




# Predictors of Health Deterioration Among Older New Zealanders Undergoing Dialysis: A Three-Year Accelerated Longitudinal Cohort Study

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## Abstract

**Background:** Patient involvement in dialysis decision-making is crucial, yet little is known about patient-reported outcomes over time on dialysis.

**Objective:** To examine health-related outcomes over 24 and 36 months in an older cohort of dialysis patients.

**Design:** The “Dialysis outcomes in those aged  $\geq 65$  years study” is a prospective longitudinal cohort study of New Zealanders with kidney failure.

**Setting:** Three New Zealand nephrology units.

**Patients:** Kidney failure (dialysis and predialysis) patients aged 65 or above. We have previously described outcomes after 12 months of dialysis therapy relative to baseline.

**Measurements:** Patient-reported social and health factors using the SF-36, EQ-5D, and Kidney Symptom Score questionnaires.

**Methods:** This article describes and compares characteristics of 120 older kidney failure patients according to whether they report “Same/better” or “Worse” health 24 and 36 months later, and identifies predictors of “worse health.” Modified Poisson regression modeling estimated relative risks (RR) of worse health.

**Results:** Of 120 patients at 12 months, 47.5% had worse health or had died by 24 months. Of those surviving at 24 months ( $n = 80$ ), 40% had “Worse health” or had died at 36 months. Variables independently associated with reduced risk of “Worse health” (24 months) were as follows: Māori ethnicity (RR = 0.44; 95% CI = 0.26-0.75), Pacific ethnicity (RR = 0.39; 95% CI = 0.33-0.46); greater social satisfaction (RR = 0.57; 95% CI = 0.46-0.7). Variables associated with an increased risk of “Worse health” were as follows: problems with usual activities (RR = 1.32; 95% CI = 1.04-1.37); pain or discomfort (RR = 1.48; 95% CI = 1.34, 1.63). At 36 months, lack of sense of community (RR = 1.41; 95% CI = 1.18-1.69), 2 or more comorbidities (RR = 1.21; 95% CI = 1.13-1.29), and problems with poor health (RR = 1.47; 95% CI = 1.41-1.54) were associated with “Worse health.”

**Limitations:** Participant numbers restricted the number of variables able to be included in the multivariable model, and hence there may have been insufficient power to detect certain associations.

**Conclusions:** In this study, the majority of older dialyzing patients report “Same/better health” at 24 and 36 months. Māori and Pacific people report better outcomes on dialysis. Social and/or clinical interventions aimed at improving social satisfaction, sense of community, and help with usual activities may impact favorably on the experiences for older dialysis patients.

**Trial registration:** Australian and New Zealand clinical trials registry: ACTRN12611000024943.

## Abrégé

**Contexte:** La participation des patients à la prise de décisions est essentielle en contexte de traitements de dialyse. On en sait toutefois peu sur les résultats observés par les patients en cours de traitement.

**Objectif:** Examiner les résultats liés à la santé sur une période de 24 et de 36 mois dans une cohorte de patients âgés suivant des traitements de dialyse.

**Type d'étude:** Cette étude intitulée *Dialysis outcomes in those aged  $\geq 65$  years* est une étude de cohorte prospective et longitudinale menée auprès de Néo-Zélandais atteints d'insuffisance rénale.



**Cadre:** Trois unités de néphrologie en Nouvelle-Zélande.

**Sujets:** Des patients âgés de plus de 65 ans atteints d'insuffisance rénale (dialyse et pré-dialyse). Nous avons antérieurement décrit les résultats observés après 12 mois de dialyse par rapport au début de l'étude.

**Mesures:** Les facteurs sociaux et l'état de santé déclarés par les patients par l'entremise des questionnaires SF-36, EQ-5D et Kidney Symptom Score.

**Méthodologie:** Dans cet article, nous décrivons et comparons les caractéristiques de 120 patients âgés atteints d'insuffisance rénale selon qu'ils avaient déclaré un état de santé «inchangé/meilleur» ou «empiré» après 24 et 36 mois. Nous discutons également des facteurs prédictifs d'un état de santé jugé «empiré». Un modèle de régression de Poisson corrigé a servi à estimer le risque relatif (RR) de progresser vers un état de santé «empiré».

**Résultats:** Des 120 patients évalués après 12 mois, 47,5% avaient déclaré un état de santé «empiré» ou étaient décédés après 24 mois. Parmi les survivants à 24 mois d'étude (n = 80), 40% avaient déclaré un état de santé «empiré» ou étaient décédés après 36 mois. Les variables associées de façon indépendante à un risque réduit de voir l'état de santé empiré (24 mois) étaient: le fait d'être Maori (RR = 0,44; IC 95% = 0.26-0.75) ou issu d'une population du Pacifique (RR = 0.39; IC 95% = 0.33-0.46) et une satisfaction sociale plus élevée (RR = 0.57; IC 95% = 0.46-0.7) constituent les variables qui ont été associées de façon indépendante à un risque réduit de voir un état de santé empiré après 24 mois. Parmi les variables associées à un risque accru d'aggravation de l'état de santé, on compte des difficultés à pratiquer les activités quotidiennes (RR = 1.32; IC 95% = 1.04-1.37) et la douleur ou l'inconfort (RR = 1.48; IC 95% = 1.34-1.63). Après 36 mois de traitement, l'absence d'un sentiment de communauté (RR = 1,41; IC 95% = 1.18-1.69), le fait de présenter au moins deux maladies concomitantes (RR = 1.21; IC 95% = 1.13-1.29) et des problèmes liés à une mauvaise santé (RR = 1.47; IC 95% = 1.41-1.54) ont été associés à un état de santé jugé «empiré».

**Limites:** Le faible nombre de participants a restreint le nombre de variables pouvant être incluses dans le modèle multivarié, il est donc possible que la puissance de détection de certaines associations soit insuffisante.

**Conclusion:** Dans cette étude, la majorité des patients âgés sous dialyse ont déclaré avoir un état de santé «inchangé/meilleur» après 24 et 36 mois de traitement. Les patients Maoris et ceux qui sont originaires du Pacifique ont déclaré de meilleurs résultats de dialyse. Les interventions sociales ou cliniques visant à améliorer la satisfaction sociale, le sentiment d'appartenance à la communauté et l'aide aux activités quotidiennes pourraient avoir un effet bénéfique sur le vécu des patients âgés suivant des traitements de dialyse.

## Keywords

dialysis, older age group, patient-centered outcomes, quality-of-life outcomes on dialysis

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## Introduction

New Zealand has an increasing number of people who are aged above 65 years and dialyzing.<sup>1</sup> Older age is independently associated with a 5-fold increase in death within 90 days of dialysis therapy initiation.<sup>2</sup> It has been reported that initiation of dialysis is linked to a decline in functional status among elderly patients with end-stage kidney disease and, therefore, can negatively affect their quality of life.<sup>3</sup> Consideration of these factors in shared decision-making with patients at the time of initiation of invasive treatment like dialysis is essential. To inform such shared decision making, data about older patient populations'

experiences, and patient-reported outcomes of dialysis are required.<sup>3</sup>

The DOS65+ (Dialysis Outcomes in Those Aged  $\geq 65$  Years Study) is a study of older New Zealanders (NZers) with chronic kidney disease stage 5 (CKD5).<sup>4,6</sup> Previously, we have investigated global self-reported health status at 12 months compared to time of recruitment (baseline) to DOS65+ for 150 patients who were dialyzing at time of recruitment.<sup>4</sup> A significant proportion of participants with poorer health at 12 months, reported less satisfaction with social relationships, little sense of community, and/or had mobility problems at baseline. Multivariable analysis found

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participants reporting Māori or Pacific ethnicities were less likely to report poorer health at 12 months compared to NZ European participants. Patients with higher number of comorbidities, poor health and/or problems with EQ-5D-3L anxiety or depression at baseline reported worse health outcomes. With regards to modality of dialysis, patients on peritoneal dialysis were at reduced risk of reporting worse health outcomes.<sup>4</sup> This article reports global self-reported health outcomes of DOS65+ participants on dialysis therapy to medium and longer-term follow-up points (ie, 24 months and 36 months) relative to 12 months earlier. Specifically, we aim to investigate which, if any, demographic, health and functioning, social, and clinical characteristics are associated with “poorer health” at 24 and 36 months compared to the 12 months before. Prospective long term data related to factors which are important determinants of quality of life outcomes, as well as survival for older individuals, will help to inform patient focused discussions around dialysis.

## Methods

The DOS65+ protocol and baseline data have previously been described.<sup>5,6</sup> DOS65+ is an “accelerated longitudinal design” prospective cohort study. Participants were eligible if they were aged  $\geq 65$  years, had kidney failure, were on an active conservative pathway, or had commenced kidney replacement therapy, or preparing to commence kidney replacement therapy having received kidney replacement education. Three New Zealand District Health Board (DHB) nephrology units (Counties Manukau, Hawkes Bay, and Southern) were involved in the study. Counties Manukau DHB has a tertiary nephrology unit serving a large urban population with high proportions of Māori, Pacific and lower socio-economic status patients. Hawkes Bay DHB is a provincial rural center with a relatively high proportion of Māori. Southern DHB has a tertiary nephrology center with a more geographically dispersed population, with an exclusive home dialysis policy.<sup>4,6</sup> New Zealand has a tax-funded public health care system for all citizens. As such, New Zealand is well suited to outcomes research for patients with kidney failure because there are neither direct health care costs related to dialysis incurred by patients, nor financial incentives for health care professionals affecting treatment choices or service provision.<sup>7,8</sup>

Eligible patients, identified from treatment center databases, were contacted by telephone to arrange an interview. All interviews were completed either by telephone or face-to-face by trained DOS65+ research interviewers, which were independent of the nephrology team providing patient care.<sup>4,6</sup> Interviews were conducted at baseline (ie, recruitment), with follow-up interviews occurring 12, 24, and 36 months later. At the time of each follow-up, participants had to be clinically stable with no recent inter-current illness requiring hospitalization within four weeks. Follow-up interviews were not done if the treating nephrologist determined

an interview to be inappropriate (eg, because the patient had a terminal diagnosis or a serious cognitive impairment making an interview impossible).<sup>4,6</sup>

DOS65+ received ethical approval from the New Zealand Multi-Regional Ethics Committee (MEC/10/084), and was registered with the Australian and New Zealand clinical trials registry: ACTRN12611000024943. Study enrolment ran from 2010 to 2014.

## Variables Collected at Each Interview

Information collected included demographics, socio-economic, health, and functioning, dialysis modality (either hemodialysis or peritoneal dialysis), and end-stage kidney disease symptoms. Demographic information included age, sex, ethnicity,<sup>9,10</sup> and living arrangements.<sup>11</sup> The socio-economic information included household income where participants were asked to respond as “more than enough, enough or not enough money to meet their everyday needs, such as accommodation, food, clothing, or other necessities?”<sup>12</sup> Participants were asked about their satisfaction with social relationships, family involvement, and their sense of community and responses were categorized as reported in Table 1, consistent with earlier analyses.<sup>4,13-15</sup>

Clinical information was collected by the treating DHB nephrologists, with participants’ consent, from the clinical records at recruitment to DOS65+ and throughout follow-up. This included the etiology of kidney failure and comorbidity which was categorized according to the Dialysis Outcomes and Practice Patterns study (DOPPS) and the Australian and New Zealand Dialysis and Transplant Registry (ANZDATA).<sup>1,16</sup> Patients were recorded as having, or not having, the following conditions: cardiovascular disease, cerebrovascular disease, peripheral vascular disease, lung disease, musculoskeletal disease, diabetes, cancers (other than skin cancer).<sup>1,16</sup>

For general health status, we used the EQ-5D-3L.<sup>17</sup> EQ-5D-3L asks about problems with mobility, self-care, usual activities, pain or discomfort, anxiety or depression; for multivariable analysis people were categorized as having “No problems” or “Any problems.”

We assessed kidney symptom burden using the KDQOL questionnaire.<sup>18</sup> For multivariable modeling, this score was dichotomized as greater bother ( $\geq 31$ ) and less or no bother ( $< 31$ ) as done previously.<sup>4</sup>

The key outcome of interest for this article was determined by asking participants: “Compared to 1 year ago, how would you rate your health in general now?”<sup>19</sup> People who responded that their health is “About the same as 1 year ago,” “Somewhat better now than 1 year ago,” or “Much better than 1 year ago” were classified as having the “Same or better health”; those responding that their health is “Somewhat worse than 1 year ago” or “Much worse now than 1 year ago” were classified as having “Worse health.”

**Table 1.** 12-Month Characteristics of Patients Stratified by Health Status at 24 Months.

| 12 months characteristics      | Health state at 24 months relative to 12 months |      |                        |      | P-value |
|--------------------------------|-------------------------------------------------|------|------------------------|------|---------|
|                                | Same or better (N = 67)                         |      | Worse or died (N = 53) |      |         |
|                                | n                                               | %    | n                      | %    |         |
| <b>Demographics</b>            |                                                 |      |                        |      |         |
| Age <sup>a</sup>               |                                                 |      |                        |      |         |
| 65-69                          | 33                                              | 70.2 | 14                     | 29.8 | .05     |
| 70-74                          | 20                                              | 52.6 | 18                     | 47.4 |         |
| 75-79                          | 10                                              | 43.5 | 13                     | 56.5 |         |
| 80+                            | 4                                               | 33.3 | 8                      | 66.7 |         |
| Sex <sup>a</sup>               |                                                 |      |                        |      |         |
| Male                           | 39                                              | 52.0 | 36                     | 48.0 | .28     |
| Female                         | 28                                              | 62.2 | 17                     | 37.8 |         |
| Body mass index <sup>a</sup>   |                                                 |      |                        |      |         |
| 18.5-24.9                      | 17                                              | 51.5 | 16                     | 48.5 | .69     |
| 25.0-29.9                      | 17                                              | 53.1 | 15                     | 46.9 |         |
| 30+                            | 33                                              | 60.0 | 22                     | 40.0 |         |
| Ethnicity (prioritized)        |                                                 |      |                        |      |         |
| Maori                          | 21                                              | 77.8 | 6                      | 22.2 | .01     |
| Pacific                        | 17                                              | 70.8 | 7                      | 29.2 |         |
| European                       | 22                                              | 40.7 | 32                     | 59.3 |         |
| Other                          | 7                                               | 46.7 | 8                      | 53.3 |         |
| <b>Social factors</b>          |                                                 |      |                        |      |         |
| Social relationships           |                                                 |      |                        |      |         |
| Completely/mostly satisfied    | 61                                              | 55.5 | 49                     | 44.5 | .39     |
| Others                         | 4                                               | 80.0 | 1                      | 20.0 |         |
| Sense of community             |                                                 |      |                        |      |         |
| Some/little                    | 32                                              | 51.6 | 30                     | 48.4 | .36     |
| Strong                         | 33                                              | 62.3 | 20                     | 37.7 |         |
| Living arrangement             |                                                 |      |                        |      |         |
| With others                    | 58                                              | 57.4 | 43                     | 42.6 | .78     |
| Alone                          | 7                                               | 50.0 | 7                      | 50.0 |         |
| Family involvement             |                                                 |      |                        |      |         |
| Small/very small               | 5                                               | 55.6 | 4                      | 44.4 | 1.00    |
| Large/very large               | 60                                              | 56.1 | 47                     | 43.9 |         |
| Adequacy of household income   |                                                 |      |                        |      |         |
| Not enough/just enough         | 34                                              | 59.6 | 23                     | 40.4 | .70     |
| Enough/more than enough        | 31                                              | 54.4 | 26                     | 45.6 |         |
| <b>General health measures</b> |                                                 |      |                        |      |         |
| Comorbidities                  |                                                 |      |                        |      |         |
| CVD                            | 40                                              | 51.9 | 37                     | 48.1 | 0.44    |
| Cerebrovascular diseases       | 3                                               | 33.3 | 6                      | 66.7 | 0.30    |
| Peripheral vascular diseases   | 12                                              | 46.2 | 14                     | 53.8 | 0.38    |
| Diabetes                       | 32                                              | 53.3 | 28                     | 46.7 | 0.85    |
| Lung diseases                  | 13                                              | 65.0 | 10                     | 43.5 | 1.00    |
| Musculoskeletal                | 23                                              | 56.1 | 18                     | 43.9 | 0.84    |
| Cancer (except skin cancer)    | 12                                              | 48.0 | 13                     | 52.0 | 0.50    |
| Other comorbidities            | 36                                              | 51.4 | 34                     | 48.6 | 0.45    |
| Comorbidity count              |                                                 |      |                        |      |         |
| 0-2                            | 32                                              | 61.5 | 20                     | 38.5 | 0.18    |
| 3+                             | 32                                              | 49.2 | 33                     | 50.8 |         |
| Overall general health         |                                                 |      |                        |      |         |
| Fair/poor                      | 10                                              | 32.3 | 21                     | 67.7 | <0.01   |
| Excellent/very good/good       | 55                                              | 64.7 | 30                     | 35.3 |         |

(continued)

Table 1. (continued)

| 12 months characteristics                           | Health state at 24 months relative to 12 months |      |                        |      | P-value |
|-----------------------------------------------------|-------------------------------------------------|------|------------------------|------|---------|
|                                                     | Same or better (N = 67)                         |      | Worse or died (N = 53) |      |         |
|                                                     | n                                               | %    | n                      | %    |         |
| EQ5D mobility                                       |                                                 |      |                        |      |         |
| No problems                                         | 32                                              | 65.3 | 17                     | 34.7 | 0.10    |
| Some problems                                       | 32                                              | 48.5 | 30                     | 48.4 |         |
| Extreme problems                                    | 1                                               |      | 3                      | 75.0 |         |
| EQ5D selfcare                                       |                                                 |      |                        |      |         |
| No problems                                         | 50                                              | 61.0 | 32                     | 39.0 | 0.13    |
| Some problems                                       | 13                                              | 39.4 | 12                     | 48.0 |         |
| Extreme problems                                    | 2                                               |      | 6                      | 75.0 |         |
| EQ5D usual activities                               |                                                 |      |                        |      |         |
| No problems                                         | 30                                              | 66.7 | 15                     | 33.3 | 0.80    |
| Some problems                                       | 29                                              | 41.4 | 27                     | 48.2 |         |
| Extreme problems                                    | 6                                               |      | 8                      | 57.1 |         |
| EQ5D pain/discomfort                                |                                                 |      |                        |      |         |
| No problems                                         | 42                                              | 62.7 | 25                     | 37.3 | 0.11    |
| Some problems                                       | 21                                              | 43.8 | 24                     | 53.3 |         |
| Extreme problems                                    | 2                                               |      | 1                      | 33.3 |         |
| EQ5D anxiety/depression                             |                                                 |      |                        |      |         |
| No problems                                         | 52                                              | 59.1 | 36                     | 40.9 | 0.32    |
| Some problems                                       | 12                                              | 44.4 | 14                     | 53.8 |         |
| Extreme problems                                    | 1                                               |      | 0                      | 0.0  |         |
| Intellectual ability                                |                                                 |      |                        |      |         |
| No problems                                         | 49                                              | 62.8 | 29                     | 37.2 | 0.05    |
| Some problems                                       | 13                                              | 35.1 | 21                     | 61.8 |         |
| Extreme problems                                    | 3                                               |      | 0                      | 0.0  |         |
| Chronic kidney disease (CKD)-related factors        |                                                 |      |                        |      |         |
| Type of dialysis                                    |                                                 |      |                        |      |         |
| Hemodialysis                                        | 47                                              | 65.3 | 25                     | 34.7 | 0.01    |
| PD                                                  | 16                                              | 39.0 | 25                     | 61.0 |         |
| Not dialyzing now                                   | 4                                               | 57.1 | 3                      | 42.9 |         |
| Vintage                                             |                                                 |      |                        |      |         |
| 0 to <2 years                                       | 21                                              | 61.8 | 13                     | 38.2 | 0.72    |
| 2 to <6 years                                       | 38                                              | 53.5 | 33                     | 46.5 |         |
| 6+ years                                            | 8                                               | 53.3 | 7                      | 46.7 |         |
| Dialysis dose at baseline(minutes dialyze per week) |                                                 |      |                        |      |         |
| <120                                                | 2                                               | 66.7 | 1                      | 33.3 | 0.45    |
| 120-239                                             | 6                                               | 50.0 | 6                      | 50.0 |         |
| 240-359                                             | 43                                              | 61.4 | 27                     | 38.6 |         |
| 360+                                                | 14                                              | 45.2 | 17                     | 54.8 |         |
| Cause for CKD                                       |                                                 |      |                        |      |         |
| Glomerulonephritis                                  | 16                                              | 69.6 | 7                      | 30.4 | 0.07    |
| Hypertensive vascular                               | 6                                               | 28.6 | 15                     | 71.4 |         |
| Polycystic                                          | 5                                               | 62.5 | 3                      | 37.5 |         |
| Diabetics                                           | 27                                              | 60.0 | 18                     | 40.0 |         |
| Other                                               | 13                                              | 56.5 | 10                     | 43.5 |         |
| Kidney Disease Quality Of Life score (KDQOL)        |                                                 |      |                        |      |         |
| 70+                                                 | 49                                              | 59.8 | 33                     | 40.2 | 0.22    |
| <70                                                 | 16                                              | 47.1 | 18                     | 52.9 |         |

Note. P-value is from chi-square test or Fisher's exact as appropriate.

<sup>a</sup>Age, sex, body mass index, and ethnicity were as at baseline.<sup>6</sup>

Participants who faced the previous interview but had died before the next follow-up were also included in the “Worse health” group.<sup>19</sup>

## Analysis

All eligible participants experiencing “same/better” or “worse/died” health outcomes at 24 or 36 months relative to their health state 12 months previously were examined according to each potential explanatory variable using the Chi-square test or Fisher’s Exact test as appropriate. To identify possible predictors of “Worse health” at 24 and 36 months, we used univariate and multivariable modified Poisson regression models with robust standard errors to estimate relative risks (RRs) and 95% confidence intervals (CIs).<sup>20</sup> To overcome the insufficiency of the sample size to implement a variable selection from the large list of prospective predictor variables in multivariable model building, and as a practical approach to prevent model overfitting, for 24 and 36 months separately, we used a 2-step process to develop multivariable models. At the first step, we developed separate sub-models for each of the following 4 groups of characteristics: demographics (age, sex, and ethnicity), socioeconomic (social satisfaction, sense of community, living arrangements, household income, and family involvement), health and functioning (comorbidities, overall general health, and 5 EQ-5D-3L domains), and kidney-related variables (dialysis modality, dialysis vintage, dialysis dose, cause for kidney failure, and KDQOL score). This step used backward stepwise procedures to identify “important” variables using  $P$ -value thresholds of  $P = .20$  to enter variables to the sub-model and  $P = .25$  to remove variables from the sub-model. This step was a screening of variables that are unlikely to be related to the outcome. These very large  $P$ -value thresholds were used to retain variables that may be “important” when adjusting for variables used in other sub-models even though not “important” when adjusted for variables used in the current sub-model. At the second step, the final model was developed using variables identified in any of the 4 sub-models. Backward stepwise procedures were used again but with  $P$ -value thresholds of .10 and .12 used respectively to enter and remove variables. As done in previous studies,<sup>4,5</sup> comorbidities, dialysis modality, and dialysis vintage were not allowed to be dropped from any of the models they were used in (irrespective of  $P$ -values), and possible clustering by treating nephrology center was accounted for in the modeling.<sup>4,5</sup> Analyses were undertaken using Stata 15.1 software.<sup>21</sup>

## Results

**Study Participants:** The DOS65+ study recruited 225 participants. Of these, 56 participants were not on dialysis at baseline. Of the remaining 169 participants, 26 had died in the first 12 months (recruitment to 12-month interview) and

23 had missing outcome data. We have previously described the outcomes at 12 months of dialysis therapy relative to baseline.<sup>4</sup> The flow chart of participants is described in Figure 1. Data from 120 participants was available for analysis at 24 months.

## 24-Month Analyses

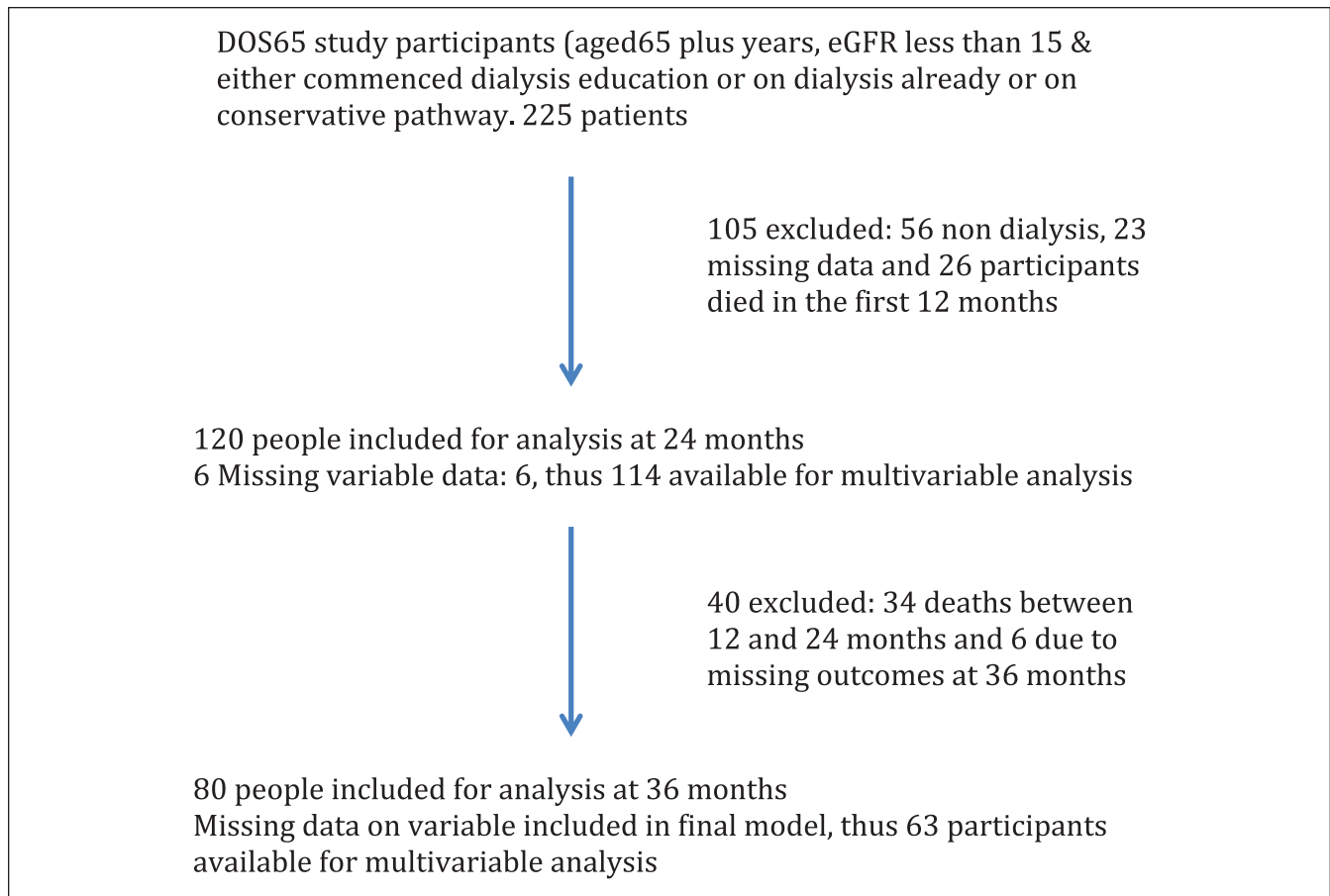
Table 1 presents participants’ characteristics at 12 months according to health outcome at 24 months follow-up. Among demographic characteristics, a higher proportion of those in the “Worse health/died” group were above the age of 70 years. A higher proportion of NZ Europeans ( $n = 32$ ; 59%) were in the “Worse health/died” group compared to Māori ( $n = 6$ ; 22%) and Pacific peoples ( $n = 7$ ; 29%). Participants with cerebrovascular disease at 12 months reported worse health outcomes compared to those without cerebrovascular disease. The EQ-5D-3L found a higher proportion of patients who reported problems with mobility, usual activities at 12 months were in the “Worse health/died” at 24 months. Those with problems with intellectual activity were also in “Worse health.”

Multivariate analysis of characteristics at 12 months associated with “Worse health/died” at 24 months: Of the 120 participants, 6 had missing information for all 12 month variables retained in the multivariable model. Table 2 presents relative risk (RRs) of worse health at 24 months based on data from 114 participants who had non-missing information for all 12 month variables retained in the multivariable model. Participants older than 75 had worse health outcomes (RR = 1.32; 95% CI = 1.25-1.39) compared to their younger counterparts. Pacific (RR = 0.39; 95% CI = 0.33-0.46) and Māori (RR = 0.44; 95% CI = 0.26-0.75) participants had lower risk of “Worse health/died” at 24 months compared to New Zealand Europeans and other ethnicities. Among health and health status characteristics at 12 months, problems with EQ-5D usual activities (RR = 1.32; 95% CI = 1.04-1.67) and EQ-5D pain/discomfort (RR = 1.48; 95% CI = 1.34-1.63) independently placed participants in the “Worse health/died” group. EQ-5D mobility was not retained in the final model; nor was intellectual functioning.

Among dialysis characteristics, more PD patients were in the “Worse health/died” group at 24 months (RR = 1.21; 95% CI = 1.08-1.35) relative to hemodialysis (HD) patients. Participants reporting greater bother with symptoms as per KDQOL symptom score at 12 months were at reduced risk for worse health outcomes at 24 months (RR = 0.87; 95% CI = 0.79-0.96).

## 36-Month Analyses

We had 120 participants for analysis at 24 months potentially available for analyses of health related outcomes at 36 months. Of these, 34 participants died between 12 and 24 months. Of the remaining 86, 6 had missing outcome data at



**Figure 1.** Flow chart of DOS65+ (Dialysis Outcomes in Those Aged  $\geq$  65 Years).

Note. Study participants recruited for analysis at 24 months and 36 months.

36 months. Thus, 80 participants were included for analysis at 36 months.

Table 3 presents participants' characteristics at 24 months according to health outcomes at 36 months follow-up period. A higher proportion of Māori were in the "Same/Better health" group compared to New Zealand Europeans and Pacific ethnicities. NZ Europeans tended to experience "Worse health/died" outcome as compared to both Māori and Pacific. Patients with problems with intellectual ability at 24 months were in the "Worse health" group at 36 months.

Multivariate analysis of characteristics at 24 months associated with worse health at 36 months follow-up period: Of the 80 participants included for analysis at 36 months, 17 had missing data on variables retained in the final model. Hence, data from 63 participants was analyzed at 36 months for multivariable analysis. Table 4 presents the relative risk of "Worse health/died" outcomes at 36 months follow-up period based on data from 63 participants who had non-missing data on all variables retained in the final model. Age and ethnicity were not in the mini model stage. Among social characteristics participants reporting no satisfaction (RR = 1.20; 95% CI = 0.99-1.46), without a strong sense of community (RR = 1.41; 95% CI = 1.18-1.69) and without large family

involvement in management of chronic kidney disease (RR = 1.68; 95% CI = 0.90-3.12) experienced "Worse health/died." Among health characteristics, patients with three or more comorbidities were in the "Worse health/died" group (RR = 1.21; 95% CI = 1.13-1.29). Those who reported overall fair or poor health at 24 months reported "Worse health/died" outcomes at 36 months (RR = 1.47; 95% CI = 1.41-1.54).

Among dialysis characteristics, those on PD were at reduced risk of "Worse health/died" outcomes compared to HD patients (RR = 0.82, 95% CI = 0.29-2.38). Longer dialysis vintage was associated with reporting worse health outcome (RR = 1.06; 95% CI = 1.03-1.08) Cause of chronic kidney disease and KDQOL symptom score were not retained in the final model.

## Discussion

According to ANZDATA registry figures, 54% of NZ dialysis patients are over the age of 65 years.<sup>1</sup> The incidence of renal replacement therapy in patients above the age of 65 years is on the rise with the highest incidence of dialysis in the 65- to 74-year age group.<sup>1</sup> The median survival for

**Table 2.** Showing Multivariate Analysis of Outcomes at 24 Months Relative to Characteristics at 12 Months: Final Models. Outcome is the Health Status Becoming “Worse” or Death Occurring Within Past 12 Months.

| Characteristics (measured 12 months prior to measuring the outcome) | 24 months (N = 114) |               |      | P-value |
|---------------------------------------------------------------------|---------------------|---------------|------|---------|
|                                                                     | RR                  | 95% CI for RR |      |         |
| <b>Demographics</b>                                                 |                     |               |      |         |
| Age**                                                               |                     |               |      | <.01    |
| 65-74                                                               | Ref                 |               |      |         |
| 75+                                                                 | 1.32                | 1.25          | 1.39 |         |
| Ethnicity(prioritized)**                                            |                     |               |      | <.01    |
| Maori                                                               | 0.44                | 0.26          | 0.75 |         |
| Pacific                                                             | 0.39                | 0.33          | 0.46 |         |
| European/Other                                                      | Ref                 |               |      |         |
| <b>Social factors</b>                                               |                     |               |      |         |
| Social relationships                                                |                     |               |      |         |
| Completely/mostly satisfied                                         | Ref                 |               |      |         |
| Others                                                              | 0.57                | 0.46          | 0.70 | <.01    |
| <b>General health factors</b>                                       |                     |               |      |         |
| Comorbidity types                                                   |                     |               |      |         |
| 0-2                                                                 | Ref                 |               |      |         |
| 3+                                                                  | 1.34                | 0.75          | 2.39 | .33     |
| EQ5D usual activities                                               |                     |               |      |         |
| No problems                                                         | Ref                 |               |      |         |
| Some problems                                                       | 1.32                | 1.04          | 1.67 | .03     |
| EQ5D pain/discomfort                                                |                     |               |      |         |
| No problems                                                         | Ref                 |               |      |         |
| Some problems                                                       | 1.48                | 1.34          | 1.63 | <.01    |
| <b>Chronic kidney disease factors</b>                               |                     |               |      |         |
| Type of dialysis                                                    |                     |               |      |         |
| Hemodialysis                                                        | Ref                 |               |      | <.01    |
| PD                                                                  | 1.21                | 1.08          | 1.35 |         |
| Not dialyzing now                                                   | 0.72                | 0.36          | 1.45 |         |
| Vintage (years)#                                                    | 1.01                | 0.99          | 1.03 | .38     |
| Kidney Disease Quality Of Life score (KDQOL)                        |                     |               |      |         |
| 70+ (less bother)                                                   | Ref                 |               |      |         |
| <70 (more bother)                                                   | 0.87                | 0.79          | 0.96 | .01     |

Note. RR = relative risks.

\*\* refers to age or ethnicity as recorded at entry into the study.

patients above the age of 65 years on dialysis is 2 to 3.7 years, with a 5-year survival of 38% in patients 65 to 75 years and 20% in patients above 75 years of age.<sup>1</sup> This study provides insights into the older patients' self-reported health after 24 and 36 months of dialysis therapy. A large proportion of patients in our study reported the same or better health outcome at both time points.

In our study, Māori and Pacific participants experienced better health at both 24 months and 36 months compared to New Zealand Europeans (although it was only statistically significant at 24 months, probably due to the smaller numbers at 36 months). Of interest, there was a strong association between same or better health with a sense of community and family support. Among the Indigenous (ie, Māori) and Pacific participants, the cultural importance of family and elders is very strong and is an important component of general well-being.<sup>22</sup> Future studies with larger numbers of

Māori and Pacific participants are required to further understand these relationships.

Kimmel et al studied the impact of social factors like living arrangements and household income on mortality in dialysis patients.<sup>23</sup> The authors concluded that residence in highly segregated areas and lower median household income are associated with higher mortality in dialysis patients.<sup>23</sup> Increased perception of social support is associated with improved survival in hemodialysis patients.<sup>24</sup> In our study, over the 36 months of follow-up, patients who were not satisfied with their social relationships reported worse health outcomes. A similar finding was noted for patients who reported a strong sense of community. These participants tend to report less worse outcomes at 12 months,<sup>4</sup> and 24 months. These results reflect the importance of social connectedness in older dialyzing individuals and its impact on self-reported health outcomes.



**Table 3.** 24-Month Characteristics of Patients Stratified by Health State at 36 Months.

| 24-month characteristics       | Health state at 36 months relative to 24 months |      |                        |      | P-value |
|--------------------------------|-------------------------------------------------|------|------------------------|------|---------|
|                                | Same or better (N = 48)                         |      | Worse or died (N = 32) |      |         |
|                                | n                                               | %    | n                      | %    |         |
| <b>Demographics</b>            |                                                 |      |                        |      |         |
| Age <sup>a</sup>               |                                                 |      |                        |      |         |
| 65-69                          | 22                                              | 62.9 | 13                     | 37.1 | .90     |
| 70-74                          | 13                                              | 56.5 | 10                     | 43.5 |         |
| 75-79                          | 10                                              | 62.5 | 6                      | 37.5 |         |
| 80+                            | 3                                               | 50.0 | 3                      | 50.0 |         |
| Sex <sup>a</sup>               |                                                 |      |                        |      |         |
| Male                           | 23                                              | 47.9 | 25                     | 52.1 | .01     |
| Female                         | 25                                              | 78.1 | 7                      | 21.9 |         |
| Body mass index <sup>a</sup>   |                                                 |      |                        |      |         |
| 18.5-24.9                      | 14                                              | 63.6 | 8                      | 36.4 | .87     |
| 25.0-29.9                      | 12                                              | 63.2 | 7                      | 36.8 |         |
| 30+                            | 22                                              | 56.4 | 17                     | 43.6 |         |
| Ethnicity (prioritized)        |                                                 |      |                        |      |         |
| Maori                          | 14                                              | 73.7 | 5                      | 26.3 | .10     |
| Pacific                        | 10                                              | 62.5 | 6                      | 37.5 |         |
| European                       | 21                                              | 61.8 | 13                     | 38.2 |         |
| Other                          | 3                                               | 27.3 | 8                      | 72.7 |         |
| <b>Social factors</b>          |                                                 |      |                        |      |         |
| Social relationships           |                                                 |      |                        |      |         |
| Completely/mostly satisfied    | 42                                              | 59.2 | 29                     | 40.8 | 1.00    |
| Others                         | 2                                               | 66.7 | 1                      | 33.3 |         |
| Sense of community             |                                                 |      |                        |      |         |
| Some/little                    | 21                                              | 51.2 | 20                     | 48.8 | .25     |
| Strong                         | 23                                              | 65.7 | 12                     | 34.3 |         |
| Living arrangement             |                                                 |      |                        |      |         |
| With others                    | 41                                              | 58.6 | 29                     | 41.4 | .69     |
| Along                          | 3                                               | 50.0 | 3                      | 50.0 |         |
| Family involvement             |                                                 |      |                        |      |         |
| Small/very small               | 3                                               | 42.9 | 4                      | 57.1 | .45     |
| Large/very large               | 41                                              | 59.4 | 28                     | 40.6 |         |
| Adequacy of household income   |                                                 |      |                        |      |         |
| Not enough/just enough         | 24                                              | 64.9 | 13                     | 35.1 | .49     |
| Enough/more than enough        | 22                                              | 55.0 | 18                     | 45.0 |         |
| <b>General health measures</b> |                                                 |      |                        |      |         |
| Comorbidities                  |                                                 |      |                        |      |         |
| CVD                            | 22                                              | 51.2 | 21                     | 48.8 | .31     |
| Cerebrovascular diseases       | 2                                               | 50.0 | 2                      | 50.0 | 1.00    |
| Peripheral vascular diseases   | 8                                               | 53.3 | 7                      | 46.7 | .77     |
| Diabetes                       | 15                                              | 48.4 | 16                     | 51.6 | .23     |
| Lung diseases                  | 12                                              | 70.6 | 5                      | 29.4 | .26     |
| Musculoskeletal                | 16                                              | 55.2 | 13                     | 44.8 | 1.00    |
| Cancer (except skin cancer)    | 10                                              | 62.5 | 6                      | 37.5 | .77     |
| Other comorbidities            | 19                                              | 39.6 | 20                     | 51.3 | .14     |
| Comorbidity count              |                                                 |      |                        |      |         |
| 0-2                            | 17                                              | 60.7 | 11                     | 39.3 | .57     |
| 3+                             | 21                                              | 53.8 | 18                     | 46.2 |         |
| Overall general health         |                                                 |      |                        |      |         |
| Fair/poor                      | 10                                              | 47.6 | 11                     | 52.4 | .31     |
| Excellent/very good/good       | 34                                              | 61.8 | 21                     | 38.2 |         |

(continued)

**Table 3. (continued)**

| 24-month characteristics                            | Health state at 36 months relative to 24 months |       |                        |       | P-value |
|-----------------------------------------------------|-------------------------------------------------|-------|------------------------|-------|---------|
|                                                     | Same or better (N = 48)                         |       | Worse or died (N = 32) |       |         |
|                                                     | n                                               | %     | n                      | %     |         |
| EQ5D mobility                                       |                                                 |       |                        |       |         |
| No problems                                         | 19                                              | 65.5  | 10                     | 34.5  | .34     |
| Some problems                                       | 24                                              | 51.1  | 20                     | 45.5  |         |
| Extreme problems                                    | 1                                               |       | 2                      | 66.7  |         |
| EQ5D selfcare                                       |                                                 |       |                        |       |         |
| No problems                                         | 30                                              | 56.6  | 23                     | 43.4  | .80     |
| Some problems                                       | 13                                              | 56.5  | 5                      | 27.8  |         |
| Extreme problems                                    | 1                                               |       | 4                      | 80.0  |         |
| EQ5D usual activities                               |                                                 |       |                        |       |         |
| No problems                                         | 20                                              | 66.7  | 10                     | 33.3  | .24     |
| Some problems                                       | 20                                              | 41.7  | 15                     | 42.9  |         |
| Extreme problems                                    | 4                                               |       | 7                      | 63.6  |         |
| EQ5D pain/discomfort                                |                                                 |       |                        |       |         |
| No problems                                         | 19                                              | 39.6  | 14                     | 42.4  | 1.00    |
| Some problems                                       | 21                                              | 48.8  | 17                     | 44.7  |         |
| Extreme problems                                    | 4                                               |       | 1                      | 20.0  |         |
| EQ5D anxiety/depression                             |                                                 |       |                        |       |         |
| No problems                                         | 32                                              | 56.1  | 25                     | 43.9  | .79     |
| Some problems                                       | 10                                              | 52.6  | 6                      | 37.5  |         |
| Extreme problems                                    | 2                                               |       | 1                      | 33.3  |         |
| Intellectual ability                                |                                                 |       |                        |       |         |
| No problems                                         | 25                                              | 55.6  | 20                     | 44.4  | .64     |
| Some problems                                       | 19                                              | 61.3  | 11                     | 36.7  |         |
| Extreme problems                                    | 0                                               |       | 1                      | 100.0 |         |
| Type of dialysis                                    |                                                 |       |                        |       |         |
| Hemodialysis                                        | 29                                              | 56.9  | 22                     | 43.1  | 1.00    |
| PD                                                  | 14                                              | 58.3  | 10                     | 41.7  |         |
| Not dialyzing now                                   | 5                                               | 100.0 | 0                      | 0.0   |         |
| Vintage                                             |                                                 |       |                        |       |         |
| 0 to <2 years                                       | —                                               | —     | —                      | —     | 1.00    |
| 2 to <6 years                                       | 42                                              | 60.0  | 28                     | 40.0  |         |
| 6+ years                                            | 6                                               | 60.0  | 4                      | 40.0  |         |
| Dialysis dose at baseline(minutes dialyze per week) |                                                 |       |                        |       |         |
| <120                                                | 2                                               | 50.0  | 2                      | 50.0  | 0.28    |
| 120 - 239                                           | 5                                               | 62.5  | 3                      | 37.5  |         |
| 240 - 359                                           | 30                                              | 65.2  | 16                     | 34.8  |         |
| 360+                                                | 6                                               | 37.5  | 10                     | 62.5  |         |
| Cause for chronic kidney disease                    |                                                 |       |                        |       |         |
| Glomerulonephritis                                  | 13                                              | 72.2  | 5                      | 27.8  | 0.66    |
| Hypertensive vascular                               | 6                                               | 54.5  | 5                      | 45.5  |         |
| Polycystic                                          | 5                                               | 71.4  | 2                      | 28.6  |         |
| Diabetics                                           | 14                                              | 51.9  | 13                     | 48.1  |         |
| Other                                               | 10                                              | 58.8  | 7                      | 41.2  |         |
| Kidney Disease Quality Of Life score (KDQOL)        |                                                 |       |                        |       |         |
| 70+                                                 | 26                                              | 61.9  | 16                     | 38.1  | 0.49    |
| <70                                                 | 18                                              | 52.9  | 16                     | 47.1  |         |

Note. P-value is from chi-square test or Fisher's exact test as appropriate.

<sup>a</sup>Age, sex, BMI, and ethnicity were as at baseline.<sup>6</sup>

**Table 4.** Showing Multivariable Analysis at 36 Months Relative to Characteristics at 24 Months: Final Models.

| Characteristics (measured 12 months prior to measuring the outcome) | 36 months (N = 63)                             |               |        | P-value |
|---------------------------------------------------------------------|------------------------------------------------|---------------|--------|---------|
|                                                                     | RR                                             | 95% CI for RR |        |         |
| <b>Demographics</b>                                                 |                                                |               |        |         |
| Sex**                                                               |                                                |               |        |         |
| Male                                                                | Ref                                            |               |        |         |
| Female                                                              | 0.42                                           | 0.30          | 0.59   | <.01    |
| <b>Social factors</b>                                               |                                                |               |        |         |
| Social relationships                                                |                                                |               |        |         |
| Completely/mostly satisfied                                         | Ref                                            |               |        |         |
| Others                                                              | 1.20                                           | 0.99          | 1.46   | .06     |
| Sense of community                                                  |                                                |               |        |         |
| Some/little                                                         | 1.41                                           | 1.18          | 1.69   | <.01    |
| Strong                                                              | Ref                                            |               |        |         |
| Family involvement                                                  |                                                |               |        |         |
| Small/very small                                                    | 1.68                                           | 0.90          | 3.12   | .10     |
| Large/very large                                                    | Ref                                            |               |        |         |
| <b>General health factors</b>                                       |                                                |               |        |         |
| Comorbidity types                                                   |                                                |               |        |         |
| 0-2                                                                 | Ref                                            |               |        |         |
| 3+                                                                  | 1.21                                           | 1.13          | 1.29   | <.01    |
| Overall general health                                              |                                                |               |        |         |
| Fair/poor                                                           | 1.47                                           | 1.41          | 1.54   | <.01    |
| Excellent/very good/good                                            | Ref                                            |               |        |         |
| EQ5D selfcare                                                       |                                                |               |        |         |
| No problems                                                         | Ref                                            |               |        |         |
| Some problems                                                       | 0.74                                           | 0.66          | 0.83   | <.01    |
| <b>Chronic kidney disease factors</b>                               |                                                |               |        |         |
| Type of dialysis                                                    |                                                |               |        |         |
| Hemodialysis                                                        | Ref                                            |               |        |         |
| PD                                                                  | 0.82                                           | 0.29          | 2.38   | .72     |
| Not dialyzing now                                                   | Drop due to everyone had "same/better" outcome |               |        |         |
| Vintage (years)#                                                    | 1.06                                           | 1.03          | 1.08   | <.01    |
| Dialysis dose (minutes per week)#                                   | 1.0005                                         | 1.0003        | 1.0007 | <.01    |

Note. Outcome is the health status becoming "worse" or death occurring within past 12 months. RR = relative risks. # refers to dialysis vintage and dialysis dose at baseline entry into the study.

Previous studies show that the benefit of dialysis over conservative management is lost in patients more than 75 years of age with high comorbidities and poor performance status.<sup>25-27</sup> In our study, participants with 3 or more comorbidities reported worse health outcomes, however, it was only statistically significant at 36 months. Of those who reported fair or poor general health at 24 months, 74% were at risk of reporting poor health outcomes at 36 months. Thus, the assessment of patient's overall health and burden of comorbidities is important in decision-making regarding the benefit of dialysis over the longer term in this population.

In New Zealand since 2013, approximately 40% to 43% of dialysis patients aged above 65 years are on peritoneal dialysis.<sup>1</sup> Survival on peritoneal dialysis in this age group in NZ is 92% at 1 year, 67% at 3 years and 42% at 5 years. When we look at hemodialysis patients above 65 years of age, survival is 90% at 1 year, 65% at 3 years, and 46% at 5

years.<sup>1</sup> These data suggest that there is no survival difference in patients on hemodialysis and peritoneal dialysis. The North Thames Dialysis Study, conducted in patients more than 70 years of age looking at quality of life, indicated that survival, hospitalization, and quality of life were similar between patients on hemodialysis and peritoneal dialysis.<sup>28-30</sup> The BOLDE study (Broadening Options for Long term Dialysis in the Elderly) found the older patients on peritoneal dialysis have significantly less perception of intrusion of disease in their lives.<sup>31</sup> In our study, patients on peritoneal dialysis tended to experience less "Worse health" at 12 months,<sup>4</sup> and 36 months as compared to hemodialysis patients. Our results are in keeping with these previously reported studies where patients on peritoneal dialysis reported better health outcomes than patients on haemodialysis.<sup>28-30</sup> Longitudinal analysis specifically to examine the changes in health states over time by dialysis modality has been planned.

There is an increase in the relative risk of death with increasing dialysis vintage both in peritoneal dialysis and hemodialysis patients.<sup>32,33</sup> In this study, longer dialysis vintage was associated with a higher risk of reporting worse health outcomes at both 24 months and 36 months analysis. The higher mortality in patients with longer dialysis vintage may be due to increased incidence of major cardiovascular events and infections in this group.<sup>34,35</sup>

One of the strengths of this study is its prospective design and focus on the patient's perspectives and patient-reported outcomes. Engaging patients in decision making about initiating or continuing dialysis therapy is essential. Our study highlights the importance of factors like sense of community, satisfaction with social relationships, and functional problems such as issues with mobility, self-care, and intellectual ability and the impact of these factors on patient-reported health outcomes. Clinicians and health care providers should focus on interventions at improving social satisfaction, sense of community, mobility, which may improve experiences in older patients on dialysis. It also highlights the importance of patient-centered data collection.

There are a number of limitations from this study. Although DOS65+ study has a larger cohort ( $n = 225$ ),<sup>4</sup> participants who had died in the preceding 12-month period were removed from subsequent analysis, reducing the patient population included in the analysis at 24 months to 120 and 36 months to 80 in total. Smaller patient population limits the number of variables that were able to be included in the multivariable model, which likely means we are underpowered to detect associations, which do, in truth, exist. Another significant limitation is the basement or floor effect.<sup>36,37</sup> The question asked the participants, that was used to derive our response variable, was whether they felt their health is the "same or better" or "worse" compared to 1 year ago. For example, if the participant reported feeling worse at 24 months and continued to feel worse at 36 months, they would report being feeling the same. Although some people can actually improve from "worse" at 24 months to "same/better" at 36 months, such reporting could be at least partly due to floor effect (ie; of the people at "worse health" state at 24 months, if some continue to remain at that state for next 12 months, then they will fall into the "same/better" group at 36 months even though they have not actually improved). This floor effect was observed to be larger among those who reported EQ5D self-care problems than those who not reported such problems at 24 months (50% vs 36%). This basement effect can produce on-the-face counter-intuitive results (Table 4).

In the multivariable analysis model, there is also a possibility of having inflated type 1 and/or type 2 errors due to 2-step model building with 2 backward selection procedures. To mitigate this, we purposely selected large  $P$ -value thresholds at all levels of model building; however, we do not claim our mitigation measures completely eliminated the

possible inflation of type1 and type2 errors. Also, in the multivariable analyses, the list of variables retained at the 2-time points is not the same, and a possible reason for this is that patients that could be used in these models were not the same even though data were collected longitudinally over the years from the same cohort. As a result, we cannot interpret the results as trends over time but have to interpret the models separately at each time point. Longitudinal studies with more focused research questions are planned so that trends over time can be analyzed in more detail. However, multiple imputation or any other way of handling missing data to retain everyone in a longitudinal analysis is likely to amplify the imperfections of imputation procedures given the large proportion of ( $>30\%$ ) missing data.<sup>38</sup> Also, because some people were not included in the 36 months multivariable model due to item missingness, we assessed possible bias due to this by comparing those included and not included in the final model. This found, the vintage is larger ( $P = .01$ ) among those included in the model than others, while no difference was observed in any of the other variables. Therefore we may have overestimated the influence of vintage.

## Conclusion

In summary, patient-reported outcome measures are critical in informed shared decision making regarding the impact and on-going maintenance of dialysis, as previously highlighted by the SONG (Standardized Outcomes In Nephrology) initiative.<sup>39</sup> Our study highlights the importance of consideration of factors like burden of comorbidities, social characteristics like satisfaction with relationships, and sense of community amongst other factors in predicting health outcomes.

## Authors' Note

These data were presented in abstract form at the Australian and New Zealand Society of Nephrology Annual Scientific Meeting November 2020 (online). Bronwen McNoe coordinated the interviews and the collection of the data. The data are securely stored in the Department of Preventive and Social Medicine. It is not available in the public domain due to Ethics requirements. Access to de-identified data for recognized research will be considered with appropriate application to the corresponding author.

## Author Contributions

Research idea and study design: RW, SD, and JS. Data acquisition: AS. Statistical analysis: RS and AS. Data analysis and interpretation: RS, AS, SD, RW, JS, and EW. Preparation of manuscript: RS, SD, JS, AS, EW, and RW. Each author contributed important intellectual content during manuscript drafting or revision and accepts accountability for the overall work by ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved.

## Ethics Approval and Consent to Participate

DOS65+ received ethical approval from the New Zealand Multi-Regional Ethics Committee (MEC/10/084), and was registered with the Australian and New Zealand clinical trials registry: ACTRN 12611000024943. Study enrolment ran from 2010 to 2014.

## Consent for Publication

The authors have all consented to publication of the article.

## Availability of Data and Materials

At the time the study was undertaken, NZ ethics did not allow for data to be stored off-shore in a repository. De-identified data will be made available upon reasonable request to the corresponding author with appropriate ethics committee approval

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## References

1. The Australia and New Zealand Dialysis and Transplant Registry. <http://www.anzdata.org.au/>. Accessed September 10, 2020.
2. Shah S, Leonard A, Thakar C. Functional status, pre-dialysis health and clinical outcomes among elderly dialysis patients. *BMC Nephrol*. 2018;19(1):100.
3. Bowling CBO, Hare AM. Managing older adults with CKD: individualized versus disease based approach. *Am J Kidney Disease*. 2012;59(2):293-302.
4. Derrett S, Samaranayaka A, Schollum JBW, et al. Predictors of health deterioration among older adults after 12 months of dialysis therapy: a longitudinal Cohort Study from New Zealand. *Am J Kidney Dis*. 2017;70(6):798-806.
5. Walker R, Derrett S, Campbell J, et al. Dialysis outcomes in those aged  $\geq 65$  years. *BMC Nephrol*. 2013;14:175.
6. McNoe B, Schollum J, Derrett S, et al. Recruitment and participant baseline characteristics in the dialysis outcomes in those aged 65 years or older study. *BMC Nephrol*. 2019;20:137.
7. USRDS. Annual Data Report: atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States. Bethesda, MD: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 2013.
8. Rivara MB, Mehrotra R. The changing landscape of home dialysis in the United States. *Curr Opin Nephrol Hypertens*. 2014;23(6):586-591.
9. Statistics New Zealand. Statistical Standard for Ethnicity. Wellington: Statistics New Zealand; 2005.
10. Page M, Wyeth E, Samaranayaka A, et al. Accuracy of ethnicity data recorded in clinical records and the New Zealand Dialysis and Transplant Registry. *N Z Med J*. 2017;130:1454.
11. Ministry of Health. *Ethnicity data protocols for the health and disability sector*. Wellington, New Zealand: Ministry of Health; 2004. <https://www.fmhs.auckland.ac.nz/assets/fmhs/faculty/tkhn/tumuaki/docs/ethnicity-data-protocols.pdf>. Accessed August 7, 2017.
12. Ministry of Social Development. Direct measurement of living standards: the New Zealand ELSI Scale—survey of working age people in 2000. Wellington, New Zealand: Ministry of Social Development; 2000.
13. Derrett S, Samaranayaka A, Wilson S, et al. Prevalence and predictors of sub-acute phase disability after injury among hospitalised and non-hospitalised groups: a longitudinal cohort study. *PLoS One*. 2012;7(9):e44909.
14. The School of Psychology Massey University, The Health Research Council of New Zealand, The New Zealand Institute for Research on Ageing, et al. Health, Work and Retirement Survey 2006. Palmerston North, New Zealand: Massey University; 2006.
15. Portney K, Berry J. Mobilizing minority communities. *Am Behav Scientist*. 1997;40(5):632-644.
16. Miskulin D, Bragg-Gresham J, Gillespie B, et al. Key Comorbid Conditions that are predictive of Survival among Haemodialysis Patients. *Clin J Am Soc Nephrol*. 2009;4:1818-1826.
17. EQ-5D. <https://euroqol.org/eq-5d-instruments/eq-5d-3l-about/>. Accessed September 7, 2020.
18. Kidney Disease Quality of Life Instrument (KDQOL). [https://www.rand.org/health-care/surveys\\_tools/kdqol.html](https://www.rand.org/health-care/surveys_tools/kdqol.html). Accessed September 11, 2020.
19. Ware JE, Snow KK, Kosinski M, et al. SF-36 Health Survey: Manual and Interpretation Guide. Lincoln, RI: Quality-Metric Inc.; 2000.
20. Zou G. A modified Poisson regression approach to prospective studies with binary data. *Am J Epidemiol*. 2004;159(7):702-706.
21. StataCorp: Stata Statistical Software: Release 15. College Station, Texas: StataCorp LP; 2017.
22. Edwards S, McCreanor T, Moewaka Barnes H. Maori family culture: a context of youth development in Counties/Manukau. *Kōtuitui: NZ J Social Sci*. 2007;2:11-15.
23. Kimmel PL, Fwu CW, Eggers PW. Segregation, income disparities, and survival in a hemodialysis patient. *J Am Soc Nephrol*. 2013;24(2):293-301.
24. Spinale J, Cohen SS, Khetpal P, et al. Spirituality, social support, and survival in hemodialysis patients. *Clin J Am Soc Nephrol*. 2008;3(6):1620-1627.
25. Chandna SM, Da Silva-Gane M, Marshall C, Warwicker P, Greenwood RN, Farrington K. Survival of elderly patients with stage 5 CKD: comparison of conservative management and renal replacement therapy. *Nephrol Dial Transplant*. 2011;26(5):1608-1614.
26. Hussain JA, Mooney A, Russon L. Comparison of survival analysis and palliative care involvement in patient over 70 years choosing conservative management or renal replacement therapy in advanced chronic kidney disease. *Palliat Med*. 2013;27(9):829-839.

27. Reindl-Schwaighofer R, Kainz A, Kammer M, Dumfarth A, Oberbauer R. Survival analysis of conservative vs. *PLoS One*. 2017;12(7):e0181345.
28. Grun RP, Constantinovici N, Normand C, Lamping DL, North Thames Dialysis Study Group. Costs of dialysis for elderly people in the UK. *Nephrol Dial Transplant*. 2003;18:2122-2127.
29. Harris SA, Lamping DL, Brown EA, Constantinovici N North Thames Dialysis Study Group. Clinical outcomes and quality of life in elderly patients on peritoneal dialysis versus haemodialysis. *Perit Dial Int*. 2002;22:463-470.
30. Brown EA. Should older patients be offered peritoneal dialysis. *Perit Dial Int*. 2008;28(5):444-448.
31. Brown EA, Johansson L, Farrington K, et al. Broadening options for long term dialysis in the elderly (BOLDE): differences in quality of life on peritoneal dialysis compared to hemodialysis for older patients. *Nephrol Dial Transplant*. 2010;25:3755-3763.
32. MM, Avram Mittman N, Fein PA, et al. Dialysis vintage, body composition, and survival in peritoneal dialysis patients. *Adv Perit Dial*. 2012;28:144-147.
33. Sumida K, Yamagata K, Iseki K, Tsubakihara Y. Different impact of hemodialysis vintage on cause-specific mortality in long term hemodialysis patients. *Nephrol Dial Transplant*. 2016;31(2):298-305.
34. Shurraw S., Majumdar SR, Thadhani R, Wiebe N, Tonelli M, Alberta Kidney Disease Network. Glycemic control and the risk of death in 1,484 patients receiving maintenance haemodialysis. *Am J Kidney Dis*. 2010;55:875-884.
35. Thorsteinsdottir B, Swetz KM, Albright RC. The ethics of chronic dialysis for the older patient: time to reevaluate the norms. *Clin J Am Soc Nephrol*. 2015;10(11):2094-2099.
36. Howe, Adele. Ceiling and Floor Effects. <https://www.cs.colostate.edu/~howe/EMAI/ch3/node7.html>. Accessed September 12, 2020.
37. Howe, Adele. Ceiling and Floor Effects. <https://www.cs.colostate.edu/~howe/EMAI/ch3/node8.html>. Accessed September 12, 2020.
38. White IR, Royston P, Wood AM. Multiple imputation using chained equations: issues and guidance for practice. *Statist Med*. 2011;30:377-399.
39. Tong A, Manns M, Hemmelgarn B, et al. Establishing core outcomes domains in hemodialysis: report of the standardized outcomes in Nephrology-hemodialysis (SONG-HD) consensus workshop. *Am J Kidney Dis*. 2016;69(1):97-107.