Cognitive Functioning in Older New Zealand Adults: A Pilot Study on the use of the Addenbrooke's Cognitive Examination –Revised.

Lauren Callow

Massey University, Wellington, New Zealand

Abstract

As the New Zealand population ages there is a growing need to ascertain and provide for the needs of older adults. Impairment of cognitive functioning decreases the ability to undertake activities of daily living and can impact significantly on the ability to sustain independent living. The rate of cognitive impairment in New Zealand among older adults is unknown and the accuracy of assessments of older adults is questionable. This current study is a pilot to assess the validity and utility of the 'Kiwi' Addenbrooke's Cognitive Examination – Revised (ACE-R) for use in a longitudinal study of older New Zealanders. The cognitive functioning of forty-five older community dwelling adults was measured. Results suggest that the 'Kiwi' ACE-R is a valid and useful measure of cognition for older people in New Zealand and can be used in longitudinal studies of ageing of community dwelling older adults.

Introduction

Due to the rapid ageing trend across many populations in the world, ageing has become increasingly recognised as a vital issue facing individuals, families, communities and nations. Estimates of the world's population aged over 60 have more than doubled from 1960 (225 million) to 1990 (450 million) and that number is set to increase substantially by 2051 with over 25% of the developed region's population estimated to being over 60, outpacing the growth of all other age groups (Statistics New Zealand, 2012).

New Zealand shows the same ageing trend as the developed world due to the continual increase in life expectancy and the post WWII 'baby boomers' entering retirement age. In 1901 4% of the New

Zealand population was aged over 64 years of age, and. similar to world projections, this age group has had a dramatic increase in numbers with 13% falling into the 65+ category in 2006 and a projected increase to 25% of all New Zealanders in 2051 (Statistics New Zealand, 2012). This pervasive and enduring population trend opens up many opportunities and challenges which the New Zealand government has highlighted as a national priority (Ministry of Health, 2007).

With the increase in older adults there is a need to further develop understanding of this population and their specific requirements. The increased physical and mental health needs of this growing population group have major implications for community, primary health, and residential care services. There is likely to be a greater demand for residential support and health and disability services, including specialist services for older adults (Te Pou, 2011). The New Zealand government has reflected this with specific ageing policies. For example, there has been a strong push towards maintaining older people's independence in their own homes and developing community based models of care that reduce the need for institutionalized, or residential care (Ministry of Social Development, 2001; Parsons et al., 2012).

Cognitive decline, which is a hallmark of ageing, is the leading cause of institutionalization of older people (National Institute on Aging & National Institutes of Health, 2007) and therefore there is a need to support those people who show impairment to stay in their homes for longer and maintain their quality of life.

Declining cognitive functioning

Cognitive ageing refers to a pattern of age-related changes of cognitive functioning. Common problems include forgetfulness, word finding difficulty, slowed reaction time and difficulty learning new tasks. Declining cognitive functioning is a common feature of ageing, with 50% of adults over 60 years of age expressing concern about declining mental abilities, with one of the most common complaints among middle-aged and older adults being that their memory is not as good as it used to be (Lachman, 2010).

A decline in adequate cognitive functioning can impact the ability to perform instrumental activities of daily life (e.g., paying bills, medical regimes, planning activities) and activities of daily life (e.g., dressing, bathing) (Brown, Devanand, Liu, & Caccappolo, 2011). It is also a significant indicator of overall health (Anstey, Luszcz, Giles, & Andrews, 2001), associated with increased rates of hospitalization and mortality (Anstey et al., 2001; Herzog & Wallace, 1997; Matusik, Tomaszewski, Chmielowska, Nowak, & Nowak, 2012), reduced quality of life, increased disability and increased health care costs (Plassman et al., 2008). These impairments play a pivotal role in relation to health care utilization among older adults and can also impact economically by affecting work, decision making and retirement (Lachman & Spiro, 2002)..

Accurate estimates of the national prevalence of cognitive impairment are important for determining the financial and social impact of reduced cognitive functioning. Estimates of cognitive impairment in community samples vary depending on what criteria are used and what population is sampled. Longitudinal studies find rates of cognitive impairment, (not dementia), ranging from 4-35% in the community with an exponential increase in impairment 1.7 times higher than previous age groups (Herzog & Wallace, 1997). A longitudinal study in the United Kingdom had estimates of impairment ranging from 2.3% (65-74 years old), 7.2% (75-84 years old) and 21.9% (85+), (Melzer, Ely, & Brayne, 1997). A population-based study in Finland examined the prevalence of age associated cognitive decline and found a rate of 27% in people aged between 68 and 78 years (Hanninen et al., 1996). The Health Retirement Study/Asset and Health Dynamics Among the Oldest Old (HRS/AHEAD) study found that in the community, an estimated 6% of people aged 70 years and older have moderate to severe cognitive impairment and this increased sharply with age (Suthers, Jung, & Crimmins, 2003). This was the first time nationally representative data assessing cognitive function in older people was gathered and it has continued longitudinally (National Institute on Aging & National Institutes of Health, 2007). Given the high and varied rates of cognitive impairment within communities, the assessment and treatment of cognitive functioning represents an important

component of geriatric care and suggests a need for standardised assessment and criteria to assess cognitive functioning in older adults.

A national report about the mental health of community dwelling New Zealanders stated that "due to either the unavailability of data or the lack of reliable data, these indicators [for dementia] could not be included in this report" (Ministry of Health, 2006, p. 2). The exclusion of rates of cognitive impairment in the mental health literature represents a significant gap in research and has policy implications in terms of planning and expenditure in this area for the upcoming influx of older adults. One early study has suggested that the prevalence rates of dementia in New Zealand are around 7.7% for people aged over 65, with around 30% of those over 85 having dementia (Campbell et al., 1983). Rates of dementia are likely to have significantly changed since this study due to the comparative increase in the older population and better assessment. Therefore, there is a need for more up to date and accurate predictions of cognitive functioning in New Zealand so that we can gauge functional ability, diagnose conditions and establish baseline cognitive functioning levels. As yet, there is no known research regarding the prevalence of cognitive functioning difficulties in different ethnicities within New Zealand. If differences exist it may help inform specific interventions for different ethnic groups and further our knowledge of the specific risk factors that give rise to cognitive functioning difficulties.

Assessing cognitive functioning

Accurate assessment, capable of identifying individuals that are showing cognitive change is a prerequisite to effective post-diagnosis support, or early intervention. Early detection of cognitive impairments is a challenge but screening for early impairments has become more important with the 'work up' offering the best opportunity for secondary prevention (Shulman et al., 2006) in early stages of cognitive decline (Crawford, Whitnall, Robertson, & Evans, 2012). For example, disease-modifying treatments, such as medication and lifestyle change factors (Benerjee & Wittenberg, 2009) could be introduced earlier. The New Zealand 2008 Dementia Manifesto (Alzheimer's New Zealand, 2008), emphasised the need for early diagnosis and dementia-specific training for primary health staff

as dementia is often only diagnosed at a late stage, because primary care settings are not geared to routinely screen for cognitive impairment (Boustani, Peterson, Hanson, Harris, & Lohr, 2003). Population-based studies find the prevalence of undiagnosed dementia among those over 65 years ranging from 1.8% (Sternberg, Wolfson, & Baumgarten, 2000) to 12% (Boustani et al., 2003). It is estimated that in New Zealand only a third of those with dementia receive a diagnosis (National Audit Office, 2007). Routine screening, with accurate measures could, therefore, potentially increase substantially the number of people diagnosed with dementia, and newly discovered cases would have mild to moderate forms of the disease. Thus there is a national priority for service providers to increase the ability to accurately detect signs of cognitive decline. Studies have found that cognitive performance strongly predicts pathological diagnosis of Alzheimer's Disease (AD) over six years of follow-up with a diagnostic accuracy of 75% (Elias et al., 2004) and over longer follow-ups of twenty-two years on measures of verbal fluency, with one standard deviation difference in baseline performance increasing the risk of AD by 60% (Powell et al., 2006). These studies highlight the need and appropriateness for early assessment and intervention.

There has been a substantial increase in the development of evaluative methods in the screening of cognitive functioning in older adults (Witta & Sivo, 2002). Cognitive screening tools offer a quick, objective initial assessment of cognitive functioning. Whilst they are not sufficient to make a diagnosis, they can be used as part of a comprehensive assessment.

Longitudinal or prospective surveys represent the most powerful designs for describing change and investigating the causal linkages between cognitive performance and its precursors and consequences. It is commonly believed that cognitive functioning exists on a continuum, in which mild cognitive impairment represents a transition state between normal cognitive ageing and dementia (Gauthier et al., 2006; Prichep et al., 2006). Whilst not all people continue along the continuum it highlights the importance of assessing cognitive performance difficulties in older people longitudinally, as cognitive difficulties can be progressive, meaning that prevention or intervention may be possible at a stage along the continuum. Longitudinal studies provide information that cross-sectional studies cannot

such as estimates of individual rates of decline, risk factors for decline and data on correlations between changes in cognitive ability and changes in other non-cognitive domains. Longitudinal studies have shown that subtle changes can be measured over just short periods of time (e.g., 2-2.5 years), especially in the oldest age groups (Albert et al., 1993). However these studies can also underestimate change due to practice effects and selective attrition and can be influenced by society or cultural changes (Salthouse, 2004). Longitudinal studies, like cross-sectional, can also comment on how cognitive functioning may vary across individuals. For example, research commonly finds an association between measures of depressive and anxiety symptoms and cognition, finding that those people who show significant signs of depressive or anxiety symptoms perform more poorly on cognitive measures; however, the mechanisms are unclear, (Beaudreau & O'Hara, 2009; Gonzáleza, Bowena, & Fisher, 2008; La Rue, Swan, & Carmelli, 1995). Furthermore, cognitive functioning may be altered depending on demographic variables (e.g., age, sex, education).

Many large health studies do not typically look at cognition (Lachman & Spiro, 2002; Ofstedal et al., 2005). It is assumed that reliable cognitive measurements are too difficult and time consuming to administer in a survey format by lay interviewers. Furthermore, poor response rates, institutionalisation of those at risk and cognitive impairment can affect data collection and quality of responses. Due to the suspected difficulties of assessing cognitive function on a large population based level there have been limited studies of community based cognitive functioning and the quality of the data from these studies may be compromised.

Summary

The current lack of knowledge about base rates of cognitive function in New Zealand makes it difficult to derive reliable and valid national impairment estimates, develop explanatory models of cognitive changes and predict the needs of this growing population for policy and care implementation. Measuring cognitive functioning is essential because it helps to characterise; what normal cognitive ageing is, what aspects are protective for quality of life, the role of demographic variations in cognitive functioning and how it can be an important resource in later life as a moderator

of differences in health, functional capacity and retirement (Lachman & Spiro, 2002). There have been no population based studies in New Zealand investigating the cognitive functioning of older adults living in the community. Through the piloting and use of New Zealand adapted cognitive measures we can assess the validity and utility of the measures with this population which will help create a more accurate picture of cognitive functioning and open up research opportunities to begin addressing many of these issues facing our ageing nation.

The current study

The current research project is a pilot study to investigate the feasibility of using the adapted 'Kiwi' version of the ACE-R in the New Zealand Longitudinal Study of Ageing (NZLSA)[1]. This paper represents the first steps towards identifying community levels of cognitive functioning in New Zealand and provides a context from which the development on New Zealand norms and assessment of cognition in longitudinal studies can be facilitated. This research aims to:

- Pilot the use of the Kiwi adapted ACE-R with older New Zealanders.
- Determine the feasibility of using the "Kiwi"ACE-R within the NZLSA
- Note whether the ACE-R is influenced by psychological (depression and anxiety symptoms) or demographic variables (e.g., age, sex, education).

Method

Participants

The sample consisted of forty-five community dwelling volunteers from the wider Wellington region. Participants were recruited through; community notices, emails to age-associated organizations and word of mouth. Ages ranged from 56-87 (mean = 71.6, SD =7.8). The age range chosen reflects both the guidelines given by the longitudinal study, as well as capturing age groups that may have been more susceptible to cognitive change. There were 27 females and 18 males. The majority of the

[1] The NZLSA is a population based longitudinal study following a national sample of over 4,000 New Zealanders with the aim to discover what factors lead to good retirement planning, health and independence in older people. It is a research collaboration between the Health and Ageing Research Team at Massey University and the Family Centre Social Policy Research Unit.

sample was of European ethnicity (86.7%), over half of the sample was married (53%) and others were mostly either divorced (15.6%) or widowed (15.6%). Overall this sample was well educated, having obtained a university degree (35.6%), finished high school or achieved a post-secondary qualification (58%). Table 1 summarises the participants' demographic information that was used in the analysis.

Table 1.
Summary of demographic information.

	Number n= 45	Percentage %
Age	Mean = 71.6 Range = 56-87	
Gender		
Male	18	40
Female	27	60
Ethnicity		
New Zealand European	39	86.7
Other	9	13.3
Marital Status		
Single	3	5.7
Married	24	53.3
Divorced	7	15.6
Widowed	7	15.6
De-facto	2	4.4
Other	2	4.4
Living arrangement		
Alone	4	31.1
With partner/De-facto	24	53.4
Other	7	15.6
Qualification Level		
No qualifications	3	6.7
Secondary school	14	31.1
Post-secondary/trade	12	26.7
University degree	16	35.5

Procedure

Promotional material and emails were sent to community organizations to advertise the study. People who indicated an interest in participating were contacted via telephone or email and provided with more details about the study. Participants residing in the community (i.e., non-institution) were interviewed, as the focus for this study was a community-based, non-clinical sample. Informed consent was gained and interviews arranged with those who indicated an interest, with the majority of

participants interviewed in their own residence. All interviews were conducted by the author. Participants were first administered a demographic questionnaire, followed by depression and anxiety symptom questionnaires and finally the cognitive assessment. Each participant interview took approximately an hour. All participants were thanked for their time with the choice of a gift of $10 in value.

Measures

Demographic questionnaire. The demographic questionnaire was based on the 2006 New Zealand census demographic information (e.g., gender, age, ethnicity, qualifications, Statistics New Zealand, 2008). The questionnaire included questions relating to participants' subjective ratings of their current level of physical health and ratings of their current level of memory ability and their memory ability compared to two years ago.

Addenbrooke's Cognitive Examination-Revised (ACE-R). The ACE-R is a cognitive screening measure designed to screen for dementia. It is scored on a scale from 0-100 and assesses five cognitive domains: Attention/Concentration (18 points), Memory (26 points), Verbal Fluency (14 points), Language (26 points) and Visual-spatial (16 points).

The ACE-R was originally normed using a control group (N=63) and this group was used to demark cut-off scores for dementia, (<2 standard deviations below the norm) and mild cognitive impairment, (<1.5 standard deviations below the norm). The control group was recruited from a U.K. volunteer panel at the Medical Research Council Brain Sciences, or were spouses of patients attending the memory clinic. The sample was 44% male, had an average of 12.7 years of education and an average age of 64.4 years old. Ethnicity was not noted. The ACE-R showed very good internal consistency, (as measured by the alpha coefficient, α=0.80) and concurrent validity between ACE-R and Clinical Dementia Rating Scale (CDRS) (r=-0.321, p<0.00). There was no significant age or education effect on scores (Mioshi et al., 2006a).

Two cut-off scores have been proposed that demark likely cognitive impairment (Mioshi et al., 2006a). A cut off score of <88 gives 0.94 sensitivity (i.e. it misses 6% of cases) and 0.89 specificity for dementia (i.e. 89% of cases are dementia rather than another difficulty like depression). A cut off score of <82 gives 0.84 sensitivity (i.e., misses 16% of cases) and 1.00 specificity for dementia (i.e., all cases identified are dementia).

Other cognitive measures. To allow for cross-country comparisons of data, measures used in a large representative longitudinal study in the United States, the Health Retirement Study (HRS), were included. The HRS used questions which are an amalgam of items from the Wechsler Intelligence Scale-Revised, (which was the most recent version of the scale at the time the longitudinal study commenced) and the Telephone Interview for Cognitive Status (TICS). Items assessed memory, (e.g., immediate, delayed and working), mental status (e.g., knowledge, language and orientation), abstract reasoning (e.g., similarities subtest), vocabulary (e.g., definitions) and numeracy (e.g., math problems). Results are publicly available and allow for cross-nation comparisons of cognitive ability on these items (see Herzog & Wallace, 1997 for a review of the cognitive measures over different wave years).

*Depression and Anxiety symptoms***.** To see whether depressive or anxiety symptoms impacted on ACE-R scores, measures of depression and anxiety were chosen and are outlined below. Two measures of depressive symptomology were included in this study due to the dissatisfaction of some participants with the Geriatric Depression Scale. Participants who were piloted felt that the scale was too restrictive in the options available for answering questions. Due to this, the Centre for Epidemiological Studies Depression Scale was introduced as a further measure of depressive symptoms.

Center for Epidemiologic Studies Depression Scale (CES-D 10). Developed in the United States by Radloff (1977), the CESD is a self-report scale designed to screen for depressive symptoms in general populations, with an emphasis on depressed mood over the last week. Each item is rated on a

four-point scale, scored from 0 to 3. An example of an item measuring depressive affect is *"I was bothered by things that don't usually bother me".* The psychometric properties of the CES-D 10 item are comparable with the original 20-item scale with reliability coefficients ranging from 0.85-0.91 and test re-test reliability studies show moderate correlations (r=0.51-0.67) (Irwin, Artin, & Oxman, 1999). Validity ratings between other depression measures (Symptom Checklist-90, Hamilton Rating scale for Depression and the Geriatric Depression Scale) range from 0.49-0.89 (Radloff & Locke, 2000). Using an optimal cut-off score of 4 the sensitivity of the 10-item CES-D was 100% and specificity, 93% (Irwin et al., 1999), when used with adults over 60 years of age. New Zealand studies suggest good internal consistency with mature older adults, (α=0.88-0.92) (Brown, Jose, Hung Ng, & Guo, 2002) and middle aged women (Knight, Williams, McGee, & Olaman, 1997).

The CES-D was chosen for the current study because it has demonstrated suitability for older populations (Brown et al., 2002), including New Zealand and it has widespread use internationally, which both attests to its reliability and validity for a variety of subpopulations, and allows for greater comparability with existing research. The CES-D has been used in a number of large epidemiological studies including; the National Health and Nutrition Examination Survey (NHANES), the Established Populations for Epidemiologic Study of the Elderly (EPESE), the National Longitudinal Surveys (NLS Mature Women, NLS-Older Men, NLSY), and the Americans' Changing Lives study (ACL).

Geriatric Depression Scale (GDS-15). The Geriatric Depression Scale (GDS) is a widely used self-report measure of depressive symptoms felt over the last week (Yesavage et al., 1982). It is used as a screen for depressive illness, severity of depression and monitoring of change with treatment. The measure is answered in a yes/no format. An example of an item assessing depressive affect is, "*do you feel that your life is empty?"* The 15 item version of the GDS (GDS-15) was found to be a good screening instrument for major depression as defined by both the ICD-10 and DSM-IV (Almeida & Almeida, 1999). The reliability of the scale has been found to be high, averaging 0.84 and test –retest reliability over one month is high (r=0.85), (Kieffer & Reese, 2002). It has good convergent validity with depression measures such as the Beck's Depression Inventory (BDI-II) and the Hamilton

Depression Rating Scale and discriminates between older adults with depression and no depression (O'Hara & Yesavage, 2002). A cut off score 4/5 for the GDS-15 provides 92.7% & sensitivity and specificity of 65.2% (Almeida & Almeida, 1999). A New Zealand study of 252 healthy volunteers found support for the use of the GDS with findings of high alpha coefficients (α= 0.84), test retest reliability (Pearson's r= 0.74) and construct validity (r= 0.68) (Knight, McMahon, Green, & Skeaff, 2004).

Geriatric Anxiety Inventory (GAI). The Geriatric Anxiety Inventory (GAI) is a self-report measure designed to assess common symptoms of anxiety in older adults (Pachana, Byrne, Siddle, Koloski, & Arnold, 2007). It contains 20 items with a dichotomous response format "agree/disagree". An example of an item is, "*I think of myself as a worrier*". In the original paper internal consistency was high, α=0.91. Convergent validity with a number of other anxiety scales (e.g., the State Trait Anxiety Inventory and Beck Anxiety Inventory and the Positive and Negative Affect Schedule) ranged from 0.70-0.80 (Pachana et al., 2007). A New Zealand study of older adults (n=32, mean age = 75.5) found that a cut off of 8/9 (out of 20) has a sensitivity of 73% and a specificity of 80% in identifying people with an anxiety disorder. (Cheung, 2007).

Results

Statistical Analysis

All statistics were performed using SPSS 18.0 (SPSS Inc, Released 2009). Demographic analyses were conducted; ACE-R scores were analysed across the full sample using Pearson correlations, across gender using T-tests for differences between means, and across age groups using a one-way analysis of variance (ANOVA) with Tukey posthoc tests. Reliability was calculated using the Chronbach alpha coefficient (Chronbach, 1951). Concurrent validity was calculated using a two-tailed spearman correlation between ACE-R scores and HRS scores.

Distribution

Scores on the ACE-R (Figure 1) ranged from 74 to 99 with a mean of 92.36 (standard deviation=5.51). High scores on the ACE-R were expected as it was developed as a screening test for cognitive impairment which only affects a minority of the population. The distribution was significantly non-normally distributed, with skewness of -1.42 (standard error = 0.35) and kurtosis of 2.12 (standard error = 0.70).

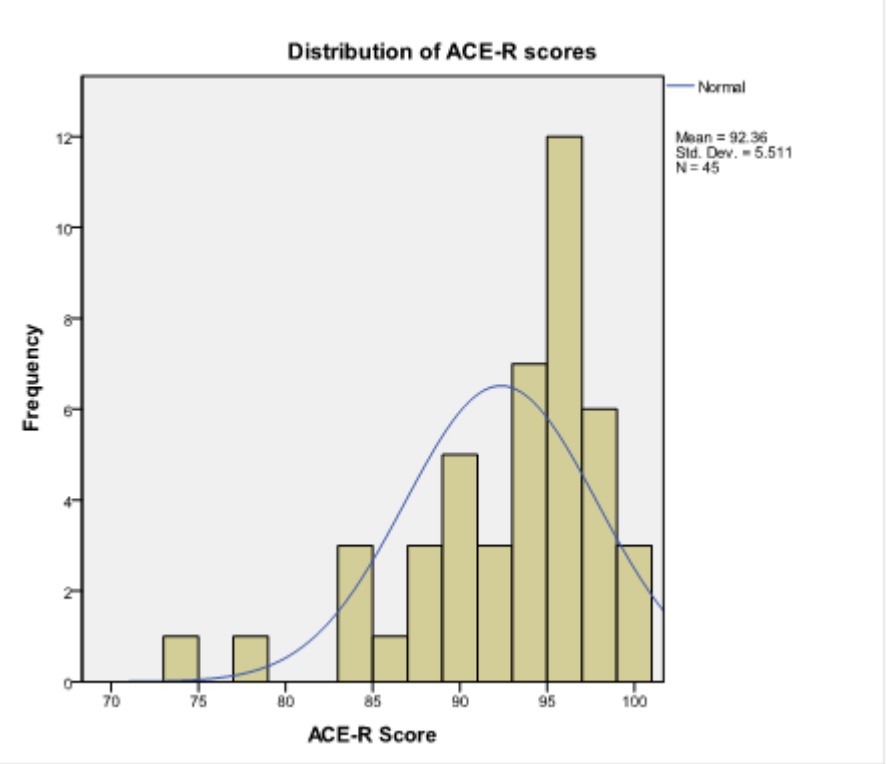

Figure 1. Distribution of ACE-R scores showing normal distribution curve.

Reliability and Validity

Chronbach's alpha coefficients were used to test internal consistency of the ACE-R. The Chronbach's alpha for the ACE-R items was α = 0.66 (n=26 items), which is slightly lower than recommended (0.7) for psychometric measures (McDowell & Newell, 1996). The ACE-R total and domains correlated significantly with Pearson correlations ranging from 0.55-0.79. Table 2 lists the inter-correlations between ACE-R total and the domains.

Table 2.
Pearson correlations between ACE-R subscales and other cognitive tests.

Domains	Attention/ Orientation	Memory	Verbal Fluency	Language	Visual-spatial
ACE-R total	0.55**	0.79**	0.60**	0.59**	0.57**
Attention / Orientation		0.34*	0.27	0.32**	0.18
Memory			0.14	0.41**	0.20
Verbal Fluency				0.30	0.33**
Language					0.50**
Visual-spatial					

**Correlation is significant at the .001 level (2-tailed), *Correlation is significant at the .05 level (2-tailed)

The spread, means and standard deviations for the total ACE-R and subscales are provided in Table 3. Overall there was a good spread of scores with participants scoring at high and low ends of the ACE-R scale. None of the participants attained a perfect score and there were no extremely low scores, indicating no overall ceiling or floor effects. On individual items there were some ceiling effects. For example, 100% of people identified the fragmented letters correctly and 88% correctly answered questions relating to orientation and knowledge. Only one person incorrectly wrote a sentence, had difficulty copying pentagons and could not immediately recall three objects. The ACE-R correlated highly with other tasks of cognitive functioning such as the MMSE; r =0.70, p<.00 and items from the HRS study; r = 0.60, p <.00, suggesting good concurrent validity.

Table 3.
ACE-R result summary.

Domains (points available)	N	Minimum	Maximum	Mean (SD)
ACE-R total (100)	45	74	99	92.36 (5.51)
Attention/Orientation (18)	45	14	18	17.69 (0.79)
Memory (26)	45	15	26	23.24 (3.14)
Verbal Fluency (14)	45	3	14	11.20 (2.24)
Language (26)	45	23	26	24.87 (1.08)
Visual-spatial (16)	45	11	16	15.33 (1.09)

Face validity was assessed through participant interviews. The majority of participants found the test straight forward and easy to understand. While some reported confusion about the purpose and meaning of particular tasks, there was no negative feedback about the process (e.g., “this is fun”, “it’s like being back at school”). Participants had a variety of answers to the picture naming sub-domains,

which required interviewer judgement when scoring, (e.g., accepting 'keg' rather than 'barrel' and 'crocodile' rather than 'alligator').

Comparison to original normed control group

Table 4 provides a comparison of the sub-domains of the ACE-R between the present sample and the original control sample. There were significant differences between the pilot study sample and the original control in the cognitive domain of Visual-spatial. The original control sample scored significantly lower, on this subscale. The effect size was moderate. Overall, the current sample did not differ significantly in ACE-R total score (M= 92.22, SD= 5.66) from the control sample (M=93.7, SD=4.3), t (106) = -1.42, p< 0.16.

Table 4.
Two tailed t-test comparisons of ACE-R and sub-domain scores between the current sample and the ACE-R original control group.

	Pilot Sample (N= 45, mean age 71.6)	Mioshi control (N=63, mean age 64.4)	Comparison t-tests (df= 106)
	Mean (SD)	Mean (SD)	t-score (SE Mean)
ACE-R total (100)	92.36 (5.51)	93.7 (4.3)	-1.34 (0.95), p=0.16
Attention/Orientation	17.69 (0.79)	17.7 (0.5)	0.08 (0.12), p=0.94
Memory	23.24 (3.14)	23.4 (2.7)	0.28 (0.56), p=0.77
Verbal Fluency	11.20 (2.24)	11.9 (1.7)	1.87 (0.38), p=0.07
Language	24.87 (1.08)	25.1 (1.5)	0.89 (0.26), p= 0.38
Visual-spatial	15.33 (1.09)	15.7 (0.7)	2.15 (0.17), p= 0.03**

**significant at p<.05

Demographic variables

The Pearson correlation between ACE-R score and age was non-significant (r=-0.19, p<0.21). There was no significant difference between male (M=92.06, SD=5.72) and female gender (M=92.56, SD=5.26); t (43) = -0.30, p=0.77, nor across level of qualifications gained; no qualifications (M=91.67, SD=5.19), trade/post-secondary (M=93.08, SD=4.56) and tertiary (M=92.81, SD=6.64); F (3, 44) = 0.38, p<0.77.

Cognitive Impairment.

Two cut-off scores were developed for the ACE-R in the original development paper based on the calculations of sensitivity and specificity and positive predictive values at different prevalence rates. The likelihood ratio described in that research showed that the more stringent cut-off for impairment of 82 is 100 times more likely (than a score of 88) to come from somebody with dementia than without. At the more stringent cut-off of <82 two people in this sample would be classified as significantly cognitively impaired (4.4%).

Depression and anxiety symptomology

The 'Kiwi' ACE-R was not significantly associated with either of the depression scales (CES-D10, GDS15) or the anxiety measure (GAI-20). All the mood scales were significantly correlated with each other ($r=0.42$-0.57, $p<0.00$). According to the suggested clinical cut off scores for each of the scales (Brown & Schinka, 2005; Pachana et al., 2007; Radloff & Locke, 2000), seven people met clinical criteria for depression using the GDS, eleven people meet criteria for depression using the CES-D and three people met the cut-off criteria for anxiety using the GAI.

Comparison to HRS results

This current sample differed significantly from the HRS scores on the cognitive functioning sub-domains. The current sample was significantly poorer at recalling items after a delay. However, this New Zealand sample performed significantly better on tests of vocabulary and serial 7's (which measure both information and working memory). Table 5 outlines the means, standard deviations and mean differences of the two groups on the different sub-domains. Given the significant difference in sample size and the unknown age range, caution must be taken in interpreting this data.

Table 5.
Mean differences between the current sample and HRS sample on different cognitive tests.

	HRS 2002	'Kiwi' ACE-R Pilot, 2011 N=45	Mean point difference
Immediate Recall (10 points)	5.51 (1.82) n=15051	5.91 (1.55)	0.40
Delayed Recall (10 points)	4.52, (2.17) n=15001	3.22 (1.96)	1.30
Total Recall (20 points)	10.05, (3.71) n=15001	9.13 (3.11)	0.92
Serial 7's subtraction (5 points)	3.67, (1.71) n=14698	4.91 (0.42)	1.24
Vocabulary (10 points)	5.66 (2.04) n=9423	7.82 (1.69)	2.16

Discussion

The aim of this study was to pilot the use of the modified Kiwi version of the ACE-R with community dwelling older New Zealanders.

The adapted 'Kiwi' ACE-R discriminated among different levels of cognitive functioning, (as evidenced by a good spread of scores), was easily understood by the participants, and correlated well with other measures of cognitive functioning. The internal consistency was slightly low compared to other studies that have used the measure (Hsieh et al., 2013; Mioshi et al., 2006b).

'Kiwi' ACE-R scores did not differ significantly from the control group in the original development paper. This suggests that; a) New Zealanders do not differ significantly from the United Kingdom controls, and b) adaptations to make this measure more acceptable for New Zealand participants did not negate the integrity of the measure. Within the sub-domains, New Zealand participants scored significantly lower in the visual-spatial domain. This discrepancy needs to be investigated further to see if this is a true difference in cognitive functioning in these populations, a result of cultural differences or unique to the population sampled. Investigating other norms of verbal fluency,

language and visual-spatial skills in other countries and other separate norms in New Zealand for equivalent tests may help with understanding the cross-nation discrepancies.

A few cautions are necessary when administering and scoring this measure. For example, in the naming sub-domain, interviewer judgement is required to ascertain the accuracy of these replies. Participants often named a barrel as a keg or named the crocodile/alligator as a lizard. Using the strict guidelines provided in the scoring manual, answers of 'keg' and 'lizard' would be scored as incorrect. However, keg is a more culturally accepted term in New Zealand, and it is impossible to judge size scale in these pictures (e.g., crocodile versus lizard), so these were both accepted as correct in the current study. These points may need to be elaborated on in the scoring criteria. In addition, when naming the rhinoceros some people called it a hippopotamus which may reflect a priming effect from a previous task (a task requiring the repetition of the 'hippopotamus') rather than any difficulty with naming items. Participants appeared to become quite confused when doing the three stage command, ("take paper in hand, fold it and put in on the floor") due to the unusual nature of the task. A discussion at the start of the assessment with the participants about being asked to do tasks that may seem easy, hard or strange, may help ease the administration of this item.

Interestingly, age was not correlated with cognitive functioning which is consistent with the original control group in which age had very little impact on scores, but inconsistent with the majority of research suggesting that cognitive function declines with age (Albert et al., 1993; Christensen et al., 1999; Cullum et al., 2000; Salthouse, 2002). This may be due to the restricted age range in this sample, with over half of the participant's ages within 10 years of each other, as was the case in the original control sample too.

Years of education had a significant impact on performance on the Malaysian version of the ACE (Mathuranath et al., 2007), which suggests that the ACE-R may be influenced by education. Educational experience needs to be routinely reported and explored to see whether or not it has a potential moderating effect on ACE-R performance. This could be a potential source of spectrum bias.

Within this sample education did not have an impact on 'Kiwi' ACE-R score. However, with over 60% of the sample having a post school qualification it is possible that there was not enough variability in qualification levels to show a significant difference in score.

There are a number of ways to define cognitive impairment and the lack of consensus around theoretical understandings of cognitive decline and the subsequent variations in measuring it, creates difficulty in deciding rates of impairments. The higher ACE-R pre-determined cut-off (<88) would overestimate the rate of impairment in New Zealand communities based on comparisons to other community research data (Bachman et al., 1992; Herzog & Wallace, 1997; Melzer et al., 1997). The alternative, more stringent, ACE-R cut-off (<82) is more likely to represent more accurate estimates of cognitive impairment in this sample.

There are a number of limitations in this study. The pilot study was conducted with people from the greater Wellington region in New Zealand and therefore the extent to which the sample is representative of the wider New Zealand population is unclear, reducing the ability for results to be generalized to all New Zealanders. Furthermore, this sample was comprised of volunteers who may not be representative of members of their generations. For example, volunteers are more often healthier, socially economically advantaged, intellectually able, well educated, confident and highly motivated (Ganguli, Lytle, Reynolds, & Dodge, 1998). Furthermore, the current sample was predominantly in the age group 65-75, ('young old') and therefore the results may only be generalizable to this age group. Cohort differences such as quality of childhood and lifetime nutrition, exposure to toxins or health hazards and education levels, work and lifestyles may also impact on scores. Due to the possible bias of participant selection, scores may present an elevated level of cognitive functioning than what would normally be expected. Collecting more extensive information about demographic factors and life course histories, and having a more representative sample of the population under investigation will improve the validity of findings and allow for more sophisticated data analyses.

Conclusions

The adapted ‘Kiwi’ ACE-R represents a reliable and valid assessment tool for measuring multiple cognitive domains in non-clinical older adult community samples. Whilst some flexibility in the scoring criteria for naming, and consideration of priming effects need to be considered, overall it is a well-accepted measure. It is likely to add great value to research and primary health settings and aid in the early assessment of cognitive functioning in older adults.

References

Albert, M., Jones, K., Savage, C., Berkman, L., Seeman, T., Blazer, D., & Rowe, J. (1993). Predictors of cognitive change in older persons: MacArthur studies of successful aging. *Psychology and Aging, 10*(4), 578-589.

Almeida, O., & Almeida, S. (1999). Short versions of the geriatric depression scale: a study of their validity for the diagnosis of a major depressive episode according to ICD-10 and DSM-IV. *International Journal of Geriatric Psychiatry, 14*(10), 858-865. doi: 10.1002/(sici)1099-1166(199910)14:10<858::aid-gps35>3.0.co;2-8

Alzheimers New Zealand. (2008). Dementia Manifesto from http://www.alzheimers.org.nz/files/reports/Dementia-Manifesto-2.pdf

Anstey, K., Luszcz, M., Giles, L., & Andrews, G. (2001). Demographic, Health, Cognitive, and Sensory Variables as Predictors of Mortality in Very Old Adults. *Psychology and Aging, 16*(1), 3-11.

Bachman, D., Wolf, P., Linn, R., Knoefel, J., Cobb, J., & Belanger, A. (1992). Prevalence of dementia and probable senile dementia of the Alzheimer type in the Framingham Study. *Neurology, 42*, 115-119.

Beaudreau, S., & O'Hara, R. (2009). The association of anxiety and depressive symptoms with cognitive performance in community-dwelling older adults. *Psychology and Aging, 24*(2), 07-512.

Benerjee, S., & Wittenberg, R. (2009). Clinical and cost effectiveness of servces for early diagnosis and intervention in dementia. *International Journal of Geriatric Psychiatry, 24*(7), 748-754.

Boustani, M., Peterson, B., Hanson, L., Harris, R., & Lohr, K. N. (2003). Screening for Dementia in Primary Care: A Summary of the Evidence for the U.S. Preventive Services Task Force. *Annals of Internal Medicine, 138*(11), 927.

Brown, P., Devanand, D., Liu, X., & Caccappolo, E. (2011). Functional impairment in elderly patients with mild cognitive impairment and mild Alzheimer disease. *Archives of General Psychiatry, 68*(6), 617.

Brown, J., Jose, P., Hung Ng, S., & Guo, J. (2002). Psychometric properties of three scales of depression and well-being in a mature New Zealand sample. *New Zealand Journal of Psychology, 31*(1), 39-46.

Brown, L., & Schinka, J. (Writers). (2005). Development and initial validation of a 15-item informant version of the Geriatric Depression Scale: John Wiley & Sons, Ltd.

Campbell, A., McCosh, L., & Reinken, J. (1983). Dementia in old age and the need for services. *Age and Ageing, 12*, 11-16.

Cheung, G. (2007). Concurrent validity of the Geriatric Anxiety Inventory in late-life depression. *International psychogeriatrics, 19*(02), 333-335. doi: 10.1017/S1041610206004340

Christensen, H., MacKinnon, A., Korten, A., Jorm, A., Henderson, A., Jacomb, P., & Rodgers, B. (1999). An analysis of diversity in the cognitive performance of elderly community dwellers: individual differences in change scores as a function of age. *Psychology and Aging, 14*(3), 365-379.

Chronbach, L. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297-334.

Crawford, S., Whitnall, L., Robertson, J., & Evans, J. (2012). A systematic review of the accuracy and clinical utility of the Addenbrooke's Cognitive Examination and the Addenbrooke's Cognitive Examination-Revised in the diagnosis of dementia. *International Journal of Geriatric Psychiatry, 27*(7), 659-669. doi: 10.1002/gps.2771

Cullum, S., Huppert, F., McGee, M., Dening, T., Ahmed, A., Paykel, E., & Brayne, C. (2000). Decline across different domains of cognitive function in normal ageing: results of a longitudinal population based study using CAMCOG. *International Journal of Geriatric Psychiatry, 15*, 853-862.

Elias, M., Sullivan, L., D'Agostino, R., Elias, P., Beiser, A., Au, R., . . . Wolf, P. (2004). Framingham Stroke Risk Profile and Lowered Cognitive Performance. *Stroke, 35*(2), 404-409. doi: 10.1161/01.str.0000103141.82869.77

Ganguli, M., Lytle, M., Reynolds, M., & Dodge, H. (1998). Random versus volunteer selection for a community-based study. *The Journals of Gerontology Series: Biological Sciences and Medical Sciences, 53*(1), 39-46.

Gauthier, S., Reisberg, B., Zaudig, M., Petersen, R., Ritchie, K., Broich, K., . . . Winblad, B. (2006). Mild cognitive impairment. *The Lancet, 367*(9518), 1262-1270.

Gonzáleza, H., Bowena, M., & Fisher, G. (2008). Memory Decline and Depressive Symptoms in a Nationally Representative Sample of Older Adults: The Health and Retirement Study (1998-2004). *Dementia and Geriatric Cognitive Disorders, 25*(3), 266-271.

Hanninen, T., Koivisto, K., Reinikanen, K., Helkala, E., Soininen, H., Mykkanen, L., . . . Riekkkinen, P. (1996). Prevalence of ageing-associated cognitive decline in an elderly population. *Age and Ageing, 25*, 201-205.

Herzog, A., & Wallace, R. (1997). Measures of cognitive functioning in the AHEAD study. *The Journals of Gerontology Series B, 52B (special issue)*, 37-48.

Hsieh, S., Schubert, S., Hoon, C., Mioshi, E., & Hodges, J. (2013). *Validation of the Addenbrooke's Cognitive Examination-III in Frontotemporal Dementia and Alzheimer's disease*. Neuroscience Research Australia and School of Medical Sciences University of New South Wales.

Irwin, M., Artin, K., & Oxman, M. (1999). Screening for depression in the older adult: Criterion validity of the 10-item Center for Epidemiological Studies Depression Scale (CES-D). *Archives of Internal Medicine, 159*(9/23), 1701-1705.

Kieffer, K. M., & Reese, R. J. (2002). A Reliability Generalization Study of the Geriatric Depression Scale. *Educational and Psychological Measurement, 62*(6), 969-994. doi: 10.1177/0013164402238085

Knight, R., McMahon, J., Green, T., & Skeaff, M. (2004). Some normative and psychometric data for the Geriatric Depression Scale and the Cognitve Failures Questionnaire from a sample of healthy older persons. *New Zealand Journal of Psychology, 33*(3), 163-201.

Knight, R., Williams, S., McGee, R., & Olaman, S. (1997). Psychometric properties of the Center for Epidemiologic Studies Depression Scale (CES-D) in a sample of women in middle life. *Behavioural Research and Therapy, 35*(4), 373-380.

La Rue, A., Swan, G., & Carmelli, D. (1995). Cognition and depression in a cohort of aging men: results from the Western Collaborative Group study. *Psychology and Aging, 10*(1), 30-33.

Lachman, W. (2010). Perceived control over memory aging: Developmental and intervention perspectives. *Journal of Social Issues, 47*(4), 159-175.

Lachman, M., & Spiro, A. (2002). Critique of Cognitive measures in the health retirement study (HRS) and the Asset and Health Dynamics among the Oldest Old (AHEAD) study. U.S: National Institute on Aging.

Mathuranath, P., Cherian, P., Mathew, R., George, A., Alexander, A., & Sarma, S. (2007). Mini Mental State Examination and the Addenbrooke's Cognitive Examination: Effect of education and norms for a multicultural population. *Neurology India, 55*(1), 106-110.

Matusik, P., Tomaszewski, K., Chmielowska, K., Nowak, J., & Nowak, W. (2012). Severe frailty and cognitive impairment are related to higher mortality in 12-month follow-up of nursing home residents. *Archives of Gerontology and Geriatrics, 55*(1), 22-24.

McDowell, I., & Newell, C. (1996). *Measuring health: A guide to rating scales and questionnaires* (2nd ed.). New York: Oxford.

Melzer, D., Ely, M., & Brayne, C. (1997). Cognitive impairment in elderly people: population based estimate of the future in England, Scotland, and Wales. *British Medical Journal, 315*(7106), 462. doi: 10.1136/bmj.315.7106.462

Ministry of Health. (2006). *Older People's Health Chart Book 2006*. (12). Wellington: Ministry of Health.

Ministry of Health. (2007). Statement of intent 2007-2010. Wellington: Ministry of Health.

Ministry of Social Development. (2001). *New Zealand Positive Ageing Strategy*. Wellington: Ministry of Social Development.

Mioshi, E., Dawson, K., Mitchell, J., Arnold, R., Hodges, J., & Turvey, C. (2006a). The Addenbrooke's Cognitive Examination Revised (ACE-R): a brief cognitive test battery for dementia screening. *International Journal of Geriatric Psychiatry, 21*, 1078-1085.

Mioshi, E., Dawson, K., Mitchell, J., Arnold, R., Hodges, J., & Turvey, C. (2006b). The Addenbrooke's Cognitive Examination Revised (ACE-R): a brief cognitive test battery for dementia screening. *International Journal of Geriatric Psychiatry, 21*(11), 1078-1085. doi: 10.1002/gps.1610

National Audit Office. (2007). Improving services and support for people with dementia. Retrieved 01/07, 2012, from http://www.nao.org.uk/publications/0607/support_for_people_with_dementia.aspx

National Institute on Aging, & National Institutes of Health. (2007). Chapter One: Health. In F. Karp (Ed.), *Growing Older in America: The Health and Retirement Study* (pp. 20-38). U.S: U.S. Department of Health and Human Services.

Ofstedal, M., Fisher, G., & Herzog, R. (2005). HRS/AHEAD Documentation Report: Documentation of Cognitive Functioning Measures in the Health and Retirement Study. Michigan: Survey Research Center, University of Michigan.

O'Hara, R., & Yesavage, J. A. (2002). *The Geriatric Depression Scale: Its Development and Recent Application*: John Wiley & Sons, Ltd.

Pachana, N., Byrne, G., Siddle, H., Koloski, N., & Arnold, E. (2007). Development and validation of the Geriatric Anxiety Inventory. *Internation Psychogeriatrics, 19*(1), 103-114.

Parsons, M., Senior, H. E. J., Kerse, N., Chen, M.-h., Jacobs, S., Vanderhoorn, S., . . . Anderson, C. (2012). The Assessment of Services Promoting Independence and Recovery in Elders Trial (ASPIRE): a pre-planned meta-analysis of three independent randomised controlled trial evaluations of ageing in place initiatives in New Zealand. *Age and Ageing, 41*(6), 722-728. doi: 10.1093/ageing/afs113

Plassman, B., Langa, K., Fisher, G., Heeringa, S., Weir, D., Ofstedal, M., . . . Wallace, R. (2008). Prevalence of cognitive impairment without dementia in the United States. *Annals of Internal Medicine, 148*, 427-434.

Powell, M., Smith, G., Knopman, D., Parisi, J., Boeve, B., & Petersen, R. (2006). Cognitive measures predict pathologic Alzheimer disease. *Archives of Neurology, 63*, 865-868.

Prichep, L., John, E., Ferris, S., Rausch, Fang, L., Cancrob, R., . . . Reisberg, B. (2006). Prediction of longitudinal cognitive decline in normal elderly with subjective complaints using electrophysiological imaging. *Neurobiology of Aging, 27*(3), 471-481.

Radloff, L. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*(3), 385-401.

Radloff, L., & Locke, B. (2000). Center for Epidemiologic Studies Depression Scale (CES-D). In J. Rush (Ed.), *Psychiatric Measures*. Washington DC: APA.

Salthouse, T. (2002). Age related effects on memory in the context of age-related effects on cognition. In N. Ohta & P. Graf (Eds.), *Proceedings of Tsukuba International Conference on Memory* (pp. 139-158). Massachusetts: MIT Press.

Salthouse, T. (2004). What and when of cognitive aging. *Current Directions in Psychological Science, 13*(4), 140-145.

Shulman, K., Herrmann, N., Brodaty, H., Chiu, H., Lawlor, B., Ritchie, K., & Scanlan, J. (2006). IPA survey of brief cognitive screening instruments. *International Psychogeriatrics, 18*(2), 281-294.

SPSS Inc. (Released 2009). PASW Statistics for Windows. *Version 18.0*.

Statistics New Zealand. (2008). Demographic Trends: 2007. Wellington: Statistics New Zealand.

Statistics New Zealand. (2012). *Demographic trends: 2011*. Wellington: Statistics New Zealand.

Sternberg, S., Wolfson, C., & Baumgarten, M. (2000). Undetected dementia in community-dwelling older people: the Canadian Study of Health and Aging. *Journal of the American Geriatrics Society, 58*, 1430–1434.

Suthers, K., Jung, K., & Crimmins, E. (2003). Life Expectancy with Cognitive Impairment in the Older Population of the United States. *The Journals of Gerontology: Social Sciences, 58*(3), 179-186.

Te Pou. (2011). Older adults in New Zealand: Population changes, health, service use and workforce needs. Wellington The national centre of mental health research, information and workforce development.

Witta, E., & Sivo, S. (2002). *Measuring cognitive function: an empirical investigation of the psychometric properties of a cognitive measure*. Paper presented at the Annual Meeting of the America Evaluation Association, Washington, DC.

Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., Adey, M., & Leirer, V. O. (1982). Development and validation of a geriatric depression screening scale: A preliminary report. *Journal of Psychiatric Research, 17*(1), 37-49.