The University of Auckland

Dementia

Supplementary Findings from LiLACS NZ for Section Five, 'Service Use and Common Health Conditions' in the report 'Health, Independence and Caregiving in Advanced Age'

LILACS NZ

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

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Members of the LiLACS NZ data collection team include academic staff, Māori advisors, community partners and data specialists. These people, as well as the funders of the LiLACS NZ data collection, can be found on the LiLACS NZ webpages https://www.fmhs.auckland.ac.nz/en/faculty/lilacs.html

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'It was a most pleasant surprise when I found I had been asked to take part in the LiLACS NZ study. At the age of 85 years it gave me a lift and made me feel useful at this late stage of life.'

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Executive Summary

This executive summary outlines the aims and methods of the LiLACS NZ cohort study, specifies the research commissioned for this report and outlines key findings.

Introduction

Dementia affects an increasing number of older people in New Zealand and the co-occurrence of dementia with chronic medical conditions complicates management and outcomes. A higher prevalence of risk factors for the development of dementia, such as heart and lung disease and socioeconomic inequality, coupled with a more rapidly ageing population, means that the incidence of dementia in Māori may increase more rapidly than in non-Māori in years to come. Dementia amongst Māori has not been studied. Moreover, ethnically sound measurement of dementia is important to identifying those at risk.

Te Puāwaitanga O Ngā Tapuwae Kia Ora Tonu/ Life and Living in Advanced Age, a Cohort Study in New Zealand, known as LiLACS NZ, is a longitudinal cohort study that aims to determine the predictors of successful advanced ageing and understand the trajectories of health and wellbeing in a Māori and non-Māori New Zealand population in advanced age.

This report supplements Section Five of the main report from LiLACS NZ, *Health, Independence and Caregiving in Advanced Age: Findings from LiLACS NZ*, available at: https://www.fmhs.auckland.ac.nz/en/faculty/lilacs.html.

Section Five of that report examines how the presence of depression affects people and the services they use when they also have the most common physical health conditions of advanced age (namely cardiovascular disease, chronic lung disease and diabetes mellitus).

The aim of the LiLACS NZ research described in this supplementary report is to establish how the presence of dementia affects people and the services they use when they also have cardiovascular disease, chronic lung disease and diabetes mellitus.

LiLACS NZ: a longitudinal study of advanced ageing

A total of 421 Māori (42% men) and 516 non-Māori (46% men) constitute the two inception cohorts of LiLACS NZ. Interviews and assessments began in 2010 with annual follow-up over the subsequent five years (data collection ‘waves’).

The study was approved by the Northern Regional Ethics Committee (NXT 09/09/088) in 2009**.**

LiLACS NZ dementia sub-study

Each wave of LiLACS NZ gathered data on cognitive function from participants who completed full questionnaires. Participants completed the Modified Mini Mental State Examination (3MS), a validated screening test for dementia.

A validation sub-study examined the performance of the 3MS against a clinical dementia assessment. A cut-off score of 80 for Māori and 84 for non-Māori was established as most accurately differentiating between those with and without dementia. The complete LiLACS NZ

dataset for Waves 1 to 4 was then analysed, with those below these cut points considered to be likely to have dementia.

Material for this report is taken from the first four waves of LiLACS NZ data collection, as well as from some additional public data sources. Cognition scores were obtained for 387 Māori and 504 non-Māori with varying numbers of participants having data on other relevant indicators. Analyses in this report are cross-sectional for each of the four waves of the study and include all those who had relevant data.

Quotes from participants are included in this report to add a personal voice to the data. The quotes are drawn from the Wave 3 questionnaire where we asked what the highlights of this stage of life were for the participants.

Key findings

- Dementia was present in 16 percent of LiLACS NZ participants at Wave 1, with no significant differences in prevalence between Māori and non-Māori nor between women and men.
- Dementia was present in 26 percent of LiLACS NZ participants at some time in the study. Dementia was associated with lower functional status, higher frailty, poorer mental and physical health-related quality of life and higher health service use and cost.
- Cardiovascular disease (CVD) was the most prevalent of the four conditions examined. More than 50 percent of participants had CVD without dementia and around 10 percent had both dementia and CVD. Participants with the combination of dementia and CVD had lower functional status and more frailty than those with either of the conditions alone. Participants with both dementia and CVD had significantly lower mental and physical health-related quality of life. Dementia associated with CVD increased health service use and costs.
- Thirty percent of participants had chronic lung disease (CLD) and around 10 percent had both dementia and CLD. Dementia increased the association of CLD with lower functional status and frailty and poorer quality of life. Participants with both dementia and CLD had increased health service use and costs.
- More than 20 percent of participants had diabetes mellitus (DM) and 4 percent had both dementia and DM. Dementia increased the association of DM with lower functional status and frailty and poorer quality of life. Participants with both dementia and DM had increased health service use and costs.
- The combination of dementia with a physical health condition worsened health status and increased health service use and costs.

1. Introduction and methods

1.1 Background

People aged 85+ in New Zealand have the highest rate of hospitalisation and preventable hospital admissions[1,2] and receive more health and disability support per capita than any other age group.[3] Over the next two decades the proportion of the population aged 85+ will rise from 1 percent to 6 percent, the fastest growth of any age group. During any year, one in ten of this group will die, one in five will be hospitalised for cardiovascular disease[4] and almost half will use residential care before their death.[5–9] LiLACS NZ data suggest that despite increasing frailty and co-morbidities, most of those in advanced age live independently in the community. Multi-morbidity is ubiquitous in advanced age, with 93 percent of LiLACS NZ participants having two or more diagnosed health conditions.

This supplementary report highlights several common health conditions of advanced age (namely cardiovascular disease, chronic lung disease and diabetes mellitus) and examines their impact on functional status, frailty, quality of life and health service use when dementia symptoms are also present. It follows the same format as Section Five of our main research report *Health, Independence and Caregiving in Advanced Age: Findings from LiLACS NZ*, available at: https://www.fmhs.auckland.ac.nz/en/faculty/lilacs.html. That section examined how the presence of depression affects people and the services they use when they also have these common physical health conditions.

The level of disability experienced by people with chronic conditions is heightened by co-morbidities, particularly when physical and mental health conditions are experienced together. Greater knowledge of the prevalence of these conditions and how they interact will assist clinicians and planners to understand health complexities and impacts amongst Māori and non-Māori people in advanced age. New knowledge can potentially alter treatment and/or management plans for the common conditions examined, as well as for the mental health conditions (depression and dementia) studied in our research. Similarly, conditions existing in isolation may be managed differently than co-morbid conditions.

1.2 Dementia

Dementia is a significant mental health problem for people in advanced age[10,11] and, along with co-morbidities and frailty, has been shown to be strongly related to functional status, quality of life and transitions in health status for older people.[12] The prevalence of dementia in New Zealand has not been comprehensively examined and dementia amongst Māori has not been studied.

‘To me memories are wonderful, memories going back, collecting up memories with old friends and family, making connections and talking.’

The strongest risk factors for dementia include age and genetic predisposition; however, education, hypertension, diabetes mellitus, atrial fibrillation, carotid artery disease, obesity, and hyperlipidaemia contribute to the risk of both vascular dementia and Alzheimer's disease.[13] Cardiovascular risk factors for dementia are more prevalent in older Māori and have been shown in the LiLACS NZ data. Socioeconomic inequalities are well documented for Māori and have been shown in LiLACS NZ.[14] Socioeconomic deprivation increases the impact of dementia on whānau, families and persons with dementia.

As dementia increases in prevalence with age, demographic ageing projections suggest that dementia will increase in prevalence internationally[10] and in New Zealand over the next 20 years.[15] The prevalence of dementia in Māori may increase even more rapidly as the Māori population is more rapidly ageing.

1.3 Common health conditions of advanced age

Cardiovascular disease (CVD) is frequent in advanced age. Co-morbidity with CVD is very common. One study found that around 15 percent of older people with heart failure had one or two co-occurring conditions, one-third had three or four, and *half* had five or more co-occurring conditions.[16] Thus the 'single disease' framework for primary care is challenged and it may be that considering combinations of disease is as important for the primary care health practitioner as looking at any single disease.[17]

Disparities in risk factors for and outcomes from CVD for Māori are documented[18] and socioeconomic inequalities in mortality persist into old age.[19] LiLACS NZ data shows that congestive heart failure and atrial fibrillation are more prevalent amongst Māori.[20]

Chronic obstructive lung disease (CLD) is one of the most common of the major respiratory diseases.[21] Historically, smoking prevalence differs between Māori and non-Māori and one of the consequences of this is that more older Māori suffer from respiratory disease. LiLACS NZ data show that CLD is more common amongst Māori.[14]

Diabetes mellitus (DM) is more frequent in older ages. DM is twice as prevalent amongst Māori compared to non-Māori and 1.4 times as prevalent amongst men compared to women. It is nearly twice as common in areas of the highest socioeconomic deprivation.[22] DM is also more prevalent amongst Māori in LiLACS NZ.[14]

1.4 Methods

Full details of engagement and recruitment to LiLACS NZ are presented in *Health, Independence and Caregiving in Advanced Age: Findings from LiLACS NZ*, available at: https://www.fmhs.auckland.ac.nz/en/faculty/lilacs.html. In brief, a bicultural longitudinal cohort study of advanced ageing was initiated in 2010 after a feasibility study,[23] engagement with communities and organisations, and development of comprehensive interview and assessment schedules.

All Māori aged 80 to 90 years and non-Māori aged 85 years living in the Bay of Plenty and Lakes District Health Board (DHB) areas (excluding the Taupō area) were invited to participate in the study. The first wave enrolled 937 people, 421 Māori and 516 non-Māori. There were 244 Māori women and 177 Māori men (42% Māori men); 279 non-Māori women and 237 non-Māori men (46% non-Māori men). Each year some people left the study through death, ill-health or by choice.[24] By Wave 4, a total of 438 (47% of Wave 1) people were interviewed. This comprised

161 Māori (39% of Wave 1) and 276 non-Māori (54% of Wave 1). Figure 1.1 in the *Health, Independence and Caregiving in Advanced Age* report gives full details of study attrition.

All participants in LiLACS NZ completed a short 'core' questionnaire and most completed a much longer 'full' questionnaire by interview (refer to the LiLACS NZ website and publications for full details of data-gathering processes). Informed consent was obtained from participants before data collection proceeded. Appendix 1 of this report shows the LiLACS NZ questionnaire items that were used in this report and Table 1 (Appendix 4) shows the number of participants contributing data for each of a number of health and health service indicators over the four years of data collection.

Permission to access Ministry of Health data on hospitalisations based on matching the National Health Index number was sought and given by 380 Māori and 498 non-Māori.

Analyses are cross-sectional for each of the four waves of the study and include all those who had relevant data. Generalised linear models were used for analysis of potentially significant predictors of outcomes and controlled for age, ethnic group, sex and socioeconomic deprivation.

1.4.1 Diagnosis of dementia

Every year those who undertook the full interview completed the Modified Mini Mental State Examination (3MS),[25,26] a validated screening test for dementia. The 3MS gives a score out of 100, with a lower score meaning that the participant's cognition is worse and they are more likely to have dementia. A full dementia assessment conducted by a clinician was not possible with all participants but was completed on a subset. Their 3MS scores were compared to their clinical diagnosis to establish the level of accuracy or validity of the 3MS. This sub-study was specifically conducted to validate the 3MS cut-off scores for the Māori and non-Māori enrolled in LiLACS NZ (Appendix 2). The sub-study established that cut-off scores of 80 for Māori and 84 for non-Māori were the most accurate to differentiate between those with and without dementia. The data presented here use these cut points as the indicator of dementia.

1.4.2 Diagnosis of chronic conditions

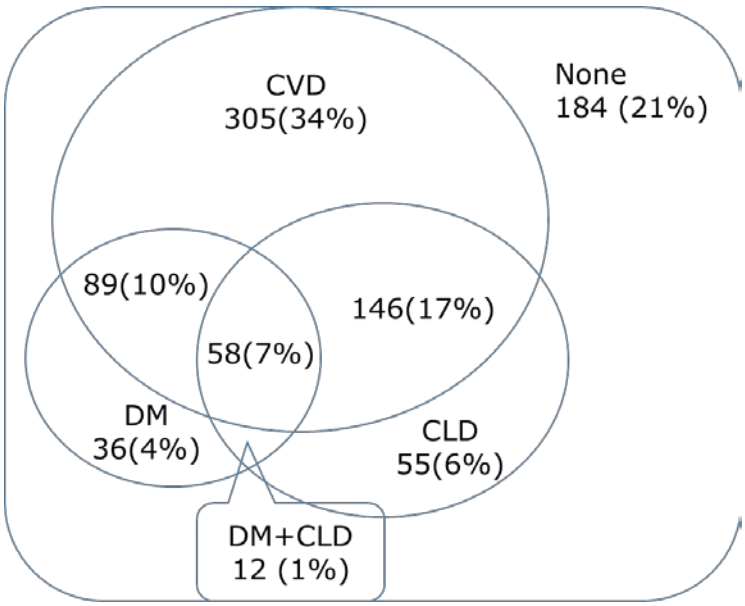
To identify those who had CVD, LiLACS NZ used information from the participant's self-report, a GP record review and diagnoses from hospital records. An algorithm was used to combine self-report, GP record review and hospitalisations data to ascertain 15 diagnoses.[24] In Wave 1 of LiLACS NZ we found that 22 percent had prior myocardial infarction, 14 percent prior stroke, and 15 percent heart failure. Overall, 67 percent of LiLACS NZ participants were found to have CVD.[20]

For CLD, participants were asked if they had chronic obstructive lung disease or emphysema or asthma. Similar data were obtained from a GP record review. These diagnoses were combined to make up the category of CLD, for which smoking is a major identifiable cause.

DM was diagnosed in LiLACS NZ by any one of the following: self-report, GP record review, diagnosis from hospital records or if the LiLACS NZ blood test examining glucose and HbA1c indicated that DM was present.

Of participants with data on these three conditions in Wave 1, 184 (21%) had none of the three conditions, 305 (34%) had CVD only, and 58 (7%) had all three conditions (Figure 1-1). Thirty-five percent had comorbidity amongst the conditions.

Figure 1-1: Overlap between the conditions of cardiovascular disease, chronic lung disease and diabetes mellitus, Wave 1



Source: LiLACS NZ

Note: CVD = Cardiovascular disease, CLD = chronic lung disease, DM = diabetes mellitus.

1.4.3 Health and health service use indicators

For this report a number of health indicators and health service use indicators are analysed against dementia alone and for dementia in relation to CVD, CLD and DM.

The health indicators are functional status (using the Nottingham Extended Activities of Daily Living Scale, NEADL);[27] frailty (using the Fried phenotype[28] which defines frailty as having three of five key deficits: slowness, weakness, weight loss, fatigue and low activity); and physical and mental health-related quality of life (HRQOL).[29]

The health service use indicators are GP visits (the percentage of participants making more than four visits to their GP per annum); hospital admissions (rates per person per year); length of hospitalisation (nights in hospital per person per year); and costs of hospitalisation (given in 2015-16 NZ dollar equivalent). Hospitalisation costs were calculated by multiplying the cost weights given by the Ministry of Health by 4751.58 to give 2015-16 dollar equivalent amounts.

Most of the analyses in this section use data from both the Māori and non-Māori cohorts instead of separating them as was done in other sections of the LiLACS NZ *Health, Independence and Caregiving in Advanced Age* report. Analysing the cohorts together enables greater statistical power and where differences between the ethnic groups are notable, separate results are presented.

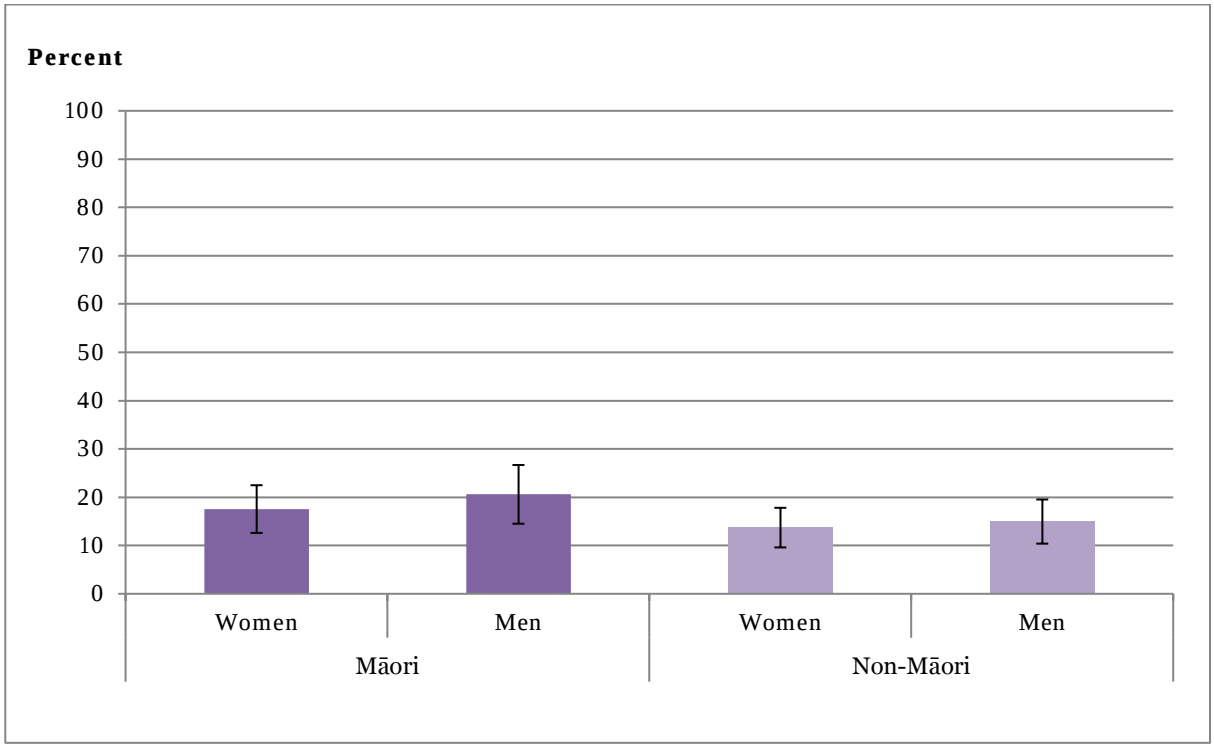
2. Dementia and common health conditions: Findings

2.1 Dementia

2.1.1 Dementia was present in 16 percent of LiLACS NZ participants at Wave 1, with no significant differences in prevalence between Māori and non-Māori nor between women and men

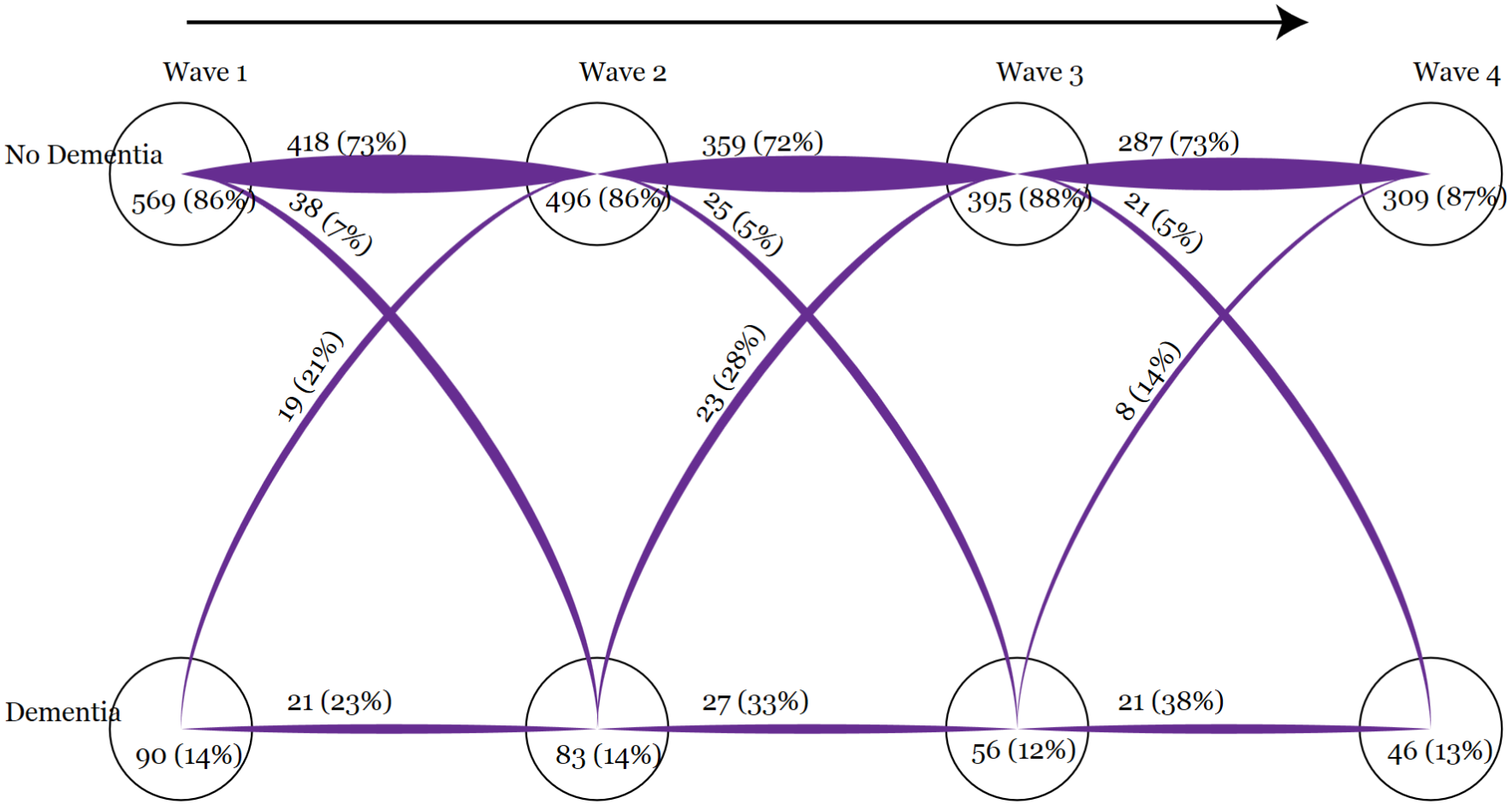
LiLACS NZ participants completed the 3MS[26] in each wave of the study. The scale gives a score out of 100, a higher score indicating better cognition. For the purposes of this report, a score of 80 or less for Māori and 84 or less for non-Māori (established by the validation sub-study) indicates a significant likelihood that the participant has dementia. Such scores are referred to as 'dementia' and scores higher than these levels are considered 'no dementia'. In Wave 1, 16 percent of all participants (19% of Māori and 14% of non-Māori) scored in the dementia range (Figure 2-1 below; and Table 2 in Appendix 4). There was *no significant difference* in the prevalence of dementia between Māori and non-Māori, adjusting for age, sex and socioeconomic deprivation. Fifteen percent of women and 17 percent of men had dementia, which was *not significantly different*. Dementia did not vary by socioeconomic deprivation.

Figure 2-1: Dementia prevalence by sex and ethnic group, Wave 1



Source: LiLACS NZ
Note: Proportion scoring in the range meaning they are likely to have dementia on the Modified Mini Mental State Examination: 80 or less for Māori, 84 or less for non-Māori, Wave 1.

Figure 2-2: Transitions in dementia over time, Waves 1 to 4



Source: LiLACS NZ
Note: 'Dementia' denotes a score of 80 or less for Māori or 84 or less for non-Māori on the 3MS cognition scale, associated with significant likelihood of dementia diagnosis. The number of people scoring in the range indicating dementia and no dementia are shown with the diagonal lines indicating the number (and percent of group of origin) transitioning between. Numbers do not add to totals as some participants died or dropped out.

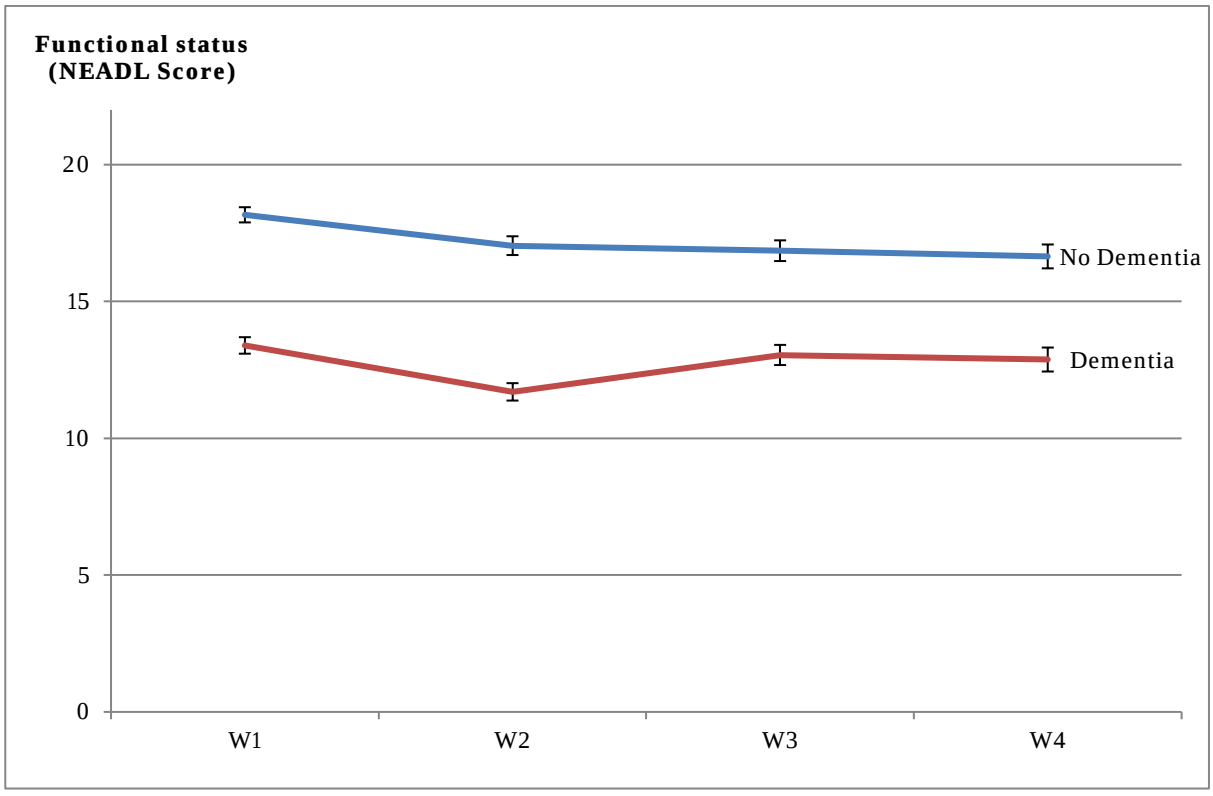
2.1.2 Dementia was present in 26 percent of LiLACS NZ participants at some time in the study; some of those with scores in the dementia range improved over time

Over time the proportion of participants with no dementia stayed steady at approximately 87 percent. There were changes for individuals, with up to 28 percent of those who scored in the dementia range improving their scores at a later interview. Cognitive assessment can vary with co-occurrence of acute illness and sometimes people will score lower than usual at times of illness. On the other hand, the condition of dementia is characterised by a consistent decline in cognitive function. Therefore the assessment of cognition with a screening tool is a snapshot in time. A diagnosis requires a clinical assessment by a dementia expert and we were able to conduct a clinical assessment only for some participants during the validation study. There were some people in the LiLACS NZ study whose scores improved over time, fewer than those whose scores declined. Across all waves, dementia was present in 26 percent of participants at some time. Figure 2-2 shows the transitions in dementia over time.

2.1.3 Dementia was associated with lower functional status, higher frailty and poorer mental and physical health-related quality of life (HRQOL)

Participants with dementia had *significantly lower* functional status, as measured by NEADL scores, adjusting for age, ethnic group, sex and socioeconomic deprivation. This difference was maintained over Waves 1 to 4 of the study (Figure 2-3 summarises the difference, Table 3 in Appendix 4 shows the data for ethnic group and sex).

Figure 2-3: Dementia and functional status (mean NEADL scores), Waves 1 to 4



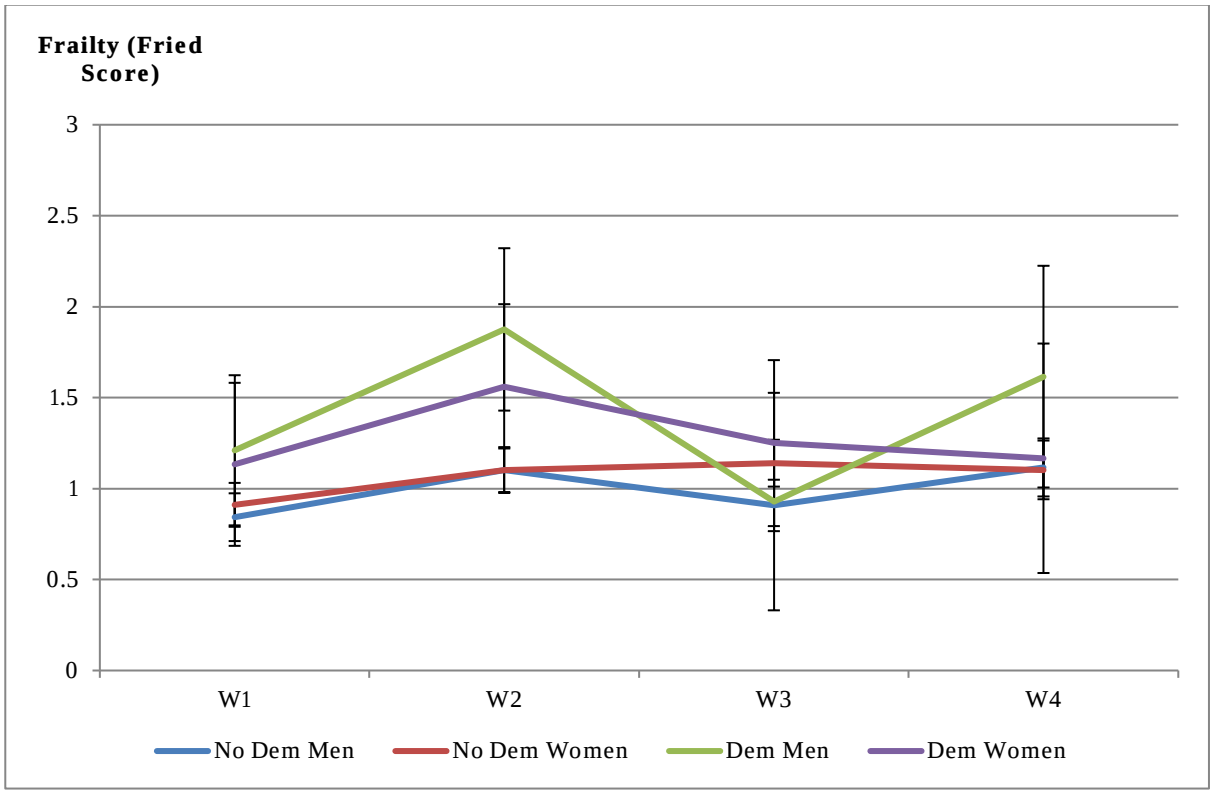
Source: LiLACS NZ
Note: NEADL = Nottingham Extended Activities of Daily Living Scale, higher score is better function.

The relationship between dementia and functional status *did not significantly vary* by ethnic group, sex or socioeconomic deprivation, adjusting for age (Table 3). Māori and men had lower scores overall.

Participants with dementia had *significantly greater* Fried scale scores (more frailty), adjusting for age, ethnic group, sex and socioeconomic deprivation (Figure 2-4 shows the Fried scores by sex, Table 3 in Appendix 4 shows the scores with ethnic group, age and socioeconomic data).

Quality of life, both physical and mental, was *significantly lower* for participants with dementia than for those without. But there were *no significant differences* in the pattern of HRQOL scores by dementia between Māori and non-Māori nor by socioeconomic deprivation, adjusting for age and wave of the study (Table 3). Physical HRQOL was *significantly lower* for women.

Figure 2-4: Dementia and frailty by sex, Waves 1 to 4



Source: LiLACS NZ
Note: Dem = dementia.

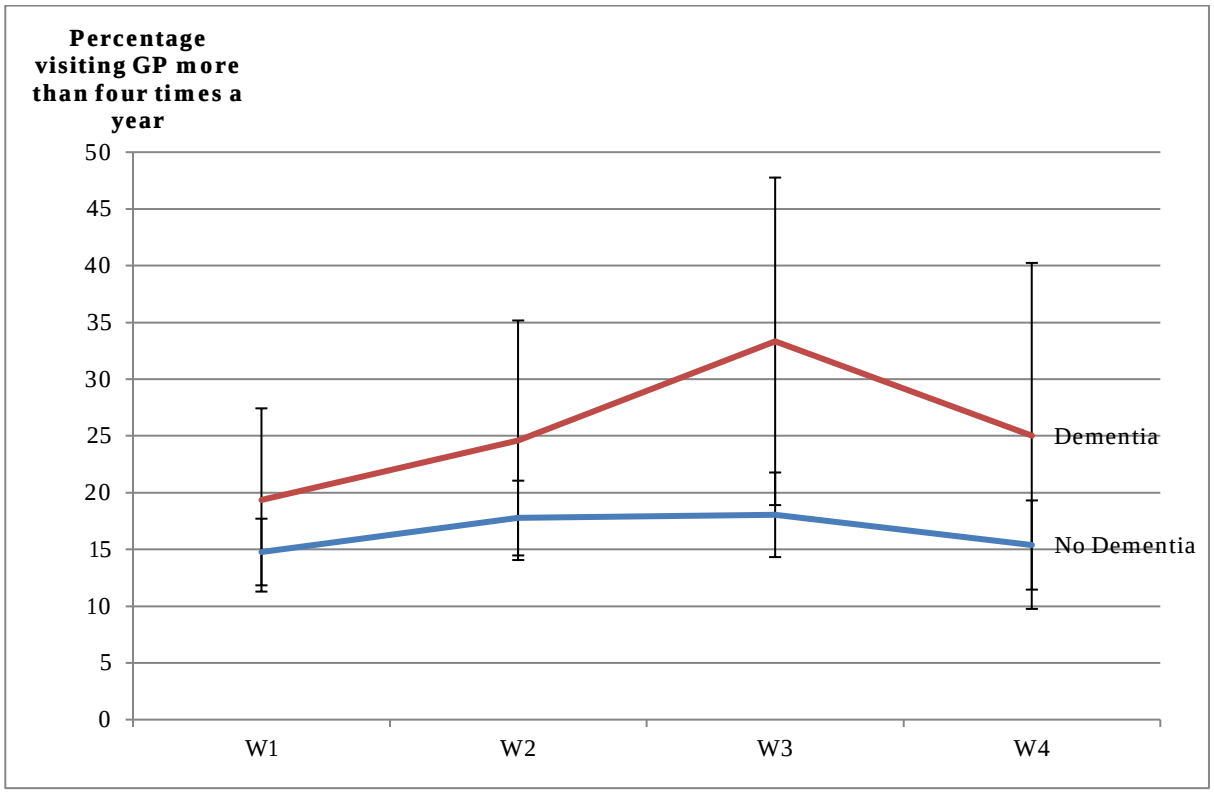
'Immense challenge of caring for my wife who needs 95% support owing to advancing memory loss.'

2.1.4 Dementia was associated with higher health service use and cost

Participants with dementia made *significantly more* GP visits than those without dementia in each of the four waves of the study, adjusting for age, ethnic group, sex and wave of the study (Figure 2-5, Table 3). This was most marked in Wave 3, where the percentage of participants with dementia who visited their GP more than four times a year was double that of those without dementia.

The relationship between dementia and GP visits *did not significantly vary* between Māori and non-Māori, adjusting for age and sex, nor between women and men, adjusting for age and ethnic group. Participants living in areas of high socioeconomic deprivation visited the GP *significantly more* than those living in areas of low socioeconomic deprivation, adjusting for ethnic group, sex and the presence of dementia.

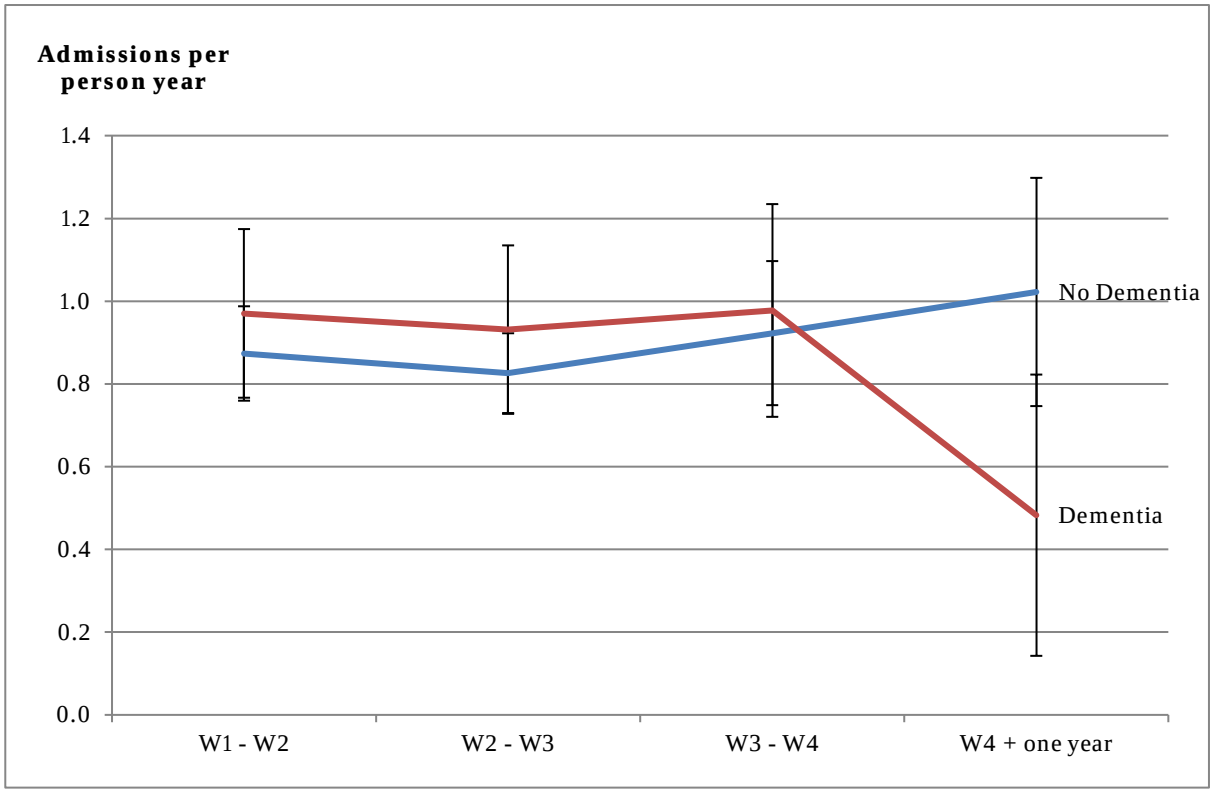
Figure 2-5: Dementia and multiple GP visits, Waves 1 to 4



Source: LiLACS NZ

There was *no significant difference* in the number of hospital admissions between those with dementia and those without dementia, adjusting for age, ethnic group, sex and wave of the study (Figure 2-6, Table 4). In Wave 4, 39 people had dementia and their rate of hospitalisation dropped. This may be due to the low numbers left in the sample by Wave 4 or it may be that those with a later stage of dementia were less likely to be admitted to hospital. It is most likely due to small sample size or this effect would have been seen in earlier periods.

Figure 2-6: Dementia and hospital admission rates, Waves 1 to 4



Source: LiLACS NZ

Participants with dementia had *significantly longer* stays in hospital than those without dementia (7.8 nights per person year across the study compared to 4.5 nights per person year) (Table 5). Men had longer stays in hospital than women and Māori had longer stays than non-Māori, adjusting for age and wave of the study. The length of stay did not vary by socioeconomic deprivation, adjusting for age and wave of the study.

Longer stays in hospital meant increased costs for participants with dementia (Table 6). Across the study, the hospitalisation costs per year were $6,396 for participants with dementia and $4,429 for participants without dementia.

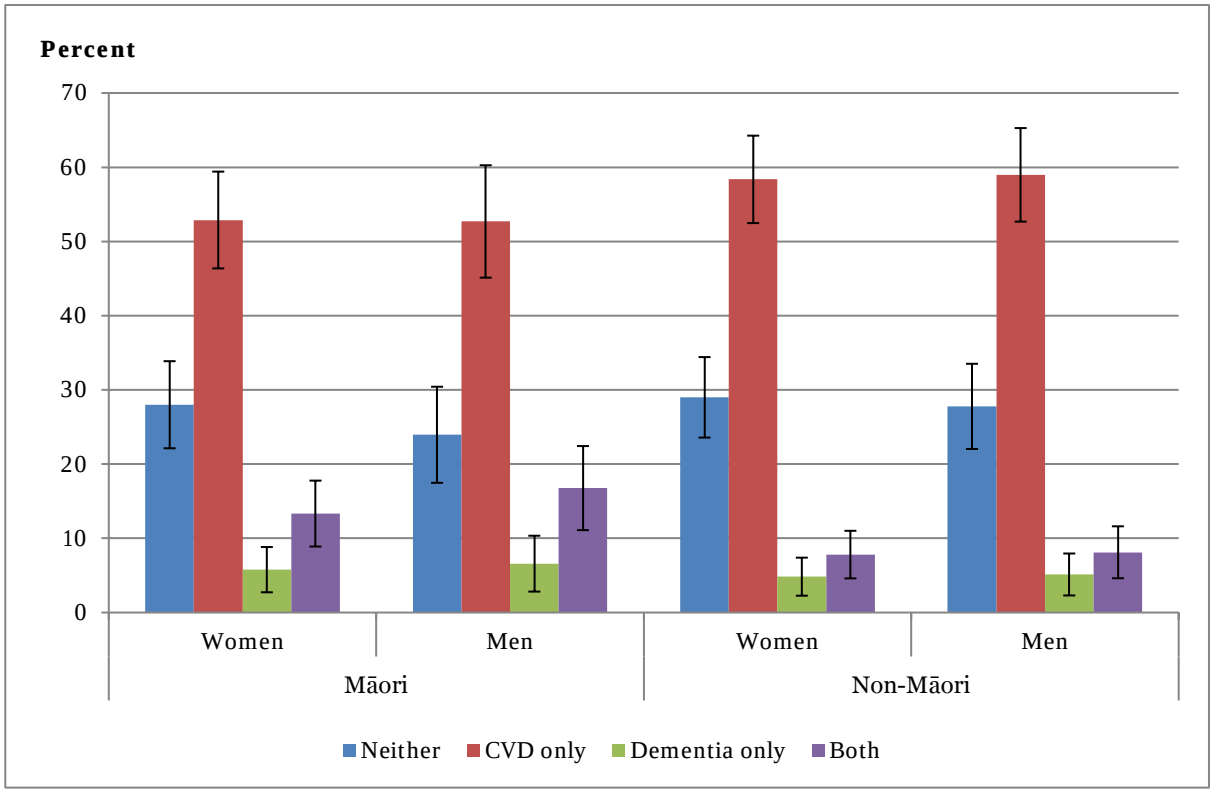
2.2 Cardiovascular disease and dementia

2.2.1 More than 50 percent of participants had cardiovascular disease (CVD) with no dementia and around one in ten had both dementia and CVD

At Wave 1, 28 percent of participants had neither dementia nor CVD and around 10 percent had both dementia and CVD (15% for Māori and 8% for non-Māori, Figure 2-7, Table 7). Neither sex nor ethnic group were significant predictors of having CVD plus dementia.

Most participants had CVD only (53% of Māori women, 53% of Māori men, 58% of non-Māori women and 59% of non-Māori men) and 5 percent had dementia without CVD.

Figure 2-7: Dementia and cardiovascular disease by ethnic group and sex, Wave 1



Source: LiLACS NZ
Note: CVD = cardiovascular disease.

2.2.2 Participants with the combination of dementia and CVD had lower functional status and more frailty than those with either of the conditions alone

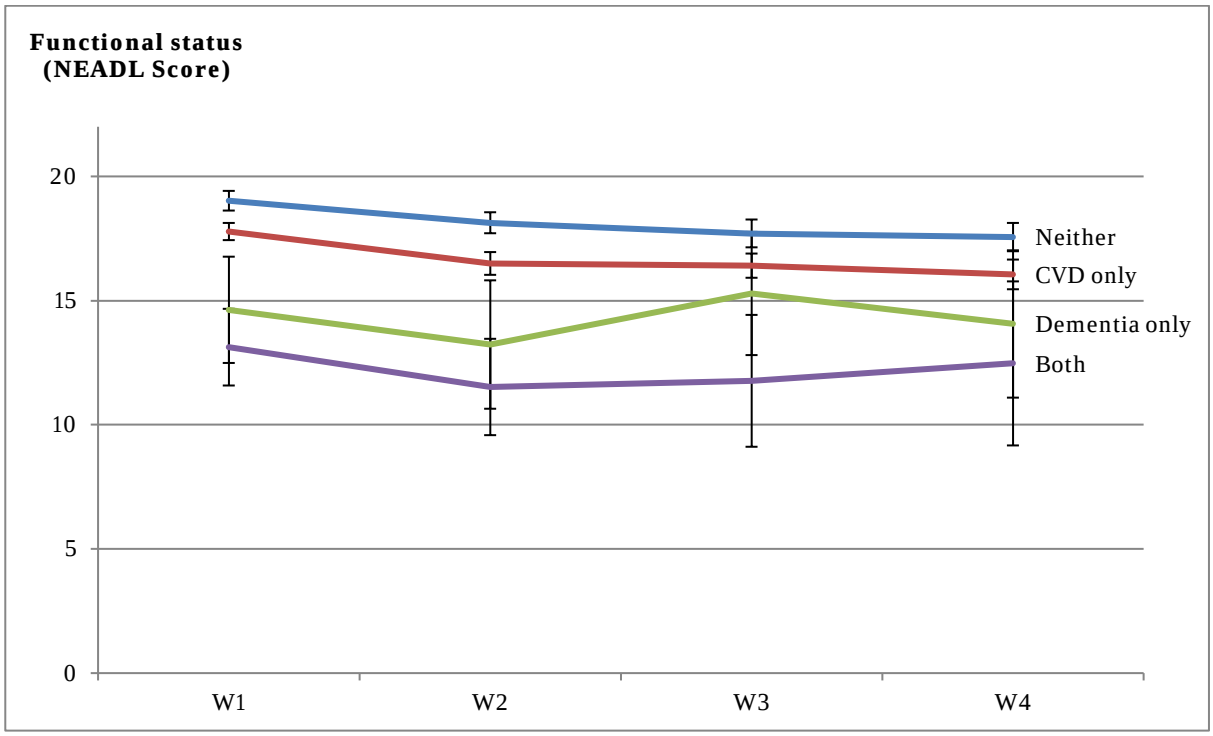
Participants with neither dementia nor CVD had *significantly higher* functional status compared to those with either dementia or CVD. Participants with both dementia and CVD had *significantly lower* functional status than the other groups (Figure 2-8, Table 8). Dementia was more strongly associated with functional status than CVD, when adjusted for age, ethnic group, sex, socioeconomic deprivation and wave of the study.

There was *no significant difference* in the dementia/CVD-related differential in functional status between Māori and non-Māori, women and men, nor by socioeconomic deprivation, adjusting for age, ethnic group, sex and wave of the study (Table 8).

Overall, frailty varied *significantly* with the presence or absence of dementia and CVD (Figure 2-9, Table 8). Participants with both dementia and CVD were *significantly more likely* to be frail than those with neither, adjusting for age, ethnic group, sex and wave of the study. However, this difference varied over time. The increased frailty with dementia was most prominent in Waves 1 and 2.

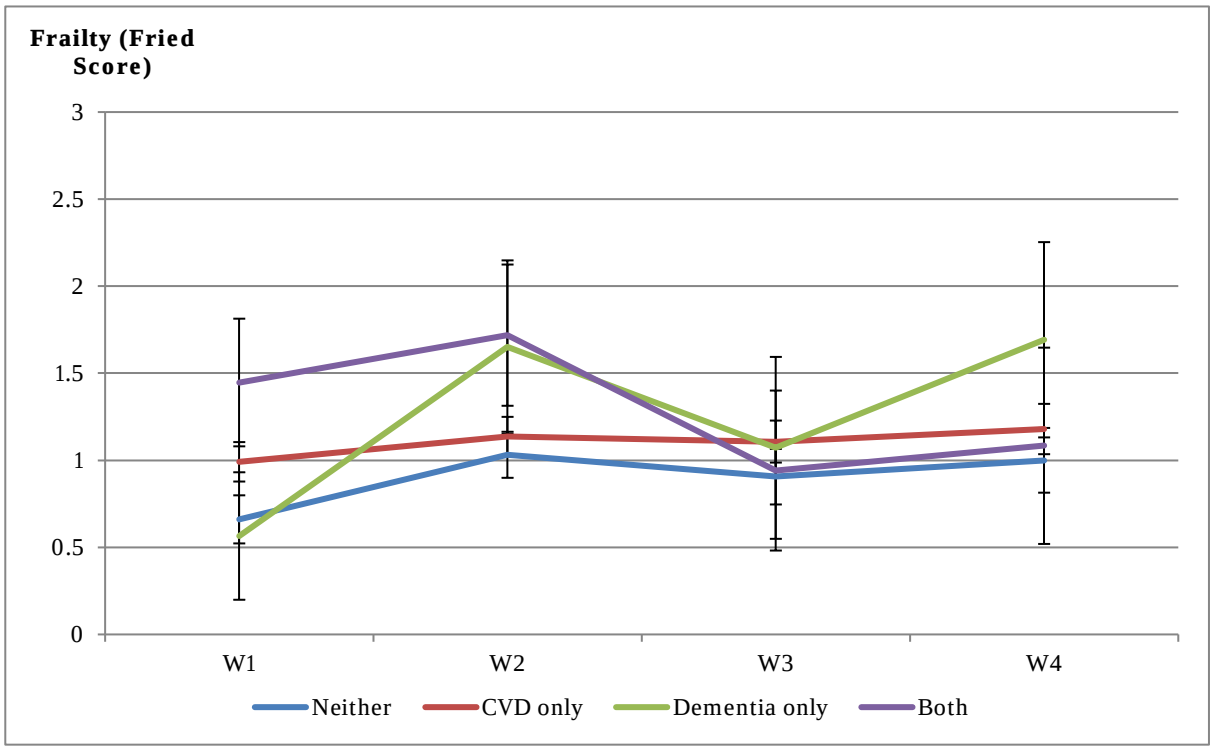
There was *no significant difference* in the dementia/CVD-related differential for frailty scores between Māori and non-Māori, women and men, nor by socioeconomic deprivation, adjusting for age, ethnic group and sex (Table 8).

Figure 2-8: Dementia and cardiovascular disease by functional status (NEADL score), Waves 1 to 4



Source: LiLACS NZ
Note: CVD = cardiovascular disease. NEADL = Nottingham Extended Activities of Daily Living Scale, higher score is better function.

Figure 2-9: Dementia and cardiovascular disease by frailty, Waves 1 to 4



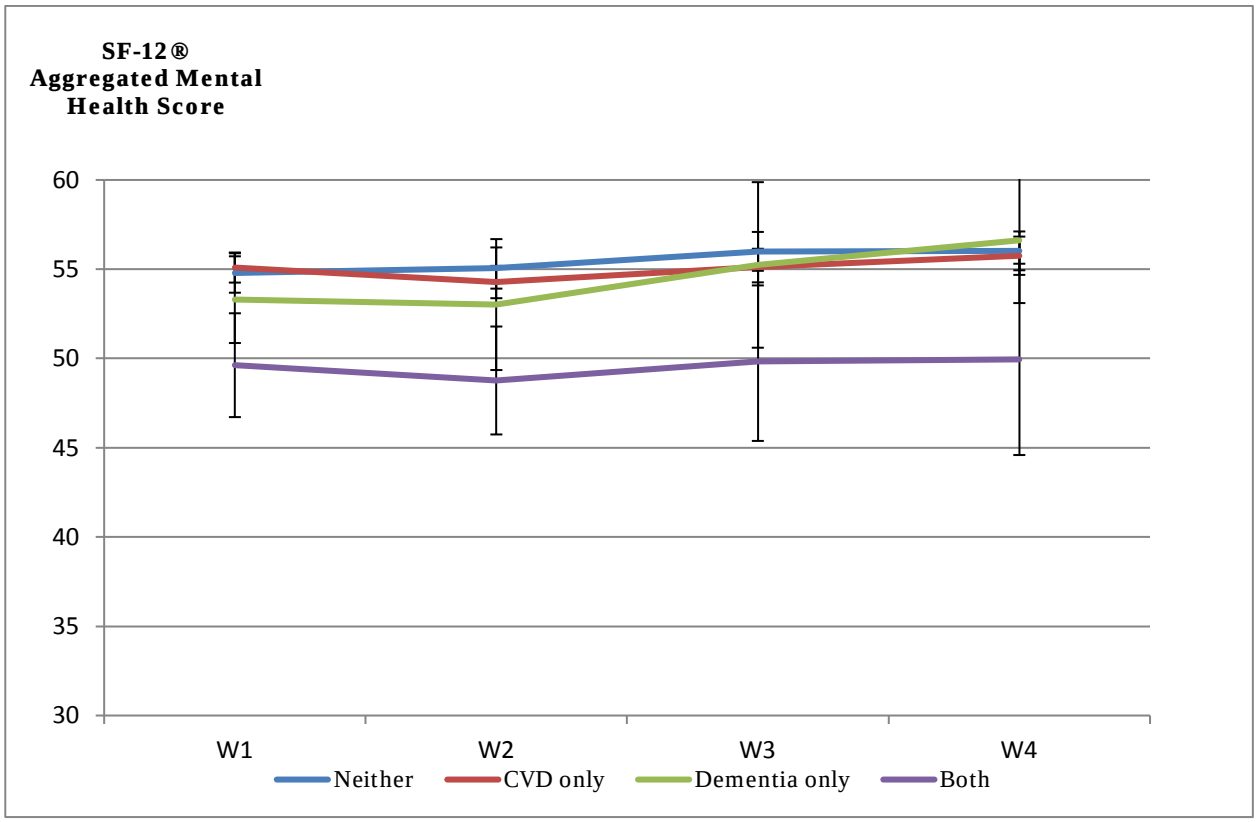
Source: LiLACS NZ
Note: CVD = cardiovascular disease.

2.2.3 Participants with dementia and CVD had significantly lower physical and mental HRQOL

Participants with both dementia and CVD had *significantly lower* physical HRQOL compared to those with either dementia or CVD only or neither condition (Table 8).

Participants with both dementia and CVD had *significantly lower* mental health-related quality of life compared to those with either dementia or CVD only or neither condition (Figure 2-10, Table 8).

Figure 2-10: Dementia and cardiovascular disease and mental health-related quality of life (HRQOL), Waves 1 to 4



Source: LiLACS NZ
Note: CVD = cardiovascular disease.

2.2.4 Dementia associated with CVD increased health service use and costs

Participants with both dementia and CVD had significantly more GP visits than those with either dementia only or CVD only, adjusting for age, ethnic group, sex, and wave of the study (Table 8). Among the group with neither dementia nor CVD, fewer than 10 percent visited their GP more than four times per year (8%), whereas around 34 percent of those with both conditions visited their GP more than four times a year.

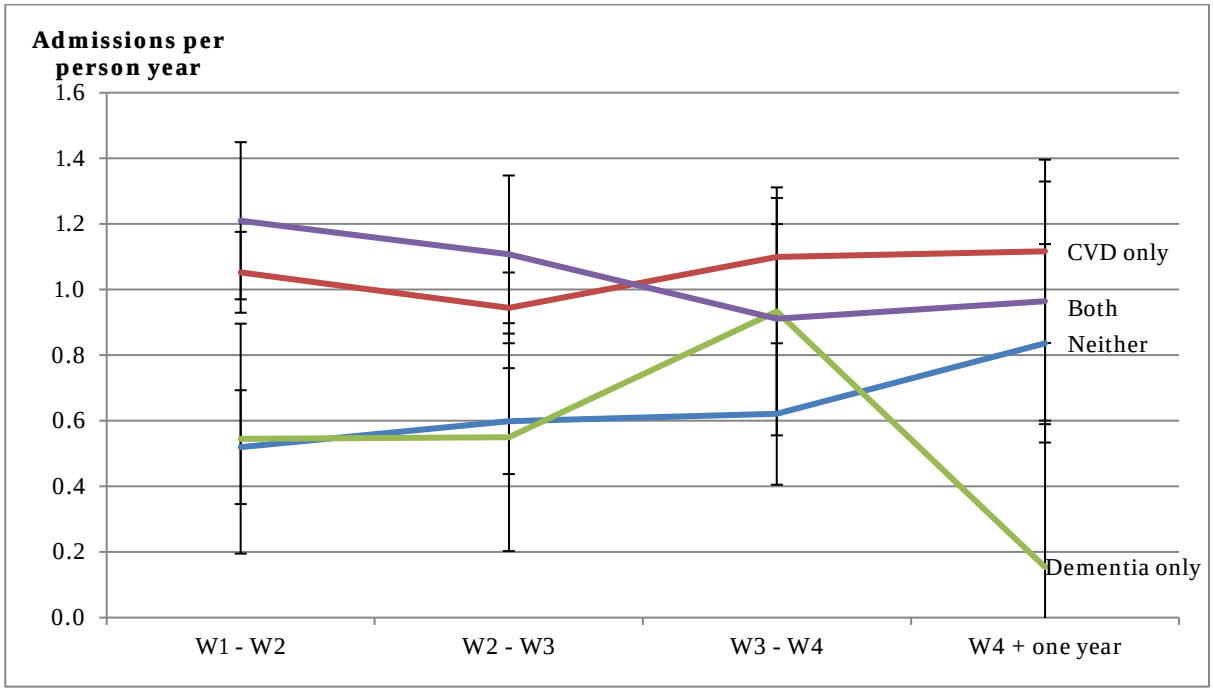
There was *no difference* in the dementia/CVD-related differential in GP visits between Māori and non-Māori, adjusting for age, sex and wave of study, nor between women and men,

adjusting for age, ethnic group and wave of the study. GP visits varied *significantly* by socioeconomic deprivation (Table 8).

In Wave 1, participants with neither dementia nor CVD and those with dementia only had less than half the rate of hospital admissions of those with CVD only or both conditions. This was a *significant difference* adjusting for age, ethnic group, sex and wave of the study (Figure 2-11, Table 9). There was *no difference* in this pattern of dementia/CVD-related hospital admissions between Māori and non-Māori, nor by socioeconomic deprivation, adjusting for age and wave of the study (Table 9).

Men had *significantly more* admissions than women. CVD was more closely associated with admission to hospital than was diagnosis of dementia.

Figure 2-11: Dementia and cardiovascular disease by hospital admissions, Waves 1 to 4



Source: LiLACS NZ
Note: CVD = cardiovascular disease.

In Wave 4 the rate of hospitalisations dropped for those with dementia. This could be due to a combination of factors, such as that those who had mild dementia in earlier data collection waves were more severe by Wave 4 and were receiving more care in place (both in residential care and in the family home), thus having fewer public hospital admissions for minor illnesses and injuries. This progression would also reduce the opportunity for self-injury (mainly unintentional), thus reducing the number of minor injuries needing hospital.

Participants with dementia and CVD not only had more hospital admissions, they also stayed *significantly longer* in hospital. On average they spent 10.7 nights per person year in hospital across all waves of the study compared to 3.1 nights for those with neither dementia nor CVD

(Table 10). Participants who had CVD alone had *significantly longer* lengths of stay than those with dementia alone (5.2 and 3.6 nights respectively).

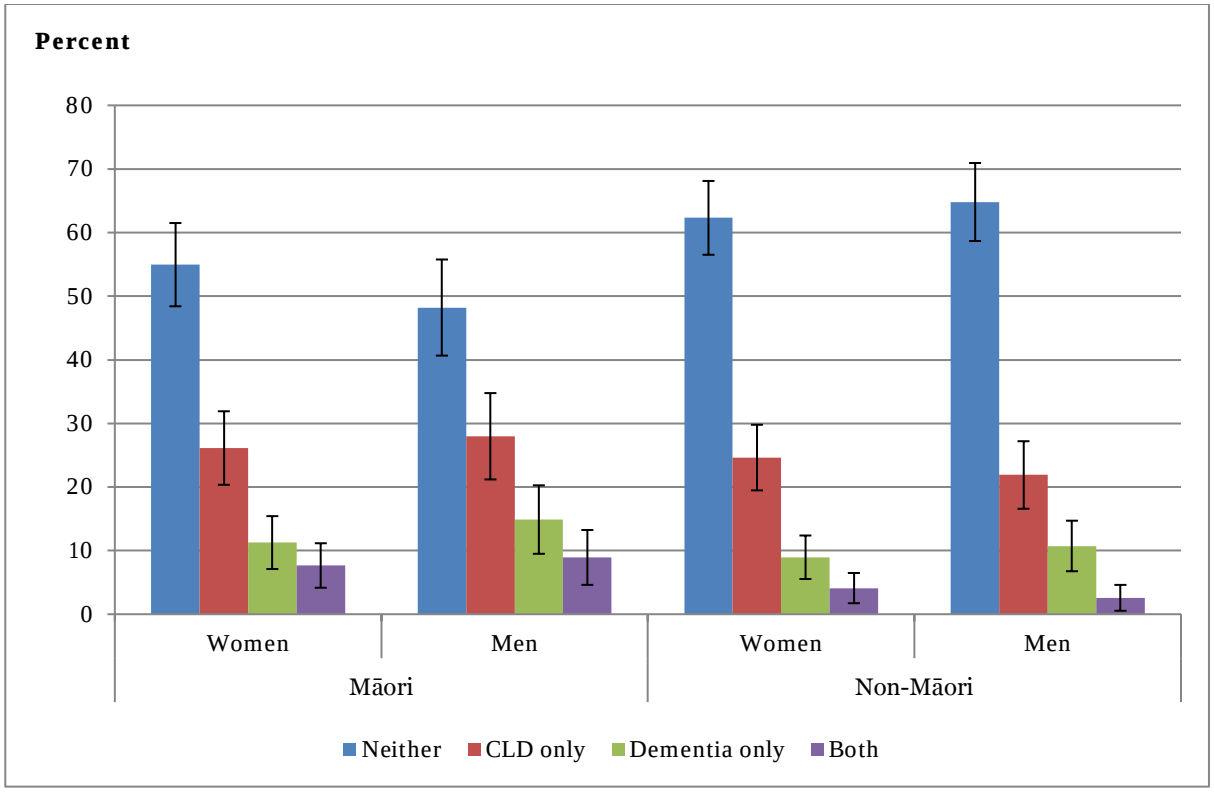
More frequent and longer hospitalisations meant costs were *significantly higher* for participants with dementia and CVD ($9,399 per person year over the study) than for those with just dementia ($3,621) or neither condition ($3,784). The diagnosis of CVD was the main driver of costs (Table 11).

2.3 Chronic lung disease and dementia

2.3.1 Thirty percent of participants had chronic lung disease (CLD) and around 10 percent had both dementia and CLD

CLD was less common amongst participants than CVD; 30 percent of participants had CLD in Wave 1 of the study. *Significantly more* Māori had CLD and s*ignificantly more* Māori had both dementia and CLD (7%) than did non-Māori (4%). There was *no significant difference* between women and men who had both dementia and CLD, with 6 percent of women and 5 percent of men having both conditions. Fifty-eight percent of participants had neither condition (Figure 2-12, Table 12).

Figure 2-12: Dementia and chronic lung disease by ethnic group and sex, Wave 1

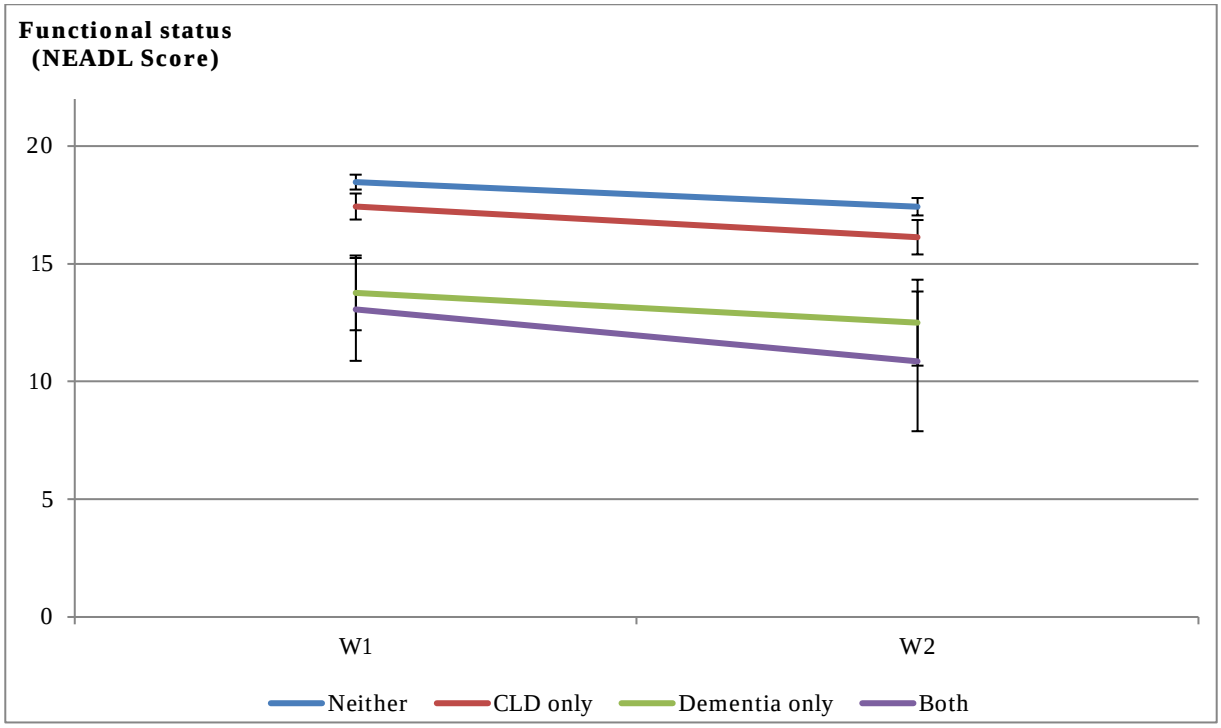


Source: LiLACS NZ
Note: CLD = chronic lung disease.

2.3.2 Dementia increased the association of CLD with lower functional status and frailty and poorer quality of life

There was a *significant difference* in functional status between those with both dementia and CLD and those with neither, adjusting for age, ethnic group, sex and wave of the study (Figure 2-13, Table 13). Participants with neither dementia nor CLD, as well as those with CLD only, had *significantly higher* functional status than those with both conditions or with dementia alone.

Figure 2-13: Dementia and chronic lung disease by functional status, Waves 1 and 2



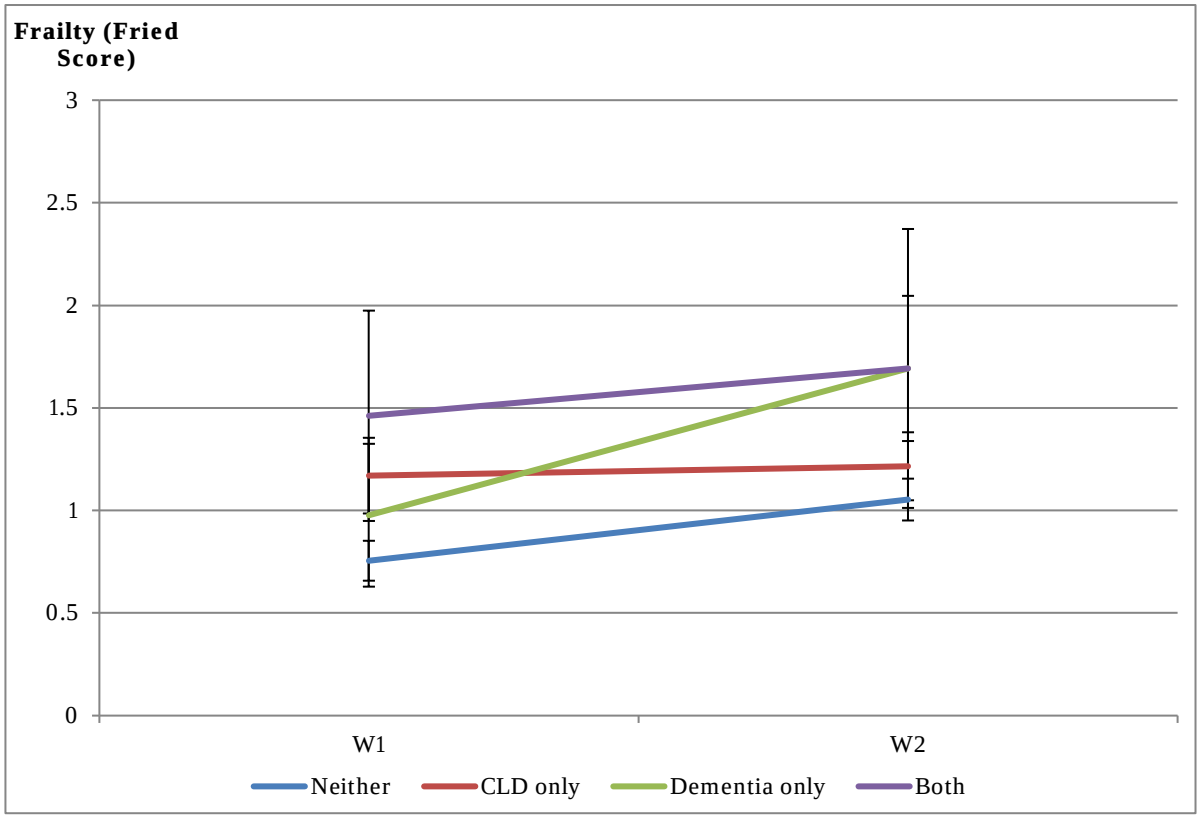
Source: LiLACS NZ
Note: CLD = chronic lung disease.

Overall, participants with neither dementia nor CLD, as well as those with only CLD, adjusting for age, ethnic group, sex and wave of the study, were *significantly less* frail than those with both conditions or with dementia alone (Figure 2-14, Table 13). The difference was more obvious in Waves 1 and 2. The small number of people with dementia only and with both conditions in Waves 3 and 4 makes it more difficult to see a difference.

Participants with dementia or dementia and CLD had *significantly lower* physical and mental HRQOL than those with CLD only or neither condition adjusting for age, ethnic group, sex, socioeconomic deprivation and wave of the study (Table 13).

Men had *significantly higher* physical HRQOL than women, adjusting for age, ethnic group, socioeconomic deprivation, wave of the study and presence of conditions (Table 13).

Figure 2-14: Dementia and chronic lung disease by frailty, Waves 1 and 2



Source: LiLACS NZ

Note: CLD = chronic lung disease.

2.3.3 Participants with dementia and CLD had increased health service use and costs

Participants with dementia and CLD were *significantly more likely* to visit GPs more than four times per annum than those with CLD only or those with neither condition (Table 13).

There was *no difference* in the dementia/CLD-related differential on GP visits between Māori and non-Māori, and women and men, nor by socioeconomic deprivation, adjusting for age, ethnic group and sex (Table 13).

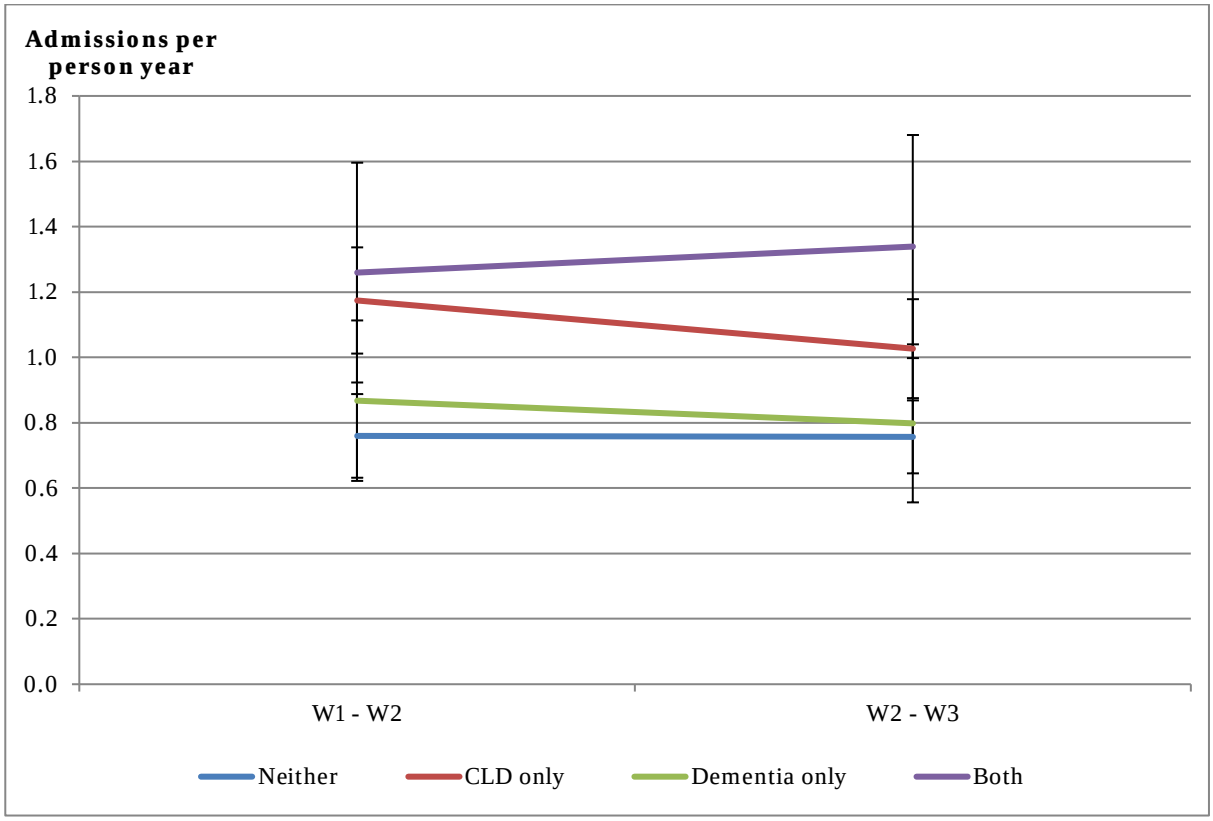
Figure 2-15 shows annual hospital admissions for people with or without dementia and CLD (Table 14). Those with neither condition had *significantly fewer* admissions per year than those with both conditions. The number of participants with both conditions was small in Waves 3 and 4 (Table 12) so it requires a stronger difference between the groups to prove statistical significance.

There was *no difference* in the pattern of dementia/CLD-related hospital admissions between Māori and non-Māori, nor by socioeconomic deprivation, adjusting for age, ethnic group, sex and wave of the study. Men had *significantly more* admissions than women, adjusting for age, ethnic group, socioeconomic deprivation, wave of the study and presence of conditions (Table 14).

Participants with neither dementia nor CLD had a *significantly shorter* length of stay in hospital than the other groups (Table 15).

More frequent and longer hospitalisations meant increased costs for participants with both dementia and CLD (averaging $7,497 per person year across the study) (Table 16). Costs of hospitalisation for those with dementia only ($6,904) and CLD only ($6,080) were *significantly less*.

Figure 2-15: Dementia and chronic lung disease by hospital admissions in following year, Waves 1 and 2



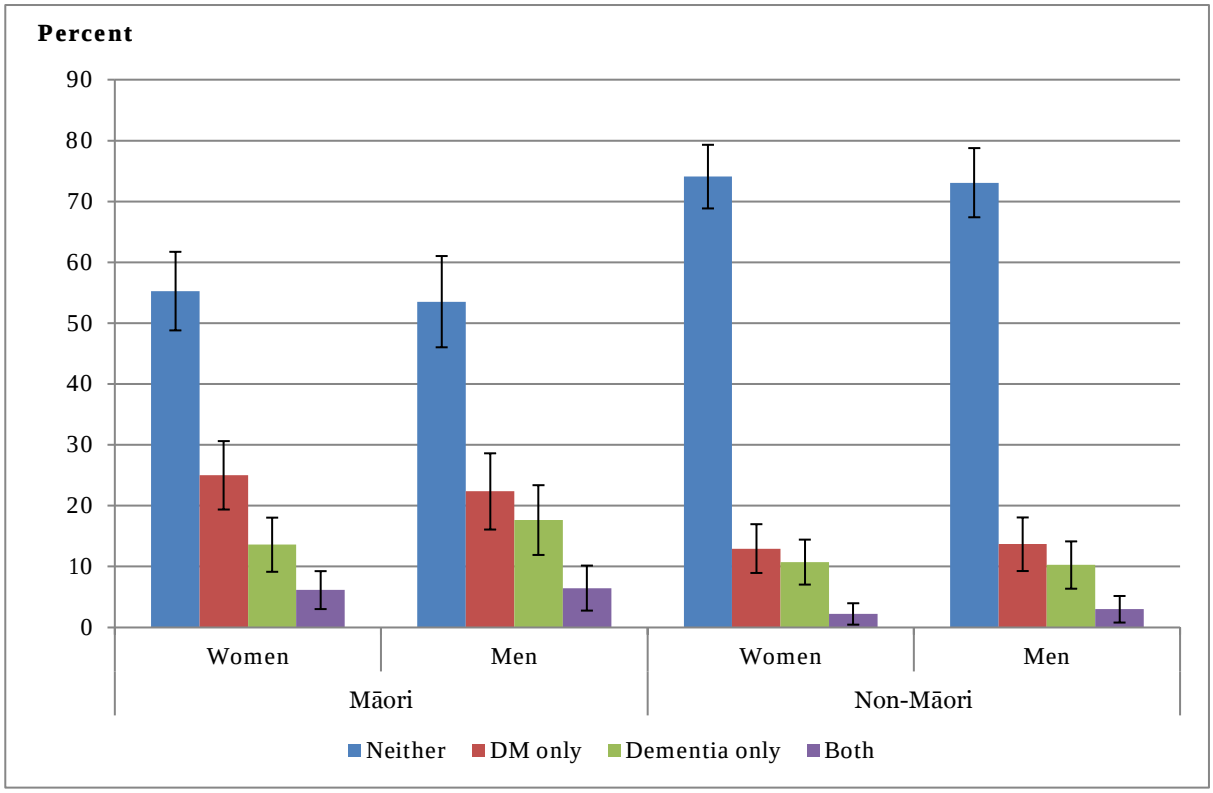
Source: LiLACS NZ
Note: CLD = chronic lung disease.

2.4 Dementia and diabetes mellitus

2.4.1 More than 20 percent of participants had diabetes mellitus (DM) and 4 percent had both dementia and DM

DM was also less common amongst participants than CVD. Twenty-two percent of participants in Wave 1 had DM, *significantly more* Māori (30%) than non-Māori (16%). There was no significant difference in the proportion of Māori who had both dementia and DM (6%) compared to non-Māori (3%). Four percent of women and 4 percent of men had both dementia and DM. Around 55 percent of Māori and 74 percent of non-Māori had neither condition (Figure 2-16, Table 17).

Figure 2-16: Dementia and diabetes mellitus by ethnic group and sex, Wave 1



Source: LiLACS NZ
Note: DM = diabetes mellitus.

2.4.2 Dementia increased the association of DM with lower functional status and frailty and poorer quality of life

Overall, participants with neither dementia nor DM, as well as those with DM only, had *significantly higher* functional status than those with both conditions or with dementia only, adjusting for age, ethnic group, sex and wave of the study (Figure 2-17, Table 18).

Non-Māori and women had *significantly higher* functional status than Māori and men respectively, adjusting for age, ethnic group, sex, socioeconomic deprivation, wave of the study and presence of conditions (Table 18).

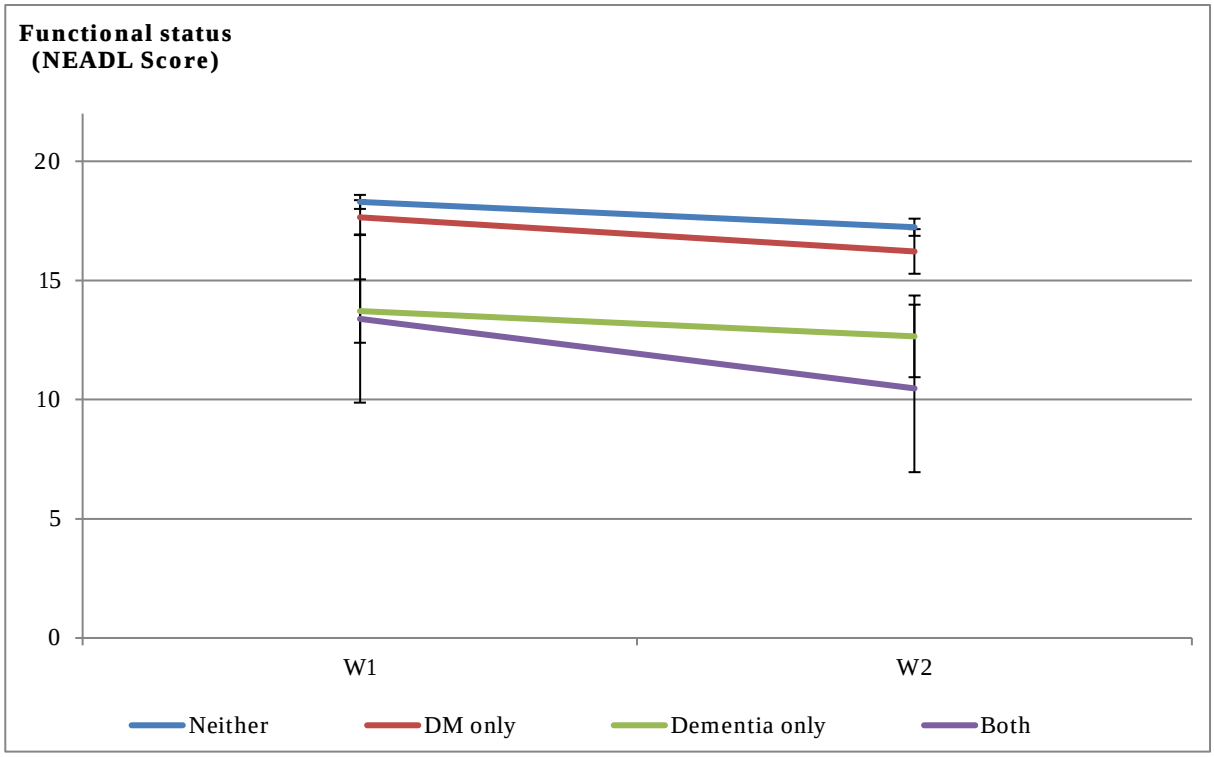
Overall, participants without dementia or DM, as well as those with DM only, were *significantly less* frail than those with both conditions, adjusting for age, ethnic group, sex and wave of the study (Figure 2-18, Table 18).

There were *no differences* in the pattern of the relationship between frailty and dementia and DM between Māori and non-Māori, women and men, nor by socioeconomic deprivation, adjusting for age, ethnic group, sex and wave of the study (Table 18).

Participants with dementia and DM had *significantly lower* physical and mental HRQOL than those with neither condition (Table 18).

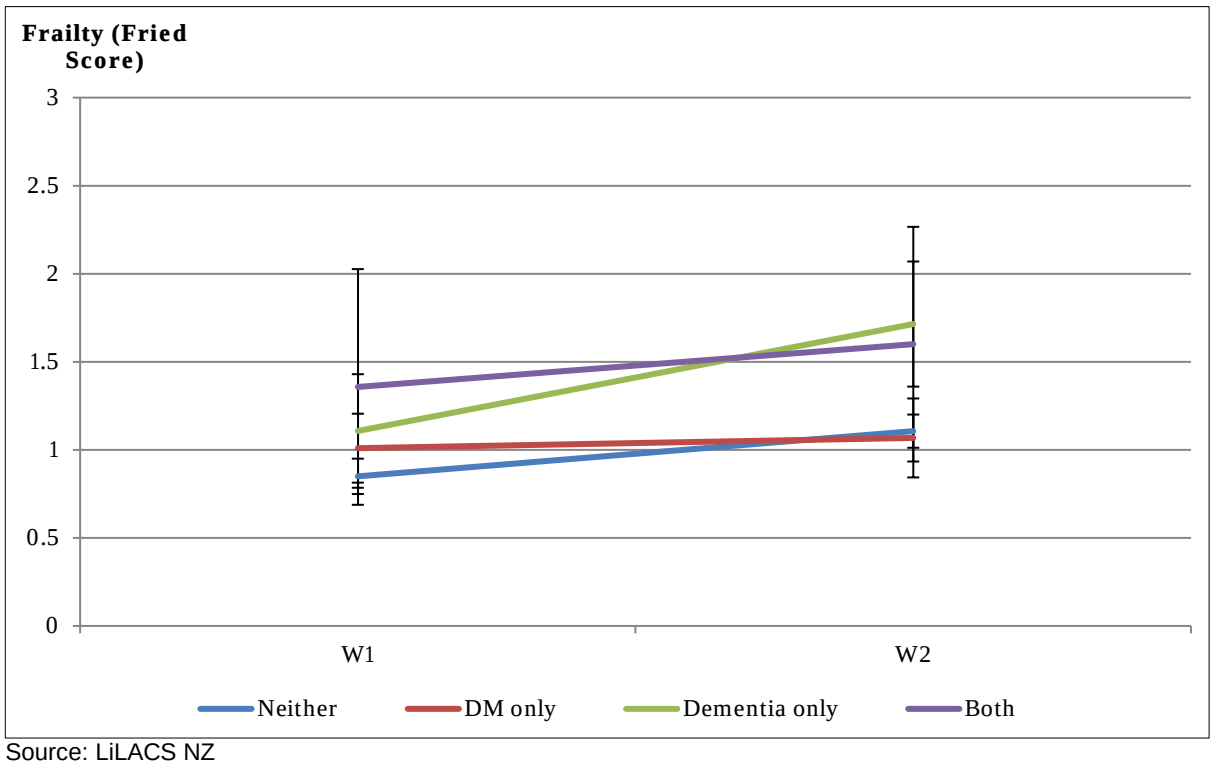
Men had *significantly higher* physical HRQOL scores than women, adjusting for age, ethnic group, sex, socioeconomic deprivation, wave of the study and presence of conditions (Table 18).

Figure 2-17: Dementia and diabetes mellitus by functional status, Waves 1 and 2



Source: LiLACS NZ
Note: DM = diabetes mellitus.

Figure 2-18: Dementia and diabetes mellitus by frailty, Waves 1 and 2



Source: LiLACS NZ
Note: DM = diabetes mellitus.

2.4.3 Participants with dementia and DM had increased health service use and costs

Participants with both dementia and DM were *significantly more likely* to visit GPs more than four times per annum throughout the study than those with neither condition (Table 18), adjusting for age, ethnic group, sex and wave of the study.

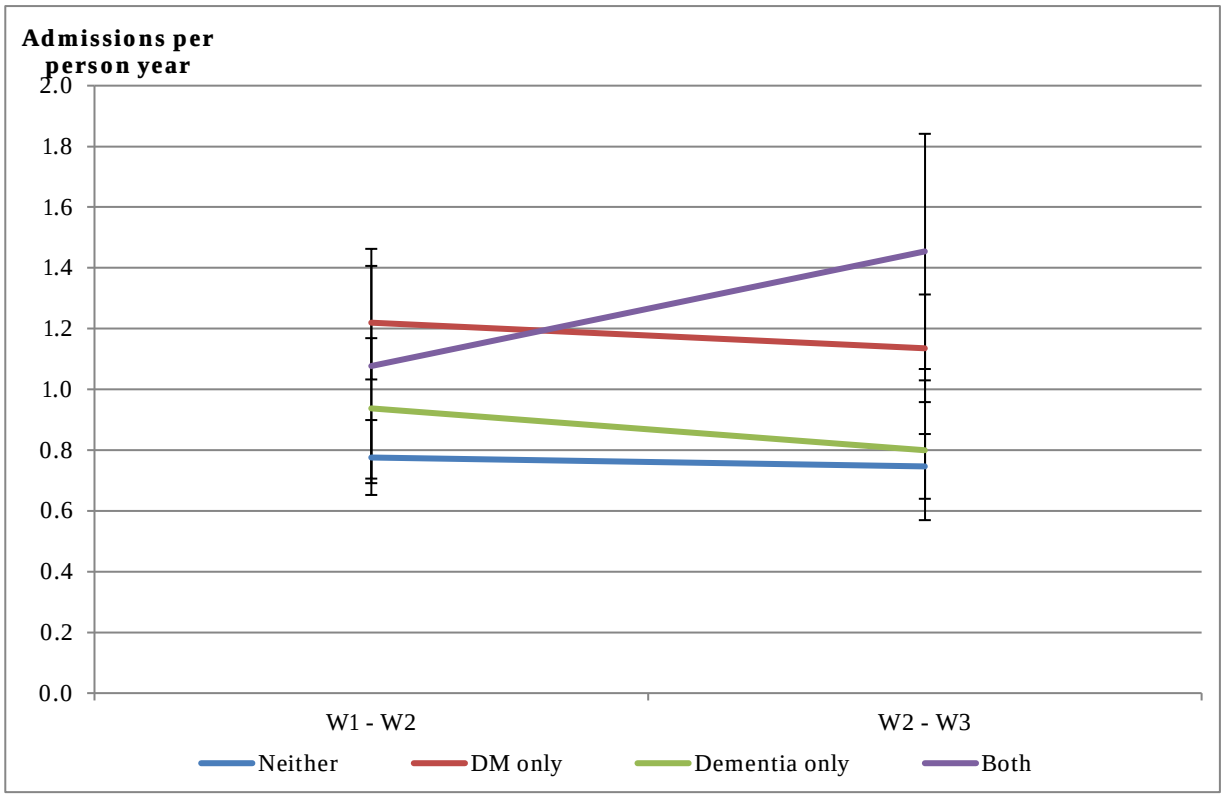
There were *no differences* in the relationship between GP visits and dementia and DM, between Māori and non-Māori, women and men, nor by socioeconomic deprivation, adjusting for age, ethnic group and sex (Table 18).

Figure 2-19 shows annual hospital admissions for people with or without dementia and DM (Table 19). Adjusting for age, ethnic group, sex, and wave of the study, there was a significant difference overall between the four groups. Admissions per year were *significantly lower* for those with neither condition or with DM only, and those with dementia only or with both conditions had the most admissions.

Participants with neither dementia nor DM had *significantly lower* rates of hospital admission compared to those with both conditions.

Participants with neither condition had *significantly shorter* lengths of stay in hospital than those with both conditions (Table 20).

Figure 2-19: Dementia and diabetes mellitus by hospital admissions in following year, Waves 1 and 2



Source: LiLACS NZ
Note: DM = diabetes mellitus.

More frequent and longer hospitalisations meant increased costs associated with participants with dementia and DM (Table 21). Participants with both conditions had hospital costs across the study averaging $7,187 annually, compared to costs for those with DM alone ($5,590) and those with dementia alone ($5,734).

3. Conclusion and Discussion

Dementia was present in 16% of LiLACS NZ participants at the beginning of the study and 26% over the three years of follow-up. Dementia diagnosis was based on the validated ethnicity-specific scores on a screening test for dementia (the 3MS). There was no difference between Māori and non-Māori nor between women and men in the prevalence of dementia as identified by this screening tool; however, the screening tool is not as accurate as a full clinical assessment and the real prevalence of dementia may be higher.

There are established inequalities in the risk factors for dementia for Māori. Non-Māori were privileged in access to education. Māori who are now in their 80s and in the LiLACS NZ study, were less likely to finish high school and achieve tertiary qualifications.[14] Other risk factors for dementia, such as cardiovascular disease and smoking, are also higher amongst Māori. Again, non-Māori are privileged in education, socioeconomic position, and access to health care. On the other hand, bilingual status is associated with a lower risk of dementia. Older Māori have substantial roles involving advanced cognitive activities and, along with kapa haka, cultural activities may provide greater cognitive stimulation and thus preservation of cognition with advanced age for Māori.

In other indigenous groups, a higher prevalence of dementia has been observed, such as that found for Australian Aboriginals.[31]

In the validation study, the Māori assessed by a trained clinician as having no dementia had lower scores on the 3MS than non-Māori without dementia. The ethnic-specific cut points on the scale meant the most accurate estimation of dementia was used; however, cognition assessment amongst culturally diverse groups is best completed with a culturally sensitive tool.[32] As no Māori-specific tool is available, it is possible that the true prevalence of dementia could be higher than that identified here. The current study is the only available data on dementia amongst older Māori. Further development of a Māori-specific assessment process and larger prevalence survey for dementia are needed to more accurately say how many Māori have dementia.

Assessment of cognition across age and educational ranges is recognised as a reason to adjust scores on cognition assessments. One study allows the addition of 12 points to a 3MS-R scale for those with no educational achievement. In addition, scores in the very old were noted to be lower.[33]

3.1 Dementia and the common health conditions

Of the four conditions assessed, CVD was the most prevalent.

Participants with dementia alone had worse functional status and more frailty than those with CLD or DM alone. For those with CVD alone, functional status was higher than for those with dementia alone, but they were frailer.

Participants with CVD, compared to the other physical health conditions, had the lowest physical HRQOL, most frequent GP visits, most hospital admissions and highest hospital costs. They also had the longest stays in hospital.

Participants who had the combination of dementia plus one of the other health conditions had lower HRQOL than those without dementia or those with just one health condition or dementia alone.

Participants with dementia and a co-morbid physical health condition had more frequent hospitalisations compared to those without dementia or with dementia alone. This was true when dementia was co-morbid with CVD, CLD or DM.

The combination of dementia and other common chronic conditions was associated with greater hospital costs.

Looking at the three conditions in combination with dementia, dementia with CVD was associated with the lowest mental HRQOL and dementia with CLD was associated with the lowest physical HRQOL. Dementia with DM was associated with the poorest status on all other health indicators, but the combinations of dementia with another condition in each instance gave similar results.

The importance of dementia as a driver of poorer health status and increased health service use deserves further exploration with later waves of LiLACS NZ data.

While it is not possible to establish whether it is the dementia that makes the impact of the chronic condition worse, or the chronic condition that makes the impact of the dementia worse, it is clear that the combination leads to worse outcomes for older people. The prevalence of CVD is very high in this age group, and around 14 percent of those with CVD have dementia. Thus clinicians and planners may be prompted to think more systematically about the combination of common chronic conditions with dementia. Finding the best strategy to reduce the impact of chronic disease and dementia will require evaluation of trials to screen for dementia in the context of chronic disease management and also a focus on the management of chronic disease for people with dementia.

4. Key findings

- Dementia was present in 16 percent of LiLACS NZ participants at Wave 1, with no significant differences in prevalence between Māori and non-Māori nor between women and men.
- Dementia was present in 26 percent of LiLACS NZ participants at some time in the study; some of those with scores in the dementia range improved over time.
- Dementia was associated with lower functional status, higher frailty and poorer mental and physical health-related quality of life.
- Dementia was associated with higher health service use and cost.
- CVD was the most prevalent of the four conditions examined. More than 50 percent of participants had CVD without dementia and around 10 percent had both dementia and CVD.
- Participants with the combination of dementia and CVD had lower functional status and more frailty than those with either of the conditions alone.

- Participants with dementia and CVD had significantly lower mental and physical health-related quality of life.
- Dementia associated with CVD increased health service use and costs.
- Thirty percent of participants had CLD and around 10 percent had both dementia and CLD.
- Dementia increased the association of CLD with lower functional status, frailty and poorer quality of life.
- Participants with both dementia and CLD had increased health service use and costs.
- More than 20 percent of participants had DM and 4 percent had both dementia and DM.
- Dementia increased the association of DM with lower functional status and frailty and poorer quality of life.
- Participants with both dementia and DM had increased health service use and costs.
- The combination of dementia with a physical health condition worsened health status.
- Having both dementia and a physical health condition increased health service use and costs.

‘Not worried by what I can and can’t do. Just happy to see family grow up and see how the world evolves.’

Glossary

3MS	a global cognition test commonly used as a screening tool. Higher scores indicate better cognition.
advanced age	term used for our study population
adjusting	a statistical method for dealing with confounding variables, such as sex, ethnic group or socioeconomic deprivation
core questionnaire	the short three-page LiLACS NZ questionnaire
DHB	District Health Board
Fried frailty score	a score based on an assessment of frailty, defined as having three of five key deficits: slowness, weakness, weight loss, fatigue and low activity. Also known as the Fried phenotype. Higher scores indicate greater frailty.
full questionnaire	the full 72-page LiLACS NZ questionnaire
HRQOL	health-related quality of life, measured by the SF-12®
kaitiaki	guardians
kaupapa Māori process	a Māori methodology that enhances, protects and conserves te reo Māori me ngā tikanga Māori/Māori language and culture
LiLACS NZ	*Te Puāwaitanga O Ngā Tapuwae Kia Ora Tonu/* Life and Living in Advanced Age, a Cohort Study in New Zealand
NEADL	Nottingham Extended Activities of Daily Living scale, which asks questions about everyday activities in order to assess dependence. Lower scores indicate greater dependence.
NZDep 2006[30]	New Zealand Deprivation Index, a census-derived tool to estimate the relative socioeconomic deprivation of an area. A lower rating indicates a higher level of deprivation.
QOL	quality of life
Rōpū Kaitiaki o ngā Tikanga Māori	LiLACS NZ guardianship group
SF-12®	a 12-item shorter version of the SF-36® questionnaire, widely used as a measure of quality of life; both versions can generate separate physical and mental composite scores. Higher scores indicate better quality of life.
socioeconomic deprivation	as measured by NZDep, see above
te reo Māori	Māori language
whānau	extended family

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Appendix 1: Questions

Code	Question	Options
LiLACS NZ Questionnaire		
AA2.	Gender	1 = Male 2 = Female
AB2.	Which ethnic group(s) do you belong to: Māori	0 = No 1 = Yes
AE1_1	When were you born? Year	
AE1_2	Month	
AE1_3	Day	
AE1_4	Where were you born? Town	
AE1_5	Region	
AE2_1	Repeat three words: Shoes	
AE2_2	Black	
AE2_3	Modesty	
AE3	Please count from 1 to 5. Now count backwards from 5 to 1	
AE4_1	Please spell the word 'WORLD' backwards: D	
AE4_2	L	
AE4_3	R	
AE4_4	O	
AE4_5	W	
AE5_1	Repeat three words: Shoes	
AE5_2	Black	
AE5_3	Modesty	
AE6_1	What year is this?	Accurate = 8, miss by 1 = 4, miss by 2-5 = 2
AE6_2	What season is it?	Accurate or within 1 month = 1
AE6_3	What month is it?	Accurate or within 5 days = 2, miss by 1 month = 1
AE6_4	What is the date?	Accurate = 3, miss by 1-2 days = 2, miss by 3-5 days = 1
AE6_5	What day of the week is it?	Accurate = 1
AE7_1	Where are we now?	Accurate – score 1
AE7_2	What region are we in?	Accurate – score 2
AE7_3	What district is this?	Accurate – score 1
AE7_4	What city (town) is this?	Accurate – score 1
AE8_1	What is this?: Pencil	
AE8_2	Watch	
AE8_3	Shoulder	
AE8_4	Elbow	
AE8_5	Knuckle	
AE9	You have thirty seconds to answer this next question. Naming as many as you can, what animals have 4 legs?	
AE10_1	In what way are an arm and a leg alike?	
AE10_2	In what way are laughing and crying alike?	
AE10_3	In what way are eating and sleeping alike?	
AE11	Please repeat the following – "no ifs, ands or buts"	

Code	Question	Options
AE12	Please read this and do what it says.	
AE13	Please write a sentence – it can say anything you like.	
AE14	Please copy this drawing exactly as it is	
AE15_1	Take this paper in your right hand,	
AE15_2	fold it in half,	
AE15_3	and hand it back to me	
AE16_1	Repeat three words: Shoes	
AE16_2	Black	
AE16_3	Modesty	
CB1_a	Have you ever been told by a doctor that you have had a Heart attack/myocardial infarction	0 = No 1 = Yes 3= Don't Know
CB1_b	Have you ever been told by a doctor that you have had Angina	0 = No 1 = Yes 3= Don't Know
CB1_c	Have you ever been told by a doctor that you have had a Stroke	0 = No 1 = Yes 3= Don't Know
CB1_d	Have you ever been told by a doctor that you have had a Transient Ischemic Attack / mini stroke	0 = No 1 = Yes 3= Don't Know
CB1_e	Have you ever been told by a doctor that you have had High blood pressure	0 = No 1 = Yes 3= Don't Know
CB1_f	Have you ever been told by a doctor that you have had Atrial fibrillation or irregular heartbeat	0 = No 1 = Yes 3= Don't Know
CB1_g	Have you ever been told by a doctor that you have had Congestive heart failure	0 = No 1 = Yes 3= Don't Know
CB1_h	Have you ever been told by a doctor that you have had Intermittent claudication	0 = No 1 = Yes 3= Don't Know
CB1_i	Have you ever been told by a doctor that you have had Rheumatic fever	0 = No 1 = Yes 3= Don't Know
CB1_j	Have you ever been told by a doctor that you have had Other heart or circulatory problem	0 = No 1 = Yes 3= Don't Know
GA2a	In the last year have you visited: a General practitioner	0 = Not at all 1 = About once a year 2 = About every 6 months 3 = About every 3 months 4 = About every month 5 = About every week 6 = Don't know
GB4_4	Have you ever been told by a doctor or optician that you have had: Diabetic eye disease	0 = No 1 = Yes 2 = Don't know
GP Record review		
C_lung	Medical Record: Chronic lung disease	0 = No 1 = Yes 2 = Don't Know
Diabetes	Medical Record: Diabetes mellitus	0 = No 1 = Yes 2 = Don't Know
MI	Medical Record: Myocardial Infarction	0 = No 1 = Yes 2 = Don't Know
CHF	Medical Record: Congestive heart failure	0 = No 1 = Yes 2 = Don't Know
Carotid	Medical Record: Carotid endarterectomy	0 = No 1 = Yes 2 = Don't Know
C_bypass	Medical Record: Coronary bypass surgery	0 = No 1 = Yes 2 = Don't Know
A_bypass	Medical Record: Leg artery bypass surgery	0 = No 1 = Yes 2 = Don't Know
Repair	Medical Record: Repair of aortic aneurysm	0 = No 1 = Yes 2 = Don't Know
Pace	Medical Record: Pacemaker implant	0 = No 1 = Yes 2 = Don't Know
C_angio	Medical Record: Angioplasty of the coronary arteries	0 = No 1 = Yes 2 = Don't Know
A_angio	Medical Record: Angioplasty of the leg arteries	0 = No 1 = Yes 2 = Don't Know

Appendix 2: Diagnosing dementia: Validation of the 3MS for Māori and non-Māori octogenarians

Usually the diagnosis of dementia is made after a thorough clinical evaluation by a clinician with expertise in dementia, which includes the use of a cognition screening test. In many epidemiological studies a validated screening test for dementia is used alone, as a full clinical assessment is not possible.

The Modified Mini Mental State (3MS)[34] is a global cognition test commonly used as a screening tool. It was developed as an extended version of the Mini Mental State Examination (MMSE).[26,35] Compared to the MMSE, the 3MS provides more detailed scoring guidelines and adds four tasks: date and place of birth, animal naming, similarities and an additional delayed recall of words task. The maximum score was increased from 30 to 100.[33] Higher scores indicate better cognition.

The 3MS is a validated instrument[25] but has not previously been used in our specific populations of interest, that is, non-Māori New Zealanders aged 85+ and Māori aged 80+ years.

A large normative assessment study administered the 3MS-R (a slightly modified version of the 3MS) to 2,913 elders free from dementia. Subsamples had a dementia assessment. Lower age, higher education, and female gender were associated with higher 3MS-R scores. Education effects were most prominent in the youngest age groups. Selection of a cut point at the seventh percentile revealed 69–70 percent sensitivity (the true positive rate) for detecting dementia, and higher sensitivity for individuals in the youngest age groups. Specificity, a measure of the false positive rate at this cut point, was 89 percent. Raising the cut point to the 10th percentile improved sensitivity to 73–76 percent, but reduced specificity to 85–86 percent. Conclusions suggest that cut points could be raised in the oldest age groups (85+) to maintain the utility of the screening test. The cut point for those in the 80+ age range was 86 and diagnostic accuracy was lower in those over age 90 years.[26]

This sub-study of LiLACS NZ aimed to validate the 3MS against a gold standard clinical assessment amongst Māori and non-Māori.

Method

LiLACS NZ participants completed the 3MS cognitive test in each of the six waves of LiLACS NZ data collection.

Potential participants for the sub-study were randomly selected from those with ‘normal’ scores and then oversampled for those with scores that were decreasing over time or were lower than 80 at any time. Participant selection was undertaken by a researcher distant from the assessments. Participants were invited to the sub-study by the local coordinator, written informed consent was obtained from the participant and/or from whānau/family. A clinical dementia assessment was carried out at a convenient time during the five years, once for each participant. An informant was contacted for additional information if necessary. The sub-study continued until there was a similar number of Māori and non-Māori to distinguish cut points in each cohort.

A clinical assessment procedure was designed in collaboration with Dr Phil Wood and Dr Graeme Davison, based on the assessment protocol of the Memory Clinic of the Waitemata District Health Board. A trained clinician (Prof Ngaire Kerse or Dr Wood), to whom the 3MS scores were not released, then conducted a standard interview covering the essential clinical

aspects of cognitive impairment and dementia, including assessment of risk factors for dementia, course of onset, specific symptoms and review of medications. Interviewers were medically qualified (a GP or geriatrician) and had spent at least six months working in the Memory Clinic. The Addenbrooke Cognitive Examination Revised instrument was used as part of the gold standard interview.

The clinical assessments were followed by an interdisciplinary discussion led by Dr Wood of the Waitemata Memory Clinic, a dementia specialist (now advisor to the Ministry). Prof Kerse (GP), Dr Lorna Dyall (Māori scholar), Kristy Zawaly (PhD candidate) and Dr Pam Bennet (Māori psychiatrist) participated in the meetings. A diagnosis of dementia, mild cognitive impairment or normal cognition was made at the interdisciplinary meetings where each case was discussed in detail. The Clinical Dementia Rating Scale was used to rate the severity of cognitive decline.

Because the timing of the 3MS score and the clinical assessment were sometimes quite distant, we imputed 3MS scores to match the timing of the clinical assessment as follows. A weighted average of the two 3MS scores either side of the assessment interview was imputed (for example, if the clinical dementia interview was three months after the Wave 3 interview, the formula used was 0.75 * W3 3MS + 0.25 * W4 3MS, a weighted average of the two scores, weighted towards the closer score). If the gold standard interview was conducted after all other interviews, a linear trend was extrapolated from the last two 3MS scores.

A sensitivity analysis was also used to examine 3MS scores immediately preceding the clinical assessment and the nearest 3MS to the clinical assessment was used. For example, if the gold standard interview was three months after the Wave 3 interview, the Wave 3 3MS score was used but if it was nine months after the Wave 3 interview, the Wave 4 3MS score was used.

Analyses

We constructed Receiver Operating Characteristic (ROC) curves comparing the sensitivity and specificity of various cut points on the 3MS and comparing these with the diagnoses of dementia. For our initial analysis we compared those clinically assessed as having dementia to those without dementia (those who had a diagnosis of mild cognitive impairment combined with those who were assessed as normal).

Results

Seventy-three participants completed the validation sub-study. Table A shows their ethnic group and dementia diagnosis.

Table A: Validation sub-study participants by ethnic group and dementia status who completed the 3MS and the clinical assessment

	Dementia present	Dementia not present	Total
Māori	12	20	32
Non-Māori	12	29	41

Ethnic-specific cut points are desirable as for different ethnicities there are different prevalences of risk factors for dementia, such as disparities in education and socioeconomic deprivation.

There are also disparities in the prevalence of some CVD diagnoses which are also risk factors for the development of dementia.

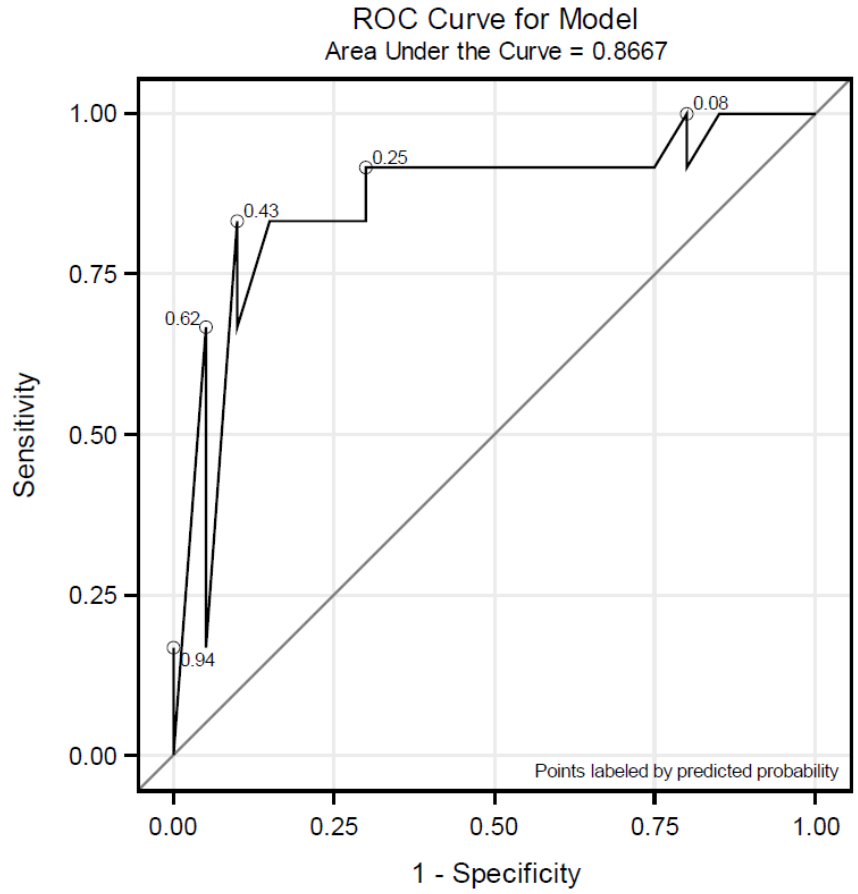
For each ethnic group the ROC curve is presented.

For Māori, the area under the curve was 0.8667. A score of 80 has a sensitivity of 83 percent, and a specificity of 90 percent and is the most efficient cut point.

For non-Māori, the area under the curve is 0.9031 showing good discrimination of this test to differentiate dementia. A cut-off score of 84 has a sensitivity of 83 percent and a specificity of 80 percent.

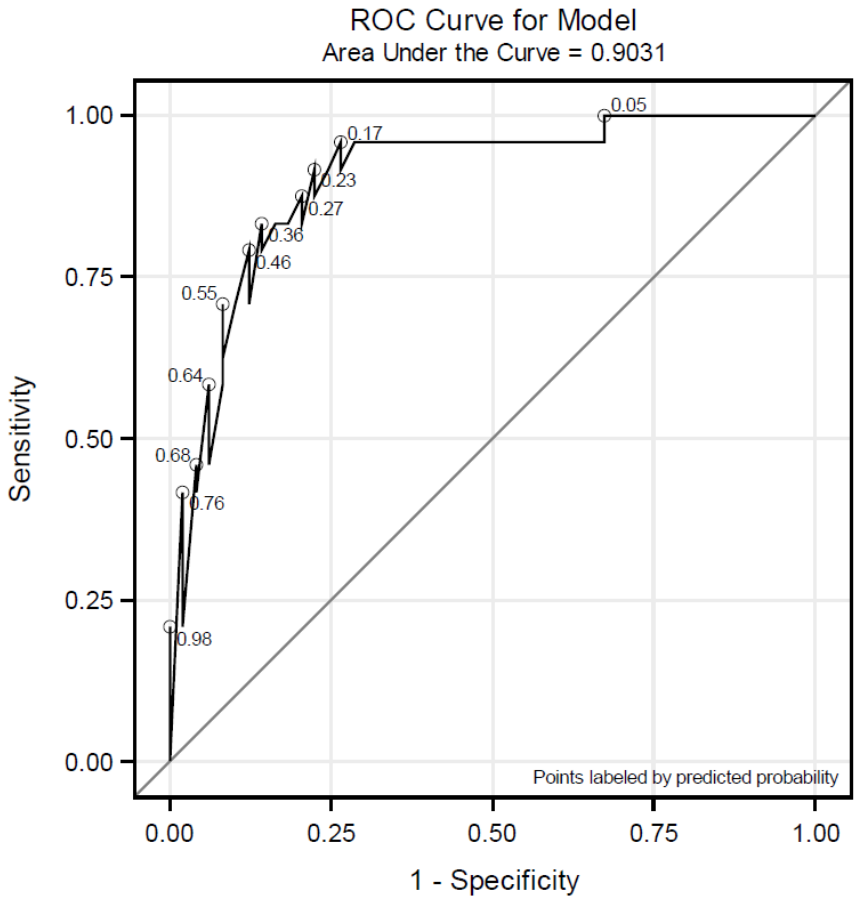
The sensitivity analyses using the 3MS values that were not imputed showed similar findings (data not shown).

Figure 1. Receiver Operating Characteristic curve for diagnosis of dementia for Māori. Imputed values are presented



Source: LiLACS NZ

Figure 2. Receiver Operating Characteristic curve for diagnosis of dementia for non-Māori. Imputed values are presented



Source: LiLACS NZ

Implications for the whole sample

The distributions of the 3MS scores in LiLACS NZ differ between Māori and non-Māori with Māori having, on average, a score 5 points lower and with a wider distribution than non-Māori (Figures 3 and 4). The 3MS was developed from a Western world view and was translated to te reo Māori, but not adapted in other ways. This, along with disparities, particularly in education, is evidence that the tool may operate differently between the two cohorts. Thus ethnic-specific cut points may be necessary to accurately represent cognitive function.

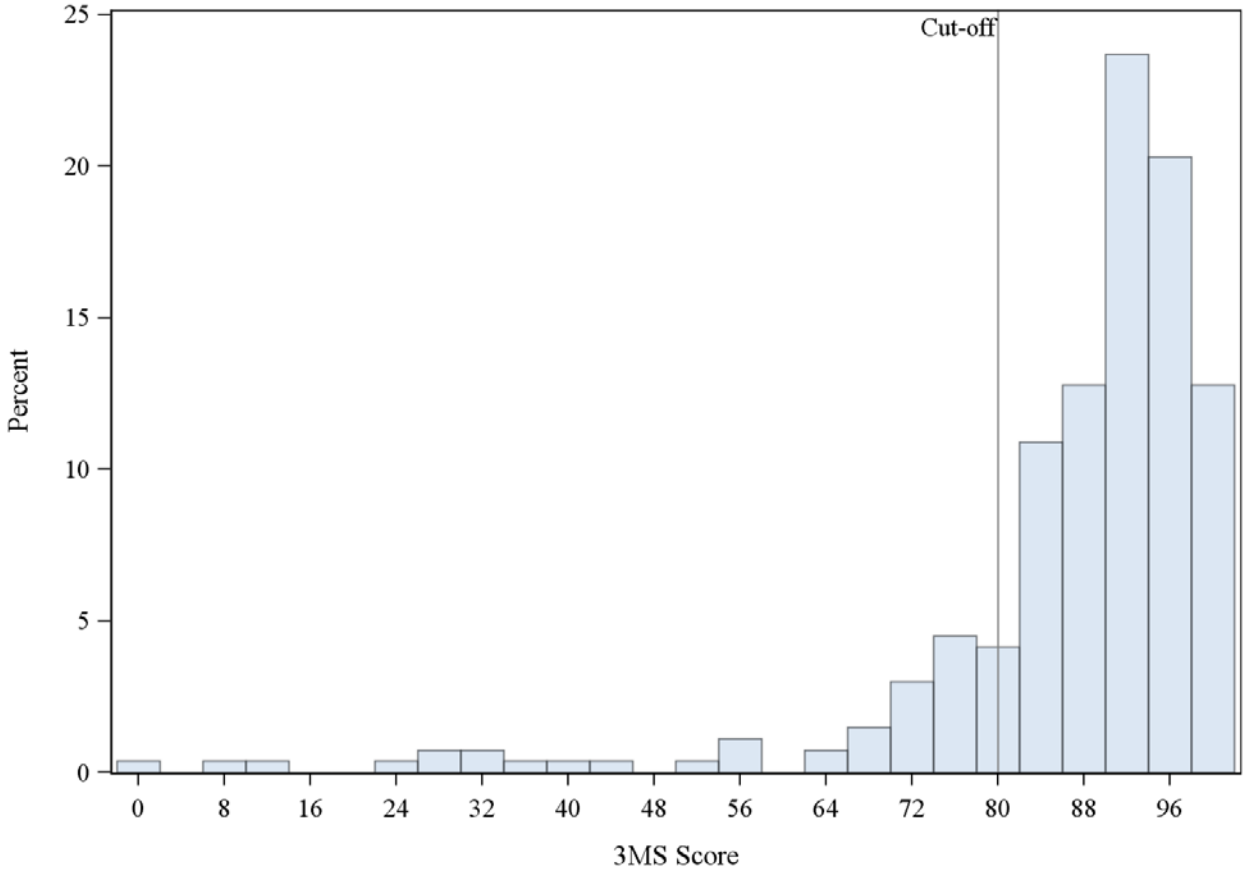
Cut-off scores of 80 for Māori and 84 for non-Māori have the best psychometric properties for test performance. This is one way of acknowledging that educational and socioeconomic disparity will affect performance on the test.

For Māori, disparities in education and health[18,19] are documented indicating an increased prevalence of risk factors for dementia. The LiLACS NZ Māori participants in this sample had lower levels of education and higher rates of CVD.[14] The performance on the standard cognition screening test by Māori led to an overall lower mean value. However, when assessed by a trained clinician, dementia was not present. For example Māori with a score of 82 did not have dementia whereas non-Māori with a score of 82 did have dementia. The lower level of education and higher rate of CVD may explain some of this difference.

There may also be a real difference in the prevalence of dementia that is not detected in this study due to the relatively small number of participants. The distribution of the scores is similar in both populations. One very large study of the 3MS suggested that those with greater age, and those with low income achieved lower scores without necessarily having dementia.[33]

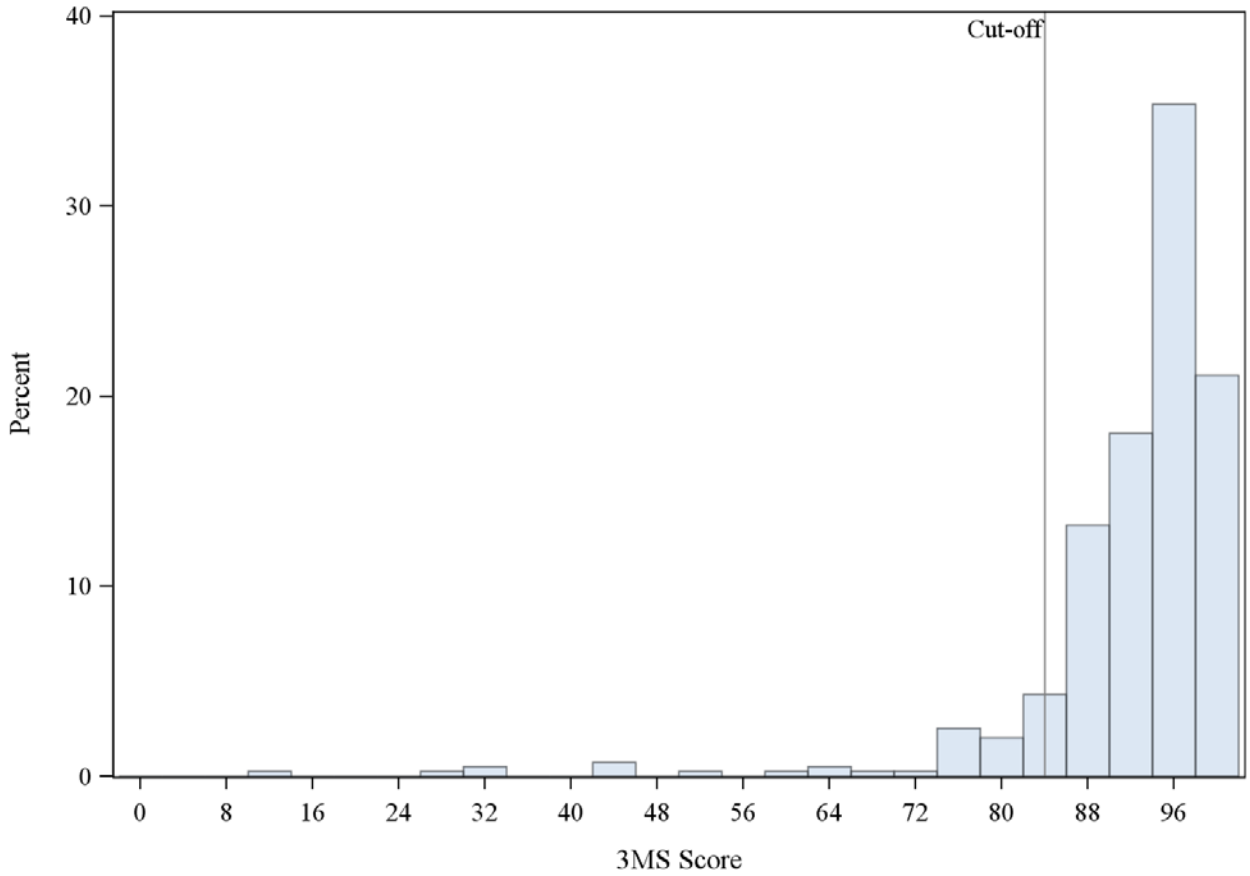
The cut-off scores were applied to the whole sample. Figures 3 and 4 show the distribution of the 3MS scores. The mean score is different between the two samples. We show the cut-off scores on the graphs.

Figure 3: Distribution of 3MS scores for Māori in LiLACS NZ



Source: LiLACS NZ
Note: Māori mean score was 85, cut-off score was 80.

Figure 4: Distribution of 3MS scores for non-Māori in LiLACS NZ



Source: LiLACS NZ
Note: Non-Māori mean score was 90.5, cut-off score was 84.

Appendix 3: Statistical significance testing as used in this report

The following excerpt from 'Te Ohonga Ake 2: The Health Status of Māori Children and Young People in New Zealand' explains significance testing clearly.

Understanding Statistical Significance Testing

Inferential statistics are used when a researcher wishes to use a sample to draw conclusions about the population as a whole (e.g. weighing a class of 10 year old boys, in order to estimate the average weight of all 10 year old boys in New Zealand). Any measurements based on a sample however, even if drawn at random, will always differ from that of the population as a whole, simply because of chance. Similarly, when a researcher wishes to determine whether the risk of a particular condition (e.g. lung cancer) is truly different between two groups (smokers and non-smokers), they must also consider the possibility that the differences observed arose from chance variations in the populations sampled.

Over time, statisticians have developed a range of measures to quantify the uncertainty associated with random sampling error (e.g. to quantify the level of confidence we can have that the average weight of boys in our sample reflects the true weight of all 10 year old boys, or that the rates of lung cancer in smokers are really different to those in non-smokers). Of these measures, two of the most frequently used are:

P values: The p value from a statistical test tells us the probability that we would have seen a difference at least as large as the one observed, if there were no real differences between the groups studied (e.g. if statistical testing of the difference in lung cancer rates between smokers and non-smokers resulted in a p value of 0.01, this tells us that the probability of such a difference occurring if the two groups were identical is 0.01 or 1 percent.) Traditionally, results are considered to be statistically significant (i.e. unlikely to be due to chance) if the probability is <0.05 (i.e. less than 5 percent).

Confidence Intervals: A 95% Confidence Interval suggests that if you were to repeat the sampling process 100 times, 95 times out of 100 the confidence interval would include the true value. In general terms, if the 95% confidence intervals of two samples overlap, there is no significant difference between them (i.e. the p value would be $\geqslant 0.05$), whereas if they do not overlap, they can be assumed to be statistically different at the 95% confidence level (i.e. the p value would be <0.05).

Reference

Craig E, McDonald G, Adams J, Reddington A, Reddington A, Wicken A, Simpson J. 2012. *Te Ohonga Ake 2: The health status of Māori children and young people in New Zealand.* Dunedin: New Zealand Child and Youth Epidemiology Service.

The signalling of statistical significance in this report

In order to assist the reader to identify whether tests of statistical significance have been applied in a particular section, the significance of the associations presented has been signalled in the text with the words *significant* or *not significant* in italics. Where the words significant or not significant do not appear in the text, then the associations described do not imply statistical significance or non-significance.

Appendix 4: Technical tables

The following tables provide detailed data for the key indicators presented in this section. The tables present the prevalence and number of people by sex and ethnic group and 95 percent confidence intervals for all estimates. Generalised linear models were used for analysis of potentially significant predictors of outcomes and controlled for age, sex, socioeconomic deprivation and ethnic group.

Significance tests were performed by constructing multivariate generalised linear regression models, all models contained as covariates age, ethnic group, sex, socioeconomic deprivation (NZDep) of the participant's meshblock of residence and wave of the interview. In relation to sex, ethnic group and socioeconomic deprivation: where interaction terms between them and the variable of interest were found to be significant, separate results are presented for subgroups, for example in the case of sex, a separate model for women and a separate model for men are presented. These interactions were investigated in the order: sex, ethnic group and socioeconomic deprivation. In this cohort study, anyone identifying themselves as Māori was classed as Māori and anyone not identifying themselves as Māori was classed as non-Māori, meaning that Māori classification was prioritised. Data for this section were not imputed. Where the value of the variable was unknown, data were not used, hence the varying numbers in Table 1.

Generalised linear models were used for analysis of potentially significant predictors of outcomes and controlled for age, sex, socioeconomic deprivation and ethnic group. Although there is a link between education and socioeconomic deprivation, this has not been examined in the analyses at this time.

Comparisons between those with and without three common chronic conditions and dementia over time were calculated using generalised linear models controlled for age, sex, socioeconomic deprivation and ethnic group. All models contained sex, ethnic group, NZDep and either dementia, CVD:dementia, CLD:dementia or DM:dementia. All interaction terms were checked but not significant.

Table 1: Number of LiLACS NZ participants with data on each indicator

	Māori women	Non-Māori women	Māori men	Non-Māori men
NEADL				
Wave 1	154	212	102	188
Wave 2	132	195	92	175
Wave 3	97	156	58	149
Wave 4	75	129	42	117
Fried				
Wave 1	134	187	94	173
Wave 2	102	172	68	163
Wave 3	73	124	47	130
Wave 4	55	105	35	107
Physical HRQOL				
Wave 1	148	205	103	183
Wave 2	129	180	91	170
Wave 3	96	149	56	146
Wave 4	72	122	40	117

	Māori women	Non-Māori women	Māori men	Non-Māori men
Mental HRQOL				
Wave 1	148	205	103	183
Wave 2	129	180	91	170
Wave 3	96	149	56	146
Wave 4	72	122	40	117
GP Visits more than four times a year				
Wave 1	155	211	101	188
Wave 2	132	193	91	175
Wave 3	96	156	57	149
Wave 4	74	128	42	117
Hospitalisations				
Wave 1	218	265	162	233
Wave 2	197	253	146	214
Wave 3	111	175	72	159
Wave 4	101	161	65	144

Note: NEADL = Nottingham Extended Activities of Daily Living, HRQOL from the SF-12® summary scales; HRQOL = Health related quality of life

Table 2: LiLACS NZ participants with and without dementia by ethnic group and sex, Waves 1-4

N (%)		Māori women	Non-Māori women	Māori men	Non-Māori men
Wave 1 901 (96)	No Dementia	187 (82)	233 (86)	135 (79)	199 (85)
	Dementia	40 (18)	37 (14)	35 (21)	35 (15)
Wave 2 825 (88)	No Dementia	176 (87)	222 (87)	122 (80)	188 (88)
	Dementia	27 (13)	34 (13)	30 (20)	26 (12)
Wave 3 527 (56)	No Dementia	105 (91)	160 (90)	60 (80)	147 (92)
	Dementia	10 (9)	18 (10)	15 (20)	12 (8)
Wave 4 483 (52)	No Dementia	97 (92)	148 (90)	58 (84)	135 (93)
	Dementia	8 (8)	16 (10)	11 (16)	10 (7)

Note: Neither ethnic group nor sex are significant predictors of dementia (p = 0.44 and 0.44 respectively).

Table 3: Dementia and functional status, frailty, quality of life and GP visits by ethnic group and sex, Waves 1-4

	Māori women	Non-Māori women	Māori men	Non-Māori men
NEADL mean score (CI) Participants with no dementia				
Wave 1	18.2 (17.5, 18.9)	18.2 (17.7, 18.7)	17.7 (16.9, 18.5)	18.3 (17.9, 18.7)
Wave 2	17.5 (16.8, 18.2)	17.3 (16.7, 17.9)	15.8 (14.8, 16.9)	17.0 (16.4, 17.5)
Wave 3	17.4 (16.5, 18.4)	17.0 (16.4, 17.7)	15.7 (14.4, 17.0)	16.7 (16.1, 17.2)
Wave 4	16.4 (15.2, 17.7)	16.9 (16.1, 17.7)	15.7 (14.6, 16.8)	16.9 (16.3, 17.4)
NEADL mean score (CI) Participants with dementia				
Wave 1	13.0 (10.0, 16.0)	12.5 (9.6, 15.4)	14.1 (11.6, 16.6)	14.0 (11.5, 16.4)
Wave 2	13.4 (9.3, 17.4)	10.1 (6.1, 14.0)	12.2 (9.5, 14.9)	11.8 (9.2, 14.5)
Wave 3	14.8 (8.4, 21.1)	13.4 (9.5, 17.4)	13.0 (10.0, 16.0)	11.1 (6.4, 15.8)
Wave 4	14.6 (6.2, 23.0)	12.6 (7.7, 17.5)	13.9 (9.8, 18.0)	11.3 (6.1, 16.4)
Dementia, ethnic group and sex were significant predictors of NEADL score (p-values < 0.0001, 0.0125 and 0.0036 respectively); NZDep and wave of the study were not (p-value = 0.2171).				

	Māori women	Non-Māori women	Māori men	Non-Māori men
Fried frailty mean score (CI) Participants with no dementia				
Wave 1	0.78 (0.61, 0.94)	1.01 (0.84, 1.17)	0.87 (0.64, 1.10)	0.83 (0.67, 0.99)
Wave 2	1.09 (0.91, 1.27)	1.11 (0.95, 1.27)	1.14 (0.89, 1.40)	1.09 (0.94, 1.23)
Wave 3	1.09 (0.89, 1.29)	1.17 (1.00, 1.34)	0.88 (0.57, 1.18)	0.92 (0.75, 1.08)
Wave 4	1.16 (0.89, 1.43)	1.07 (0.87, 1.28)	1.00 (0.70, 1.31)	1.15 (0.96, 1.34)
Fried mean score (CI) Participants with dementia				
Wave 1	1.00 (0.32, 1.68)	1.25 (0.54, 1.96)	1.00 (0.41, 1.59)	1.40 (0.75, 2.05)
Wave 2	1.55 (0.99, 2.10)	1.57 (0.76, 2.38)	2.00 (1.26, 2.74)	1.77 (1.06, 2.47)
Wave 3	1.60 (0.92, 2.28)	1.09 (0.39, 1.79)	0.67 (-0.19, 1.52)	1.13 (-0.01, 2.26)
Wave 4	1.75 (0.23, 3.27)	0.88 (-0.07, 1.82)	1.17 (0.38, 1.96)	2.00 (0.81, 3.19)
Dementia was a significant predictor of Fried score (p-value < 0.0001); ethnic group, sex, NZDep and wave of the study were not (p-values = 0.5181, 0.9251 and 0.1741 respectively).				
Physical HRQOL SF-12® PHC mean score (CI) Participants with no dementia				
Wave 1	43.0 (41.0, 44.9)	39.9 (38.1, 41.6)	44.9 (42.5, 47.3)	43.4 (41.5, 45.2)
Wave 2	43.9 (42.0, 45.8)	40.9 (39.0, 42.7)	43.0 (40.3, 45.7)	44.4 (42.7, 46.1)
Wave 3	41.8 (39.7, 43.9)	39.8 (37.8, 41.8)	43.8 (41.0, 46.7)	43.5 (41.7, 45.4)
Wave 4	44.3 (41.9, 46.6)	40.8 (38.8, 42.9)	41.3 (38.3, 44.4)	43.6 (41.7, 45.5)
Physical HRQOL SF-12® PHC mean score (CI) Participants with dementia				
Wave 1	38.9 (32.9, 44.8)	38.4 (32.5, 44.3)	44.8 (40.3, 49.2)	40.9 (35.9, 45.9)
Wave 2	48.0 (42.1, 53.8)	37.8 (30.5, 45.0)	41.3 (34.5, 48.0)	42.6 (35.7, 49.5)
Wave 3	46.2 (35.9, 56.4)	37.7 (31.3, 44.0)	45.2 (38.9, 51.4)	46.6 (35.4, 57.7)
Wave 4	42.2 (29.0, 55.4)	30.7 (22.6, 38.8)	48.0 (40.6, 55.4)	36.6 (28.1, 45.0)
SF-12® PHC dementia and sex were significant predictors (p-values = 0.0214 and 0.0028 respectively); ethnic group and NZDep were not (p-values = 0.6384 and 0.0858 respectively).				
Mental HRQOL SF-12® MHC mean score (CI) Participants with no dementia				
Wave 1	54.0 (52.6, 55.4)	55.3 (54.0, 56.5)	53.5 (51.5, 55.5)	55.9 (54.9, 57.0)
Wave 2	53.7 (52.0, 55.5)	55.1 (53.7, 56.5)	53.0 (51.2, 54.8)	54.9 (53.8, 56.0)
Wave 3	55.9 (54.3, 57.6)	55.2 (53.8, 56.7)	53.7 (51.0, 56.4)	55.9 (54.8, 57.1)
Wave 4	56.5 (54.8, 58.1)	56.3 (54.9, 57.6)	54.8 (52.2, 57.5)	55.7 (54.3, 57.0)
Mental HRQOL SF-12® MHC mean score (CI) Participants with dementia				
Wave 1	51.5 (46.4, 56.6)	51.7 (46.6, 56.7)	51.1 (47.8, 54.4)	50.5 (45.4, 55.5)
Wave 2	51.0 (46.4, 55.5)	47.4 (39.9, 54.9)	51.9 (47.1, 56.8)	52.2 (47.5, 57.0)
Wave 3	53.5 (43.3, 63.6)	53.2 (46.8, 59.6)	49.3 (38.2, 60.4)	50.5 (41.0, 59.9)
Wave 4	52.6 (39.0, 66.2)	52.7 (44.9, 60.4)	52.9 (42.2, 63.7)	50.0 (43.9, 56.2)
For SF-12® MHC dementia was a significant predictor (p-value < 0.0001); ethnic group, sex and NZDep were not (p-values = 0.7411, 0.2288 and 0.4247 respectively).				
GP Visits more than four times a year Percentage of participants with no dementia				
Wave 1	17 (11, 24)	10 (6, 15)	28 (18, 39)	17 (11, 24)
Wave 2	20 (13, 29)	17 (12, 24)	22 (13, 33)	15 (9, 21)
Wave 3	19 (11, 28)	22 (15, 29)	15 (6, 29)	15 (10, 22)
Wave 4	15 (8, 26)	14 (8, 21)	18 (7, 35)	17 (10, 25)
GP Visits more than four times a year Percentage of participants with dementia				
Wave 1	26 (10, 48)	9 (1, 29)	33 (15, 57)	26 (10, 48)
Wave 2	29 (8, 58)	32 (13, 57)	25 (7, 52)	13 (2, 38)
Wave 3	50 (12, 88)	31 (11, 59)	40 (12, 74)	20 (3, 56)
Wave 4	40 (5, 85)	27 (6, 61)	13 (0, 53)	25 (3, 65)
For GP visits dementia and NZDep were significant predictors (p-values = 0.0466 and 0.0479 respectively); ethnic group and sex were not (p-values = 0.8645 and 0.0982 respectively).				

Note: For all variables in this table dementia is significantly associated. Neither the ethnic group x dementia nor gender x dementia interactions are significant.

Table 4: Dementia and hospital admissions per person year by ethnic group and sex, Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	No dementia	0.89 (0.76, 1.03)	0.62 (0.52, 0.72)	0.99 (0.82, 1.16)	1.08 (0.93, 1.22)
	Dementia	1.10 (0.77, 1.42)	0.55 (0.31, 0.79)	0.74 (0.45, 1.02)	1.58 (1.16, 1.99)
W2 - W3	No dementia	0.60 (0.49, 0.71)	0.72 (0.61, 0.82)	1.08 (0.90, 1.25)	1.02 (0.88, 1.16)
	Dementia	1.11 (0.78, 1.44)	0.82 (0.53, 1.11)	0.77 (0.48, 1.06)	1.06 (0.72, 1.40)
W3 - W4	No dementia	0.81 (0.68, 0.94)	0.83 (0.71, 0.95)	0.98 (0.81, 1.15)	1.08 (0.94, 1.23)
	Dementia	1.06 (0.74, 1.37)	0.78 (0.50, 1.07)	0.92 (0.60, 1.24)	1.28 (0.91, 1.66)
W4 + one year	No dementia	1.19 (1.03, 1.34)	0.73 (0.62, 0.84)	1.34 (1.15, 1.54)	1.11 (0.96, 1.25)
	Dementia	0.84 (0.56, 1.13)	0.54 (0.31, 0.78)	0.40 (0.19, 0.61)	0.14 (0.01, 0.26)

Note: Total number of hospital admissions per person year. Sex was a significant predictor of hospitalisation (p-value = 0.0009); dementia, ethnic group and NZDep were not (p-values = 0.2831, 0.2442 and 0.1062 respectively).

Table 5: Dementia and length of stay in hospital by ethnic group and sex, Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	No dementia	5.99 (5.64, 6.34)	3.39 (3.16, 3.63)	4.22 (3.88, 4.57)	6.10 (5.76, 6.44)
	Dementia	7.45 (6.60, 8.30)	4.64 (3.95, 5.34)	6.56 (5.71, 7.41)	18.87 (17.43, 20.31)
W2 - W3	No dementia	2.87 (2.63, 3.11)	2.77 (2.56, 2.99)	4.08 (3.74, 4.42)	5.84 (5.51, 6.18)
	Dementia	8.57 (7.66, 9.48)	4.72 (4.02, 5.42)	4.18 (3.50, 4.85)	20.32 (18.82, 21.81)
W3 - W4	No dementia	4.15 (3.85, 4.44)	5.78 (5.47, 6.09)	2.76 (2.48, 3.04)	4.00 (3.72, 4.28)
	Dementia	1.64 (1.25, 2.04)	1.96 (1.51, 2.41)	4.68 (3.96, 5.40)	15.88 (14.56, 17.2)
W4 + one year	No dementia	4.95 (4.63, 5.27)	4.89 (4.61, 5.18)	6.00 (5.59, 6.41)	4.24 (3.95, 4.52)
	Dementia	5.76 (5.01, 6.50)	3.64 (3.03, 4.26)	1.92 (1.46, 2.37)	0 (0, 0)

Note: Total number of nights in hospital per person year. For hospital length of stay dementia, ethnic group and sex were significant predictors (p-values = 0.0013, 0.0092 and 0.0256 respectively); NZDep was not (p-value = 0.1779).

Table 6: Dementia and hospitalisation costs by participants with and without dementia ($)

		Māori women	Non-Māori women	Māori men	Non-Māori men	Total
W1 - W2	No Dementia	5592.46 (5581.77, 5603.15)	3629.38 (3621.64, 3637.11)	6722.58 (6708.75, 6736.41)	6783.19 (6771.74, 6794.63)	5497.07
	Dementia	6569.50 (6544.38, 6594.62)	3734.52 (3714.83, 3754.21)	4997.07 (4973.65, 5020.49)	17136.04 (17092.67, 17179.40)	7821.12
W2 - W3	No Dementia	2909.52 (2901.81, 2917.23)	3378.00 (3370.54, 3385.47)	5072.28 (5060.26, 5084.29)	6039.55 (6028.75, 6050.34)	4243.75
	Dementia	6811.99 (6786.42, 6837.57)	4466.46 (4444.93, 4488.00)	4929.49 (4906.23, 4952.75)	17139.52 (17096.15, 17182.90)	7792.66
W3 - W4	No Dementia	4682.93 (4673.15, 4692.71)	6035.68 (6025.70, 6045.65)	4384.28 (4373.11, 4395.45)	5519.53 (5509.21, 5529.85)	5368.24
	Dementia	4229.93 (4209.77, 4250.08)	2508.06 (2491.92, 2524.20)	6047.25 (6021.49, 6073.02)	13360.87 (13322.57, 13399.16)	6181.62
W4 + one year	No Dementia	6022.38 (6011.29, 6033.48)	4418.93 (4410.40, 4427.47)	6637.45 (6623.70, 6651.19)	4810.31 (4800.67, 4819.95)	5168.32
	Dementia	6748.69 (6723.23, 6774.15)	2433.11 (2417.21, 2449.00)	1890.82 (1876.41, 1905.22)	70.11 (67.33, 72.88)	2646.94

Note: Calculations based on 2015 NZ dollar costs per person per year. Dementia and sex were significant predictors of hospital costs (p-values = 0.0148, and 0.001 respectively); ethnic group and NZ Dep were not (p-values = 0.2624 and 0.2142 respectively).

Table 7: Cardiovascular disease and dementia by ethnic group and sex, Waves 1-4

N (%)		Māori women	Non-Māori women	Māori men	Non-Māori men
Wave 1	Neither	64 (29)	77 (29)	42 (25)	63 (27)
	CVD only	122 (54)	156 (58)	92 (55)	136 (58)
	Dementia only	11 (5)	14 (5)	9 (5)	14 (6)
	Both	27 (12)	22 (8)	24 (14)	21 (9)

N (%)		Māori women	Non-Māori women	Māori men	Non-Māori men
Wave 2	Neither	64 (32)	75 (29)	37 (25)	59 (28)
	CVD only	111 (56)	147 (58)	84 (56)	129 (60)
	Dementia only	9 (5)	14 (5)	9 (6)	11 (5)
	Both	16 (8)	19 (7)	19 (13)	15 (7)
Wave 3	Neither	38 (33)	57 (32)	19 (25)	50 (31)
	CVD only	67 (58)	103 (58)	41 (55)	97 (61)
	Dementia only	< 5	10 (6)	6 (8)	6 (4)
	Both	7 (6)	8 (4)	9 (12)	6 (4)
Wave 4	Neither	37 (35)	56 (34)	19 (28)	48 (33)
	CVD only	60 (57)	92 (56)	39 (57)	87 (60)
	Dementia only	< 5	10 (6)	< 5	6 (4)
	Both	5 (5)	6 (4)	7 (10)	< 5

Note: CVD:dementia, ethnic group and sex were significant predictors of NEADL score (p-values < 0.0001, 0.0248 and 0.0044 respectively); NZDep was not (p-value = 0.2104).

Table 8: Cardiovascular disease, dementia and functional status, frailty, quality of life and GP visits, by ethnic group and sex, Waves 1-4

	Māori women	Non-Māori women	Māori men	Non-Māori men
NEADL mean score (CI) Participants with neither CVD nor dementia				
Wave 1	19.2 (18.3, 20.1)	18.9 (18.2, 19.6)	18.9 (17.8, 20.1)	19.2 (18.5, 19.8)
Wave 2	19.0 (18.1, 19.8)	18.2 (17.4, 19.0)	17.3 (15.9, 18.7)	17.6 (16.8, 18.4)
Wave 3	18.6 (17.5, 19.8)	18.1 (17.3, 19.0)	16.5 (12.9, 20.1)	17.0 (16.2, 17.9)
Wave 4	18.3 (17.1, 19.6)	17.5 (16.4, 18.5)	15.6 (13.7, 17.4)	17.5 (16.6, 18.5)
NEADL mean score (CI) Participants with CVD only				
Wave 1	17.7 (16.8, 18.5)	17.9 (17.3, 18.6)	17.5 (16.6, 18.3)	17.9 (17.4, 18.4)
Wave 2	16.7 (15.7, 17.7)	16.8 (16.0, 17.6)	15.2 (13.8, 16.6)	16.7 (16.0, 17.4)
Wave 3	16.8 (15.4, 18.1)	16.4 (15.6, 17.3)	15.5 (14.1, 16.9)	16.5 (15.8, 17.2)
Wave 4	15.2 (13.3, 17.0)	16.4 (15.3, 17.6)	15.7 (14.4, 17.1)	16.4 (15.7, 17.2)
NEADL mean score (CI) Participants with dementia only				
Wave 1	14.9 (8.6, 21.1)	14.9 (10.1, 19.7)	13.3 (6.4, 20.2)	14.5 (10.2, 18.8)
Wave 2	14.3 (-1.1, 29.6)	11.9 (4.6, 19.2)	12.7 (7.9, 17.4)	14.7 (9.8, 19.5)
Wave 3	19.0 (8.2, 29.8)	14.1 (7.8, 20.5)	15.5 (11.3, 19.7)	13.4 (6.7, 20.1)
Wave 4	17.0 (5.6, 28.4)	11.5 (2.8, 20.2)	16.0 (9.4, 22.6)	12.8 (3.4, 22.1)
NEADL mean score (CI) Participants with CVD and dementia				
Wave 1	12.1 (8.4, 15.9)	10.7 (6.8, 14.6)	14.5 (11.9, 17.1)	13.6 (10.4, 16.9)
Wave 2	13.0 (8.4, 17.6)	8.8 (3.5, 14.2)	11.9 (7.9, 15.9)	10.1 (6.8, 13.4)
Wave 3	12.2 (1.9, 22.5)	12.8 (6.2, 19.3)	11.3 (6.8, 15.9)	8.8 (-0.4, 18.0)
Wave 4	11.0 (-77.9, 99.9)	13.7 (5.5, 21.8)	12.6 (5.5, 19.7)	9.8 (-1.1, 20.6)
Adjusted for age, ethnic group, sex, socioeconomic deprivation and wave of the study, the NEADL score is significantly associated with CVD: dementia (p <0.0001)				
Fried mean score (CI) Participants with neither CVD nor dementia				
Wave 1	0.61 (0.31, 0.91)	0.78 (0.55, 1.01)	0.57 (0.18, 0.95)	0.60 (0.31, 0.88)
Wave 2	1.15 (0.87, 1.43)	0.93 (0.70, 1.16)	1.00 (0.57, 1.43)	1.18 (0.92, 1.44)
Wave 3	0.88 (0.54, 1.21)	1.10 (0.79, 1.40)	0.33 (-0.05, 0.72)	0.85 (0.58, 1.12)
Wave 4	0.94 (0.37, 1.52)	1.05 (0.74, 1.36)	0.67 (-0.19, 1.52)	1.02 (0.73, 1.32)

	Māori women	Non-Māori women	Māori men	Non-Māori men
Fried mean score (CI) Participants with CVD only				
Wave 1	0.86 (0.65, 1.07)	1.13 (0.90, 1.35)	1.00 (0.72, 1.28)	0.93 (0.73, 1.13)
Wave 2	1.05 (0.82, 1.28)	1.21 (0.99, 1.42)	1.22 (0.89, 1.56)	1.04 (0.86, 1.22)
Wave 3	1.21 (0.95, 1.47)	1.21 (1.01, 1.42)	1.03 (0.67, 1.39)	0.95 (0.74, 1.16)
Wave 4	1.28 (0.99, 1.57)	1.09 (0.81, 1.38)	1.09 (0.74, 1.43)	1.24 (0.99, 1.49)
Fried mean score (CI) Participants with dementia only				
Wave 1	0.25 (-0.55, 1.05)	0.17 (-0.26, 0.60)	0.86 (-0.13, 1.85)	0.86 (-0.13, 1.85)
Wave 2	1.33 (-0.1, 2.77)	1.40 (-0.27, 3.07)	1.80 (0.18, 3.42)	1.17 (-0.06, 2.39)
Wave 3	1.67 (0.23, 3.10)	1.20 (0.16, 2.24)	0.50 (-5.85, 6.85)	0.80 (-0.82, 2.42)
Wave 4	2.00 (-0.48, 4.48)	1.50 (-0.55, 3.55)	1.00 (1.00, 1.00)	2.00 (0.16, 3.84)
Fried mean score (CI) Participants with CVD and dementia				
Wave 1	1.30 (0.40, 2.20)	1.90 (0.98, 2.82)	1.09 (0.22, 1.96)	1.69 (0.79, 2.59)
Wave 2	1.63 (0.86, 2.39)	1.67 (0.51, 2.82)	2.17 (1.13, 3.20)	2.29 (1.41, 3.17)
Wave 3	1.50 (-4.85, 7.85)	1.00 (-0.33, 2.33)	0.75 (-0.77, 2.27)	1.67 (-2.13, 5.46)
Wave 4	1.00 (1.00, 1.00)	0.25 (-0.55, 1.05)	1.25 (-0.27, 2.77)	2.00 (-2.30, 6.30)
CVD:dementia was a significant predictor of Fried score (p-value < 0.0001); ethnic group, sex and NZDep were not (p-values = 0.4611, 0.9296 and 0.2305 respectively).				
Physical HRQOL SF-12® PHC mean score (CI) Participants with neither CVD nor dementia				
Wave 1	48.3 (45.5, 51.1)	42.7 (39.8, 45.5)	47.4 (43.1, 51.7)	48.2 (45.4, 50.9)
Wave 2	48.0 (44.8, 51.2)	43.7 (40.5, 46.9)	47.7 (43.2, 52.2)	48.0 (45.6, 50.4)
Wave 3	45.5 (42.1, 49.0)	43.3 (40.1, 46.4)	49.3 (44.8, 53.8)	46.7 (43.7, 49.6)
Wave 4	48.2 (45.4, 51.0)	43.5 (40.2, 46.7)	45.6 (41.7, 49.4)	46.4 (43.5, 49.3)
Physical HRQOL SF-12® PHC mean score (CI) Participants with CVD only				
Wave 1	40.1 (37.7, 42.5)	38.4 (36.2, 40.5)	43.5 (40.5, 46.5)	41.1 (38.8, 43.5)
Wave 2	41.6 (39.3, 44.0)	39.3 (37.0, 41.6)	41.1 (37.9, 44.4)	42.8 (40.7, 45.0)
Wave 3	39.6 (37.1, 42.2)	37.8 (35.2, 40.3)	41.9 (38.5, 45.3)	41.9 (39.6, 44.2)
Wave 4	41.7 (38.5, 45.0)	39.0 (36.3, 41.7)	40.2 (36.6, 43.9)	41.9 (39.4, 44.3)
Physical HRQOL SF-12® PHC mean score (CI) Participants with dementia only				
Wave 1	50.6 (37.8, 63.5)	43.7 (32.8, 54.6)	45.1 (36.0, 54.3)	46.5 (39.0, 54.1)
Wave 2	49.7 (35.3, 64.1)	37.7 (20.4, 54.9)	43.9 (32.4, 55.3)	48.5 (35.3, 61.7)
Wave 3	52.7 (1.3, 104.0)	39.3 (28.1, 50.6)	45.5 (34.0, 57.0)	52.8 (41.1, 64.6)
Wave 4	45.9 (14.0, 77.7)	29.5 (3.0, 55.9)	45.6 (23.4, 67.7)	38.3 (20.6, 56.0)
Physical HRQOL SF-12® PHC mean score (CI) Participants with CVD and dementia				
Wave 1	34.4 (28.4, 40.5)	35.5 (28.0, 43.0)	44.6 (38.7, 50.4)	36.9 (30.2, 43.6)
Wave 2	47.2 (39.2, 55.2)	37.8 (28.1, 47.6)	39.7 (29.8, 49.7)	38.7 (29.8, 47.5)
Wave 3	43.6 (28.6, 58.6)	36.0 (26.4, 45.5)	44.9 (33.0, 56.7)	38.2 (5.6, 70.8)
Wave 4	36.6 (-5.6, 78.9)	31.6 (23.2, 39.9)	50.4 (37.4, 63.5)	34.8 (18.6, 51.1)
For SF-12® PHC CVD:dementia and sex were significant predictors (p-values < 0.0001 and 0.001 respectively); ethnic group and NZDep were not (p-values = 0.5637 and 0.066 respectively).				
Mental HRQOL SF-12® MHC mean score (CI) Participants with neither CVD nor dementia				
Wave 1	53.6 (51.5, 55.6)	54.4 (52.1, 56.6)	52.4 (48.7, 56.0)	57.1 (55.6, 58.6)
Wave 2	55.7 (53.4, 58.0)	55.6 (53.4, 57.8)	51.1 (47.5, 54.8)	55.2 (53.2, 57.2)
Wave 3	55.9 (53.0, 58.7)	56.3 (54.6, 58.1)	54.4 (51.1, 57.8)	56.3 (54.4, 58.1)
Wave 4	56.1 (54.0, 58.2)	55.9 (53.8, 58.0)	51.2 (45.9, 56.5)	57.1 (55.5, 58.7)

	Māori women	Non-Māori women	Māori men	Non-Māori men
Mental HRQOL SF-12® MHC mean score (CI) Participants with CVD only				
Wave 1	54.2 (52.3, 56.2)	55.7 (54.3, 57.2)	53.9 (51.4, 56.4)	55.4 (54.0, 56.8)
Wave 2	52.7 (50.3, 55.0)	54.8 (53.1, 56.6)	53.7 (51.6, 55.9)	54.8 (53.5, 56.1)
Wave 3	56.0 (53.9, 58.0)	54.6 (52.6, 56.6)	53.5 (50.0, 57.0)	55.7 (54.3, 57.2)
Wave 4	56.7 (54.3, 59.1)	56.6 (54.8, 58.4)	55.8 (52.7, 58.9)	54.8 (52.8, 56.8)
Mental HRQOL SF-12® MHC mean score (CI) Participants with dementia only				
Wave 1	55.8 (49.9, 61.7)	56.5 (52.7, 60.2)	52.6 (46.0, 59.3)	52.8 (48.1, 57.5)
Wave 2	52.7 (37.7, 67.7)	56.9 (46.8, 67.1)	55.1 (47.4, 62.8)	50.4 (40.5, 60.2)
Wave 3	63.5 (49.3, 77.7)	54.1 (42.3, 65.9)	56.1 (42.9, 69.3)	50.9 (35.4, 66.3)
Wave 4	56.0 (26.4, 85.6)	58.0 (54.2, 61.7)	57.4 (39.5, 75.3)	53.5 (41.2, 65.9)
Mental HRQOL SF-12® MHC mean score (CI) Participants with CVD and dementia				
Wave 1	49.9 (43.0, 56.8)	49.1 (41.6, 56.6)	50.3 (46.0, 54.6)	48.8 (40.3, 57.3)
Wave 2	50.2 (44.7, 55.7)	42.2 (32.6, 51.7)	50.0 (42.9, 57.1)	53.5 (47.2, 59.8)
Wave 3	49.5 (36.5, 62.4)	52.2 (43.1, 61.4)	43.9 (23.0, 64.8)	50.0 (17.6, 82.4)
Wave 4	47.5 (-46.5, 141.5)	49.1 (35.5, 62.7)	48.5 (18.0, 79.0)	46.5 (37.3, 55.8)
For mental health-related QOL CVD:dementia was a significant predictor (p-value < 0.0001) ethnic group, sex and NZDep were not (p-values = 0.6965, 0.229 and 0.4375 respectively).)				
GP Visits more than four times a year Percentage of participants with neither CVD nor dementia				
Wave 1	2 (0, 12)	8 (3, 17)	19 (7, 39)	2 (0, 12)
Wave 2	7 (2, 20)	17 (8, 29)	14 (3, 35)	12 (5, 24)
Wave 3	9 (2, 25)	14 (6, 27)	0 (0, 26)	9 (2, 20)
Wave 4	4 (0, 20)	4 (1, 14)	14 (0, 58)	10 (3, 23)
GP Visits more than four times a year Percentage of participants with CVD only				
Wave 1	24 (16, 35)	11 (6, 18)	31 (20, 46)	24 (16, 35)
Wave 2	27 (18, 39)	18 (11, 26)	25 (14, 39)	16 (9, 24)
Wave 3	24 (13, 38)	26 (17, 36)	21 (9, 38)	18 (11, 28)
Wave 4	23 (11, 38)	21 (12, 32)	19 (6, 38)	21 (12, 33)
GP Visits more than four times a year Percentage of participants with dementia only				
Wave 1	14 (0, 58)	0 (0, 31)	29 (4, 71)	14 (0, 58)
Wave 2	50 (7, 93)	13 (0, 53)	17 (0, 64)	0 (0, 46)
Wave 3	0 (0, 84)	13 (0, 53)	0 (0, 60)	0 (0, 52)
Wave 4	33 (1, 91)	33 (4, 78)	0 (0, 71)	25 (1, 81)
GP Visits more than four times a year Percentage of participants with CVD and dementia				
Wave 1	31 (11, 59)	17 (2, 48)	36 (13, 65)	31 (11, 59)
Wave 2	20 (3, 56)	45 (17, 77)	30 (7, 65)	20 (3, 56)
Wave 3	75 (19, 99)	50 (16, 84)	67 (22, 96)	40 (5, 85)
Wave 4	50 (1, 99)	20 (1, 72)	20 (1, 72)	25 (1, 81)
CVD:dementia and NZ Dep were significant predictors of GP visits (p-values < 0.0001 and 0.0296 respectively); ethnic group and sex were not (p-values = 0.698 and 0.1086 respectively).				

Note: For all variables in this table CVD:dementia is a significant predictor (p < 0.0001).

Table 9: Cardiovascular disease, dementia and hospital admissions per person year by ethnic group and sex, Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	Neither	0.28 (0.15, 0.41)	0.47 (0.32, 0.62)	0.55 (0.32, 0.77)	0.73 (0.52, 0.94)
	CVD only	1.21 (1.02, 1.41)	0.69 (0.56, 0.83)	1.20 (0.98, 1.43)	1.24 (1.05, 1.43)
	Dementia only	0.55 (0.11, 0.99)	0.50 (0.13, 0.88)	0.43 (0.00, 0.87)	1.11 (0.56, 1.66)
	Both	1.38 (0.94, 1.82)	0.60 (0.28, 0.93)	0.94 (0.55, 1.33)	1.87 (1.28, 2.45)

		Māori women	Non-Māori women	Māori men	Non-Māori men
W2 - W3	Neither	0.22 (0.11, 0.34)	0.61 (0.43, 0.78)	0.86 (0.58, 1.14)	0.82 (0.59, 1.04)
	CVD only	0.76 (0.60, 0.91)	0.77 (0.63, 0.91)	1.20 (0.98, 1.43)	1.11 (0.93, 1.29)
	Dementia only	0.32 (-0.02, 0.65)	0.60 (0.20, 1.01)	1.10 (0.41, 1.78)	0.22 (-0.03, 0.46)
	Both	1.58 (1.11, 2.06)	1.03 (0.61, 1.45)	0.62 (0.30, 0.93)	1.63 (1.09, 2.18)
W3 - W4	Neither	0.43 (0.27, 0.58)	0.48 (0.33, 0.63)	0.57 (0.34, 0.80)	0.94 (0.70, 1.18)
	CVD only	1.04 (0.86, 1.22)	1.03 (0.87, 1.19)	1.17 (0.95, 1.39)	1.16 (0.98, 1.34)
	Dementia only	1.85 (1.05, 2.66)	0.29 (0.01, 0.57)	1.12 (0.43, 1.81)	1.55 (0.90, 2.20)
	Both	0.57 (0.28, 0.85)	1.47 (0.97, 1.98)	0.82 (0.46, 1.18)	0.95 (0.53, 1.37)
W4 + one year	Neither	0.87 (0.64, 1.10)	0.90 (0.69, 1.11)	1 (0.7, 1.3)	0.64 (0.44, 0.83)
	CVD only	1.36 (1.16, 1.57)	0.63 (0.5, 0.75)	1.51 (1.26, 1.77)	1.37 (1.17, 1.56)
	Dementia only	0.85 (0.31, 1.40)	0 (0, 0)	0 (0, 0)	0.22 (-0.02, 0.47)
	Both	0.84 (0.49, 1.18)	1.35 (0.87, 1.84)	0.62 (0.31, 0.94)	0 (0, 0)

Note: For Hospital admissions CVD:dementia and sex were significant predictors (p-values < 0.0001 and 0.0006); ethnic group and NZDep were not (p-values = 0.3071 and 0.1295 respectively).

Table 10: Cardiovascular disease, dementia and length of stay in hospital by ethnic group and sex, Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	Neither	1.68 (1.36, 1.99)	1.90 (1.60, 2.21)	3.93 (3.33, 4.53)	7.42 (6.75, 8.09)
	CVD only	8.30 (7.79, 8.81)	4.15 (3.83, 4.47)	4.40 (3.98, 4.83)	5.47 (5.08, 5.87)
	Dementia only	1.66 (0.90, 2.43)	2.30 (1.51, 3.10)	3.26 (2.08, 4.44)	5.28 (4.08, 6.48)
	Both	9.98 (8.79, 11.17)	6.36 (5.31, 7.42)	8.61 (7.44, 9.78)	27.40 (25.16, 29.64)
W2 - W3	Neither	1.12 (0.86, 1.38)	2.11 (1.78, 2.43)	4.39 (3.76, 5.02)	2.72 (2.32, 3.13)
	CVD only	3.57 (3.24, 3.91)	3.12 (2.84, 3.40)	3.98 (3.57, 4.39)	7.30 (6.84, 7.75)
	Dementia only	0.95 (0.37, 1.52)	3.54 (2.55, 4.52)	7.69 (5.88, 9.50)	0.11 (-0.06, 0.28)
	Both	12.04 (10.73, 13.35)	5.89 (4.88, 6.90)	2.53 (1.90, 3.17)	34.00 (31.51, 36.50)
W3 - W4	Neither	4.13 (3.64, 4.63)	3.82 (3.39, 4.26)	1.86 (1.45, 2.27)	2.47 (2.08, 2.86)
	CVD only	4.15 (3.79, 4.52)	6.91 (6.50, 7.32)	3.17 (2.81, 3.53)	4.82 (4.45, 5.18)
	Dementia only	3.71 (2.57, 4.84)	1.54 (0.89, 2.19)	8.73 (6.80, 10.66)	16.60 (14.46, 18.73)
	Both	0.38 (0.15, 0.61)	2.54 (1.88, 3.21)	2.57 (1.93, 3.21)	15.01 (13.35, 16.66)
W4 + one year	Neither	5.30 (4.74, 5.86)	3.88 (3.44, 4.32)	1.87 (1.46, 2.28)	1.46 (1.16, 1.76)
	CVD only	4.75 (4.37, 5.14)	5.50 (5.13, 5.87)	8.13 (7.54, 8.71)	5.77 (5.37, 6.18)
	Dementia only	9.81 (7.96, 11.67)	0 (0, 0)	0 (0, 0)	0 (0, 0)
	Both	3.77 (3.04, 4.50)	9.07 (7.81, 10.33)	2.96 (2.28, 3.65)	0 (0, 0)

Note: For hospital length of stay CVD:dementia, ethnic group and sex were significant predictors (p-values < 0.0001, 0.0078 and 0.031); NZDep was not (p-value = 0.2421).

Table 11: Cardiovascular disease, dementia and hospitalisation costs ($), Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	Neither	1934.48 (1923.79, 1945.17)	2695.71 (2684.11, 2707.31)	5878.41 (5855.22, 5901.59)	7266.70 (7245.65, 7287.75)
	CVD only	7551.15 (7535.73, 7566.57)	4103.08 (4093.03, 4113.13)	7176.22 (7158.90, 7193.53)	6553.96 (6540.35, 6567.57)
	Dementia only	2386.41 (2357.54, 2415.28)	2688.44 (2661.28, 2715.60)	3127.13 (3090.59, 3163.66)	5407.70 (5369.18, 5446.23)
	Both	8693.59 (8658.42, 8728.76)	4582.54 (4554.25, 4610.83)	6276.40 (6244.70, 6308.09)	24493.04 (24426.10, 24559.98)

		Māori women	Non-Māori women	Māori men	Non-Māori men
W2 - W3	Neither	768.10 (761.36, 774.84)	2708.14 (2696.52, 2719.77)	4762.81 (4741.94, 4783.68)	3815.82 (3800.57, 3831.08)
	CVD only	3731.10 (3720.26, 3741.93)	3725.42 (3715.85, 3735.00)	5287.14 (5272.29, 5302.00)	7076.87 (7062.73, 7091.01)
	Dementia only	1066.60 (1047.30, 1085.90)	3854.39 (3821.87, 3886.91)	6926.19 (6871.81, 6980.56)	538.83 (526.67, 550.99)
	Both	9703.34 (9666.19, 9740.50)	5186.87 (5156.78, 5216.97)	4158.04 (4132.25, 4183.84)	28382.10 (28310.05, 28454.16)
W3 - W4	Neither	4730.86 (4714.14, 4747.58)	3959.22 (3945.17, 3973.28)	2051.65 (2037.95, 2065.35)	4522.49 (4505.89, 4539.10)
	CVD only	4654.03 (4641.93, 4666.14)	7232.26 (7218.91, 7245.60)	5461.98 (5446.88, 5477.08)	6048.79 (6035.72, 6061.86)
	Dementia only	9021.15 (8965.03, 9077.28)	1000.40 (983.83, 1016.96)	8337.28 (8277.62, 8396.93)	14178.75 (14116.37, 14241.12)
	Both	1291.60 (1278.05, 1305.16)	4610.95 (4582.57, 4639.32)	4852.84 (4824.97, 4880.71)	12359.25 (12311.70, 12406.80)
W4 + one year	Neither	7338.83 (7318.01, 7359.66)	4833.73 (4818.20, 4849.26)	3500.77 (3482.88, 3518.67)	2225.55 (2213.90, 2237.20)
	CVD only	5281.09 (5268.20, 5293.99)	4173.42 (4163.28, 4183.55)	8253.83 (8235.26, 8272.39)	6242.21 (6228.93, 6255.49)
	Dementia only	6211.76 (6165.19, 6258.34)	0 (0, 0)	0 (0, 0)	115.74 (110.10, 121.37)
	Both	7012.08 (6980.49, 7043.66)	6060.91 (6028.38, 6093.44)	2926.28 (2904.64, 2947.92)	0 (0, 0)

Summary total for all participants

	Neither	CVD only	Dementia only	Both
W1 - W2	4188.80	6161.10	3404.93	10566.53
W2 - W3	2793.04	4901.44	3152.48	11006.40
W3 - W4	4094.57	6071.54	6849.68	5564.07
W4 + one year	4411.40	5595.06	835.95	4341.87

Note: For hospital costs CVD:dementia and sex were significant predictors (p-values < 0.0001 and 0.0007 respectively); ethnic group and NZDep were not (p-values = 0.3134 and 0.2615 respectively).

Table 12: Chronic lung disease and dementia by ethnic group and sex, Waves 1-4

N (%)		Māori women	Non-Māori women	Māori men	Non-Māori men
Wave 1	Neither	124 (56)	118 (59)	69 (61)	63 (61)
	CLD only	60 (27)	56 (28)	34 (30)	32 (31)
	Dementia only	23 (10)	17 (9)	6 (5)	5 (5)
	Both	15 (7)	9 (5)	< 5	< 5
Wave 2	Neither	166 (62)	160 (63)	114 (64)	106 (65)
	CLD only	65 (24)	62 (24)	46 (26)	42 (26)
	Dementia only	25 (9)	24 (9)	14 (8)	13 (8)
	Both	12 (4)	10 (4)	< 5	< 5
Wave 3	Neither	85 (51)	79 (52)	41 (55)	40 (58)
	CLD only	48 (29)	42 (28)	19 (25)	18 (26)
	Dementia only	21 (13)	19 (13)	10 (13)	9 (13)
	Both	14 (8)	11 (7)	5 (7)	< 5
Wave 4	Neither	147 (63)	140 (65)	112 (70)	105 (72)
	CLD only	51 (22)	48 (22)	35 (22)	30 (21)
	Dementia only	29 (12)	23 (11)	11 (7)	9 (6)
	Both	6 (3)	< 5	< 5	< 5

Note: Ethnic group is a significant predictor of CLD:dementia but sex is not (p = 0.0471 and 0.48 respectively).

Table 13: Chronic lung disease, dementia and functional status, frailty, quality of life and GP visits, by ethnic group and sex, Waves 1-4

	Māori women	Non-Māori women	Māori men	Non-Māori men
NEADL mean score (CI) Participants with neither CLD nor dementia				
Wave 1	18.7 (17.9, 19.4)	18.6 (18.0, 19.1)	18.0 (16.9, 19.2)	18.4 (17.9, 18.9)
Wave 2	17.9 (17.2, 18.6)	17.7 (17.1, 18.4)	16.6 (15.5, 17.7)	17.1 (16.5, 17.7)
Wave 3	17.7 (16.6, 18.7)	17.7 (17.0, 18.4)	15.7 (13.9, 17.4)	16.8 (16.2, 17.4)
Wave 4	16.9 (15.5, 18.4)	17.1 (16.1, 18.1)	15.6 (14.1, 17.1)	16.9 (16.2, 17.6)
NEADL mean score (CI) Participants with CLD only				
Wave 1	17.2 (15.9, 18.6)	17.3 (16.2, 18.3)	17.1 (16.0, 18.2)	18.0 (17.0, 18.9)
Wave 2	16.6 (14.9, 18.2)	16.3 (15.0, 17.5)	14.5 (12.2, 16.8)	16.7 (15.5, 17.8)
Wave 3	16.8 (14.7, 18.9)	15.7 (14.3, 17.0)	15.9 (13.8, 18.0)	16.3 (15.0, 17.6)
Wave 4	14.9 (12.2, 17.5)	16.3 (14.8, 17.7)	16.0 (14.5, 17.5)	16.8 (15.6, 18.0)
NEADL mean score (CI) Participants with dementia only				
Wave 1	12.3 (7.1, 17.4)	12.8 (8.9, 16.7)	15.1 (12.6, 17.5)	14.1 (11.5, 16.7)
Wave 2	14.6 (9.1, 20.0)	9.9 (5.1, 14.7)	14.6 (12.5, 16.6)	12.0 (9.2, 14.8)
Wave 3	16.7 (10.9, 22.4)	12.8 (7.9, 17.8)	13.1 (11.7, 14.6)	11.0 (5.7, 16.3)
Wave 4	14.6 (6.2, 23.0)	11.4 (5.7, 17.1)	12.8 (7.4, 18.2)	11.7 (5.8, 17.7)
NEADL mean score (CI) Participants with both CLD and dementia				
Wave 1	13.8 (9.5, 18.1)	11.9 (6.4, 17.3)	12.5 (6.4, 18.6)	13.4 (3.9, 22.9)
Wave 2	11.2 (2.1, 20.3)	10.6 (-0.3, 21.5)	9.1 (3.7, 14.6)	10.5 (-59.4, 80.4)
Wave 3	9.0 (-105.4, 123.4)	16.0 (11.7, 20.3)	12.7 (-8.2, 33.5)	--
Wave 4	--	18.5 (12.1, 24.9)	17.0 (-8.4, 42.4)	--
For NEADL CLD:dementia, ethnic group and sex were significant predictors (p-values < 0.0001, 0.0122 and 0.0055 respectively); NZDep was not (p-value = 0.1528).				
Fried mean score (CI) Participants with neither CLD nor dementia				
Wave 1	0.68 (0.48, 0.87)	0.88 (0.71, 1.06)	0.67 (0.41, 0.94)	0.71 (0.52, 0.89)
Wave 2	1.05 (0.83, 1.27)	1.02 (0.84, 1.20)	1.18 (0.84, 1.51)	1.06 (0.89, 1.24)
Wave 3	1.09 (0.84, 1.34)	1.18 (0.98, 1.38)	0.74 (0.34, 1.15)	0.89 (0.70, 1.08)
Wave 4	1.14 (0.82, 1.47)	1.02 (0.76, 1.27)	1.05 (0.66, 1.44)	1.18 (0.96, 1.41)
Fried mean score (CI) Participants with CLD only				
Wave 1	1.00 (0.66, 1.34)	1.32 (0.92, 1.72)	1.10 (0.71, 1.50)	1.17 (0.83, 1.51)
Wave 2	1.18 (0.84, 1.51)	1.32 (0.98, 1.66)	1.06 (0.70, 1.42)	1.15 (0.86, 1.45)
Wave 3	1.09 (0.70, 1.48)	1.14 (0.78, 1.50)	1.15 (0.74, 1.57)	1.00 (0.65, 1.35)
Wave 4	1.21 (0.61, 1.82)	1.19 (0.82, 1.57)	0.89 (0.29, 1.49)	1.04 (0.69, 1.40)
Fried mean score (CI) Participants with dementia only				
Wave 1	0.17 (-0.26, 0.60)	0.91 (0.15, 1.67)	0.70 (-0.06, 1.46)	1.50 (0.83, 2.17)
Wave 2	1.57 (1.08, 2.07)	1.55 (0.58, 2.51)	1.67 (0.40, 2.94)	1.92 (1.23, 2.61)
Wave 3	1.60 (0.92, 2.28)	1.13 (0.18, 2.07)	0.60 (-0.51, 1.71)	1.29 (0.01, 2.56)
Wave 4	1.75 (0.23, 3.27)	0.67 (-0.19, 1.52)	1.20 (0.16, 2.24)	1.83 (0.44, 3.23)
Fried mean score (CI) Participants with both CLD and dementia				
Wave 1	1.71 (0.55, 2.87)	2.00 (0.04, 3.96)	1.38 (0.29, 2.46)	1.00 (-2.18, 4.18)
Wave 2	1.50 (-0.55, 3.55)	1.67 (-2.13, 5.46)	2.40 (1.29, 3.51)	--
Wave 3	--	1.00 (-1.48, 3.48)	--	--
Wave 4	--	1.50 (-17.56, 20.56)	--	--
For Fried CLD:dementia was a significant predictor (p-value < 0.0001); ethnic group, sex and NZDep were not (p-values = 0.4851, 0.6869 and 0.1874 respectively).				

	Māori women	Non-Māori women	Māori men	Non-Māori men
Physical HRQOL SF-12® PHC mean score (CI) Participants with neither CLD nor dementia				
Wave 1	44.3 (41.8, 46.8)	41.6 (39.7, 43.6)	46.4 (43.2, 49.7)	44.4 (42.3, 46.6)
Wave 2	45.7 (43.5, 47.8)	42.0 (39.8, 44.1)	45.4 (42.2, 48.6)	45.1 (43.0, 47.1)
Wave 3	42.7 (40.0, 45.3)	42.3 (40.0, 44.5)	45.6 (42.4, 48.7)	44.5 (42.5, 46.5)
Wave 4	45.3 (42.6, 48.1)	41.7 (39.2, 44.1)	40.6 (36.9, 44.3)	43.7 (41.5, 45.9)
Physical HRQOL SF-12® PHC mean score (CI) Participants with CLD only				
Wave 1	39.9 (36.6, 43.2)	35.3 (31.8, 38.8)	42.1 (38.3, 46.0)	40.3 (36.5, 44.2)
Wave 2	40.0 (36.1, 43.8)	38.1 (34.3, 41.8)	38.8 (34.3, 43.4)	42.7 (39.6, 45.8)
Wave 3	39.4 (35.8, 43.0)	33.8 (30.0, 37.5)	40.3 (34.2, 46.3)	40.6 (36.3, 44.9)
Wave 4	41.5 (36.8, 46.2)	38.8 (34.8, 42.9)	43.1 (36.8, 49.4)	43.4 (39.8, 47.1)
Physical HRQOL SF-12® PHC mean score (CI) Participants with dementia only				
Wave 1	42.0 (31.3, 52.7)	36.7 (29.3, 44.2)	47.4 (41.9, 52.9)	42.2 (36.7, 47.6)
Wave 2	51.2 (44.5, 57.9)	37.8 (29.5, 46.1)	46.2 (37.7, 54.8)	43.7 (37.0, 50.4)
Wave 3	51.0 (42.4, 59.6)	38.8 (31.6, 46.1)	47.4 (40.2, 54.6)	46.1 (32.3, 59.9)
Wave 4	42.2 (29.0, 55.4)	28.5 (20.3, 36.7)	51.0 (44.0, 58.1)	37.6 (27.9, 47.2)
Physical HRQOL SF-12® PHC mean score (CI) Participants with both CLD and dementia				
Wave 1	36.1 (28.3, 43.9)	43.3 (32.5, 54.1)	40.5 (32.3, 48.7)	34.6 (13.2, 56.1)
Wave 2	40.6 (27.3, 53.9)	37.7 (10.9, 64.4)	34.9 (23.5, 46.3)	35.1 (-182.7, 252.8)
Wave 3	34.1 (-71.0, 139.2)	33.3 (0.8, 65.8)	40.7 (16.0, 65.4)	--
Wave 4	--	39.5 (-114.3, 193.3)	41.9 (-37.8, 121.6)	--
For SF-12® PHC CLD:dementia and sex were significant predictors (p-values < 0.0001 and 0.0032 respectively); ethnic group and NZDep were not (p-values = 0.4383 and 0.1027 respectively).				
Mental HRQOL SF-12® MHC mean score (CI) Participants with neither CLD nor dementia				
Wave 1	54.4 (52.7, 56.1)	54.8 (53.4, 56.3)	54.1 (52, 56.2)	55.9 (54.7, 57.2)
Wave 2	55.1 (53.3, 56.9)	55.1 (53.5, 56.7)	52.0 (49.6, 54.4)	54.6 (53.4, 55.8)
Wave 3	56.9 (55.5, 58.4)	55.6 (54.0, 57.1)	53.6 (49.7, 57.5)	55.7 (54.5, 56.9)
Wave 4	57.0 (55.2, 58.9)	55.8 (54.2, 57.4)	55.4 (52.0, 58.9)	56.4 (55.0, 57.7)
Mental HRQOL SF-12® MHC mean score (CI) Participants with CLD only				
Wave 1	53.4 (50.7, 56.2)	56.1 (53.8, 58.4)	52.4 (48.0, 56.8)	55.9 (53.6, 58.2)
Wave 2	51.6 (48.1, 55.1)	55.1 (52.3, 57.8)	54.8 (52.0, 57.5)	55.9 (53.4, 58.4)
Wave 3	53.8 (49.8, 57.9)	54.4 (51.2, 57.6)	54.0 (51.3, 56.6)	56.6 (53.8, 59.5)
Wave 4	54.7 (51.1, 58.4)	57.5 (55.1, 59.9)	53.5 (49.1, 57.8)	53.4 (49.4, 57.5)
Mental HRQOL SF-12® MHC mean score (CI) Participants with dementia only				
Wave 1	54.6 (50.1, 59.1)	53.3 (49.6, 57.1)	51.4 (47.8, 55.0)	48.5 (42.8, 54.2)
Wave 2	50.8 (43.9, 57.7)	48.2 (39.3, 57.2)	54.2 (48.5, 60.0)	52.3 (46.9, 57.7)
Wave 3	56.8 (43.5, 70.1)	51.6 (44.3, 58.9)	50.4 (41.3, 59.5)	49.4 (38.1, 60.6)
Wave 4	52.6 (39.0, 66.2)	51.4 (41.6, 61.2)	48.7 (32.7, 64.6)	48.8 (42.3, 55.4)
Mental HRQOL SF-12® MHC mean score (CI) Participants with both CLD and dementia				
Wave 1	47.1 (36.5, 57.6)	46.6 (23.5, 69.7)	50.5 (42.6, 58.4)	60.1 (55.2, 65.0)
Wave 2	51.3 (45.2, 57.4)	45.4 (20.3, 70.5)	48.9 (39.1, 58.7)	51.8 (-11.4, 115)
Wave 3	45.1 (-28.4, 118.6)	59.0 (30.4, 87.5)	47.0 (-15.5, 109.6)	--
Wave 4	--	57.6 (13.4, 101.9)	61.5 (41.8, 81.1)	--
For SF-12® MHC CLD:dementia was a significant predictor (p-value < 0.0001); ethnic group, sex and NZDep were not (p-values = 0.7622, 0.3571 and 0.3862 respectively).				

	Māori women	Non-Māori women	Māori men	Non-Māori men
GP Visits more than four times a year Percentage of participants with neither CLD nor dementia				
Wave 1	13 (7, 22)	10 (5, 16)	22 (12, 37)	13 (7, 22)
Wave 2	15 (8, 25)	14 (8, 21)	21 (11, 36)	12 (7, 19)
Wave 3	16 (8, 28)	20 (12, 29)	13 (4, 30)	14 (8, 23)
Wave 4	14 (5, 27)	12 (6, 21)	25 (10, 47)	18 (10, 28)
GP Visits more than four times a year Percentage of participants with CLD only				
Wave 1	26 (14, 41)	11 (4, 23)	38 (21, 58)	26 (14, 41)
Wave 2	32 (18, 49)	27 (15, 41)	22 (9, 42)	21 (10, 37)
Wave 3	21 (8, 41)	26 (14, 41)	20 (4, 48)	17 (7, 34)
Wave 4	20 (6, 44)	18 (7, 35)	100 (69, 100)	12 (3, 31)
GP Visits more than four times a year Percentage of participants with dementia only				
Wave 1	17 (2, 48)	13 (2, 40)	38 (14, 68)	17 (2, 48)
Wave 2	33 (7, 70)	29 (8, 58)	22 (3, 60)	7 (0, 34)
Wave 3	40 (5, 85)	38 (14, 68)	43 (10, 82)	22 (3, 60)
Wave 4	40 (5, 85)	33 (7, 70)	17 (0, 64)	14 (0, 58)
GP Visits more than four times a year (%).Percentage of participants with both CLD and dementia				
Wave 1	40 (12, 74)	100 (59, 100)	25 (3, 65)	40 (12, 74)
Wave 2	20 (1, 72)	40 (5, 85)	29 (4, 71)	50 (1, 99)
Wave 3	0 (0, 97)	0 (0, 71)	33 (1, 91)	0 (0, 97)
Wave 4	--	0 (0, 84)	0 (0, 84)	0 (0, 97)
For GP visits CLD:dementia was a significant predictor (p-value < 0.0001); ethnic group, sex and NZDep were not (p-values = 0.9149, 0.1217 and 0.0656 respectively).				

Note: For all variables in above table CLD-dementia is a significant predictor.

Table 14: Chronic lung disease, dementia and hospital admissions per person year by ethnic group and sex, Waves 1-4

		Māori women	Non-Māori women	Māori men	Non- Māori men
W1 - W2	Neither	0.79 (0.63, 0.94)	0.61 (0.49, 0.72)	0.81 (0.62, 1.00)	0.88 (0.73, 1.03)
	CLD only	1.16 (0.88, 1.43)	0.67 (0.47, 0.87)	1.36 (1.03, 1.69)	1.68 (1.32, 2.03)
	Dementia only	0.99 (0.58, 1.39)	0.36 (0.12, 0.59)	0.55 (0.24, 0.87)	1.51 (1.06, 1.95)
	Both	1.50 (0.88, 2.12)	0.98 (0.42, 1.54)	1.03 (0.50, 1.56)	1.96 (0.84, 3.08)
W2 - W3	Neither	0.64 (0.50, 0.78)	0.68 (0.55, 0.80)	0.87 (0.68, 1.07)	0.88 (0.73, 1.03)
	CLD only	0.55 (0.36, 0.73)	0.83 (0.61, 1.05)	1.56 (1.21, 1.91)	1.43 (1.10, 1.76)
	Dementia only	0.78 (0.42, 1.14)	0.76 (0.42, 1.10)	0.83 (0.44, 1.22)	0.83 (0.50, 1.17)
	Both	1.95 (1.25, 2.66)	0.99 (0.43, 1.56)	0.67 (0.24, 1.10)	3.20 (1.77, 4.64)
W3 - W4	Neither	0.71 (0.56, 0.85)	0.73 (0.60, 0.86)	0.78 (0.6, 0.97)	1.06 (0.89, 1.23)
	CLD only	1.08 (0.81, 1.34)	1.09 (0.84, 1.35)	1.41 (1.07, 1.74)	1.15 (0.86, 1.44)
	Dementia only	1.40 (0.91, 1.88)	0.85 (0.49, 1.21)	0.93 (0.52, 1.35)	1.24 (0.83, 1.64)
	Both	0.36 (0.06, 0.66)	0.53 (0.12, 0.94)	0.88 (0.39, 1.37)	1.68 (0.65, 2.72)
W4 + one year	Neither	0.87 (0.71, 1.04)	0.74 (0.61, 0.87)	1.22 (0.99, 1.45)	0.89 (0.73, 1.04)
	CLD only	1.87 (1.53, 2.22)	0.69 (0.49, 0.90)	1.66 (1.30, 2.03)	1.89 (1.51, 2.26)
	Dementia only	0.47 (0.19, 0.74)	0.66 (0.34, 0.98)	0.49 (0.19, 0.79)	0.16 (0.01, 0.30)
	Both	1.42 (0.81, 2.02)	0 (0, 0)	0 (0, 0)	0 (0, 0)

Note: For hospital admissions CLD:dementia and sex were significant predictors (p-values = 0.0006 and 0.0008 respectively); ethnic group and NZDep were not (p-values = 0.4417 and 0.0851 respectively).

Table 15: Chronic lung disease, dementia and length of stay by ethnic group and sex, Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	Neither	3.51 (3.18, 3.84)	3.10 (2.83, 3.37)	3.42 (3.03, 3.81)	4.53 (4.19, 4.88)
	CLD only	11.55 (10.69, 12.41)	4.24 (3.74, 4.74)	5.84 (5.16, 6.53)	10.87 (9.97, 11.78)
	Dementia only	5.83 (4.85, 6.82)	2.14 (1.57, 2.72)	5.24 (4.26, 6.22)	20.05 (18.42, 21.68)
	Both	11.85 (10.11, 13.59)	10.26 (8.45, 12.08)	8.65 (7.11, 10.19)	12.21 (9.42, 15.01)
W2 - W3	Neither	3.40 (3.07, 3.72)	2.74 (2.49, 2.99)	3.64 (3.24, 4.05)	5.71 (5.32, 6.09)
	CLD only	1.89 (1.55, 2.24)	2.94 (2.53, 3.36)	5.19 (4.55, 5.83)	6.38 (5.69, 7.07)
	Dementia only	4.68 (3.79, 5.56)	4.34 (3.52, 5.16)	3.20 (2.44, 3.97)	20.24 (18.60, 21.87)
	Both	17.47 (15.35, 19.58)	5.84 (4.48, 7.21)	5.76 (4.50, 7.01)	21.05 (17.38, 24.73)
W3 - W4	Neither	4.60 (4.23, 4.98)	4.73 (4.40, 5.06)	1.66 (1.39, 1.94)	4.20 (3.87, 4.53)
	CLD only	3.49 (3.02, 3.97)	8.44 (7.73, 9.14)	5.15 (4.51, 5.79)	3.34 (2.83, 3.84)
	Dementia only	2.44 (1.80, 3.08)	2.41 (1.80, 3.02)	5.29 (4.31, 6.28)	14.44 (13.06, 15.83)
	Both	0 (0, 0)	0.27 (-0.03, 0.56)	2.94 (2.04, 3.84)	28.61 (24.33, 32.89)
W4 + one year	Neither	4.54 (4.17, 4.92)	4.97 (4.63, 5.31)	4.16 (3.73, 4.59)	3.14 (2.86, 3.43)
	CLD only	6.11 (5.48, 6.74)	4.72 (4.19, 5.25)	10.88 (9.95, 11.81)	8.10 (7.32, 8.88)
	Dementia only	5.35 (4.41, 6.30)	4.45 (3.62, 5.27)	2.34 (1.69, 3.00)	0 (0, 0)
	Both	6.38 (5.10, 7.65)	0 (0, 0)	0 (0, 0)	0 (0, 0)

Note: For hospital length of stay CLD:dementia and sex were significant predictors (p-values < 0.0001 and 0.008 respectively); ethnic group and NZDep were not (p-values = 0.0616 and 0.1583 respectively)

Table 16: Chronic lung disease, dementia and hospitalisation costs ($), Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	Neither	3936.14 (3925.10, 3947.18)	3560.80 (3551.72, 3569.88)	6941.66 (6923.95, 6959.37)	5912.64 (5900.21, 5925.07)
	CLD only	9393.53 (9369.01, 9418.06)	3916.75 (3901.53, 3931.96)	6618.25 (6595.24, 6641.27)	9501.60 (9474.84, 9528.35)
	Dementia only	5830.66 (5799.46, 5861.87)	2416.51 (2397.24, 2435.78)	4279.16 (4251.18, 4307.14)	18596.58 (18546.95, 18646.21)
	Both	9157.01 (9108.59, 9205.44)	6700.69 (6654.37, 6747.00)	6128.53 (6087.52, 6169.54)	8892.47 (8817.01, 8967.92)
W2 - W3	Neither	3267.96 (3257.89, 3278.02)	3235.77 (3227.11, 3244.42)	4343.65 (4329.64, 4357.66)	6012.46 (5999.92, 6024.99)
	CLD only	2297.88 (2285.75, 2310.01)	3836.13 (3821.08, 3851.19)	6845.43 (6822.02, 6868.83)	6252.58 (6230.87, 6274.28)
	Dementia only	3336.05 (3312.45, 3359.66)	3819.02 (3794.79, 3843.24)	3756.23 (3730.02, 3782.45)	17497.16 (17449.02, 17545.31)
	Both	14574.92 (14513.82, 14636.02)	6376.63 (6331.45, 6421.81)	6827.91 (6784.62, 6871.19)	13798.86 (13704.87, 13892.86)
W3 - W4	Neither	4828.93 (4816.70, 4841.16)	5030.60 (5019.81, 5041.39)	3712.99 (3700.03, 3725.94)	5955.01 (5942.54, 5967.49)
	CLD only	4696.94 (4679.60, 4714.28)	8586.36 (8563.83, 8608.88)	5855.42 (5833.77, 5877.07)	4067.71 (4050.21, 4085.22)
	Dementia only	5839.22 (5807.99, 5870.45)	2947.68 (2926.40, 2968.97)	6795.24 (6759.98, 6830.49)	12199.67 (12159.46, 12239.87)
	Both	924.47 (909.09, 939.86)	858.92 (842.34, 875.50)	3927.96 (3895.13, 3960.79)	23645.79 (23522.74, 23768.83)
W4 + one year	Neither	5056.05 (5043.53, 5068.56)	4520.78 (4510.55, 4531.01)	5343.33 (5327.79, 5358.87)	4124.26 (4113.88, 4134.64)
	CLD only	8324.76 (8301.67, 8347.85)	4168.98 (4153.28, 4184.67)	10073.72 (10045.32, 10102.11)	7233.42 (7210.08, 7256.76)
	Dementia only	3386.80 (3363.01, 3410.58)	2970.02 (2948.65, 2991.38)	2313.55 (2292.98, 2334.12)	80.3 (77.04, 83.56)
	Both	11868.16 (11813.03, 11923.29)	0 (0, 0)	0 (0, 0)	0 (0, 0)

Total for all participants				
	Neither	**CLD only**	**Dementia only**	**Both**
W1 - W2	4855.23	7216.00	8146.50	7472.08
W2 - W3	4192.83	4530.65	7295.43	9607.12
W3 - W4	5139.45	6044.74	6721.88	4241.73
W4 + one year	4596.85	6758.62	2218.80	4239.80

Note: 2015 dollars per person per year are shown. CLD:dementia is a significant predictor for hospitalisation costs (p = 0.0024)

Table 17: Diabetes mellitus and dementia by ethnic group and sex, Waves 1-4

N (%)		**Māori women**	**Non-Māori women**	**Māori men**	**Non-Māori men**
Wave 1	Neither	129 (57)	198 (73)	95 (56)	167 (71)
	DM only	58 (26)	35 (13)	40 (24)	32 (14)
	Dementia only	27 (12)	31 (11)	26 (15)	28 (12)
	Both	13 (6)	6 (2)	9 (5)	7 (3)
Wave 2	Neither	122 (60)	189 (74)	87 (57)	159 (74)
	DM only	54 (27)	33 (13)	35 (23)	29 (14)
	Dementia only	19 (9)	29 (11)	21 (14)	21 (10)
	Both	8 (4)	< 5	9 (6)	< 5
Wave 3	Neither	80 (70)	141 (79)	46 (61)	125 (79)
	DM only	25 (22)	19 (11)	14 (19)	22 (14)
	Dementia only	7 (6)	16 (9)	12 (16)	11 (7)
	Both	< 5	< 5	< 5	< 5
Wave 4	Neither	43 (62)	115 (79)	75 (71)	131 (80)
	DM only	15 (22)	20 (14)	22 (21)	17 (10)
	Dementia only	10 (14)	10 (7)	6 (6)	14 (9)
	Both	< 5	0	< 5	< 5

Note: Ethnic group is a significant predictor of DM:dementia but sex is not (p = 0.0249 and 0.65 respectively).

Table 18: Diabetes mellitus, dementia and functional status, frailty, quality of life and GP visits, by ethnic group and sex, Waves 1-4

	Māori women	**Non-Māori women**	**Māori men**	**Non-Māori men**
NEADL mean score (CI) Participants with neither DM nor dementia				
Wave 1	18.3 (17.5, 19.1)	18.3 (17.7, 18.8)	18.0 (17.2, 18.7)	18.5 (18.0, 18.9)
Wave 2	17.7 (16.8, 18.6)	17.2 (16.6, 17.9)	16.6 (15.6, 17.6)	17.2 (16.6, 17.7)
Wave 3	17.8 (16.7, 18.9)	17.0 (16.4, 17.7)	16.8 (15.8, 17.9)	16.7 (16.1, 17.3)
Wave 4	17.1 (15.9, 18.3)	16.9 (16.0, 17.7)	16.5 (15.4, 17.5)	17.0 (16.4, 17.6)
NEADL mean score (CI) Participants with DM only				
Wave 1	18.0 (16.7, 19.3)	18.2 (16.9, 19.4)	17.1 (15, 19.2)	17.3 (16.0, 18.7)
Wave 2	17.0 (15.5, 18.4)	17.7 (16.4, 19.1)	14.0 (11.1, 16.9)	16.1 (14.3, 17.9)
Wave 3	16.5 (14.4, 18.5)	17.0 (14.9, 19.1)	12.8 (8.9, 16.7)	16.5 (14.7, 18.2)
Wave 4	13.6 (9.7, 17.6)	16.6 (14.3, 18.9)	13.9 (11.2, 16.6)	16.3 (14.7, 17.9)
NEADL mean score (CI) Participants with dementia only				
Wave 1	13.6 (10.3, 16.8)	12.9 (9.8, 16.0)	14.1 (11.6, 16.7)	14 (11.5, 16.5)
Wave 2	17.1 (14.7, 19.5)	10.9 (6.5, 15.3)	11.4 (8.0, 14.8)	12.4 (9.6, 15.1)
Wave 3	17.2 (9.8, 24.6)	13.5 (9.2, 17.7)	12.6 (8.9, 16.3)	11.1 (6.4, 15.8)
Wave 4	15.3 (3.1, 27.4)	12.6 (7.2, 18.1)	13.1 (8.7, 17.6)	11.3 (6.1, 16.4)

	Māori women	Non-Māori women	Māori men	Non-Māori men
NEADL mean score (CI) Participants with DM and dementia				
Wave 1	10.0 (-2.9, 22.9)	8.5 (-61.4, 78.4)	14.0 (4.1, 23.9)	13.8 (-0.6, 28.1)
Wave 2	8.3 (-0.2, 16.9)	5.0 (-12.2, 22.2)	14.5 (8.9, 20.1)	8.0 (-55.5, 71.5)
Wave 3	10.7 (-12.8, 34.1)	--	14.5 (-17.3, 46.3)	--
Wave 4	--	--	--	--
For NEADL DM:dementia, ethnic group and sex were significant predictors (p-values < 0.0001, 0.0142 and 0.0118 respectively); NZDep was not (p-value = 0.1206).				
Fried frailty mean score (CI) Participants with neither DM nor dementia				
Wave 1	0.84 (0.63, 1.06)	0.93 (0.75, 1.11)	0.75 (0.49, 1.01)	0.78 (0.6, 0.95)
Wave 2	1.15 (0.95, 1.35)	1.11 (0.94, 1.28)	1.23 (0.93, 1.53)	1.05 (0.89, 1.21)
Wave 3	1.08 (0.84, 1.32)	1.10 (0.94, 1.27)	0.73 (0.42, 1.04)	0.87 (0.70, 1.04)
Wave 4	1.11 (0.77, 1.44)	1.05 (0.83, 1.26)	1.00 (0.65, 1.35)	1.08 (0.88, 1.28)
Fried frailty mean score (CI) Participants with DM only				
Wave 1	0.62 (0.36, 0.89)	1.46 (1.01, 1.91)	1.13 (0.67, 1.58)	1.13 (0.65, 1.60)
Wave 2	0.91 (0.52, 1.30)	1.10 (0.52, 1.67)	0.83 (0.30, 1.36)	1.30 (0.93, 1.68)
Wave 3	1.12 (0.72, 1.52)	1.60 (0.88, 2.32)	1.30 (0.47, 2.13)	1.25 (0.72, 1.78)
Wave 4	1.33 (0.84, 1.83)	1.30 (0.54, 2.06)	1.00 (0.12, 1.88)	1.57 (0.94, 2.20)
Fried frailty mean score (CI) Participants with dementia only				
Wave 1	0.92 (0.13, 1.70)	1.07 (0.37, 1.77)	1.14 (0.43, 1.85)	1.41 (0.68, 2.14)
Wave 2	1.57 (0.84, 2.30)	1.54 (0.66, 2.41)	2.00 (1.14, 2.86)	1.67 (0.93, 2.40)
Wave 3	1.50 (0.58, 2.42)	0.90 (0.27, 1.53)	0.60 (-0.51, 1.71)	1.13 (-0.01, 2.26)
Wave 4	1.33 (-0.10, 2.77)	0.88 (-0.07, 1.82)	1.20 (0.16, 2.24)	2.00 (0.81, 3.19)
Fried frailty mean score (CI) Participants with DM and dementia				
Wave 1	1.50 (-4.85, 7.85)	2.50 (-16.56, 21.56)	0.50 (-1.09, 2.09)	1.33 (-2.46, 5.13)
Wave 2	1.50 (-0.09, 3.09)	--	2.00 (-10.71, 14.71)	--
Wave 3	--	--	--	--
Wave 4	--	---	---	--
For Fried DM:dementia was a significant predictor (p-value < 0.0001); ethnic group, sex and NZDep were not (p-values = 0.5113, 0.7513 and 0.185 respectively).				
Physical HRQOL SF-12® PHC mean score (CI) Participants with neither DM nor dementia				
Wave 1	43.8 (41.4, 46.1)	40.2 (38.3, 42.1)	46.2 (43.3, 49.0)	44.0 (42.0, 46.0)
Wave 2	44.8 (42.5, 47.2)	40.7 (38.6, 42.7)	43.8 (40.5, 47.0)	45.3 (43.4, 47.1)
Wave 3	42.4 (40.0, 44.8)	40.2 (38.1, 42.3)	45.7 (42.9, 48.6)	43.7 (41.6, 45.8)
Wave 4	44.3 (41.7, 47.0)	40.7 (38.5, 43.0)	43.0 (39.8, 46.2)	44.6 (42.6, 46.5)
Physical HRQOL SF-12® PHC mean score (CI) Participants with DM only				
Wave 1	41.1 (37.6, 44.6)	37.6 (33.3, 41.9)	42.1 (37.4, 46.9)	39.7 (34.5, 44.9)
Wave 2	41.3 (37.8, 44.8)	42.2 (37.6, 46.7)	41.0 (36.0, 46.1)	40.2 (36.2, 44.2)
Wave 3	40.1 (35.3, 44.9)	36.5 (30.2, 42.8)	39.1 (31.9, 46.2)	42.6 (39.1, 46.0)
Wave 4	43.9 (38.6, 49.3)	41.8 (35.2, 48.4)	37.4 (30.0, 44.8)	38.8 (33.1, 44.5)
Physical HRQOL SF-12® PHC mean score (CI) Participants with dementia only				
Wave 1	41.0 (34.1, 47.8)	38.0 (31.8, 44.2)	45.6 (40.2, 50.9)	41.7 (36.0, 47.4)
Wave 2	51.3 (43.7, 58.8)	38.3 (30.9, 45.8)	42.2 (33.9, 50.5)	42.8 (35.3, 50.3)
Wave 3	51.0 (42.4, 59.6)	37.0 (30.3, 43.8)	44.2 (36.0, 52.3)	46.6 (35.4, 57.7)
Wave 4	40.8 (22.1, 59.6)	29.1 (20.8, 37.4)	48.0 (38.2, 57.8)	36.6 (28.1, 45.0)

	Māori women	Non-Māori women	Māori men	Non-Māori men
Physical HRQOL SF-12® PHC mean score (CI) Participants with DM and dementia				
Wave 1	29.4 (16.9, 41.8)	--	42.2 (30.3, 54.1)	36.8 (18.2, 55.5)
Wave 2	42.6 (31.3, 53.9)	34.3 (-168.3, 236.8)	38.5 (18.3, 58.7)	--
Wave 3	34.1 (-71.0, 139.2)	--	48.6 (3.4, 93.7)	--
Wave 4	--	--	--	--
For SF-12® PHC DM:dementia and sex were significant predictors (p-values = 0.0008 and 0.002 respectively); ethnic group and NZDep were not (p-values = 0.3688 and 0.1306 respectively).				
Mental HRQOL SF-12® MHC mean score (CI) Participants with neither DM nor dementia				
Wave 1	53.5 (51.7, 55.3)	55.0 (53.6, 56.3)	53.1 (50.6, 55.6)	56.3 (55.2, 57.5)
Wave 2	54.0 (52.2, 55.8)	55.1 (53.7, 56.5)	53.0 (50.9, 55.1)	55.5 (54.3, 56.6)
Wave 3	56.0 (54.1, 57.9)	55.6 (54.1, 57.0)	52.3 (49.0, 55.7)	56.3 (55.1, 57.5)
Wave 4	56 (54.1, 57.9)	56.2 (54.8, 57.6)	54.8 (51.4, 58.1)	55.4 (53.9, 56.9)
Mental HRQOL SF-12® MHC mean score (CI) Participants with DM only				
Wave 1	55.2 (52.9, 57.5)	57.1 (54.1, 60.1)	54.4 (50.9, 57.9)	53.8 (51.2, 56.3)
Wave 2	53.1 (49.0, 57.2)	55.3 (50.5, 60.0)	53.1 (49.1, 57.1)	52.2 (48.9, 55.5)
Wave 3	55.8 (52.4, 59.1)	52.7 (46.8, 58.6)	57.2 (53.2, 61.3)	53.9 (50.2, 57.5)
Wave 4	58.6 (55.4, 61.7)	57.1 (52.2, 61.9)	55.0 (50.1, 60.0)	57.2 (54.0, 60.5)
Mental HRQOL SF-12® MHC mean score (CI) Participants with dementia only				
Wave 1	52.4 (46.6, 58.3)	51.6 (46.3, 56.9)	50.5 (46.3, 54.8)	52.1 (47.5, 56.6)
Wave 2	51.7 (44.7, 58.6)	49.3 (41.0, 57.7)	50.0 (43.8, 56.1)	51.6 (46.7, 56.5)
Wave 3	56.8 (43.5, 70.1)	53.0 (46.0, 59.9)	48.5 (33.8, 63.2)	50.5 (41.0, 59.9)
Wave 4	54.9 (37.0, 72.7)	53.7 (45.4, 62.1)	51.5 (38.1, 64.9)	50.0 (43.9, 56.2)
Mental HRQOL SF-12® MHC mean score (CI) Participants with DM and dementia				
Wave 1	47.5 (29.9, 65.0)	--	52.8 (47.3, 58.3)	42.4 (11.1, 73.8)
Wave 2	49.8 (41.1, 58.6)	36.1 (18.3, 53.9)	57.8 (53..0, 62.6)	--
Wave 3	45.1 (-28.4, 118.6)	--	52.2 (-50, 154.5)	--
Wave 4	--	--	--	--
For SF-12® MHC DM:dementia was a significant predictor (p-value < 0.0001); ethnic group, sex and NZDep were not (p-values = 0.7415, 0.2501 and 0.3943 respectively).				
GP Visits more than four times a year Percentage of participants with neither DM nor dementia				
Wave 1	13 (7, 22)	9 (5, 14)	25 (14, 38)	13 (7, 22)
Wave 2	20 (12, 31)	16 (11, 23)	22 (12, 36)	14 (8, 21)
Wave 3	18 (10, 30)	18 (12, 26)	15 (5, 31)	15 (9, 23)
Wave 4	15 (7, 28)	11 (5, 18)	17 (5, 37)	13 (7, 22)
GP Visits more than four times a year Percentage of participants with DM only				
Wave 1	24 (12, 40)	19 (7, 39)	35 (16, 57)	24 (12, 40)
Wave 2	19 (7, 37)	27 (11, 50)	20 (6, 44)	20 (7, 41)
Wave 3	19 (5, 42)	50 (25, 75)	17 (2, 48)	14 (3, 36)
Wave 4	15 (2, 45)	38 (14, 68)	20 (3, 56)	33 (13, 59)
GP Visits more than four times a year Percentage of participants with dementia only				
Wave 1	26 (9, 51)	10 (1, 32)	31 (11, 59)	26 (9, 51)
Wave 2	38 (9, 76)	19 (4, 46)	25 (5, 57)	7 (0, 34)
Wave 3	40 (5, 85)	33 (12, 62)	50 (16, 84)	20 (3, 56)
Wave 4	25 (1, 81)	30 (7, 65)	14 (0, 58)	25 (3, 65)

	Māori women	Non-Māori women	Māori men	Non-Māori men
GP Visits more than four times a year Percentage of participants with DM and dementia				
Wave 1	25 (1, 81)	0 (0, 84)	40 (5, 85)	25 (1, 81)
Wave 2	17 (0, 64)	0 (0, 71)	25 (1, 81)	50 (1, 99)
Wave 3	0 (0, 97)	0 (0, 97)	0 (0, 84)	--
Wave 4	0 (0, 97)	0 (0, 97)	0 (0, 97)	--
For GP visits DM:dementia was a significant predictor (p-value < 0.0001); ethnic, sex and NZDep were not (p-values = 0.8249, 0.1645 and 0.0753 respectively).				

Note: DM:dementia is a significant predictor for all variables in this table.

Table 19: Diabetes mellitus, dementia and hospital admissions per person year by ethnic group and sex, Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	Neither	0.80 (0.64, 0.95)	0.60 (0.49, 0.71)	0.76 (0.59, 0.94)	0.97 (0.83, 1.12)
	DM only	1.09 (0.82, 1.36)	0.71 (0.43, 0.99)	1.54 (1.16, 1.93)	1.62 (1.18, 2.06)
	Dementia only	1.05 (0.66, 1.43)	0.36 (0.15, 0.57)	0.72 (0.39, 1.05)	1.77 (1.28, 2.26)
	Both	1.21 (0.61, 1.81)	1.55 (0.55, 2.55)	0.79 (0.21, 1.37)	0.81 (0.14, 1.48)
W2 - W3	Neither	0.51 (0.39, 0.63)	0.62 (0.51, 0.72)	0.99 (0.79, 1.18)	0.96 (0.81, 1.11)
	DM only	0.81 (0.58, 1.04)	1.31 (0.93, 1.68)	1.36 (0.99, 1.72)	1.35 (0.94, 1.75)
	Dementia only	0.87 (0.51, 1.22)	0.81 (0.49, 1.12)	0.45 (0.19, 0.71)	1.10 (0.71, 1.49)
	Both	1.83 (1.10, 2.57)	0.93 (0.16, 1.70)	1.65 (0.81, 2.49)	0.91 (0.20, 1.62)
W3 - W4	Neither	0.76 (0.61, 0.91)	0.81 (0.69, 0.94)	0.96 (0.76, 1.16)	1.02 (0.86, 1.17)
	DM only	0.99 (0.73, 1.24)	0.95 (0.63, 1.27)	1.03 (0.72, 1.35)	1.45 (1.03, 1.87)
	Dementia only	0.49 (0.23, 0.76)	0.88 (0.55, 1.21)	0.85 (0.50, 1.21)	0.99 (0.62, 1.36)
	Both	2.46 (1.61, 3.31)	0 (0, 0)	1.52 (0.71, 2.32)	6.44 (4.56, 8.32)
W4 + one year	Neither	1.27 (1.07, 1.46)	0.75 (0.63, 0.87)	1.22 (1.00, 1.44)	1.16 (1.00, 1.32)
	DM only	0.85 (0.62, 1.09)	0.58 (0.32, 0.83)	1.70 (1.30, 2.11)	0.79 (0.48, 1.10)
	Dementia only	0.76 (0.43, 1.09)	0.51 (0.25, 0.76)	0.43 (0.18, 0.69)	0.14 (0.00, 0.27)
	Both	1.06 (0.50, 1.62)	0.97 (0.18, 1.76)	0 (0, 0)	--

Note: For hospital admissions DM:dementia and sex were significant predictors (p-values = 0.0006 and 0.0009 respectively); ethnic group and NZDep were not (p-values = 0.561 and 0.1289 respectively).

Table 20: Diabetes mellitus, dementia and length of stay by ethnic group and sex, Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	Neither	4.22 (3.87, 4.57)	3.46 (3.20, 3.72)	2.72 (2.39, 3.05)	6.16 (5.79, 6.54)
	DM only	9.76 (8.95, 10.56)	3.02 (2.44, 3.60)	7.79 (6.92, 8.65)	5.76 (4.93, 6.59)
	Dementia only	6.27 (5.33, 7.22)	3.82 (3.13, 4.51)	6.45 (5.47, 7.43)	22.00 (20.27, 23.74)
	Both	10.08 (8.36, 11.81)	8.95 (6.56, 11.34)	6.86 (5.15, 8.57)	6.50 (4.61, 8.39)
W2 - W3	Neither	1.75 (1.52, 1.97)	2.43 (2.21, 2.65)	3.32 (2.95, 3.68)	3.46 (3.18, 3.74)
	DM only	5.44 (4.84, 6.05)	4.81 (4.08, 5.54)	6.30 (5.53, 7.08)	19.62 (18.08, 21.15)
	Dementia only	2.02 (1.48, 2.56)	4.13 (3.42, 4.85)	2.10 (1.54, 2.66)	24.89 (23.04, 26.74)
	Both	27.74 (24.88, 30.60)	9.92 (7.40, 12.44)	9.89 (7.83, 11.94)	1.37 (0.50, 2.23)
W3 - W4	Neither	2.98 (2.69, 3.28)	5.69 (5.36, 6.02)	2.86 (2.52, 3.20)	4.02 (3.71, 4.32)
	DM only	8.07 (7.34, 8.80)	6.49 (5.64, 7.33)	2.45 (1.97, 2.94)	3.91 (3.23, 4.60)
	Dementia only	0.33 (0.11, 0.55)	2.21 (1.69, 2.73)	4.18 (3.40, 4.97)	10.37 (9.18, 11.56)
	Both	4.92 (3.71, 6.13)	0 (0, 0)	9.09 (7.12, 11.06)	114.24 (106.32, 122.16)

		Māori women	Non-Māori women	Māori men	Non-Māori men
W4 + one year	Neither	5.45 (5.05, 5.85)	5.22 (4.90, 5.54)	4.75 (4.31, 5.18)	4.66 (4.33, 4.98)
	DM only	2.84 (2.41, 3.28)	2.45 (1.93, 2.97)	9.69 (8.72, 10.65)	1.72 (1.26, 2.17)
	Dementia only	5.54 (4.65, 6.43)	3.20 (2.57, 3.83)	2.06 (1.51, 2.62)	0 (0, 0)
	Both	6.35 (4.98, 7.72)	8.77 (6.40, 11.14)	0 (0, 0)	--

Note: For hospital length of stay DM:dementia and sex were significant predictors (p-values < 0.0001 and 0.0087 respectively); ethnic group and NZDep were not (p-values = 0.1121 and 0.2165 respectively).

Table 21: Diabetes mellitus, dementia and hospitalisation costs ($), Waves 1-4

		Māori women	Non-Māori women	Māori men	Non-Māori men
W1 - W2	Neither	4124.82 (4113.78, 4135.86)	3706.96 (3698.48, 3715.44)	4408.08 (4394.73, 4421.43)	6662.97 (6650.59, 6675.35)
	DM only	8722.26 (8698.22, 8746.3)	3183.71 (3165.02, 3202.40)	12197.69 (12163.47, 12231.92)	7428.1 (7398.24, 7457.96)
	Dementia only	6409.46 (6379.26, 6439.66)	3206.18 (3186.24, 3226.11)	5155.15 (5127.55, 5182.74)	20551.70 (20498.60, 20604.80)
	Both	6926.76 (6881.51, 6972.00)	6517.91 (6453.31, 6582.51)	4578.17 (4533.96, 4622.37)	3642.03 (3597.33, 3686.74)
W2 - W3	Neither	1926.07 (1918.53, 1933.62)	2914.49 (2906.97, 2922.01)	4618.42 (4604.76, 4632.09)	4567.61 (4557.36, 4577.86)
	DM only	5162.42 (5143.93, 5180.91)	6111.71 (6085.81, 6137.61)	6399.38 (6374.59, 6424.17)	14534.62 (14492.85, 14576.39)
	Dementia only	2174.58 (2156.99, 2192.17)	4127.13 (4104.51, 4149.74)	2108.08 (2090.43, 2125.73)	20680.21 (20626.94, 20733.48)
	Both	20384.56 (20306.94,20462.17)	7470.37 (7401.21, 7539.53)	12679.89 (12606.32, 12753.46)	2476.00 (2439.14, 2512.86)
W3 - W4	Neither	4037.78 (4026.86, 4048.71)	5885.74 (5875.05, 5896.43)	4681.21 (4667.46, 4694.97)	4973.38 (4962.68, 4984.08)
	DM only	6855.32 (6834.01, 6876.63)	7192.11 (7164.02, 7220.21)	3505.54 (3487.19, 3523.89)	8592.74 (8560.62, 8624.86)
	Dementia only	994.74 (982.84, 1006.63)	2831.86 (2813.13, 2850.60)	5930.88 (5901.28, 5960.49)	8777.39 (8742.69, 8812.10)
	Both	12294.30 (12234.02, 12354.57)	0 (0, 0)	7080.32 (7025.35, 7135.30)	95156.66 (94928.14, 95385.18)
W4 + one year	Neither	6408.17 (6394.41, 6421.93)	4566.21 (4556.80, 4575.62)	5548.72 (5533.74, 5563.70)	5069.62 (5058.82, 5080.42)
	DM only	4398.25 (4381.18, 4415.31)	3301.31 (3282.27, 3320.34)	9846.96 (9816.20, 9877.71)	3259.28 (3239.50, 3279.06)
	Dementia only	4046.81 (4022.81, 4070.81)	2257.41 (2240.68, 2274.13)	2036.39 (2019.05, 2053.74)	70.11 (67.00, 73.21)
	Both	14231.72 (14166.87, 14296.57)	4465.59 (4412.12, 4519.07)	0 (0, 0)	--

Summary total of sample

	Neither	DM only	Dementia only	Both
W1 - W2	4744.69	8161.63	8521.43	5549.61
W2 - W3	3428.68	7412.78	6643.28	12365.33
W3 - W4	5081.58	6781.88	4868.09	15324.88
W4 + one year	5215.30	4918.84	1997.30	8681.64

Note: For hospital costs DM:dementia and sex were significant predictors (p-values = 0.0002 and 0.0009 respectively); ethnic group and NZDep were not (p-values = 0.5678 and 0.2752 respectively).