

High nutrition risk related to dietary intake is associated with an increased risk of hospitalisation and mortality for older Māori: LiLACS NZ

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Population ageing in New Zealand has revealed those aged over 80 years are the fastest growing segment and are predicted to increase six-fold by 2050.¹ Māori, the indigenous people of Aotearoa, New Zealand, comprise 14% of the total population and 2% of those aged over 80 years.² The population of Māori aged over 80 years is increasing faster than the non-Māori octogenarian population.³ Advanced-age adults have the highest rates of hospitalisations compared to other age groups.⁴ The growth in numbers of people of advanced age highlights the need to develop new understandings that could lead to reductions in hospital admission rates.

Older people are known to be at a disproportionate risk of malnutrition and have an increased risk of developing health problems as result of inadequate food and nutrition intake.⁵ High nutrition risk has previously been associated with 51% greater risk of hospitalisation and 54% greater risk of mortality in the Birmingham Study of Aging, which included 1,000 people over 65 years of age from Alabama, US.⁶

Nutrition risk screening is a process to identify factors or characteristics related to nutritional status that could lead to malnutrition.⁷ Pathways to nutritional health among older people are complex and involve an array of factors related to food procurement, preparation and eating. The 'Seniors in the Community: Risk Evaluation for Eating and Nutrition' (SCREEN II) index is a

Abstract

Objectives: To investigate the association between domains of nutrition risk with hospitalisations and mortality for New Zealand Māori and non-Māori in advanced age.

Methods: Within LiLACS NZ, 256 Māori and 399 non-Māori octogenarians were assessed for nutrition risk using the Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN II) questionnaire according to three domains of risk. Sociodemographic and health characteristics were established. Five years from inception, survival analyses examined associations between nutrition risk from the three domains of SCREEN II with all-cause hospital admissions and mortality.

Results: For Māori but not non-Māori, lower nutrition risk in the Dietary Intake domain was associated with reduced hospitalisations and mortality (Hazard Ratios [HR] [95%CI] 0.97 [0.95–0.99], $p=0.009$ and 0.91 [0.86–0.98], $p=0.005$, respectively). The 'Factors Affecting Intake' domain was associated with mortality (HR, [95%CI] 0.94 [0.89–1.00], $p=0.048$), adjusted for age, gender, socioeconomic deprivation, education, previous hospital admissions, comorbidities and activities of daily living.

Conclusion: Improved dietary adequacy may reduce poor outcomes for older Māori.

Implications for public health: Nutrition risk among older Māori is identifiable and treatable. Effort is needed to engage relevant community and whānau (family) support to ensure older Māori have food security and cultural food practices are met.

Key words: octogenarian, nutrition risk, LiLACS NZ, Māori, New Zealand

14-item questionnaire specifically developed for community-living older adults,⁸ and determines nutrition risk according to three specific risk factor domains: 'Weight Change', 'Dietary Intake' and 'Factors Affecting Intake (adaptive and functional)'.⁹ Identifying nutritional problems from these domains creates the opportunity to plan appropriate interventions across the multiple pathways leading to poor nutritional health.

The SCREEN II tool has been validated among older people in Canada against the

criterion of a dietitian's clinical judgement of risk. It has high retest validity and interrater reliability as well as excellent sensitivity and specificity in detecting nutrition risk.⁸ In New Zealand, SCREEN II has been validated for non-Māori octogenarians using a nutrition risk threshold score of 49, with a lower score indicating higher nutrition risk.¹⁰ The SCREEN II questionnaire was also piloted among older Māori¹¹ and its use in the Life and Living in Advanced Age Cohort Study in New Zealand (LiLACS NZ) established the high prevalence

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of nutrition risk in Māori (49%) and non-Māori (38%) of advanced age.¹²

The aim of this paper was to examine the consequences of high nutrition risk (defined as hospital admissions and mortality at five years from inception) using the SCREEN II nutrition risk domain scores among Māori aged over 80 years and non-Māori aged over 85 years.

Methods

LiLACS NZ is a population-based cohort study¹³ with two cohorts of equal size: Māori aged 80 to 90; and non-Māori aged 85. The current study was a cross-sectional outcome analysis comparing participant five-year hospitalisation and mortality rates in relation to three domains of nutrition risk according to the SCREEN II nutrition risk assessment tool.⁸

Study Population

LiLACS NZ was initiated in 2010 and recruited 937 octogenarians living in five North Island locations, including rural and urban areas. At inception, the sample consisted of 421 Māori and 516 non-Māori. Both Māori and non-Māori cohorts are similar in gender profile with just over half being female. The overall response rate for the study was 57%. Details of the recruitment procedures have been reported.^{14,15} Participants were identified from the electoral roll, health care databases, and extensive family and personal networks. They were recruited by personal invitation from their general practitioner or community contact. Eligibility criteria were Māori born between 1 January 1920 and 31 Dec 1930 or non-Māori born between 1 January and 31 December 1925. Eligible participants were living within the defined regional boundaries of the Bay of Plenty and Lakes District Health Boards (excluding the Taupo region of the Lakes District Health Board). Recruitment occurred between March 2010 and April 2011. The Māori cohort was recruited younger than non-Māori given the gap in life expectancy between Māori and non-Māori (8.2 years for men and 8.8 years for women).¹⁶ The study was approved by the Northern X Regional Ethics Committee (Approval number: NXT 09/09/088) in 2009 and all study participants provided written informed consent.

Measures

Sociodemographic characteristics were obtained through a standardised

questionnaire administered during a face-to-face interview. Level of socioeconomic deprivation was indicated by the New Zealand Deprivation index (NZ Dep)¹⁷ and based on the address at enrolment obtained from the Ministry of Health. Highest level of education, with the categories primary, secondary (with or without qualification), trade or tertiary, was ascertained by self-report. Marital status was categorised as married, widowed, separated or never married. Living arrangement was categorised as living alone, with only a spouse, or with others (of which others could include a spouse).

Number of diagnosed conditions, of 19 listed comorbidities,¹⁸ and prescribed medications were ascertained through a combination of self-report, general practitioner and hospital medical records. Height and weight were used to calculate body mass index (BMI, kg/m²). Participants reported their smoking status with categories for current, former, or never smoked. The SF-12 questionnaire¹⁹ was used to measure self-rated physical and mental health-related quality of life. With a maximum score of 100, any score lower than 40 is indicative of subjective poor health and above 60 indicates perceived reasonable and better health. Depression was assessed using the 15-item Geriatric Depression Scale (GDS-15).²⁰ A higher GDS-15 score indicates increased severity of depressive symptoms; scores of five or more suggest significant depressive symptoms.

The Nottingham Extended Activities of Daily Living (NEADL) scale was used as a measure of physical function.²¹ Twenty-two items from the NEADL scale measured independence across four domains of physical function including mobility, kitchen tasks, domestic tasks, and leisure activities. Each item on the scale was rated on a four-point scale (0=unable to 3=able). Higher scores indicated higher levels of function and independence. Participants were also questioned on the recipient of support for daily tasks (regular support for grocery shopping, cooking, house cleaning, telephoning and transport) and difficulty getting shopping (with the categories: not at all, somewhat–moderately, very–extremely).

Nutrition risk was determined using the 14-item SCREEN II questionnaire. Items were scored (0 to 4) and summed with the total score ranging from 0 to 64. A SCREEN II score of ≤49 is considered 'high nutrition risk'. SCREEN II assessed nutrition risk from

three main domains: i) the Weight Change domain, including items assessing weight loss or gain (greater than 2.5 kg in the past six months), unintentional weight loss (in the past six months), and perception of own weight being more or less than it should be; ii) the Dietary Intake domain, including items assessing meal frequency, food avoidance, appetite, daily intake of fruit and vegetable (including canned, fresh, frozen or juice), meat or alternatives (referring to dried peas, beans, lentils, nuts, peanut butter or tofu), milk products (including fluid milk, cooking with milk, milk puddings, ice cream, cheese, yoghurt, and alternatives referring to soy beverages) and fluid (including water, tea, coffee, herbal drinks, juice, and soft drinks but not alcohol); and iii) the Factors Affecting Intake domain, including items for assessing chewing and swallowing difficulties, the use of meal replacements (shakes, energy bars, Complan, Ensure), eating alone, cooking difficulties, and problems getting groceries (due to poor health or disability, limited income, lack of transportation, weather conditions, or finding shopping assistance). The Weight Change domain contributed 19% to the total SCREEN II score (highest domain score possible is 12), the Factors Affecting Intake contributes 38% (highest score possible of 28), and the Dietary Intake domain provided 44% (highest score possible of 24) of the overall nutrition risk score.

Total all-cause hospital admissions in the 12 months preceding baseline assessment and at five years follow-up were ascertained from National Health Index (NHI) numbers. NHI numbers from the participants informed all-cause mortality at five years from inception.

Statistical analysis

Descriptive statistics were prepared for all variables. Continuous data with a non-normal distribution (determined using histogram and normal Q-Q plots) are presented as medians and interquartile ranges. Mann-Whitney tests were performed to ascertain differences between groups (men and women) for both Māori and non-Māori. Chi-square tests and Fishers exact tests were used for categorical data. Spearman's correlations test was used to investigate correlations between SCREEN II domains scores and other potentially related continuous variables. Five-year survival analyses were performed using Cox Proportional Hazard models to examine the associations between hospitalisation and mortality with the three main domains from

SCREEN II (i.e. Weight Change, Dietary Intake, and Factors Affecting Intake).²² Each model was adjusted for age (Māori only), gender, NZDep score, highest level of education, and hospitalisations at baseline (for the five-year hospitalisation model only). Variables associated with hospitalisation or mortality at $p < 0.05$ were selected for inclusion in the final model. Statistical analyses were performed with SPSS 20.0 for Windows.

Results

Table 1 provides an overview of sociodemographic and health characteristics, nutrition risk status, and five-year all-cause hospitalisations and mortality for the Māori and non-Māori participants at baseline by gender.

There was a higher prevalence of nutrition risk among Māori women compared to men (women 54% versus men 42%, $p = 0.037$). There were 1,338 all-cause hospital admissions among Māori participants over the five-year study period equating to a rate of 837 admission per 1,000 person years, with rates being more common among Māori men than women (men 974 per 1,000 person years versus women 749 per 1,000 person years, $p = 0.040$). Mortality rates were higher among Māori men compared to Māori women (men 166 per 1,000 person years versus women 110 per 1,000 person years, $p = 0.006$); 104 Māori men and 107 Māori women died during the study period.

Non-Māori women compared to non-Māori men had lower SCREEN II scores (women 50 versus men 49, $p < 0.001$) and a higher frequency nutrition risk (SCREEN II ≤ 49 : women 49% versus men 27%, $p < 0.001$). Over the five-year study period, there were 1,758 hospitalisations with rates being more common among non-Māori men than women (men 962 per 1,000 person years versus women 685 per 1,000 person years, $p = 0.0003$). Mortality rates were similar among non-Māori men and women; 120 men and 110 women died during the study period.

Table 2 shows the median (IQR) domain scores and proportion of men and women with an 'at risk' response to each of the 14 individual items from SCREEN II for Māori and non-Māori.

Māori participants

From the Weight Change domain, "weight change in the last 6 months" was the most

Table 1: Sociodemographic and health characteristics, nutrition risk status, and hospital admissions and mortality at five years follow up for Māori and non-Māori participants by gender.

Characteristics	Māori						non-Māori					
	Men n=176		Women n=244		Total n= 420		Men n=237		Women n=278		Total n=515	
	n	%	n	%	n	%	n	%	n	%	n	%
Age (years)												
Median	82		82		82		85		85		85	
IQR	4		5		5		1		1		1	
Deprivation, NZDep score												
Deprivation Quintile 1 (low)	3	1.7	7	2.9	10	2.4	14	5.9	17	6.1	31	6.0
Deprivation Quintile 2	16	9.1	34	13.9	50	11.9	47	19.8	53	19.0	100	19.4
Deprivation Quintile 3	32	18.2	35	14.3	67	16.0	61	25.7	63	22.6	124	24.0
Deprivation Quintile 4	45	25.6	54	22.1	99	23.6	71	30.0	96	34.4	167	32.4
Deprivation Quintile 5 (high)	80	45.5	114	46.7	194	46.2	44	18.6	50	17.9	94	18.2
Education												
Primary	56	32.9	59	25.0	115	28.3	44	18.9	39	14.3	83	16.4
Secondary (No qualification)	69	40.6	93	39.4	162	39.9	78	33.5	112	41.0	190	37.5
Secondary (Qualification)	30	17.9	45	19.1	75	18.5	47	20.2	58	21.2	105	20.8
Trade	5	2.9	12	5.1	17	4.2	26	11.2	34	12.5	60	11.9
Tertiary	10	5.9	27	11.4	37	9.1	38	16.3	30	11.0	68	13.4
Marital status												
Widowed	72	42.1	176	73.6	248**	60.5	73	31.2	184	66.7	257**	50.4
Living situation												
Lives alone	29	27.1	81	50.6	110**	41.2	61	32.1	134	62.6	195**	48.3
Number of conditions												
Median	5		5		5		5		5		5	
IQR	3		4		3		3		3		3	
Number of medications												
Median	5		5		5		5		5		5	
IQR	5		5		5		6		5		5	
BMI (kg/m ²)												
Median	28.9		28.5		28.7		26.4		26.1		26.3	
IQR	8		7		7		4		6		5	
Smoking status												
Current	14	8.1	29	12.3	43	10.5	14	6.0	10	3.6	24	4.7
Former	101	58.7	87	36.9	188*	46.1	144	61.3	81	29.2	225**	43.9
SF-12 Physical Health												
Median	47.0		43.9		45.5		45.6		39.1		43.0*	
IQR	19		18		18		19		18		19	
SF-12 Mental Health												
Median	53.6		54.7		54.2		57.1		57.0		57.0	
IQR	10		13		12		7		11		9	
GDS-15												
0-4 mild	86	85.1	131	85.1	217	85.1	164	88.2	186	90.3	350	89.3
5-9 moderate	14	13.9	86	13.6	35	13.7	21	11.3	19	9.2	40	10.2
10-15 severe	1	1.0	2	1.3	3	1.2	1	0.5	1	0.5	2	0.5
Physical function, NEADL score												
Median	18.0		19.0		19.0		18.5		19.0		19.0	
IQR	5		4		4		3		4		4	
Support for daily tasks												
Receives regular support services	42	42.4	68	43.9	110	43.3	91	48.9	118	56.5	209	52.9
Difficulty getting to shops												
Not at all	88	88.0	126	82.4	214	84.6	175	93.1	186	89.9	361	91.4
Somewhat/Moderately	4	4.0	9	5.9	13	5.1	7	3.7	9	4.3	16	4.1
Very/Extremely	8	8.0	18	11.8	26	10.3	6	3.2	12	5.8	18	4.6
SCREEN II score												
Median	50.0		47.0		49.0*		52.0		49.0		50.0**	
IQR	10		8		8		8		8		8	
High nutrition risk SCREEN II ≤ 49	42	42.0	84	54.2	126	49.4	50	26.6	103	48.6	153**	38.3
All-cause hospital admission 12 months prior study	77	43.5	72	29.5	149*	35.4	84	35.4	89	31.9	173	33.5
Five year all-cause hospital admission (per 1,000 person years)	611	974	727	749*	1,338	837	930	962	828	685**	1,758	808**
Five year all-cause mortality (per 1,000 person years)	104	166	107	110**	211	132	120	124	110	91	230	106

Notes:

IQR, interquartile range, SCREEN II, Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, NZDep, New Zealand Deprivation index, SF-12, 12-Item Short Form Health Survey, GDS-15, Geriatric Depression Scale, NEADL, Nottingham Extended Activities of Daily Living scale, BMI, Body Mass Index.

Values were significantly different between the reference level and other levels within a given characteristic: * $p < 0.05$; ** $p < 0.001$.

Mann-Whitney U test for sex difference on quantitative characteristics. Chi-square and Fishers exact test for sex difference on qualitative characteristics.

common nutrition risk item for Māori participants. Specifically, nearly one-quarter (24%) identified with “>2.5 kg weight loss” in the past six months. Unintentional weight change was more common among Māori women than their male counterparts (women 11% versus men 2%). Nearly half (45%) of the participants, perceived their weight to be “more or less than it should be”.

From the Dietary Intake domain, “skipping meals” was more common among Māori men (men 42% versus women 26%, $p=0.007$) and more than one-third (38%) of Māori participants would “limit[s] or avoid[s] certain foods.” More than three-quarters (77%) of Māori participants had one or less serve of meat or meat alternative intake per day and 61% had fewer than three serves of fruit and vegetables per day.

Regarding the Factors Affecting Intake domain, “eating alone” was the most common nutrition risk item, particularly for Māori women (women 54% versus men 33%, $p=0.001$).

Table 3 shows the five-year survival models for the SCREEN II domain scores and hospital and mortality outcomes for the Māori participants. After adjusting for potential covariates (age, gender, NZDep and highest education level, previous hospital admission, and comorbidities) the SCREEN II Dietary Intake domain score was significantly associated with all-cause hospitalisations (Hazard Ratio [HR] [95%CI] 0.92 [0.87–0.98] $p=0.008$) and mortality (HR, [95%CI] 0.91 [0.86–0.98] $p=0.005$), adjusted for age, gender, NZDep, education level, hospitalisation, comorbidities and NEADL

score. For the SCREEN II domain Factors Affecting Intake, there was an association with all-cause hospital admissions at five years (HR, [95%CI] 0.94 [0.89–1.00] $p=0.048$).

Non-Māori participants

Within the Weight Change domain, it was more common for women than men to have had “greater than 2.5 kg weight gain in the past six months” (women 14% versus men 4%, $p=0.002$). Further, nearly one-fifth (18%) of non-Māori participants reported greater than 2.5 kg weight loss. Nearly two-fifths (39%) of participants perceived their weight was “more or less than it should be”.

Second, within the Dietary Intake domain of SCREEN II, avoiding certain foods was more common among women (women 49% versus men 35%, $p=0.006$) who were also more likely to have a poor appetite (women 22% versus men 13%, $p=0.021$), and eat fewer than one serving of meat or meat alternatives daily (women 77% versus men 67%, $p=0.031$). Low fluid intake (less than 3–4 cups daily) was more common among men (men 20% versus women 12%, $p=0.022$). Nearly two-fifths (37%) of non-Māori participants had low milk product intake and one-fifth had low fruit and vegetable intake (19%).

There were gender differences among non-Māori participants for the Factors Affecting Intake domain where overall women had lower domain scores than men, indicating a higher level of nutrition risk for women (women 20 versus men 22 out of maximum score 28, $p<0.001$). Specifically, “eats alone” (women 57% versus men 30%, $p<0.001$) and “cooking is a chore” (women 37% versus men 12%, $p<0.001$) were the most common nutrition risk items for women from this domain. In addition, there was a higher prevalence of swallowing difficulties among women compared to men (women 19% versus men 10%, $p=0.014$).

Five-year survival models demonstrating the relationship between SCREEN II domain scores and outcomes (all-cause hospital admissions and all-cause mortality) for the non-Māori participants are shown in Table 4. There was no significant relationship between SCREEN II domain scores and all-cause hospitalisations or mortality in both the unadjusted and adjusted models.

Discussion

This study examined specific domains of nutrition risk within the SCREEN II tool in relation to hospitalisations and mortality for

Table 2: Proportion of Māori and non-Māori participants with an “at risk” response to individual SCREEN II items† as categorised by the three domains.

Characteristics	Māori				non-Māori							
	Men n=101		Women n=155		Total n=256		Men n=188		Women n=212		Total n=399	
	n	%	n	%	n	%	n	%	n	%	n	%
Nutrition risk item*												
Weight Change domain (score)												
Median	10.0		8.0		8.0†		12.0		8.0		9.0†	
IQR	4		6		4		4		6		4	
IQR												
1.a) Weight change in the last 6 months												
>2.5kg weight gain	10	10.0	24	15.5	34	13.3	8	4.3	30	14.2	38*	9.5
>2.5 kg weight loss	25	25.0	35	22.6	60	23.5	38	20.2	36	17.0	74	18.5
b) Unintentional weight change												
	2	2.0	17	11.0	19†	7.5	19	10.1	29	13.7	48	12.0
c) Perception of own weight more or less than it should be												
	37	37.4	76	49.7	113	44.8	64	34.2	91	42.9	155	38.8
Dietary Intake domain (score)												
Median	19.0		19.0		18.0		21.0		21.0		21.0	
IQR	3		4		4		4		4		4	
2. Often/always skips meals	42	42.0	40	25.8	82*	32.2	20	10.6	14	6.6	34	8.5
3. Limit or avoids certain foods	37	37.0	61	39.4	98	38.4	66	35.1	103	48.6	169*	42.3
4. Fair/poor appetite	8	7.9	17	11.0	25	9.8	25	13.3	47	22.2	72	18.0
5. Low fruit and vegetable intake (≤ 3 serves per day)	68	67.3	87	56.1	155	60.5	44	23.5	33	15.8	77	19.4
6. Low meat or meat alternative intake (≤ 1 serves per day)	73	73.3	124	80.0	197	77.0	125	67.2	160	76.9	285*	72.3
7. Low milk product intake (≤ 2 serves per day)	37	36.6	68	43.9	105	41.0	68	36.2	81	38.6	149	37.4
8. Low fluid intake (≤ 3-4 c per day)	29	28.7	36	23.2	65	25.4	37	19.8	24	11.5	61*	15.4
Factors Affecting Intake domain (score)												
Median	22.0		20.0		20.0		22.0		20.0		20.0**	
IQR	4		4		4		4		4		4	
9. Swallowing difficulty	7	6.9	19	12.3	26	10.2	19	10.1	40	18.9	59*	14.8
10. Chewing difficulty	21	20.8	29	18.7	5	19.5	30	16.0	46	21.7	76	19.0
11. Uses meal replacements	11	10.9	22	14.3	33	12.9	20	10.7	18	8.6	38	9.6
12. Eats alone	33	32.7	83	53.9	116*	45.5	57	30.3	121	57.3	178**	44.6
15. Cooking is a chore	14	13.9	28	18.1	42	16.4	23	12.2	77	36.8	100**	25.2
14. Often/always has difficulty with groceries	8	8.0	24	15.6	32	12.6	10	5.4	18	8.7	28	7.2

Notes:

a: SCREEN II items with scores less than or equal to two, out of a maximum score of four, potentially lead to ‘nutrition risk’.

IQR, interquartile range, SCREEN II, Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II.

Values were significantly different between the reference level and other levels within a given characteristic: * $p < 0.05$; ** $p < 0.001$.

Mann-Whitney U test for sex difference on quantitative characteristics. Chi-square and Fishers exact test for sex difference on qualitative characteristics.

Table 3: Survival models of SCREEN II domain scores and outcomes (all-cause hospital admissions and all-cause mortality) at five years follow up of Māori participants, unadjusted and adjusted models.^a

Independent variables	Model 1: All-cause hospital admissions, five years follow-up						Model 2: All-cause mortality, five years follow-up					
	Unadjusted model			Adjusted model			Unadjusted model			Adjusted model		
	HR	95% CI	p value	HR	95% CI	p value	HR	95% CI	p value	HR	95% CI	p value
SCREEN II domain score: Weight Change	0.988	0.97–1.01	0.359	0.98	0.96–1.01	0.238	1.02	0.96–1.09	0.50	0.99	0.93–1.07	0.863
SCREEN II domain score: Dietary Intake	0.974	0.95–0.996	0.032	0.97	0.95–0.99	0.009	0.92	0.87–0.98	0.008	0.91	0.86–0.98	0.005
SCREEN II domain score: Factors Affecting Intake	0.998	0.98–1.02	0.857	1.01	0.98–1.04	0.461	0.94	0.89–1.00	0.048	0.98	0.92–1.04	0.474
Age				1.01	0.98–1.04	0.622				1.16	1.08–1.25	0.0001
Gender				1.07	0.91–1.25	0.477				1.66	1.09–2.54	0.019
NZDep quintile				1.01	0.95–1.08	0.724				1.11	0.93–1.33	0.255
Education				0.94	0.80–1.11	0.505				1.07	0.68–1.64	0.777
Comorbidities				1.05	1.02–1.08	0.006				1.10	1.01–1.31	0.021
Previous hospital admission (12 months)				1.11	1.06–1.17	0.0001				1.17	1.03–1.31	0.0121
NEADL score				0.98	0.96–0.99	0.007				0.92	0.89–0.96	<0.0001

Notes:

a: Regression analyses adjusted for age, gender, socioeconomic deprivation (NZ Dep index quintile), highest level of education, comorbidities, hospital admission in the 12 months prior to interview, and NEADL score. Cox proportion hazard models for mortality and Prentice-Williams-Peterson counting process models for hospital admissions.

HR, Hazard Ratio, CI, Confidence Interval, SCREEN II, Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, NZDep, New Zealand Deprivation index, NEADL, Nottingham Extended Activities of Daily Living scale.

256 Māori and 399 non-Māori octogenarians. Overall, 49% of Māori and 38% of non-Māori participants were at high nutrition risk. Similarly, in the Hawkes Bay region of New Zealand, 63% of community-living older Māori and 30% of non-Māori were found to be at high nutrition risk,²³ supporting our finding for a higher prevalence of nutrition risk among Māori. Lower education has previously been identified as a risk factor for high nutrition risk in community living older people²⁴ and, in the current study, nearly twice as many Māori than non-Māori had a primary-only level of education. Older Māori tend to be more disadvantaged than older non-Māori across all socioeconomic indicators including education.²⁵ Nearly half of Māori participants lived in the highest quintile of socioeconomic deprivation. Older single Māori, mostly women, have the least material wellbeing,²⁶ which may

lead to low food security.²⁷ Food has special cultural significance for Māori. The impact of colonisation has affected access to traditional foods with limited availability of food species and time to go out on the land, the sea and the forest to harvest²⁸ and may compromise dietary quality.

For Māori, lower nutrition risk as measured from the Dietary Intake domain was independently related to reduced five-year all-cause hospitalisations and mortality, and lower risk from the Factors Affecting Intake was significantly associated with fewer all-cause hospital admissions. To our knowledge, this is the first examination of nutrition risk as it relates to three discrete domains within SCREEN II. These unique findings provide a focal point to improve the nutritional status of Māori and prevent poor health outcomes. Findings suggest that prevention of nutrition risk among older

Māori by addressing dietary inadequacies and overcoming barriers to consumption is key to improving the health of this vulnerable group. Previous studies among community-living older adults in Alabama and Canada have shown low nutrition risk is protective against both hospitalisation⁶ and mortality,²⁹ similar to findings from this study. However, current knowledge describing this particular relationship for indigenous populations is limited. The present study adds to the body of evidence by demonstrating specific domains of nutrition risk are related to all-cause hospitalisation and mortality for Māori and suggests strategies are needed to improve food intake.

The Dietary Intake domain from SCREEN II largely reflects the adequacy of intake of major food groups. Low intake of meat (or meat alternatives) was the most commonly identified nutrition risk item for three-

Table 4: Survival models of SCREEN II domain scores and outcomes (all-cause hospital admissions and all-cause mortality) at five years follow up of non-Māori participants, unadjusted and adjusted models.^a

Independent variables	Model 1: All-cause hospital admissions, five years follow-up						Model 2: All-cause mortality, five years follow-up					
	Unadjusted model			Adjusted model			Unadjusted model			Adjusted model		
	HR	95% CI	p value	HR	95% CI	p value	HR	95% CI	p value	HR	95% CI	p value
SCREEN II domain score: Weight change	0.989	0.97–1.01	0.232	0.99	0.98–1.01	0.399	0.96	0.91–1.00	0.051	0.99	0.94–1.04	0.618
SCREEN II domain score: Dietary intake	0.984	0.97–1.00	0.079	0.98	0.96–1.00	0.061	0.96	0.91–1.00	0.054	0.98	0.94–1.03	0.523
SCREEN II domain score: Factors affecting intake	0.991	0.97–1.01	0.329	0.99	0.97–1.01	0.166	0.97	0.92–1.01	0.144	0.97	0.92–1.02	0.266
Gender				1.21	1.07–1.36	0.004				1.54	1.10–2.15	0.012
NZDep quintile				1.02	0.97–1.07	0.466				1.05	0.91–1.21	0.532
Education				0.94	0.84–1.04	0.283				0.95	0.69–1.31	0.745
Comorbidities				1.06	1.03–1.09	<0.0001				1.12	1.04–1.21	0.002
Previous hospital admission (12 months)				1.07	1.03–1.12	0.008				1.05	0.93–1.17	0.407
NEADL score				1.00	0.98–1.02	0.994				0.93	0.89–0.96	0.0001

Notes:

a: Regression analyses adjusted for age, gender, socioeconomic deprivation (NZ Dep index quintile), highest level of education, comorbidities, hospital admission in the 12 months prior to interview, and NEADL score. Cox proportion hazard models for mortality and Prentice-Williams-Peterson counting process models for hospital admissions.

HR, Hazard Ratio, CI, Confidence Interval, SCREEN II, Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, NZDep, New Zealand Deprivation index, NEADL, Nottingham Extended Activities of Daily Living scale.

quarters of both Māori and non-Māori. Similarly, low milk product intake was identified in more than one-third of both Māori and non-Māori participants. At least one serving of meat or meat alternatives and at least three servings of milk or milk products per day are recommended in the New Zealand Food and Nutrition Guidelines for Healthy Older Adults.³¹ Inadequate intake of these recommended food group items may lead to adverse health outcomes, as seen in the current study. Both meat and milk products are important sources of high biological value protein that help to support the immune system and to preserve lean mass with age.³⁰ In LiLACS NZ, lower energy-adjusted protein intake was found to be independently associated with hospitalisation due to infection among older Māori³² and, in the Framington study, inadequate dietary protein intake in older adults was associated with an increased risk of falls.³³

Nearly two-thirds of Māori and one-fifth of non-Māori reported fewer than the recommended five servings of fruit and vegetables per day. As a key source of antioxidants, fruit and vegetables have a protective role in ageing,²⁸ and consumption of at least one fruit and one vegetable serving per day, as well as more than four servings per week, has been associated with improved ten-year survival rates among community living older adults in France.³⁴

Limiting or avoiding certain foods was a common SCREEN II risk factor item for both Māori and non-Māori. Older people who restrict foods have an increased risk of developing malnutrition³⁵ and, among Japanese community dwelling older adults, a higher dietary variety has been associated with higher lean mass, grip strength and faster walking speed.³⁶

For Māori, the Factors Affecting Intake domain was significantly associated with all-cause hospital admissions at five-year follow-up. Eating alone was the key risk factor for more than half of Māori women and one-third of Māori men. Women are more likely to live longer than their spouse and live alone than men, resulting in fewer meals shared with others.³⁷ Companionship facilitates eating, and those who eat alone have an increased risk of poor nutrition compared to those who eat with others.^{38,39} The recent loss of a spouse, in particular, leads to a reduced food intake.⁴⁰ Companionship and community are integral to Māori culture and the concept of manaakatanga ensures that food is

available to all.²⁴ Current New Zealand Food and Nutrition Guidelines for Healthy Older People recommend older adults take the opportunity to eat with others.³¹ Community-based interventions oriented towards improving the nutritional health for older Māori need to consider the role of traditional food practices, such as shared eating, that may protect against nutrition risk. Effort is needed to engage relevant community and whānau (family) support to ensure older Māori have food security and cultural food practices are met. There is potential for Māori-led strategies such as mobile food delivery services, outreach clinics and community group support to build on existing programs (such as led by the Rauawaawa Kaumātua Charitable Trust) that aim to enhance the quality of life and wellbeing of Kaumātua (older Māori).⁴¹ Specifically, the 'Senior Chef' program for older adults is a successful model that facilitates both community support, the development of important practical skills and sharing of meals to improve the nutritional health of those who are vulnerable.⁴²

Limitations

There are limitations to this study. Firstly, SCREEN II has been validated among older non-Māori only. Variability in interpreting certain SCREEN II items by Māori and non-Māori has been noted, for example, when using "puddings" as a prompt to describe nutrition supplements.¹¹ Traditional foods and practices are particularly important among older Māori²⁴ and approximately 1–2% of Māori consume traditional foods.²⁸ Māori have a holistic view of health and the use of generalised measures in this study (SF-12, GDS-15, and NEADL) for both Māori and non-Māori may be a further limitation. Moreover, this highlights a requirement for Indigenous-specific measures to be developed by Indigenous peoples.

Implications

This study demonstrates significant potential for poor health outcomes among community-living older Māori at nutrition risk. The Australian and New Zealand Society for Geriatric Medicine position statement on undernutrition and the older person⁴³ highlights the importance for older people to be screened and assessed for undernutrition. Although nutrition screening provides a simple and effective way to identify those at risk and reverse dietary depletion,⁷ routine

nutrition screening is not performed in the general practice setting and, among general practices in Australia, time constraints are a key barrier.⁴⁴ Further work is needed to raise awareness among primary health professionals and foster partnerships with local Māori community organisations. Interventions to improve the nutrition status of older Māori need to be based on a holistic Māori worldview. Indeed, the importance of language and culture and being able to access traditional foods are associated with lower nutrition risk in older Māori.²⁴ A multifaceted approach, including education of the health workforce, may be needed to ensure culturally appropriate food practices are met.

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Ethical Standards

All procedures involving human participants were approved by the Northern X Regional Ethics Committee (NXT 09/09/088) in 2009. Written informed consent was obtained from all study participants.

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