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Research paper

Kidney failure in Samoa

Malama Tafuna'i^{a,b,*}, Ben Matalavea^a, David Voss^c, Robin M. Turner^d, Rosalina Richards^b, Fa'afetai Sopoaga^b, Lose Hazelman^a, Robert Walker^e^a National Kidney Foundation of Samoa, Apia, Samoa^b Centre for Pacific Health, Division of Health Sciences, University of Otago, Dunedin, PO Box 56, Dunedin 9054, New Zealand^c KidneyKare, Glen Innes, Auckland, New Zealand^d Centre for Biostatistics, Division of Health Sciences, University of Otago, Dunedin, New Zealand^e Department of Medicine, Otago Medical School, University of Otago, Dunedin, New Zealand

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ABSTRACT

Background: There is limited literature on kidney disease in the Pacific Region, despite it being recognised as a leading cause of death in some Pacific Island nations. Kidney replacement therapy is only available in a handful of Pacific Islands. This paper reports the epidemiology of haemodialysis patients in Samoa.

Methods: Registry data from the National Kidney Foundation of Samoa was analysed to estimate the incidence and prevalence rates of kidney failure from the rates of haemodialysis in Samoa and to explore some of the demographic features related to kidney failure in Samoa

Findings: In total, 393 patients have received long-term haemodialysis in the National Kidney Foundation of Samoa since its inception in 2005 until August 2019. 43% of the haemodialysis population were women and the mean age of people dialysed was 54.9 years. The crude mean incidence rate of kidney failure in Samoa, based on treated kidney failure cases, is 224 patients per million population with a crude prevalence of 629 patients per million population. Diabetic nephropathy (69.4%) was the leading cause of kidney failure.

Interpretation: This is the first paper to report the epidemiology of haemodialysis patients in Samoa and reveals an urgent need for further studies on the extent of chronic kidney disease, and kidney failure, in Samoa to develop country specific prevention strategies to mitigate this growing burden and optimise care for kidney failure patients in Samoa.

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Research in context panel

Evidence before this study

Kidney failure incidence and prevalence rates in Samoa are not known. Registry data from ANZDATA, documents high prevalence rates for Pacific Islanders living in New Zealand but similar estimates have not been reported for Samoa. This is the first report of the prevalence and incidence of kidney failure estimated from the number of patients receiving

haemodialysis treatment by the National Kidney Foundation of Samoa – the sole provider of dialysis in Samoa.

Added value of this study

This study highlights the high rate of kidney failure in Samoa. Samoa, like many other Pacific island societies, is facing an epidemic of non-communicable diseases which are placing extreme pressure on very limited health resources. The crude mean incidence rate of kidney failure in Samoa, based on treated kidney failure cases, is 224 with a crude prevalence rate of treated kidney failure of 629 per million population. Diabetic nephropathy (69.4%) was the leading cause of kidney failure.

* Corresponding author at: Centre for Pacific Health, Division of Health Sciences, University of Otago, Dunedin, PO Box 56, Dunedin 9054, New Zealand.

E-mail address: lama.tafunai@otago.ac.nz (M. Tafuna'i).

Implications of the evidence

Further studies are needed to fully understand the chronic kidney disease burden in Samoa to help plan and develop country specific ways to deal with this epidemic. This study highlights a need to have a robust database for information to be collected and routinely analysed to help inform planning and practice to reduce the high rate of chronic kidney disease in Samoa.

1. Introduction

Chronic Kidney Disease (CKD) is a global public health problem. There is increasing evidence that indigenous people suffer disproportionately from CKD [1–5]. This was first recognised in End Stage Kidney Disease (kidney failure) diagnoses and subsequent Kidney Replacement Therapy (KRT) numbers amongst indigenous peoples in developed countries like New Zealand and Australia [4] and then in developing countries [2,6]. However, information in developing countries is limited as few have the infrastructure and resources to collect, document and publish such information. Little is known about the Pacific Island nations which lie in the Pacific Ocean extending from the Federated States of Micronesia in the north through Micronesia down to Tonga in the South. They are characterised by their small populations, relative isolation and economic vulnerability. Kidney failure is increasingly recognised as a concern in the Pacific region [4,7] as Pacific island nations seek assistance from developed countries [8,9] to manage kidney failure patients unable to provide KRT in their own countries. A few Pacific island nations have implemented KRT, in the form of hemodialysis, at considerable cost, and Samoa is one of these [8,10].

Samoa situated in central South Pacific consists of two main islands, Savai'i and Upolu and eight smaller islands, covering 2821 square kilometers of land. Samoa became an independent state in 1962, after gaining its sovereignty from New Zealand. Samoa is a separate country to American Samoa which is an United States territory. The current population of Samoa is 195,000 [11] and life expectancy is 74.9 years [12]. Despite being classified as an upper middle income country by the World Bank, 42.4% of the employed population earn less than the equivalent of USD4008 per year and 20% earn less than USD1846 per year [13].

Like many Pacific island nations, the impact of western lifestyle influences is having a profound influence on the health of the Samoa population. Samoa has undertaken World Health Organization (WHO) STEPwise surveillance surveys in 2002 [14] and 2012 [15] which have demonstrated a dramatic increase in the burden of non-communicable diseases most notably, obesity, diabetes and high blood pressure. Non-communicable diseases account for over 80% of deaths in Samoa and are associated with a 50% increased risk for premature death [16]. These have created a significant economic burden for Samoa [8,17], and Samoa faces the challenges of managing these NCDs and associated complications including chronic kidney disease.

Chronic Kidney Disease (CKD) in Samoa is now recognised as the fourth major cause of death after ischaemic heart disease, stroke and diabetes [18]. High numbers of individuals with diabetic chronic kidney disease progressing to end stage kidney disease has meant that the Samoan government has had to address this issue. Prior to 2005, Samoa had reached a point where it was dialysing six patients in New Zealand at a cost of approximately USD1.3million per year, which was 5% of the Samoa health budget at that time. The National Kidney Foundation of Samoa (NKFS) was set up with initial support from the Singapore National Kidney Foundation. Over time, the NKFS has become independent

providing renal replacement therapy in the form of haemodialysis only to Samoan patients with kidney failure. There are no facilities for peritoneal dialysis. The NKFS was set up as a state-owned enterprise separate to the Ministry of Health, and patients with chronic kidney disease are referred both from the National hospital and from private doctors. In addition, the NKFS has a self-referral screening clinic and a community screening programme for chronic kidney disease and associated risk factors that is provided around the entire country.

There are barriers limiting access to haemodialysis. Although the NKFS is largely government funded, patients pay USD3.70 per haemodialysis session [19], which limits access to those who can afford it. Most of these low earners reside rurally which further limits access to the dialysis centre. Samoan families also tend to be large with the average family size being 6.8, and one in four households have nine or more members [20]. It is estimated 40% of the Samoan population is economically active including children ten-plus years of age and above, further adding to the potential inability to access dialysis.

This paper reports the current kidney failure burden and characteristics of kidney failure in Samoan patients, along with the experience of the National Kidney Foundation of Samoa's provision of dialysis services since its' inception in 2005, to December 2018.

2. Methods

This study includes all patients attending the NKFS since its inception in 2005. The NKFS has two dialysis units, with 22 dialysis chairs in the larger unit based on the main island of Upolu and nine dialysis chairs based in the unit on Savai'i. Upolu provides three five-hour dialysis shifts a day, six days a week to cater for a growing demand while Savai'i provides two five-hour shifts, three days a week. Patients receive four hours of dialysis, three times a week. The dialysis facility has been largely nurse driven until 2018 when a fulltime medical officer was employed. A nephrologist from New Zealand provides clinical oversight and regular review on a quarterly basis since 2009. There are no vascular surgeons on island thus vascular access is dependent on volunteer vascular surgeons visiting two to three times a year to create arterio-venous fistulae for patients. In the interim, vascular access is via tunnelled central vein cuffed catheters placed by the medical officer under ultrasound guidance.

Patients were accepted on to the NKFS dialysis programme if they have an eGFR of less than 15ml/min/1.73m² and are symptomatic. Decisions were made on a case by case basis. Information on demographic information, diagnoses, likely cause of end stage kidney disease, associated co-morbidities and medications was obtained from the admission form that a nurse completed for all patients commencing dialysis. This information was entered into an excel spreadsheet by NKFS staff and stored under secure conditions within the NKFS electronic records system. If patients die or stop dialysis this additional information was also recorded in the spreadsheet including reasons for withdrawal and/or cause of death. Samoa is divided into 4 main regions AUA Apia Urban Area, NWU North West Upolu, ROU Rest of Upolu and Savaii. The region the patient lived in was assigned based off their village of residence on the information sheet. Patients were only included if they were diagnosed with kidney failure. All those who received acute dialysis only were excluded. Approval for this audit was given by the NKFS research committee as the audit was designed to inform the activities of the NKFS and to allow future planning of dialysis requirements, as well as providing information to the Ministry of Health and Samoan government.

Crude incidence and prevalence were calculated by dividing new and total dialysis patient numbers each year between 2006 and 2016 by the population size 15 years and older as recorded in

Table 1
Demographic information of patients diagnosed with ESKD who received haemodialysis in the NKFS between Jan 2005 and August 2019.

Characteristics	Number (%)
Gender:	
Female	169 (43.0)
Male	223 (57.7)
Missing	1 (0.3)
Age group (in years)	
15 - < 25years	12(3.1)
25 - < 35 years	13(3.3)
35 - < 45 years	33 (8.4)
45 - < 55 years	78 (19.8)
55 - < 65 years	159 (40.5)
65 - < 75 years	67 (17.0)
≥ 75 years	17 (4.3)
Missing	14 (3.6)
Suspected cause ESKD	
Diabetic nephropathy	273 (69.5)
hypertension	30 (7.6)
glomerulonephritis	20 (5.1)
unknown	20 (5.1)
Other	28 (7.1)
Missing	22 (5.6)
Region	
Apia Urban Area (AUA)	70 (17.8)
North West Upolu (NWU)	51 (13.0)
Rest of Upolu (ROU)	34 (8.7)
Savaii	10 (2.5)
Missing	228 (58.0)
Total	393 (100)

the country census for the years 2006, 2011 and 2016 [11,21,22]. Linear interpolation/extrapolation was used to estimate the population size for non-census years. The mean incidence and prevalence were calculated by summing all annual incidence and prevalence rates and dividing by the number of calendar years included. Population estimates are for the end of each year. Hemodialysis cases represent the total number of patients treated throughout the year. Age standardised incidence rates were estimated separately for each year by five year age group using the world standard population [23].

Demographic information was summarised using number and percentage for gender, age (grouped into ten-year age groups), suspected cause and region. The mean age was also calculated. Time to death was calculated using the date of death and the dialysis start date. For patients who did not die their follow-up time was censored either at the date of withdrawal from the programme if they withdrew or on the 31st December 2018, the date for end of this audit. Kaplan Meier curves, showing the survival for the entire sample and by gender, were plotted to show the proportion surviving across the follow-up time with the number still at risk and the median survival was estimated. All analyses were completed using Stata v16 [24].

2. Results

Four hundred and sixty-six patients received haemodialysis in the NKFS between Jan 2005 and August 2019. 73 patients (out of the 466 total patients (15.7%)) received acute haemodialysis for a short period as an immediate life-saving measure and were excluded. The remaining 393 were diagnosed with kidney failure and have been included in this analysis. Demographic characteristics of patients diagnosed with kidney failure who received dialysis are reported in Table 1. Females comprised 43.0% of the dialysis cohort. The mean age was 56.4 years (range 14 to 82 years) and the most common age group was 55 to 64 year olds (40.5%). Of the kidney failure patients undergoing long term maintenance

haemodialysis, 273 (69.5%) had kidney failure attributed to diabetic nephropathy and 30 (7.6%) attributed to hypertension with a further 5.1% due to presumed glomerulonephritis (not biopsied). Hypertension was prevalent in 61.3% of patients on haemodialysis and 71.1% of those with diabetic nephropathy, had persistent hypertension. Of interest, where the patient's village data was collected (210 patients), the majority of these, (152 of the 210) patients lived in urban Samoa, identified as the regions around Apia, the capital of Samoa, (Apia Urban Area (AUA), North West Upolu (NWU)).

Table 2 shows the number of new haemodialysis cases each year with the total number of cases at the end of each year. The crude mean incidence of kidney failure in Samoa, based on treated kidney failure cases, is 224 per million population with a crude prevalence of 629 per million population. Total cases of haemodialysis patients increased each year since the establishment of NKFS. New haemodialysis cases steadily increased each year in the 5 years leading up to the audit date.

Since the inception of the NKFS, 67.4% of kidney failure patients who had commenced haemodialysis had died, 29.0% were still receiving dialysis, and 3.6% had moved overseas (Table 3). Many Samoans have dual citizenship with either New Zealand or Australia and take the option to move to these countries to live. Of those that had died, 30 patients had withdrawn from dialysis treatment prior to death. The reasons for withdrawal from dialysis included patients not wanting to continue as they are either, accepting of their death, too sick to continue, and being a financial burden upon their family. Eighteen percent died within the first three months of dialysis, and within the first year of dialysis, a total of 33.5% of patients had died. The median survival estimate for patients commencing haemodialysis is 2.9 years (Fig. 1). There was essentially no difference in survival between men and women as indicated in Fig. 1(b).

3. Discussion

This is the first review of the haemodialysis service provided by the National Kidney Foundation of Samoa, since its inception in 2005. Over this period, Samoa has seen a steady growth in the numbers of patients commencing haemodialysis. The current prevalence rate is 629 patients per million population, remembering Samoa's total population is just under 200,000. By way of comparison, in 2018, the overall New Zealand (NZ) prevalence rate for people on dialysis, as reported by the ANZDATA registry, was 583 patients per million population. For Pacific people living in NZ, the prevalence rate was 796 patients per million population [25]. When considering incidence rates, the crude mean incidence of kidney failure in Samoa, based on treated kidney failure cases, is 224 patients per million population. By comparison, the NZ incidence rate is 127 per million population. However the incidence rate for Pacific people (of which Samoans make up 40%) is 494 per million population [25]. A key difference relates to the fact that in NZ health care and kidney replacement therapy is publically funded, so there are no financial barriers to accessing dialysis. Another complicating factor is the poor health literacy around kidney health and NCDs identified amongst Samoans which contribute to late presentation and poor management of kidney disease risk factors [26]. It is possible that part of the increase could be due to changes in the acceptance of dialysis and/or more dialysis chairs provided over time. However, referral processes to the NKFS have been well established over a long period of time and there are dialysis units on each main island with prevention and predialysis clinics running regularly. This combined with the increasing commitment in Samoa to address this issue suggests that there is a real increase in kidney failure cases. There does remain some resistance to dialysis amongst Samoans when counselling for dialysis. The Samoan rates of kidney failure reported here, almost certainly

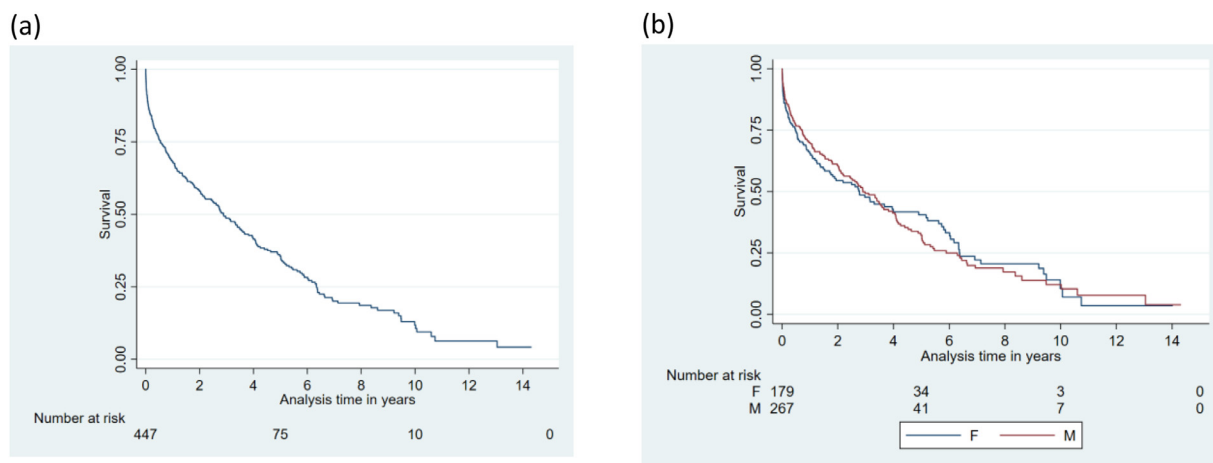


Fig. 1. Survival estimate graphs for all ESKD patients who received haemodialysis in the NKFS between Jan 2015 and December 2018. (a) Survival estimate over total number of dialysis patients (b) survival estimate for male (M) and female (F)

underestimate the true incidence and prevalence of chronic kidney disease and kidney failure in Samoa due to the lack of diagnosis or ability to access dialysis and lack of documentation.

The younger age (mean age 56.4 years) at which Samoan people commence haemodialysis, when compared to New Zealand Europeans who commence dialysis [25], along with reduced survival rates, of approximately 2.9 years, is of significant concern. This pattern of a younger age group of patients commencing haemodialysis is similar to that seen in other Pacific island nations [26–29] and among Pacific peoples living in New Zealand and Australia [26,27]. However survival rates of Pacific people on dialysis in New Zealand is far better with a 5 year survival rate over 60% [25].

Diabetes (69.5%) is the leading cause of kidney failure. Whilst diabetes is a significant contributor to the aetiology of kidney failure, there is increasing evidence that Pacific people have a strong familial predisposition to chronic kidney disease, even when controlling for diabetes and age, and the impact of non-communicable diseases enhances this risk [30]. There is considerable overlap amongst the non-communicable diseases (diabetes, cardiovascular disease, chronic kidney disease, and hypertension). Of note, hypertension was especially prevalent in this group of patients with kidney failure. At present, there are no facilities or pathology resources to undertake renal biopsies in Samoa, which limits diagnostic accuracy of CKD.

Samoa, like many other Pacific island societies, is facing an epidemic of non-communicable diseases which are placing extreme pressure on very limited health resources [8,9,26, 31–34]. This in turn will almost certainly increase the incidence of kidney failure and the demand for dialysis. Samoa is the only Polynesian island nation running a successful haemodialysis unit, that is predominantly government funded. Haemodialysis costs are currently estimated at Western Samoa Tala (WST)300.00 per session (equivalent to NZD 174 or USD116), WST900.00 per week or WST46,800.00 per annum per patient. While it is substantially supported by government funding, patients are still required to pay a fee for each dialysis session of WST 10 (USD3.70). For a large proportion of the Samoan population, this still places a major financial burden on the family. Given the relatively young age of those commencing dialysis, they are often the source of family income, placing further financial hardship upon the family unit. In addition, location, and ability to access dialysis facilities has an impact upon who may receive dialysis. Where data was recorded, most of the patients lived in urban Samoa around the capital of Apia, suggesting only those near the dialysis unit accessed these services. This suggests there are significant health inequalities in the ability to

access haemodialysis in Samoa. This information highlights a need for earlier detection of CKD and aggressive management to reduce the progression of CKD to kidney failure. Associated with the need for early detection and management of CKD, there is the need to develop clinical expertise to develop and implement community based preventative measures, along with improving the community's health literacy with respect to chronic kidney disease.

A substantial proportion (33.5%) of people who commence haemodialysis die within the first 12 months of commencing haemodialysis. There are multiple potential reasons for this, including late presentation, the underlying disease (usually diabetes) and associated comorbidities of cardiovascular and peripheral vascular disease. In addition, Samoan cultural beliefs have an important impact upon decision making, especially related to the importance of caring for the elders in the community. These influences can conflict with clinical decision making. Further work is needed to review decision making processes, suitability for dialysis and haemodialysis care, within the first 12 months of haemodialysis so practices within the unit can be adjusted to improve and provide appropriate care. Consideration of the development of palliative supportive renal care for patients who have a poor prognosis, is needed as this option is not currently available in Samoa.

There are a number of limitations to this study. Firstly, the extent and amount of data which was recorded by the NKFS staff at different times was variable so not all data was captured. Importantly, across Samoa, there was no accurate record of the number of individuals who died with chronic kidney disease, other than those who were enrolled with the NKFS to receive treatment. This means our results are likely an under estimate of the true burden of chronic kidney disease on the Samoan population. Among those with kidney failure who were included in the NKFS after starting treatment, only limited data was collected relating to living location, income and size of family as well as other potential barriers to accessing dialysis care. In addition, information about access to medications and prior management of their underlying disease(s) was not available. This is all important information for understanding the etiology and impact of chronic kidney disease in Samoa which should be routinely collected as part of a dialysis registry.

This study highlights a need to have a robust database for information to be collected and routinely analysed to help inform planning and practice. In order to provide more accurate data for the NKFS and the Samoan Ministry of Health, a registry that captures CKD and kidney failure data would be of immense value for future planning of health services. There are existing models which may be of use and collaboration with the Australian and New Zealand

Table 2 Crude incidence and crude prevalence per million population aged 15 years and older (pmp) of haemodialysis (HD) patients in Samoa from January 2005 to December 2018. The number of cases* shown are at the end of the year. Age standardised rates are standardised to the WHO world population.

Year	Number of New Cases	Total Population	Population aged 15 years and older	Number of HD cases*	Incidence pmp	Prevalence pmp	Age standardised incidence pmp
2005	21	179,325	109,122	18	192	165	219
2006	20	180,741	110,252	35	181	317	213
2007	18	182,157	111,382	40	162	449	183
2008	16	183,573	112,511	47	142	498	164
2009	16	184,988	113,641	46	141	440	153
2010	18	186,404	114,770	52	157	479	172
2011	30	187,820	115,900	59	267	569	281
2012	25	189,452	117,021	73	214	624	239
2013	21	191,084	118,142	77	178	609	190
2014	39	192,715	119,264	89	327	889	365
2015	32	194,347	120,385	92	266	872	286
2016	25	195,979	121,506	95	230	774	216
2017	37	197,611	122,627	111	343	921	327
2018	40	199,243	123,748	128	331	1196	331
Mean over the 14-year period 2005–2018					224	629	239

Table 3 Haemodialysis patient outcome for all ESKD patients receiving haemodialysis in the NKFS between Jan 2005 and Aug 2019.

Patient outcomes	Numbers	Percent
Current patients dialysing	114	29.0
Deceased	265	67.4
Overseas	14	3.6
Total	393	100

Dialysis and Transplantation Registry would be a potential pathway towards this. Related to this is the recognition of the needs of Pacific nations with respect to enhancing and supporting the training of health workers in nephrology, including doctors, nurses and biomedical personnel. There are major issues related to specialist training in all areas of medicine in Samoa and throughout the Pacific region that need to be explored in future research.

In conclusion, Samoa is facing an epidemic of kidney failure, similar to most other Pacific Islands [25–29]. The National Kidney Foundation of Samoa provides subsidised haemodialysis, and is under considerable pressure with rapidly increasing numbers of patients requiring dialysis almost certainly linked to the high incidence of other non-communicable diseases such as diabetes, hypertension and cardiovascular disease. This in turn is associated with a rising health economic burden both to the individuals and their families as well as the community. In addition to providing dialysis facilities, this study provides support for the NKFS to expand its' vision to early detection and prevention strategies as a sustainable means to address the rising CKD and kidney failure burden. Further studies are needed to fully understand the CKD burden in Samoa to help plan and develop country specific ways to deal with this burgeoning problem. Associated with this is the need to develop staff skill sets to develop and implement such research and community based preventative measures, along with improving the community's health literacy with respect to chronic kidney disease.

Declaration of Competing Interest

The authors report no conflicts of interest.

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Authors contributions

MT, BM, DV, FS, RW were involved in the concept and design of the study. MT, BM, LH were responsible for the collection of data. MT, RR and RT for the analyses of the data. All authors were involved in the interpretation of the data and writing the final manuscript.

Data statement

Due to Samoan Ministry of Health regulations, the data remains with the National Kidney Foundation of Samoa. De-identified data will be made available upon request to the corresponding author in discussion with the NKFS and Samoan Ministry of Health.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.lanwpc.2020.100058.

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