	8.9	5.1

Source data: Fiji – calculated from deaths reported to MoH (previously unpublished); New Zealand[75,76]; Australia[73,74]

is consistent with IMR falling significantly over the last several decades (1940–2006) to a level below 20 deaths per 1000 live births. Credible sources indicate IMR for 2006-08 was 18 -20 deaths per 1000 live births, suggesting s a childhood mortality rate (<5 years) of 23-26 deaths per 1000 live births (see methods).

Analysis of the MoH reported deaths shows LE was stable between 1996 and 2004, as was adult mortality which was 2 to 4 times higher in Fiji than in Australia or New Zealand (Table 1). LE estimates from MoH data were notably lower than most published estimates for the same period, but similar to estimates from demographic analysis of censuses.[38] Published estimates of LE at birth for 1995-2000 vary by 11 years in males (61 to 72 years), and by eight years in females (68 to 76 years) (Figures 2 and 3). Of the 16 sources identified for LE data, 13 were censored from the final analysis. Remaining estimates suggest improvements in LE began to stall in the 1980s for both sexes, and that it has not

Figure 1: Estimated infant mortality rate in Fiji, by data source, 1940-2004.



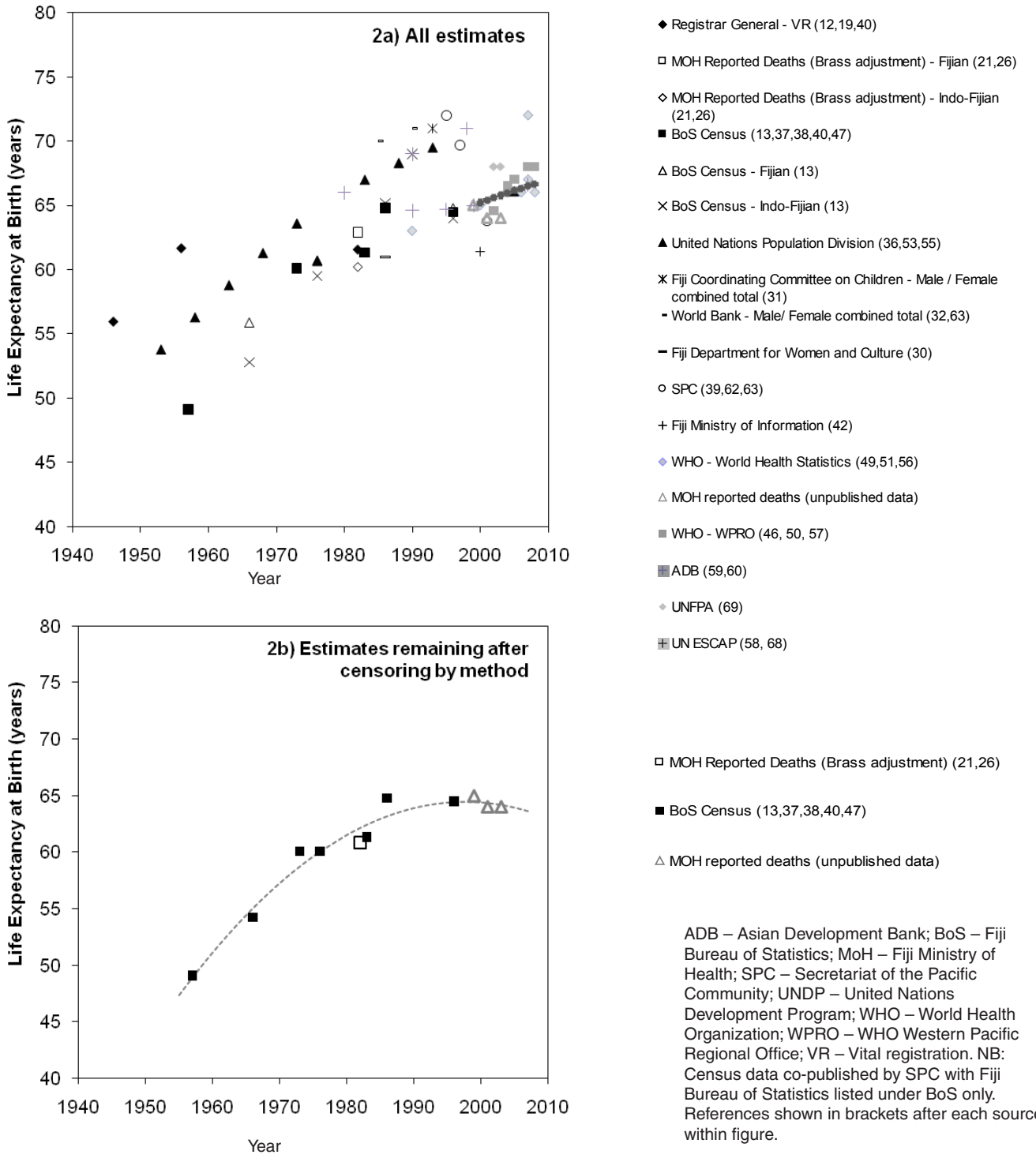
improved (Figures 2 and 3). LE for the period 2006-08 is estimated at 64 years for males and 69 years for females.

LE and adult mortality predictions from model life tables using the childhood mortality and adult mortality from MoH death recording varied less than one year from results calculated using age-specific mortality rates (not shown). However, LE predicted from childhood mortality alone over-estimated LE by 4-5 years (similar to censored estimates) and were excluded from further analysis.

Cause specific mortality

The proportion of deaths coded to ill-defined and unknown causes since 1960 generally fluctuated below 8% of deaths, with higher peaks (up to 18%) in the early 1980s and early 2000s (Figure 4). PM attributable to 'Diseases of the Circulatory System' (ICD Chapter IX) shows a significant and ongoing linear increase over 1960-2000, from around 20% of deaths to more than 45% of all deaths (Figure 4), apparent before and after ill-defined and unknown causes are excluded. Early data relating to 1960 were only available as PM

Figure 2: Male life expectancy at birth, in Fiji, by data source, 1940-2006.



ADB – Asian Development Bank; BoS – Fiji Bureau of Statistics; MoH – Fiji Ministry of Health; SPC – Secretariat of the Pacific Community; UNDP – United Nations Development Program; WHO – World Health Organization; WPRO – WHO Western Pacific Regional Office; VR – Vital registration. NB: Census data co-published by SPC with Fiji Bureau of Statistics listed under BoS only. References shown in brackets after each source within figure.

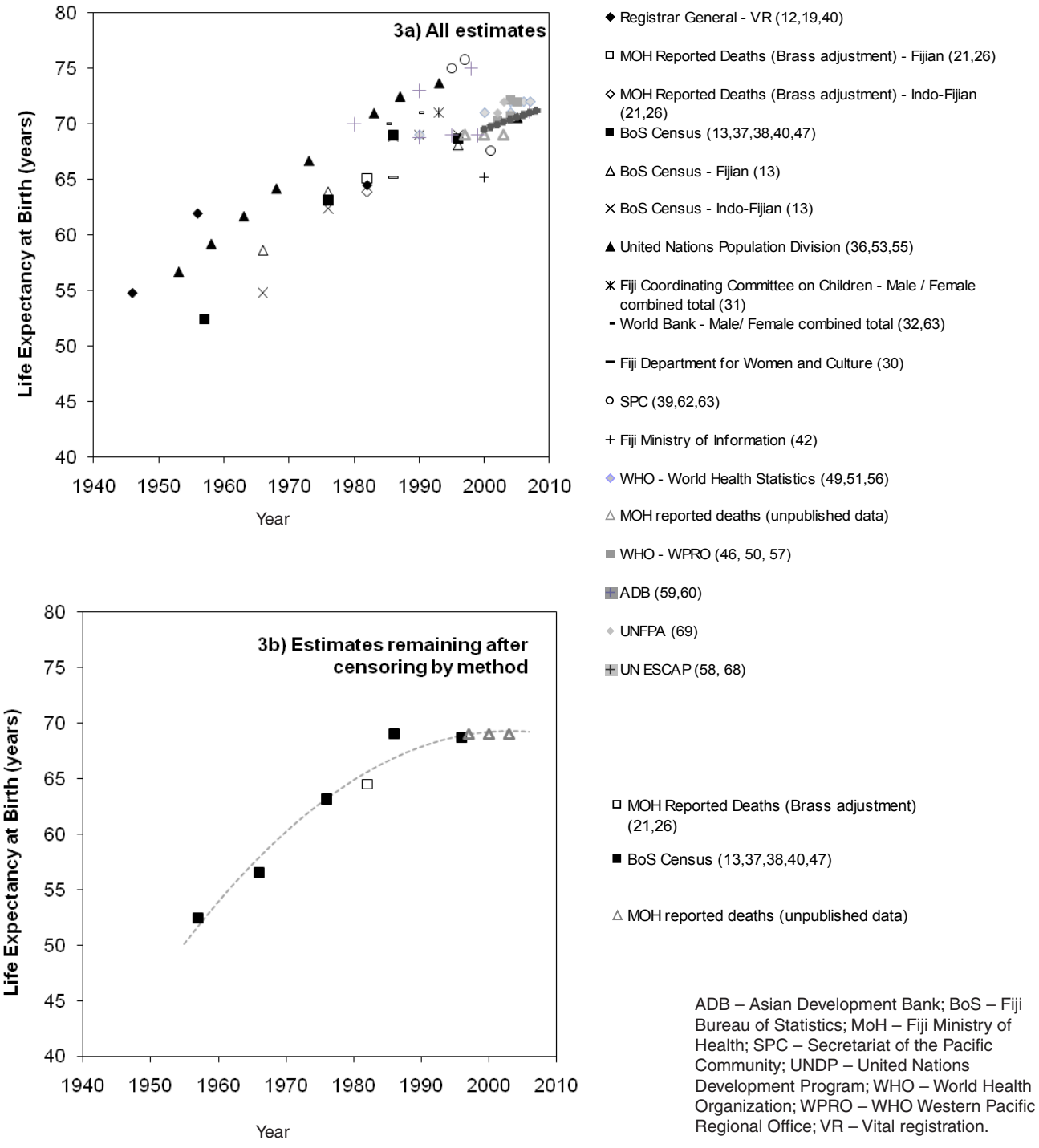
>5 years[7]; even though this would over-estimate all-ages PM from cardiovascular disease, the observed proportion (15-18%) was the lowest ever observed.

PM due to infectious diseases showed no significant trend, fluctuating between 5% and 12% of all deaths. Respiratory diseases fell linearly from 14% to 7%, and injuries varied between 4% and 10%, with a gradual decline in evidence since the mid 1980s. PM from conditions arising in the perinatal period fell from 8% in the 1970s to 2 %. There were no clear trends for any other ICD disease categories; including neoplasms, endocrine and metabolic diseases or diseases of the digestive tract and genitourinary tract.

Discussion

Credible data sources demonstrate that IMR has declined steadily to below 20 deaths per 1000 live births. While IMR has not fallen significantly since the late 1980s, at these levels it is a minor influence on the overall LE[70]. The decline in infant and child mortality since 1990 is insufficient for Fiji to meet the Millennium

Figure 3: Female life expectancy at birth, in Fiji, by data source, 1940-2006.



ADB – Asian Development Bank; BoS – Fiji Bureau of Statistics; MoH – Fiji Ministry of Health; SPC – Secretariat of the Pacific Community; UNDP – United Nations Development Program; WHO – World Health Organization; WPRO – WHO Western Pacific Regional Office; VR – Vital registration.

Development Goals by 2015;[79] meeting these targets would require an IMR comparable to that of Australia and New Zealand in 1990[74,75] where specialist medical services and technology were already available – and nutritional and environmental conditions were better. LE rose through the 1970s and 1980s, then stabilised around 64 years for males and 69 years for females.

The most reliable all-cause mortality estimates are those from demographic analyses of censuses and recent MoH death registration. LE produced from MoH data were amongst the lower estimates found in available data. No adjustment for under-reporting was made to the MOH data as they were found to be substantially complete, however it this had been performed it would have resulted in an even lower measure of LE. LE calculated from MoH death registration (direct methods) correlates closely with published Census mortality estimates (indirect methods), thus providing independent verification of these figures, and by implication, completeness of death reporting by Fiji MoH.

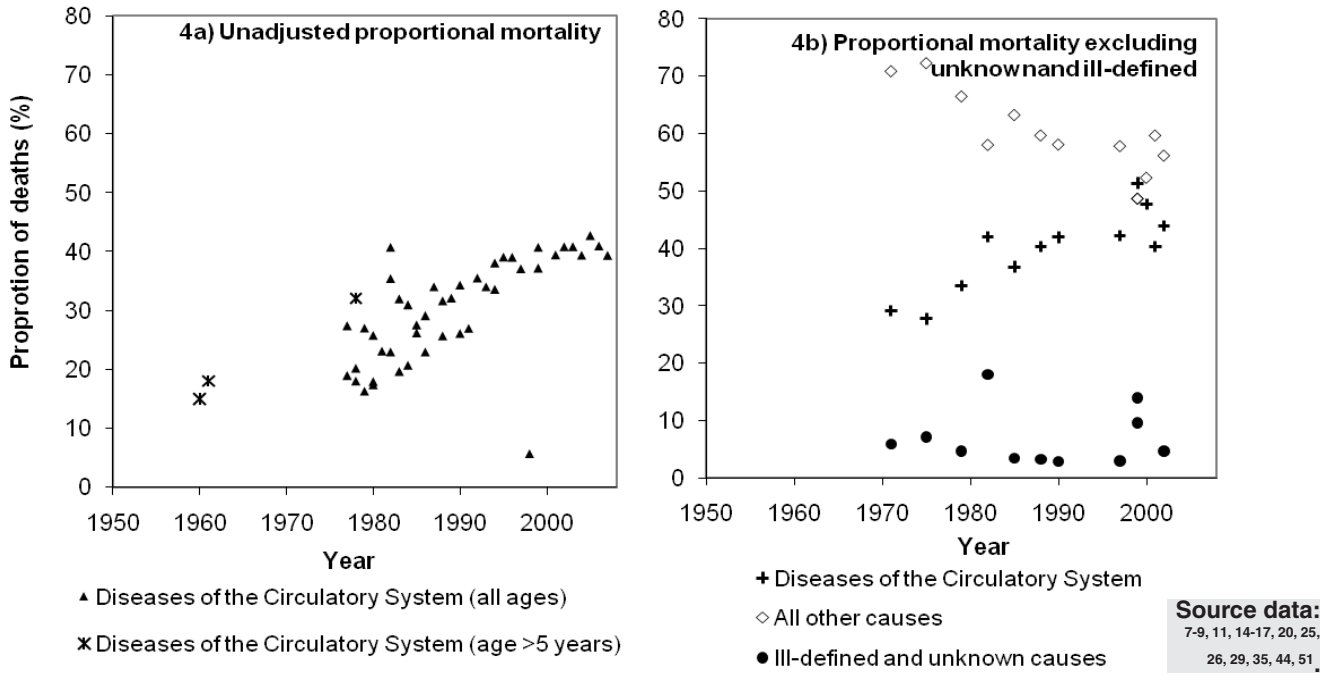
Bias was minimised by selecting the most commonly reported mortality measures (i.e. IMR rather than childhood mortality) and by converting all-cause of death information to proportional mortality where possible; although this provides only an approximate picture of cause of death patterns. As changes in the proportion of deaths due to 'Ill-defined' and 'Unknown' causes may significantly affect PM trends, PM excluding these categories was calculated where possible. The increasing trend in circulatory diseases was evident both before and after this refinement. As PM was tabulated by ICD chapter, changes in coding over time should have minimal impact as these were predominantly within chapters.[80]

In Australia, LE for males did not improve from 1945 to 1970 as increased mortality, mainly from cardiovascular diseases, offset declines in death from infectious and related diseases.[1,2,81] Similar stagnation in LE has been reported in the 20th Century in Western Europe, North America and New Zealand in association with the epidemiological transition.[3] Subsequent declines in cardiovascular mortality and improvements in LE in Australia and New Zealand from the 1970s have been driven by decreases in serum cholesterol, blood pressure and cigarette smoking,[4,5] as well as improved health care, even though body weight has increased.[82]

Adult mortality was lower than recently published predictions for 2010[83] based on adjusted civil registration data from 1970-1988. The adult mortality levels in Fiji for 2002-04 were 2-4 times higher than in Australia or New Zealand. The probabilities of dying (for 2002-04) between ages 35 and 59 years in Fiji were 25% for males and 18% for females, compared to 7–8% for males and 4–6% for females in Australia and New Zealand.[73-76] This segment of the adult age group is where cardiovascular disease is a significant cause of death. PM in Fiji from cardiovascular disease increased from just below 20% of deaths around 1960 to more than 45% of deaths in 2001. While this shift in PM may also be influenced by aging of the population, the age structure and LE in Fiji suggest that population aging alone does not explain this trend. The PM from cardiovascular diseases is substantially higher than that for infectious diseases and respiratory illnesses. While a similar stagnation in LE may be driven by increasing mortality from HIV/AIDS, Fiji is estimated to have only 0.1% HIV prevalence in the adult population, and a low mortality from AIDS.[50]

The increase in PM from cardiovascular diseases and levels of adult mortality in Fiji are consistent with documented trends since the 1970s, in both hospital admissions for cardiovascular disease and risk factor exposure for these conditions[7,82]. A national survey

Figure 4: Proportional mortality from diseases of the circulatory system in Fiji, 1950-2010.



of risk factor prevalence in 1980[7] showed adult prevalences of hypertension (5.1-9.9%) (using ≥160 mm hg systolic and/or ≥95 mm hg diastolic and/or on treatment for hypertension) and diabetes prevalence of 1.1-11.8% (using two hour post 75 g glucose load blood glucose of ≥11.1 mm/L and/or on treatment for diabetes), with the lowest prevalences in rural melanesians. The Fiji STEPS survey in 2002[84] indicated adult prevalence of hypertension of 19% (using ≥140 mmhg systolic and /or ≥90 mmhg diastolic and/or on treatment for hypertension) and diabetes prevalence of 12% (using fasting blood glucose of ≥7.0 mm/l and/or on treatment for diabetes) Cigarette sales in Fiji rose 273% from 1956 to 1984, three times the population increase (88%)[7].

Dietary intake surveys in Fiji and elsewhere in the 1980's demonstrated that urban populations were more obese, had higher prevalence of diabetes and hypertension, higher salt intake and generally higher serum cholesterol levels, than their rural counterparts, despite a lower overall calorie intake; indicating the impact of physical exercise and dietary differences on cardiovascular risk factors.[85] The relationship of Fiji adult mortality to cardiovascular risk factors was demonstrated in an 11-year follow-up[81] of the 1980 national risk factor survey,[7] which found systolic blood pressure, total serum cholesterol and two hour (post load) plasma glucose associated with cardiovascular disease mortality, with differences by sex and ethnicity. These studies suggest that the prevalence of circulatory disease risk factors in Fiji is consistent with the high adult mortality and increasing PM from cardiovascular diseases. It is unclear when decline in cardiovascular disease and subsequent increase in LE could be expected in Fiji as previously experienced in Australia and New Zealand, however, on-going monitoring of risk factors in the population by the Fiji Ministry of Health[84] will provide indications.

This study shows a range of eight years between various published estimates of LE for Fiji in the early 2000s. Spurious increases in LE imply that the health situation is improving when this is clearly unsupported by more reliable data. Extensive variation in published estimates of IMR by source (Figure 1) was also noted, with several reporting improbable levels below those of developed countries in the region such as Australia (IMR of 5.0 in 2007)[67] and New Zealand (IMR of 6.0 in 2007)[67] (Figure 1). A previous study found substantial uncertainty about mortality conditions in Pacific Island populations with variations of 10 years or more in LE in the 1990s, depending on the source.[86] Principal issues include: under-enumerated vital registration data; annual stochastic fluctuations in mortality in small populations; errors in the imputation of adult mortality from infant and childhood rates; implausible results from indirect demographic methods; use of inappropriate model life tables; and inadequately described and implausible projections.[86]

Difficulties in assessment of published data were the lack of information concerning primary data sources, methods of calculation, and assumptions. In order to deal with this, strict exclusion criteria were specified and unreliable estimates censored from further analyses. Many of the previously published estimates of LE are implausible, and it is likely that many were produced through the use of single parameter models (using infant or childhood mortality) which under-estimate adult mortality in Pacific Island populations, as shown in these results. These subsequently over-estimate LE, thus "masking" the importance of cardiovascular disease as a public health issue.

The considerable variation in mortality estimates for Fiji is a significant concern for public policy. This also occurs in other Pacific Island states.[86] Less than seven of the 27 countries of the WHO Western Pacific Region, including Fiji, have reliable mortality data.[87] These findings suggest that research is urgently required to determine whether this pattern of premature adult mortality has become the 'typical' picture of epidemiological transition throughout the Pacific Islands. Reconciliation of mortality data to reduce uncertainty is urgently needed. The quality assessment in this study indicates that measures provided by Fijian government sources based on indirect demographic methods from censuses and direct MoH death recording provide the most reliable estimates of mortality and LE at birth in Fiji. As such, these directly observed data should be used by decision makers as key tools in health planning rather than estimates from other sources.

The stagnation in life expectancy, at a relatively low IMR, combined with trends in cardiovascular disease mortality, morbidity and risk factors, suggests that NCDs are having a profound limiting effect on further mortality decline in Fiji. Other contributing factors need to be considered and require more investigation, including out-migration of skilled workers (who may be healthier than non-migrants), social dislocation, declines in health expenditure, and effects of unemployment. While further research is required, there is an urgent need for health services and donor partners to place increased emphasis on effective prevention and treatment strategies for cardiovascular disease.

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