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An Exploration of the Relationship of Social Networks with Depression  
among Older Adults: A Prospective Study

A thesis presented in partial fulfilment of the requirements for the degree of

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## Abstract

Research has highlighted social integration as a protective factor against depression among older adults. This thesis aims to clarify whether specific features of social networks are particularly important, the effect of perceived connectedness on the relationship between structural social integration and depressive symptoms, and whether social integration is a longitudinal predictor of depressive symptoms among older adults. The thesis also describes the social networks and prevalence of depression among older people in New Zealand, including older Māori, of which there is limited availability of existing research.

The current study utilised data taken at three waves of measurement from 3594 community-dwelling older people living in New Zealand including 172 older Māori. The relationship between components of social network structure and depression were compared using standard statistical techniques. Consistent with previous research, contact with non-family social ties was significantly and negatively associated with depressive symptoms whereas contact with family was not significantly correlated. Unlike other studies, social network size significantly predicted depressive symptoms. A series of hierarchical multivariate linear regression models indicated that, after controlling for demographics and health variables such as age, functional ability and exercise, structural integration and perceived connectedness uniquely explained between 1 and 4% of the variability in depressive symptoms. According to a multilevel model for change, social integration did not predict different trajectories of depressive symptoms over 36-months. Perceived connectedness was found to mediate 29% of the effect of structural social integration on depressive symptoms.

Results highlight the relative importance of perceived connectedness in older adults' depression. Composite measures of structural social integration in depression research with older people are indicated with the exception of items related to family ties and marital status. Measures of social integration, especially objective measures based on social network structure, may not be reliable indicators of depression risk. These findings highlight a need for further investigation into the efficacy of social

interventions, especially targeting non-family ties and perceived connectedness.

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## Glossary

<i>Social networks</i>	<p>The social ties that an individual has and their interactions with those ties.</p> <p>Often synonymous with the term <i>social support networks</i></p>
<i>Social network structure</i>	<p>Objective defining features of an individual's social network. This includes the nature of social ties and social interactions (e.g. number, proximity, frequency, type).</p>
<i>Perceived connectedness</i>	<p>An individual's subjective evaluation of their social network. When this evaluation is negative, it is termed <i>perceived isolation</i>.</p> <p>Often synonymous with the term <i>perceived support</i>, though perceived connectedness refers to a broader evaluation of social relationships not limited to satisfaction with available or enacted support.</p>
<i>Perceived isolation</i>	<p>When an individual's subjective evaluation of their social network is negative.</p> <p><i>Note.</i> The relationship between the terms perceived isolation and loneliness is relatively unclear in the literature. Some researchers appear to use the terms interchangeably (e.g. Cacioppo et al., 2010; Shankar, McMunn, Banks, &amp; Steptoe, 2011), yet generally loneliness appears to be viewed as an outcome of perceived isolation (e.g. a negative feeling state) rather than the negative evaluation itself (Tiikkainen &amp; Heikkinen, 2005).</p>
<i>Social integration</i>	<p>When an individual is both engaged in their social networks, in that they have regular interactions with a range of social ties, and those relationships are meaningful and satisfying to that individual. Social</p>

integration is therefore defined according to both the persons' social network structure and level of perceived connectedness.

Often synonymous with the terms *social embeddedness* and *social connectedness*

*Social isolation* When an individual is not engaged with their social ties and their social network is deficient, as defined by their social network structure and level of perceived isolation.

Often synonymous with the terms *social disintegration* and *social disconnectedness*

*Social tie* An individual or group with which an individual has recurrent patterns of interactions.

Often synonymous with the term *social relationships*

*Social interaction* Contact with a social tie. Not limited to face-to-face or one-on-one interaction.

Often synonymous with the terms *social engagement* and *social activity*

*Social support* Enacted or available assistance provided to an individual by their social ties with the aim to prevent stress to that individual.



## **Chapter 1: Introduction**

Depression is a mental disorder characterised by saddened mood or loss of enjoyment that results in a clinically significant amount of distress or impaired functioning. Across the lifespan, depression is associated with significant costs to the individual and those who are close to them, including personal suffering and stress, functional decline, interpersonal difficulties, physical health complications, and worst of all, suicide. Wider implications on societies include notable social and economic costs such as healthcare costs and resources needed to treat the depression, costs related to secondary impacts on the depressed persons' mental and physical health, and lost productivity. In order to optimally address the problem of depression, the illness must be well understood. A thorough understanding of depression means that detection, treatment, and prevention efforts, at an individual and policy level, will be better informed.

Life-span approaches to understanding depression address the disorder from a developmental perspective, out of acknowledgement that the etiology, maintenance, presentation, and phenomenology of illnesses can vary between age groups (Johnson, 2005). Researchers had relatively neglected the topic of older adults' mental health until the mid-twentieth century. The reasons for this include the fact that older adults used to comprise only a small proportion of the population, earlier dominant theories in psychology emphasised childhood experience in determining mental wellbeing, and researchers were deterred by ageist stereotypes (Birren & Schroots, 2000). Fortunately, the field of geropsychology (the psychology of older adults), including research on depression in later life, has flourished since the mid-1900s. The ageing of populations has resulted in exceeding pressure to understand depression as it is experienced among older adults, so that prevention and treatment efforts can be both efficient and effective in order to cope with the increasing demand on specialist services. Depression in later life has become increasingly acknowledged as a prevalent and treatable condition.

Biological risk for depression among older people looms large (Blazer, 2003). Additionally, older people are at risk of age-related

environmental stressors such as bereavement, physical decline, and relocation. Despite this, epidemiological research reports that older adults are not at a greater risk of depression than younger adults, and may be at lower risk especially for severe depressive symptoms (Blazer, 2002; Djernes, 2006). The trend towards lower severity and at least similar prevalence rates compared to younger adults suggests that older adults possess protective strengths. The need for preventative and treatment efforts to utilise protective strengths is highlighted by the fact that, although severity and prevalence may be lower, there are still a significant number of older people experiencing clinically significant depressive symptoms (up to 25%, see section 3.3) which require attention.

Social factors feature strongly in psychosocial theories of late life depression. Contrary to stereotypes of old age, older people tend to report being socially integrated, which may represent a protective strength against depressive symptoms. Research has clearly established that social integration is associated with decreased risk of depression among older adults, and social isolation with increased risk (Blazer, 2003; Djernes, 2006). Specific components of social network structure that are used to define social integration, such as being married, having frequent contacts with family and friends, and community involvement, have also been linked to lower depression risk (Djernes, 2006). It is possible that certain features impact depression more than others. For instance, social network size is thought to be unimportant in determining depression in older populations due to older peoples' tendency to have smaller but still emotionally rewarding social networks (Carstensen, Fung, & Charles, 2003). There is also some evidence that contact with friends may be more important relative to contact with family (e.g. Chao, 2011; Doubova et al., 2010; Fiori, Antonucci, & Cortina, 2006; Golden, Conroy, & Lawlor, 2009). Despite this, most studies have either investigated structural social integration as a whole construct or specific features in isolation. This means that little is known of the relative importance of specific features for depression in later life.

As one might expect, an individuals' perceived level of connectedness is also linked to decreased depression risk among older

people (e.g. Cacioppo, Hawkey, & Thisted, 2010; Cacioppo, Hughes, Waite, Hawkey, & Thisted, 2006; Cornwell & Waite, 2009; Heikkinen & Kauppinen, 2004; Tiikkainen & Heikkinen, 2005). Interestingly, research has suggested that, irrespective of objective indicators of social integration, older adults are more likely to perceive their social networks positively compared to younger adults (Schnittker, 2007). Moreover, compared to structural indicators of social integration, perceived connectedness appears to be a stronger predictor of depression among older adults (e.g. Chao, 2011; Cornwell & Waite, 2009; Pinqart & Sorensen, 2001; Shaw, Krause, Liang, & Bennett, 2007). A model proposed by Berkman, Glass, Brissette, and Seeman (2000) illustrates social networks influencing health via multiple pathways, namely physiological, health behavioural and psychological pathways. Due to its cognitive nature, perceived connectedness may mediate the psychological pathways through which social network structure influence depression. To date there is only preliminary evidence of a mediation effect (Cornwell & Waite, 2009; Fiori et al., 2006). Regrettably, the interactive relationship between perceived connectedness and objective social integration in determining depression risk has not been clearly established, largely because few studies to date have examined both constructs simultaneously.

The current study aims to examine both the relative contribution of specific social network components to levels of depressive symptoms experienced by older people, and to clarify the relationship between depression and structural social integration, as defined by social network structure, and perceived connectedness. Analyses are based on a longitudinal pre-existing data set taken from a large sample of older New Zealanders, including a sub-sample of older Māori. Methods include bivariate and multivariate quantitative analyses on baseline data (i.e. cross-sectional) and data from two follow-up measurement waves at 18 and 36 months after baseline (i.e. prospective).

This thesis begins by briefly reviewing the background of the study of depression among older people (Chapter 2). Then, current understandings of depression in later life are overviewed (Chapter 3). These chapters aim to provide a background and justification for the need for the current thesis.

Literature on the relationship between depression and social networks are then reviewed in more detail (Chapter 4) in order to highlight the specific hypotheses of the present study. Due to the heterogeneity evident among older adults and the breadth of literature on the topic of depression in this population, review chapters focus on older adults that are community dwelling, non-demented, and in the younger-old and middle-old (approximately 65-85 years) age range. The present study hypotheses are then defined (Chapter 5), followed by details of research methodology used to attempt to investigate these hypotheses (Chapter 6). Results of data screening, baseline bivariate and multivariate analyses, longitudinal multivariate analyses, and a mediation analysis that investigate the relationship between depression scores and social variables are then presented (Chapter 7). Finally, results are then discussed in light of hypotheses and pre-existing research findings (Chapter 8).

The present research investigates three main hypotheses. First, it is expected that components of social networks will differentially contribute to depressive symptoms: Frequency of social interactions, being married, and community ties are expected to be important, whereas social network size are not and expectations about the impact of family versus friendship ties are undetermined. Second, structural social integration and perceived connectedness are both expected to be significant predictors of depressive symptoms, cross-sectionally and longitudinally, but perceived connectedness is expected to be a stronger predictor. Third, it is hypothesised that the relationship between structural social integration and depressive symptoms will be partially mediated by perceived connectedness.

## **Chapter 2: Geropsychology and the Study of Depression in Later Life**

This chapter briefly overviews the notion of old age, the history of gerontology within the discipline of psychology ('geropsychology'), and stresses the importance of understanding late life health concerns such as late life depression in the context of ageing populations.

### **2.1. What is 'old'?**

It is not surprising given the emphasis Western societies place on chronological age that it is considered to be the foundation of defining what it is to be 'young' or 'old'. As a socially constructed means of classification, chronological age has been culturally instilled in society with events like anniversaries and legal milestones such as age of consent. The process and experience of ageing varies among individuals of the same age.

Furthermore, as a result of demographic and cultural changes, chronological age is becoming delineated from life stages of education, work, and retirement, which are now experienced, sometimes simultaneously, by individuals of varying ages.

Nevertheless, the scientific method requires individuals to be grouped into classes. Chronological age sections the course of life conveniently, and not necessarily ineffectively, from a developmental perspective. Chronological age can indicate biological and psychological changes during the course of life, societal roles, and identify those who have shared cohort experiences (Harper, 2006). What is important, given that chronological age does not measure these things directly, is for gerontologists to ensure that age is interpreted meaningfully in the context of other social characteristics relevant to the ageing process, such as gender, ethnicity, and socioeconomic status.

According to historical reports, the ages of 60 and 70 have consistently been used as official ages for withdrawal of public duties, as far back as ancient Greece and medieval England (Harper, 2006). In the 20<sup>th</sup> century, the ages of 60 and 65 were further established as the beginnings of 'old age' when many Western nations used them to define their pension

systems (Brown, 2010). Among New Zealand Māori, the mana and standing of kāumatua (respected older man or woman) status is also associated with the mid-60's age range and over (Statistics New Zealand, 2009; Walden, 2004). In line with these trends, the term 'older adults' currently tends to refer to those aged 60 or 65 years and older, including in New Zealand. Gerontologists also now differentiate within the older adult age group. For instance, some researchers distinguish between the 'younger-old' (65-74 years), 'middle-old' (75-84 years), 'older-old' (85 + years), and 'centenarians' (over 100 years), or use the 'Third Age' to refer to healthy retirement and the 'Fourth Age' to refer to a later period of increasing disability (Brown, 2010; Harper, 2006). This seemingly arose out of increasing acknowledgement of the heterogeneity that exists among this population, which covers the greatest range of years and is experiencing the greatest population growth relative to other age groups (United Nations, 2009).

## **2.2. Geropsychology of Depression: A 20th Century Phenomenon**

'Geropsychology' refers to the study of the psychology of ageing and old age (Birren & Schroots, 2000). Until more recent decades, the field of mental health relatively neglected the subject of older people and ageing. Of the small amount of geropsychology research that did begin to emerge around the beginning of the 20<sup>th</sup> Century, the subject of affective disorders like depression was largely absent. It is understandable that psychology as a discipline paid little attention to mental disorders in late life before the beginning-mid 20<sup>th</sup> Century: Few people lived past aged 50 and both lay and academic environments prioritised the health of young people in a time of high fertility and infant mortality rates (Birren & Schroots, 2000). Primary theoretical approaches at the time, behaviourism and experimental psychology, were more interested in the younger years of life in which stages of childhood development and early experiences were considered the cause of psychological disorder. However, from the late 1950's mental health researchers were calling for more serious consideration of emotional disorders like depression among older adults and acknowledgement of the effectiveness of psychotherapy with this population (e.g. Goldfarb, 1955;

Oberleider, 1966; Zung, 1970). Experts called for a movement away from common misconceptions about depression in later life, such as ideas that it is a normal part of the ageing process or an intractable biological disease. Reasons for this increase in attention to older adults' mental health and depression in later life over the last few decades include; growing recognition for older people as a distinct group with specialised needs, rising interest in challenging stereotypes that stem from stigma around being old, and ageing populations resulting in expanding numbers and proportions of older adults (Birren & Schroots, 2000).

### **2.3. Ageing Populations and Implications for Mental Healthcare**

Ageing populations are a worldwide occurrence. Between 1950 and 2006, the number of people in the world aged 60 and over tripled to 700 million (United Nations, 2009). By 2050, this figure is expected to reach 2 billion. Although United Nations projections have been criticised for relying on assumptions about converging fertility rates (Ovseiko, 2007), the trend of population ageing is nevertheless apparent. In New Zealand, older people represent one in eight of the population, a significant increase from one in twelve in the early 1970s, and it is anticipated that this will rise to one in four by 2051 (Tang, Boddington, & Khawaja, 2007). The New Zealand Māori population is also ageing, with the proportion of Māori over 65 years almost tripling between 1991 and 2011 (Statistics New Zealand, 2011).

Population ageing has predominately been caused by rapid declines in fertility rates in the last century, though older adult numbers are also increasing in the context of declining mortality and rising life expectancy (Ovseiko, 2007; United Nations, 2009). Reductions in mortality rates, which have occurred across the age ranges, have been attributed to medical advances and healthier lifestyles (Harper, 2006). Extending longevity has been linked to both the delayed onset of age-related diseases and disabilities, and the prevention or slowing down of disease progression (Howse, 2006). Consequently, the older adult population itself is ageing, with the most growth occurring among those aged 80 and over (United Nations, 2009).

Ageing populations are a key driver in the rise of geropsychology research. Recognition and interest in how older adults contribute to communities, including caregiving and volunteering roles, the value of wisdom from experience, their role of consumption in the economy, and their ability to continue workforce contributions past retirement age, are on the increase (Leeson & Harper, 2008; New Zealand Ministry of Social Development & Office for Senior Citizens, 2011). Concerns about population ageing include the fact that a rise in the number of older adults also inevitably equates to a rise in demand on health care services. In terms of depression, in New Zealand and internationally mental healthcare services specialising in the treatment of late life depression are unlikely to be able to meet labour and economic requirements associated with a greater number of older adults with depression, especially given the shortage of both specialist and general mental healthcare professionals (Te Pou & Duncan, 2011; United Nations, 2007). By 2021 it is predicted that demand for the health and disability workforce will be 30-40% higher than what is currently available (Te Pou & Duncan, 2011). In light of this there is a pressing need to understand depression in later life, to ensure that the disorder can be addressed effectively and efficiently in order to minimise associated personal, social, and economic costs.

Worldwide and in New Zealand there is a need for changes to healthcare services and policies so that the rise in the older adult population does not result in a rise in the number of older adults with depression requiring specialist care. Primary prevention, secondary prevention, and more efficient treatment are accepted approaches that aim to minimise the costs associated with depression in older people. All of these approaches share in common the need to be informed by evidence to ensure their effectiveness. Knowledge about the nature of late life depression is essential to inform policy makers for the evaluation of goals and programmes, and efforts to raise support for needed policy changes and public awareness. This includes a need for understanding about the causes, presentation, and maintaining factors associated with depression in this population.

The aim of the present study is to add to current understandings about the nature of depression in later life, specifically around

understanding how social networks influence depression in this population. The following chapter (Chapter 3) briefly reviews current understandings of depression among older adults, including diagnostic issues and how depression in this age group differs to that experienced by younger age groups. This will provide a foundation for Chapter 4, which reviews in more detail research specifically on the relationship between depression and social networks among older people.

### **Chapter 3: Depression in Later Life**

Depression is a mental condition characterised by low mood or anhedonia, along with an array of depressive symptoms that can include appetite and sleep disturbance, fatigue, feelings of worthlessness, guilt, difficulty concentrating, and thoughts of death or suicide (American Psychiatric Association [APA], 2012). The aim of this chapter is to broadly review the current status in understandings of depression among older adults, in order to lay justification for the current research and to set the context for the following chapter (Chapter 4). Research on social factors will largely be kept to discussion in Chapter 4. First, typical approaches to defining depression, in terms of either diagnostic clinical criteria or the presence of ‘clinically significant’ depressive symptoms, are explored. Then prevalence rates for depression in later life are discussed. Discussion follows on how a significant number of older people are depressed, yet protective strengths are indicated by prevalence rates that are lower or at least less severe to younger adult populations. Finally, risk factors in late life depression are briefly summarised.

#### **3.1. Review Methods**

The literature review presented in this and the following chapter (Chapter 4) was developed based on an electronic search of university library search engines, organisation websites, and online databases in September 2011 and May 2012. Google Scholar, as the source yielding the highest number of relevant literature, was searched again in January 2013. University libraries searched were Massey University (including *Bonus* + that allows access to texts from 11 universities in Australia) and the University of Auckland. New Zealand organisation websites searched were; the Ministry of Health, the Ministry of Social Development, Statistics New Zealand, the National Centre of Mental Health Research, Information, and Workforce Development (Te Pou), New Zealand Guidelines Group, and the New Zealand Mental Health Foundation. Additionally, expert advice was sought for resources specifically relevant to New Zealand Māori (Dyall, 2012).

International or overseas organisation websites searched were: the American Psychological Association (the general website and their Office on Aging website), the American Psychiatric Society, the International Psychogeriatric Association, and the International Association of Gerontology and Geriatrics. Online databases searched were Google Scholar, PsychInfo, and Proquest Dissertations & Theses. Reference lists of literature obtained from searches were checked for further relevant literature.

For the current chapter, key words searched were age-related words (old-, geriatric, elderly, 60, 65, late- life) and depression related words (depress-, mood disorder-, emotional disorder-). For this chapter review related words (review, literature, summary, meta-analysis, synthesis) were also included as key words, whereas for Chapter 4 social network related words (social, support, friends-, famil-, relationship, ties, lonel-, isolated, network-) were included as key words. To ensure specificity of results in the electronic database searches, key words were limited to the title domain and only the first 400 results viewed.

Due to the heterogeneity evident among older adults and the breadth of literature on the topic of depression in this population, literature reviewed was limited to that which focussed on community dwelling, non-demented older adults that were in the younger-old and middle-old (ranging from approximately 65-85 years) age range. This is the population most relevant to the current thesis.

### **3.2. Defining Depression with Older Adults**

There is by no means a universal consensus on the definition of depression and the common use of the term in lay language further complicates clarity around a clinical definition (McDowell, 2006). However, worldwide and in New Zealand there are two dominant approaches; the *diagnostic approach* and what will be termed the *symptomatology approach*. Generally speaking, both approaches recognise the presence of depressed mood or anhedonia as core features of depression. The diagnostic approach adheres to clinical classification systems, such as the Diagnostic and Statistical Manual of

Mental Disorders (DSM-V; APA, 2012), that provide criteria for clinical disorders in which depressive features are central to that person's presentation. To identify depression, research following this approach has used diagnosis by trained professionals, or psychometric test cut-off scores which have been validated to indicate a high probability of a particular diagnosis (e.g. the Beck Depression Scale; Beck, 1961 or the Geriatric Depression Scale; Yesavage et al., 1982). The symptomatology approach more broadly defines depression according to the presence of depressive symptoms that are causing clinically significant distress or impairment, without necessarily the need to meet other specific criteria (such as numerous symptoms or symptoms being present all day, every day). Research adhering to this approach may examine depression according to the number and/or severity of symptoms along a continuum or use symptoms checklist cut-off scores to identify levels of symptoms that are clinically significant.

The major strength of the diagnostic approach is clear definition. The DSM-V categorises presenting depressive symptoms under one of the various mood disorders, such as Major Depressive Disorder, Dysthymia, Bipolar Disorders, Mood Disorder Due to a General Medical Condition, or Substance-Induce Mood Disorder (APA, 2012). This classification can effectively aid communication and ensure individuals with similar symptoms receive similar levels of care (Nathan & Langenbucher, 2003). The use of diagnostic systems has been particularly helpful given the rise of managed care in determining treatment eligibility or residential care placement for older adults. However, the approach as applied to older adults has received criticisms: Many researchers and clinicians alike view clinical diagnosis as simply a convenient means of categorising symptoms (or as Blazer [2003] puts it; 'different ways of slicing the pie', p.249), that often do not apply neatly in practice (Walsh & Cross, 2013; Zigler & Phillips, 1961). Individuals who experience depressive symptoms can move from one diagnostic subtype to another and it has been argued that no differences have been found in clinical or demographic characteristics between different depression diagnoses (Forsell, 2007). A key criticism specific to depression in older adult populations, however, is the difficulties of applying diagnostic

criteria in the context of ageing.

Criteria for depressive disorders in the current DSM require the clinician to determine whether depression is attributable to a medical condition or substance. This can be difficult given that physical illnesses and taking a number of medications is increasingly common with ageing. Physical illness can contribute directly to the cause of depression via endocrine, immunological, neurobiological, and cardiovascular changes (Fiske, Wetherell, & Gatz, 2009). Medications, such as beta-blockers, corticosteroids, anti-Parkinson's agents, and respiratory or gastrointestinal medications, have also been associated with the onset and maintenance of depression among older adults (Fiske et al., 2009). Moreover, it can be difficult to determine whether depressive symptoms are a reaction to the stress of a co-morbid illness.

Diagnostic criteria also require marked impairment in areas such as one's occupational and interpersonal life (APA, 2012). This too can be difficult to clarify when applied to older adults given that they are typically retired, can spend much of their time at home (especially in the case of the oldest-old), and often have smaller social networks than younger adults (Litwin, 1996b). Differentiating normal or abnormal bereavement reactions from depression as a diagnostic requirement can also be difficult, and older adults are particularly vulnerable to the loss a spouse or other close confident (Blazer, 2002). Finally, diagnostic criteria place emphasis on the symptom of depressed mood which can be problematic because older adults are both less likely than their younger counterparts to experience saddened mood as a central part of their depression, and when it is experienced are less likely to report it (Christensen et al., 1999; Fiske et al., 2009).

Due to these issues of applicability, the symptomatology approach is frequently favoured for capturing a greater proportion of older adults who are experiencing distressing or impairing depressive symptoms (e.g. Luppá et al., 2012; Wardenaar, 2012). A cluster of depressive symptoms might not directly indicate a particular mood disorder, yet symptoms exceeding a screen threshold have been reliably demonstrated to be associated with significant impairment, distress, and other costs to the individual and community (Sharp & Lipsky, 2002). A symptomatology approach also tends

to adhere more strongly to a popular perspective of depression as experienced along a spectrum of severity (e.g. see Forsell, 2007; Judd et al., 1997). Furthermore, screening for clinically significant depressive symptoms often takes the form of checklists that are easily administered by lay interviewers and are relatively nonthreatening to the interviewee. Overall, a symptomatology approach, in which the presence of depressive symptoms are taken themselves to be indicators of depression irrespective of cause- or duration-related criteria, and in which a greater number or greater severity of symptoms indicates a stronger degree of depression, is thus often preferred.

The symptomatology approach does suffer two key fall-backs: First, there is a lack of consensus around defining ‘clinically significant’ symptoms. Second, there is potential for the symptomatology approach to over-include symptoms as depressive when they are due to normal signs of ageing or another cause such as physical illness. For example, an older person may reduce their participation in activities because of physical limitations associated with their ageing or a physical illness without necessarily being depressed. It is necessary for research adhering to the symptomatology approach to therefore use measures well validated in older adult populations.

### **3.3. Prevalence of Depression Among Older Adults**

Prevalence estimates for depression among older adults indicate the burden of depression, determine how depression is distributed within that population, and assist aged care facilities planning to meet the needs of a growing older adult population (Blazer, 2002). The term ‘prevalence’ is used to refer to the percentage of a population that have current depressive symptoms at a given time (Blazer, 2002). The most common measure of depression frequency is ‘point’ or ‘period prevalence’, which is the number of individuals found to meet depression criteria in a sample of the population at a particular time point or period (e.g. 12 months; Blazer, 2002).

In his thorough review, Blazer (2002) found that prevalence

estimates for Major Depressive Disorder (MDD) among community samples of older adults worldwide tended to be between 1% and 5%, with most in the lower end of the range. This has been supported by a more recent review by Djernes (2006), as well as prevalence research in New Zealand in which 1.7% of older New Zealanders have been estimated to have MDD and 2.0% to have any mood disorder (Wells et al., 2006). Prevalence estimates among older people are therefore somewhat lower than that reported in the general adult population, which in New Zealand is estimated to be 5.7% (12 month prevalence, or 8% for any mood disorder; Wells et al., 2006). There are no studies reporting the prevalence rate of depression among older Māori, probably because mental health prevalence research have been limited by small numbers of older Māori in the context of higher mortality and fertility rates (Statistics New Zealand, 2011; Tang, Boddington, & Khawaja, 2007). Te Rau Hinengaro (the New Zealand Mental Health Survey) conducted in 2003 and 2004 reported that out of 188 Māori aged 65 years and over, the prevalence of any mental disorder was 7.9% (95% confidence interval [CI] 3.2, 15.6), compared to between 23.7% and 33.2% of those in younger age groups (though data specific to depressive disorders was not reported; Baxter, Kingi, Tapsell, Durie, & McGee, 2006).

Prevalence estimates for ‘clinically significant depressive symptoms’ among community samples of older adults (i.e. from studies coming from a symptomatology approach) tend to be within the range of 10 - 25% (Anstey, von Sanden, Sargent-Cox, & Luszcz, 2007; Begg, Richardson, & Wells, 2006; Blazer, 2002; Djernes, 2006; Weyerer et al., 2008). These rates are comparable to rates reported in the general population (e.g. see Gatz & Hurwicz, 1990, cited in Anstey et al., 2007; Zung, Broadhead, & Roth, 1993). Whether or not there are fewer depressed older people than younger people is thus cause for debate.

Some researchers have proposed that diagnostic prevalence rates under-represent depression among older people. It has been argued, for instance, that depression among older people goes undetected because of issues faced when applying diagnoses to older people. In addition to diagnostic issues described in Section 3.2, these issues include: (1)

stereotypes of ageing resulting in misdiagnosis (e.g. depressive symptoms being misinterpreted as normal signs of ageing), (2) prevalence studies often excluding those older adults more likely to present with depression (e.g. the cognitively impaired, those with physical illness), and (3) depressed older people being less likely to participate in studies, less likely to report symptoms, and being more likely to drop out or be lost to follow-up (e.g. for health and mortality reasons; Blazer, 2003; Djernes, 2006; Fiske et al., 2009; Mirowsky & Reynolds, 2000). These factors have no doubt led to conservative estimates of depressive disorders among older people. However, the majority of researchers maintain that even taking this into consideration, there are real differences in the prevalence of depression among older adults relative to the general population, particularly in terms of older adults being significantly less likely to experience high severity depression (Blazer, 2002; Fiske et al., 2009).

### **3.4. The Etiology of Depression in Later Life**

Cognitive theory, first proposed by Aaron Beck (1987), has become one of the most popular theories explaining psychological processes in the etiology of depression. In simple terms (illustrated in Figure 1), Cognitive theory proposes that biological vulnerability and aversive life experiences lead to the development of a depressive thought structure called a schema (A. T. Beck, 2008). Negative events can activate these depressive schemas. Activated depressive schemas in turn bias that persons' information processing system, causing them to attend more to negative stimuli, interpreting information in a way that it is consistent with the negative belief structure, and not attend to or discount positive experiences that are inconsistent with the negative schema (A. T. Beck, 2008). This process leads to depressive symptoms such as sadness and social withdrawal.

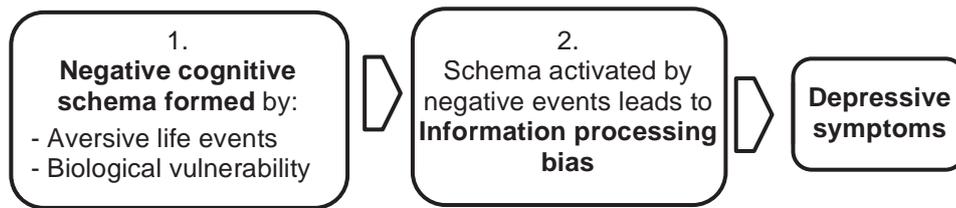


Figure 1. Pictorial representation of the etiology of depression as proposed by Cognitive theory

As Blazer (2003) stresses, biological vulnerability among older people is significantly higher than in the general adult population, with brain changes associated with age-related diseases and normal age-related changes that have been linked to the etiology of depression. For example, cerebrovascular risk factors (e.g. hypertension) and diseases (e.g. vascular dementia and heart disease) are associated with structural brain changes, such as white matter hyperintensities and damage to frontal brain regions, linked to the onset and maintenance of depression (Steffens & Potter, 2008; Taylor et al., 2003). Biological etiological factors offer some explanation to the fact that approximately half of those who experience depression in later life are experiencing it for the first time (i.e. *late-onset depression*; Fiske et al., 2009), and that older adults who are depressed tend to report more cognitive symptoms than younger adults, such as difficulty concentrating, episodic memory complaints, visuospatial difficulties, and language problems (Blazer, 2002; Steffens & Potter, 2008).

In addition to biological vulnerability, older adults are more vulnerable to certain aversive life experiences that may contribute to the formation and activation of negative schema: Bereavement, relocation into supported care or to live closer to family who are able to provide support, functional impairment, loss of social roles (e.g. retirement), and ageism, are all either uniquely or more frequently experienced by older people. Cognitive, biological, and social environment factors are summarised in Figure 2.

It has been argued that the large majority of older people are not depressed (and arguably less depressed than their younger counterparts) despite prevalent biological and environmental stressors associated with older age, because cognitive strengths act against the activation of negative

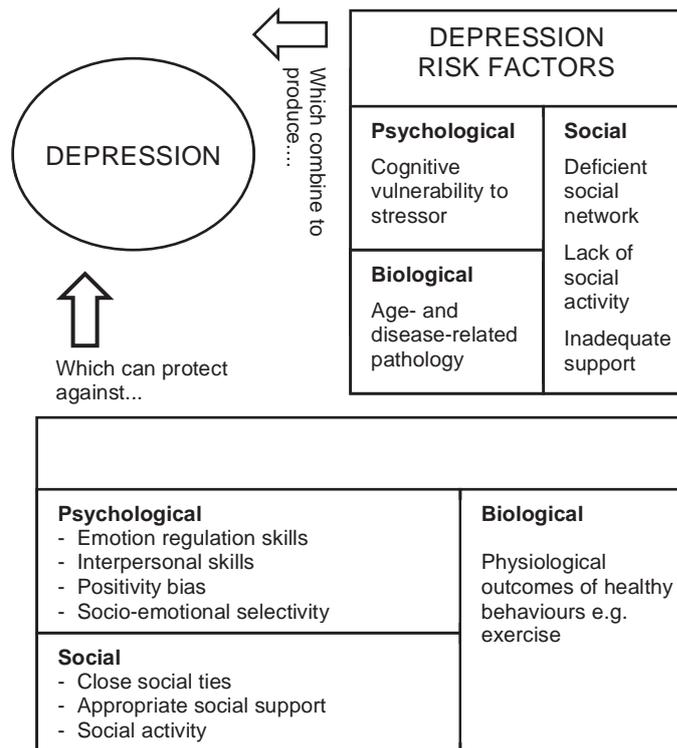


Figure 2. Psychological, social, and biological factors in the etiology of late life depression

cognitive schema which is a key part of the onset of depressive symptoms (A. T. Beck, 2008; Blazer, 2002). The notions that older adults possess cognitive strengths has received empirical support: For example, studies have found older adults to demonstrate improved knowledge and skill in emotion regulation and the application of psychological coping strategies (Charles, 2011). Older adults have been shown to be more likely to positively appraise daily events, reflect positively on their life history, attend to positive stimuli, and actively avoid or quickly disengage from situations that elicit negative emotions (Carstensen et al., 2003; Charles, 2011; Fiske et al., 2009; Luong, Charles, & Fingerma, 2010). These strengths have been attributed to both life experience (i.e. increasing cognitive skills in emotion regulation with age) and to the idea that as people age they actively prioritise their emotional well-being over other goals and therefore are more likely to act in its best interest (known as *socio-emotional selectivity*; Carstensen, Fung, & Charles, 2003).

Unfortunately, most studies investigating age-related psychological

strengths have not examined these in the context of depression. One study by Garnefski and Kraaij (2006) found cognitive emotion regulation strategies of acceptance, positive refocusing, positive reappraisal, and putting into perspective, were associated with reduced depressive symptoms in a community sample of older adults ( $N = 89$ ). However, other than the acceptance strategy, older participants did not evidence increased utilisation of these strategies relative to younger participants. Further research is needed to establish whether psychological strengths explain an apparent resilience to depressive symptoms among older people. For example, a study could examine for evidence of these strengths buffering against depressive symptoms in the presence of known age-related biological and environmental risk factors.

### **3.5. Risk Factors for Depression in Later Life**

A life-span developmental model acknowledges that depression among older people occurs in the context of both risk and protective factors associated with the later stages of life (Fiske et al., 2009). Moreover, a biopsychosocial approach recognises the various forms that these factors can take (i.e. factors with biological, psychological, and social origins; Fiske et al., 2009). As one might imagine, risk factors found to be associated with increased risk of depression are numerous and it is beyond the scope of this review to discuss these in detail (see Anstey et al., 2007; Blazer & Hybels, 2005; Cole & Dendukuri, 2003; Djernes, 2006; Weyerer et al., 2008), with the exception of social network factors (e.g. social support, social network structure) which are explored in the following chapter. A brief outline is therefore simply presented to illustrate risk factors that have been suggested to be especially relevant in older adult populations and to place in context social network contributing factors discussed in the next chapter.

In Djernes' (2006) comprehensive review the most significant predictors of depression for both clinical depressive disorders and clinically significant depressive symptoms among community-dwelling older adults were (in approximate order of strength); functional impairment, lost or limited social contacts, history of depression, widowhood (particularly for

older men), stressful life events (particularly for those with a prior history of depression), low income, dissatisfaction with social networks, lack of social activities, low educational level, and use of depressiogenic medications (p. 383). All of these predictors were also noted in other reviews (i.e. Anstey et al., 2007; Blazer & Hybels, 2005; Cole & Dendukuri, 2003; Djernes, 2006; Weyerer et al., 2008). Other reviews have additionally highlighted the following factors as potential risk factors; historical or current other psychiatric disorders, excessive amounts of social support, poor self-rated health, low levels of life satisfaction, on-going life stressors (e.g. neighbourhood problems, caregiving stress), living alone, being unmarried (never married, divorced, or single), involuntary retirement, cognitive impairment, sensory loss, sleep disturbance, and poor lifestyle behaviours (e.g. regular alcohol use, smoking, lack of exercise) (Anstey et al., 2007; Blazer & Hybels, 2005; Cole & Dendukuri, 2003; Djernes, 2006; Fiske et al., 2009; Heikkinen & Kauppinen, 2004; Ministry of Health & New Zealand Guidelines Group, 2008).

Medical outpatients (i.e. those with chronic somatic illnesses) also report significantly higher depression prevalence rates, especially patients with cardiovascular disease (Djernes, 2006). For instance up to 50% of older adults with heart disease report significant depressive symptoms (Fiske et al., 2009). In line with findings across the adult years, older females are reported to be at significantly higher risk of depression than older males (Djernes, 2006; Kendler & Gardner, 2002; Luppala et al., 2012). However, it is possible that this gender gap is narrower among older people than in middle-life (Qualls & Knight, 2006). In terms of age, the oldest-old report the highest levels of depression among older adults (Luppala et al., 2012). Having said that, the general consensus is that age itself is not a risk factor for depression after controlling for risk factors associated with advanced age (e.g. physical or functional disability, greater proportion of females; Blazer, 2003; Djernes, 2006).

Generally, studies report no relationship between ethnicity and depression in later life, though some studies in the United States found higher prevalence rates among Hispanics than in the general population, and higher rates among African-Americans compared to both Caucasian

Americans and Hispanics (Anstey et al., 2007; Blazer & Hybels, 2005; Cole & Dendukuri, 2003; Djernes, 2006; Weyerer et al., 2008). In New Zealand, 12-month prevalence estimates of depression were reportedly similar between Māori and 'Other' (those who were of neither Pacific nor Māori ethnicity). Other than Pacific people, who had slightly lower depression prevalence rates than the general population (after adjusting for the effects of age, sex, educational qualifications, and household income), no other differences by ethnicity were reported (Wells, 2006).

Social network related risk and protective factors clearly feature in research on depression among older people. Features of older peoples' social networks, such as being married, taking part in local organisations, and having frequent social interactions, are often cited as protective factors against depression. The following chapter will review research on the relationship between features of older adults' social networks and depression, the understanding of which is of interest to prevention and intervention efforts.

### **3.6. Depression in Later Life: Conclusion**

Depression is a significant health concern among older adults. Clinical diagnosis of depressive disorders, although a valued approach, can result in the under-recognition of the significance of the disorder in this population. A significant number of older adults are experiencing clinically significant depressive symptoms which have been argued to be better captured by a symptomatology approach. The prevalence of depression among older adults is overall comparable and possibly less than younger adult populations, at least in terms of severity. Older people experience more biological risks and related symptoms, and can experience unique or more environmental stressors associated with their life stage. Protectively, older adults may demonstrate psychological strengths that act against cognitive distortions that are placed centrally in theory explaining the etiology of depressive symptoms. Social factors feature strongly in findings on risk and protective factors associated with depression among older people. The next chapter will discuss in detail literature on the relationship between social

networks and depression in later life, and by doing so will highlight gaps in current understanding, and subsequently justify the need for this research and provide a foundation for the hypotheses that the present study investigates.

## Chapter 4: Social Networks and Depression in Later Life

Social networks strongly feature in psychosocial theories of late life depression. The social network construct extends back to the mid-20<sup>th</sup> Century in psychology, where pioneers such as Bowlby (1953) generated interest in how social worlds determine psychological well-being (Blazer, 2002). When it came to older peoples' social networks, however, these were initially disregarded as unimportant to their health: Disengagement theory (Cumming & Henry, 1961) argued that with old age came a natural, mutual disengagement between the older person and society. Maddox (1964) challenged this view, arguing that it is social activity, not disengagement that ensures an older persons' wellbeing. Subsequent research indeed found that older people actively seek social interaction and that those who are socially engaged report greater life satisfaction (Blazer, 2002; Carstensen, 1995).

From a life-span perspective, older adults' social networks are likely to differ from younger adults social networks. Older adults often have different roles, values, and social needs than earlier in their life, such as the need to maintain a sense of purpose after retirement and the need for instrumental support in the case of functional disability. Older peoples' social networks are more vulnerable to changes associated with increased depression risk, such as widowhood, bereavement of close friends, relocation into supported accommodation, and cognitive or physical decline limiting their ability to participate in previous social activities. On the other hand, older adults are thought to have especially rewarding social ties and interactions, characterised by emotional closeness and high degrees of reported satisfaction with relationships (Carstensen et al., 2003). This gives rise to the questions: What constitutes optimal social networks for older adults in terms of protecting them against depression? And what features of social networks among older people promote depression?

Existing research investigating the relationship between social networks and depression have consistently found that socially integrated older adults are at a significantly lower risk of depression relative to those who are socially isolated. Numerous aspects of older people's social

networks have been linked with lower depression risk, including being married, having frequent social interactions (particularly with non-family ties), and the perception of one's social network as satisfying and meaningful. However, multiple components used to define social networks tend not to be examined together, with most studies either investigating social integration as a composite construct, or a specific subcomponent such as frequency of social interactions without consideration of other subcomponents. Therefore, it remains to be determined whether certain features of social networks drive the reported relationship between socially integrated networks and depression.

This chapter will discuss existing research on the relationship between social integration and depression among older adults. First, relevant definitions are clarified, which is important given that definitions in social research are frequently unclear and inconsistent. Then, the mechanisms through which social networks influence depression are discussed, highlighting that the psychological pathways through which an individual's social network influences depression are probably mediated by their perception of their social networks. Finally, research on the relationship between structural social integration and depression, and perceived connectedness and depression are summarised. This chapter aims to provide a background for the hypotheses proposed by the current study and highlight the need for the present research to address gaps in existing literature.

#### **4.1. Defining Social Network Constructs**

Definitions of social networks and the various constructs that the broad term embodies are troublesomely diverse and used inconsistently. The significant lack of consensus and clarity around social network constructs has always been, and continues to be, a major criticism of social research (e.g. Barrera, 1986; Berkman et al., 2000). Although this thesis will not solve this problem, it will address it as much as possible by a) adhering to constructs that are the most well defined and accepted in the literature (i.e. those most clearly and frequently used), and b) being clear about the meanings of terms used in this thesis. A glossary of terms is provided on pages xi and xii.

*Social networks* are the web of social relationships and the characteristics of those relationships that surround an individual (Berkman et al., 2000; Johnson, 2005). They are the social ties that an individual has and his or her interactions with those ties, including relationships with family and friends as well as other forms of social ties such as interpersonal contact with neighbours and community groups (Litwin, 1996b; Moren-Cross & Lin, 2005). Generally, superficial interactions, such as that between a patron and wait staff when ordering at a cafe, are excluded from this definition. On a semantic level, they typically would not meet the definition for relationships as ‘...recurrent patterns of interactions with other individuals’ (Krause, 2005, p.182) and on a methodological level, most research investigating the impact of social networks on health are large, quantitative studies where analysis of day-to-day interactions with weak ties would be difficult to measure reliably.

The term *social isolation*, which has been used synonymously with social disconnectedness or social disintegration (Blazer, 2002; Cornwell & Waite, 2009) refers to:

...a state in which the individual lacks a sense of belonging socially, lacks engagement with others, has a minimal number of social contacts and they are deficient in fulfilling and quality relationships. (Nicholson Jr., 2009, p. 1346)

*Social integration* is the reverse of social isolation, and often used synonymously with the terms social embeddedness or social connectedness (Barrera, 1986; Cornwell & Waite; Cornwell, 2012; Leighton, 1974, cited in Blazer, 2002; Pillemer, 2000). Social integration refers to a social network that has frequent social interactions with a range of social ties and in which the individual perceives their social networks as meaningful and satisfying (Blazer, 2002).

Social networks are typically operationalised according to features of social network structure, which can include the number and geographical proximity of social ties, the composition of social ties (e.g. friends, family, community groups), the heterogeneity or homogeneity of network composition (e.g. diverse types of ties or one dominant type), the frequency

of social interactions, and the types of social interactions (e.g. speaking on the phone, attending religious or cultural activities, receipt of instrumental support) (Berkman et al., 2000; Blazer, 2002; Litwin, 1996a; Pillemer, 2000). Structural social integration is typically indicated by social ties that are numerous, geographically close, diverse, and/or involve frequent social interactions, whereas social isolation tends to be indicated by social ties that are few in number, geographically sparse, homogenous, and/or involve infrequent social interactions (Cornwell & Waite, 2009; Pillemer, 2000). Research findings on social network structure and depression among older adults are discussed in Section 4.3.

*Perceived connectedness* is another key construct in social network research that, in contrast to social network structure as an objective indicator of social integration, refers to an individual's subjective evaluation of their social network. Perceived connectedness is operationalised by measures of a person's sense of belonging, intimacy, dependability, being understood, and whether a person is generally satisfied with their social network (Barrera, 1986; Blazer, 2002). The term 'perceived support' is more commonly used; however, the construct not only embodies an individual's evaluation of enacted or available social support but also their satisfaction with their social networks more generally. Thus 'perceived connectedness' was deemed preferable. *Perceived isolation*, the reverse of perceived connectedness, refers to an individual's negative cognitive appraisal of their social network as being unsatisfactory or inadequate (Cornwell & Waite, 2009).

## **4.2. The Mechanisms Through Which Social Networks Influence Depression**

Not only are social networks multifaceted constructs, the mechanisms through which they influence depression are equally dynamic and ill defined: Social research has been criticised for either not empirically investigating the underlying mechanisms through which social networks result in health outcomes at all, or for focussing exclusively on social support as *the* function of social networks (R. G. Adams & Blieszner, 1994;

Berkman et al., 2000). In an article by Berkman and colleagues (2000), the authors present a model to clarify the mechanisms through which social networks influence health (see Figure 3). This model categorises the numerous functions of social networks on health under four psychosocial functions: Social support, social interactions, social influence, and access to resources. They propose that these four functions each influence health via psychological, physiological, or health behavioural pathways.

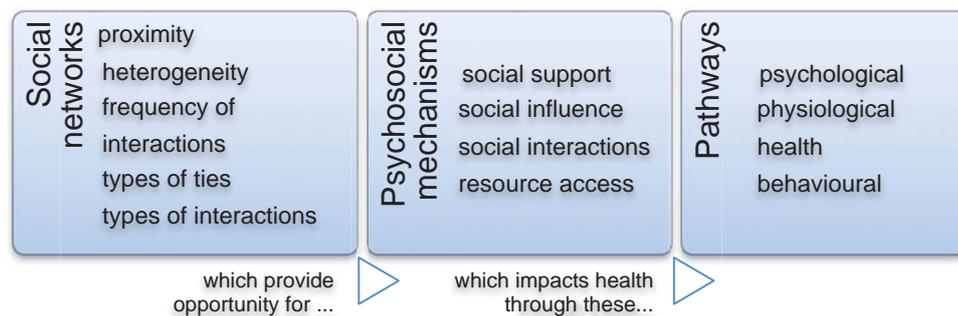


Figure 3. Social networks and the mechanisms by which they influence depression. Adapted from "From Social Integration to Health: Durkheim in the New Millennium" by L. F. Berkman, T. Glass, I. Brissette, and T. E. Seeman, 2000, *Social Science and Medicine*, 51, p. 847.

In terms of depressive symptoms, an example of physiological pathways would be social networks providing nurturance (resource access), task-orientated assistance (social support), and protective endocrine responses triggered by social interactions (Berkman et al., 2000; Blazer, 2002). Health behavioural pathways could include social influence encouraging physical and cognitive exercise, medication adherence, or a healthy diet (e.g. Greaves & Farbus, 2006). In terms of psychological pathways, social networks can act protectively against depression by, for example, promoting a sense of meaning and belonging, ensuring one feels valued and emotionally supported, and buffering the effect of stress (Berkman et al., 2000; Blazer, 2002; Cohen & Wills, 1985). Such pathways could act against biological and environmental stressors that act to form depressive cognitive schema in the first place (stage 1 in Figure 1) or buffer against a stressor that

could potentially activate negative schema (stage 2 in Figure 1).

**The role of perceived support.**

Intuitively, one would expect that the psychological benefits associated with feeling valued, supported, and listened to, or in the case of perceived isolation, psychological harms associated with feeling isolated would be influenced by an individuals' perceived level of connectedness (Blazer, 2002). That is, whether an individual attributes their social network as integrated or isolated is likely to facilitate whether or not a structurally integrated network results in psychological benefits. This implies that perceived connectedness *mediates* the psychological pathways through which social networks influence depression (see Figure 4).

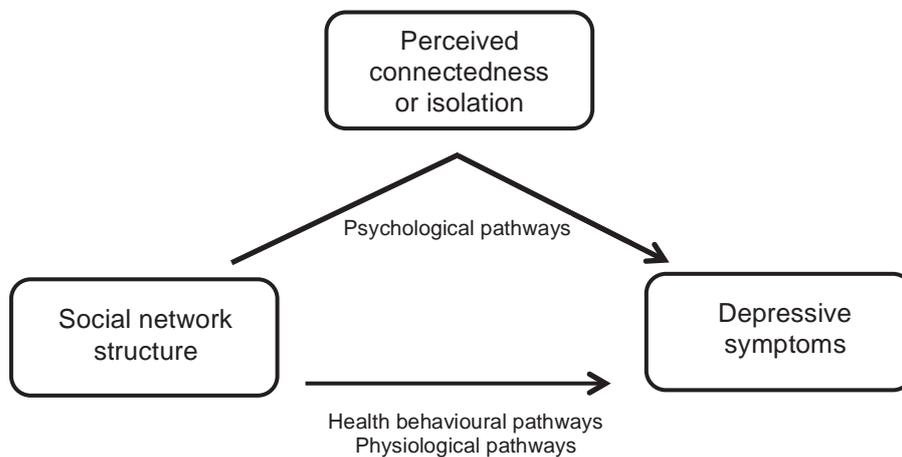


Figure 4. Hypothesised partial mediation of perceived connectedness on the pathway relationship between social network structure and depressive symptoms

The idea that someone's perceptions influence his or her emotional responses is not new: The Greek philosopher Epictetus from 121-180CE has been quoted stating that “Men are not moved by things, but by the view they take of them.” (Hoffmann, 2012, p. 4). As prior-mentioned in Chapter 3, Cognitive Theory argues that our cognitive appraisals (i.e. perceptions) of things strongly influence our emotional responses and can be core to the etiology of mental disorder such as depression (Hoffmann, 2012). In the context of depressive symptoms, perceived isolation could play a role in the etiology of depression by being an adverse condition that contributes to the

formation or activation of negative cognitive schema, the emotional effect of which leads to depressive symptoms (see Figure 1). Similarly, perceived connectedness could protect against formation or activation of negative cognitive schema, both directly by providing experiences inconsistent with negative schema (e.g. promoting feelings of being valued, fulfilling attachment needs) and by buffering the effect of potential etiological stressors (e.g. feeling supported in the context of a bereavement) (Bowlby, 1969; Cohen & Wills, 1985).

The inclusion of perceived connectedness in the study of social networks and depression acknowledges that the relationship between social variables is not entirely a matter of the social network shaping the individual but that the individuals' interaction with network features can determine the effect on his or her health (Cornwell & Waite, 2009; Moren-Cross & Lin, 2005). Unfortunately, as will be discussed in Section 4.4, the relationship between structural social integration or isolation, perceived connectedness or disconnectedness, and depressive symptoms remains to be empirically determined.

### **4.3. Research Findings: Structural Social Integration and Depression in Later Life**

Research on the relationship between social integration and depression to date has generally either examined the impact of structural social integration (or isolation) as a whole construct, or investigated the effect of a specific component of social networks such as social network size or frequency of interactions. The following subsections describe research findings from this body of research and highlight the need for research that synthesises the two approaches by investigating within the same study both social networks as a whole and the relative impact of individual components of social networks on depressive symptoms among older people. Individual components that are discussed are; social network size, different types of social ties, diversity of social ties, different types of social interactions, and frequency of social interactions.

### **Social networks and their composite effect on depression.**

In the past decade, most research assessing the impact of structural social integration or isolation on depression among older people has clustered participants into network types. Network types are classified as structurally isolated or integrated according to composite measures of structural features such as the number and kind of social ties (e.g. spouse, friends, community groups, family) and the frequency of social interactions with those ties. For instance, Wenger (1991; 1997) developed five network types based on observational and experimental findings from older adults in the United Kingdom; locally integrated, wider-community focussed, local self-contained, local family-dependent and private-restricted. These network types, described in Table 1, were defined by the diversity of social ties, the proximity of social ties, and the frequency of social interactions with these ties.

Wenger (1997) proposed that each network type represented unique risks for depression. Those individuals who were socially connected, that is, who had diverse networks involving frequent interactions with a relatively broad range of ties (i.e. locally integrated), were argued to have the lowest risk of depression. Similarly, those who were more socially disconnected, characterised by restricted networks involving fewer social interactions with smaller numbers of social ties (i.e. private-restricted), were argued to be at the highest risk. Wenger (1997) also highlighted that in the context of less diverse networks (i.e. all but the locally integrated type); depression risk would be exacerbated when individuals experienced high functional dependency because fewer social ties would be available to provide care and support. A number of network typology studies like Wenger's, that have been conducted across various cultures, have consistently reported that the majority of older adults are structurally socially integrated and that belonging to a socially integrated network type is associated with reduced risk of depression relative to those belonging to socially isolated networks (K. B. Adams, Sanders, & Auth, 2004; Cacioppo et al., 2010; Chan, Malhotra, Malhotra, & Østbye, 2011; Cheng, Lee, Chan, Leung, & Lee, 2009; Doubova et al., 2010; Fiori et al., 2006; Fiori, Smith, & Antonucci, 2007; Golden, Conroy, & Lawlor, 2009; Golden, Conroy, Bruce et al.,

Table 1

## Wenger's Older Adult Social Network Types

<b>Network type</b>	<b>Network characteristics</b>	<b>Network risk</b>
Locally integrated	Interactions with local community, including family, friends, and neighbours  Some involvement in community groups  Local relatives usually provide informal care, with support from other network members	Lowest levels of risk
Wider community focussed	Interactions with friends and community groups. Absence of local family  High levels of involvement in community  Friends provide emotional support and care. Distant family may provide short-term care	Risks associated with high functional dependency (friends may withdraw)
Local self-contained	Some interactions with neighbours and minimal interactions with non-local family  Low levels of involvement in community  Neighbours may provide short term care	Risks associated with high functional dependency (neighbours and family provide short-term minimal care)
Local family dependent	Interactions with family, especially family member/s living in close proximity  Low levels of involvement in community  Support provided by close relative/s	Risks associated with high functional dependency (caregiving burden on family, feelings of being a burden)
Private restricted	Little contact with family or friends Absence of local family  Low levels of involvement in community  No sources of informal support	Highest risk of isolation and depression

*Note.* Adapted from "Social networks and the prediction of elderly people at risk" by G. C. Wenger, 1997, *Aging and Mental Health*, 1, p. 316-318. Copyright 1997 by Carfax.

2009; Litwin & Shiovitz-Ezra, 2010; Schwarzbach et al., 2013; Sicotte, Alvarado, León, & Zunzunegui, 2008).

### **Specific social network components and their effect on depression.**

Network typology research to date has not investigated whether specific features of social network structure drive the association between structural social integration and depressive symptoms. A body of research, which is discussed in the following subsections, has investigated the relationship between specific social network components and depression among older people and suggests that some, such as social network size and contact with family, are less important relative to others. However, research on specific network components has tended to examine their individual effect on depression without taking into consideration the relative effect of others. Knowledge of whether certain features of social networks are of more importance relative to others in the context of depression among older people would help ensure that efforts to utilise the protective potential of social networks are aimed at the most influential elements.

#### ***Social network size.***

Generally, research has found older adults' social networks to be smaller in size relative to their younger adulthood (Johnson, 2005; Litwin, 1996a; Schnittker, 2007). Most studies find the average number of reported social ties to be between 3 and 7 (Bowling, 1994; Cornwell & Waite, 2009; Koopman-Boyden & Waldegrave, 2009b; Wenger, 1991). Research has indicated that social network size is unrelated to depressive symptoms among older people (Schnittker, 2007; Voils et al., 2007). Despite having smaller networks, older adults have similar if not lower depression prevalence rates compared to younger adults (see Section 3.3). Although a review of the literature revealed no New Zealand studies that have examined the relationship between depression and social network size, Koopman-Boyden and Waldegrave (2009a) found that the number of social ties did not significantly predict well-being among a large sample of older New Zealanders.

Socioemotional Selectivity Theory argues, with empirical support,

that having smaller social networks does not pose a risk to older adults' emotional wellbeing because their smaller networks are a result of a tendency to actively prune peripheral social ties in favour of a smaller number of close, emotionally rewarding ones (Carstensen, 1992, 1995; Lang & Carstensen, 1994). The theory proposes that this is because as we age, we become increasingly aware of our shorter futures and consequently prioritise emotional goals (Carstensen, 1995; Lang & Carstensen, 1994). Support for Socioemotional Selectivity Theory comes from research findings that reductions to older people's networks predominately occur in peripheral (i.e. not emotionally close) social ties and that, despite having smaller networks, older adults tend to report higher levels of satisfaction with their social networks than younger adults (Lang & Carstensen, 1994; Lansford, Sherman, & Antonucci, 1998; Luong et al., 2010). Furthermore, although older adults are especially vulnerable to loss of close ties (e.g. death of a spouse) the number of close confidants has been found to be stable in later life, suggesting that older adults are particularly resourceful with the social ties that are available to them (Schnittker, 2007).

### ***Types of social ties.***

#### *Friendship versus family ties.*

Interestingly, in addition to those who are socially isolated those with whom contact is predominately with family members are frequently reported to be at greater risk of depression relative to those who have more contact with non-family ties (Chao, 2011; Doubova et al., 2010; Fiori et al., 2006; Golden, Conroy, & Lawlor, 2009; Litwin & Shiovitz-Ezra, 2010). Why contact with family, which intuitively appears to be an integral part of older peoples social networks, predicts increased depression risk remains to be confirmed.

There is some empirical support for the notion that family contact is an unimportant predictor of depression relative to non-family contact: A study of over 1,300 older people in Ireland by Golden, Conroy, and Lawlor (2009) found that family ties did not predict depression whereas contact with non-family ties did. However, this seems contrary to the widely accepted notion that family are integral to the well-being of older people. Families tend to provide the most help with activities of daily living, the

most support during illness, and the most social contact for older people (Bowling, 1994; Ramos, 2001; Wenger, 1991). A study of older New Zealanders found that participants considered their adult children, grandchildren and partners to be their most important social ties, who provide more social interactions and emotional and instrumental support relative to when they were younger (Koopman-Boyden & Waldegrave, 2009b; Ministry of Social Development, 2007; Stephens, 2008).

One possible explanation is that family-dominated networks lack non-family ties and that it is the absence of non-family ties rather than the unimportance of family ties that results in increased risk for those with family-orientated social networks. In support of this, two network typology studies found that the combination of family and non-family ties was associated with the lowest risk relative to those whose networks are dominated by either type of tie alone (Cheng et al., 2009; Doubova et al., 2010). Some argue that friendship ties are more important to the well-being of older adults than family ties (e.g. R. G. Adams, 1986; O'Connor, 1995; Pinquart & Sorensen, 2001). Pinquart and Sorensen (2001) note that friendships are voluntary and more likely to be reciprocal compared to family relationships which are structurally determined, can be characterised by obligatory interactions, and often involve care responsibilities. In cultures where adult children do not typically live with their older parents, friends and neighbours can represent important daily contacts, and can provide companionship and support when unexpected needs arrive that distal family are not able to provide for (Lee & Ishii-Kuntz, 1987; Pinquart & Sorensen, 2001; Wenger, 1991).

Another possible explanation is that those with family-dominated networks are more likely to be experiencing functional disability, which itself is strongly associated with depression risk (Doubova et al., 2010; Litwin & Shiovitz-Ezra, 2011; Wenger, 1991). Generally, family members are more likely than friends to provide instrumental support whereas friends are more likely to provide emotional support (Adams & Blieszner, 1994a; Bowling, 1994; Wenger, 1997). In times of higher need for instrumental support, friends and neighbours can withdraw and functional disability can limit the interactions one would normally have with them (Wenger, 1997).

Thus, older adults with high levels of functional disability are more likely to belong to family-focussed networks and could be at greater risk to depression due to the stress of functional decline, receipt of instrumental support, lost emotional support from friends, and resulting isolation from their community. In support of this, Fiori et al. (2007) found that older people with friend-focused networks but who *did* receive above average amounts of instrumental support were more likely to be depressed than those who did not. Many studies on the effect of friendship versus family ties have not controlled for functional disability.

It is also possible that the importance of family relationships varies in cultures where close relationships with adult children, such as cohabitation, is more of a cultural normality and can serve different functions, (Nemoto, 1998; Taylor et al., 2004). Indeed, findings emphasising the importance of friendships relative to family ties have been predominately from Western countries. Studies in Brazil, China, Cuba, and Spain have emphasised close contact with family members as an important predictor for older adults mental health, though depression specifically has not been examined in detail (Cheng et al., 2009; Ramos & Wilmoth, 2003; Sicotte et al., 2008; Zunzunegui, Béland, & Otero, 2001).

Overall, further research is needed to determine the relationship between family versus friend ties after controlling for functional disability. Research is also needed to investigate the effect of contact with grandchildren on depression risk, which appears to be absent in the literature. It is also not yet known whether older New Zealanders generally or older New Zealand Māori would mimic findings from other Western countries rather than non-Western countries who tend to find family contact to be relatively more important.

#### *Spouse ties.*

Being married (or living with a spouse) is consistently associated with lower risk of depression in older adult populations (Anstey et al., 2007; Djernes, 2006; Hong, Hasche, & Bowland, 2009), including in studies in Australia (Vanderhorst & McLaren, 2005), Brazil (Ramos & Wilmoth, 2003), China (Chao, 2011), and Spain (Zunzunegui et al., 2005). This relationship is reportedly longitudinal: Hong et al. (2009) found that being unmarried was

associated with significant increases in depressive symptoms over a six year period. Older New Zealanders who live with a partner have reported a higher level of wellbeing than older people living alone (divorced or widowed) or with others (Koopman-Boyden & Waldegrave, 2009a).

An older person's relationship with their spouse tends to be their strongest bond and is thought to fulfil basic and universal human needs, providing companionship, a likely confidant, and greater economic resources (Koopman-Boyden & Waldegrave, 2009a; Stroebe, Stroebe, Abakoumkin, & Schut, 1996). In addition, older people who are not married are more likely than not to be widowed, and widowhood is a risk factor for depression (Djernes, 2006). Being unmarried in older age can therefore indicate both the absence of the protective factor of having a spouse, and the presence of the risk factor of having gone through loss of a spouse.

#### *Community ties.*

Research suggests that older people who have community ties may find them rewarding; yet a significant proportion have little or no community ties. A study of older New Zealanders, for instance, found that 47% and 36% of those surveyed identified that their social networks orientated around community activities of hobbies and church respectively (Ministry of Social Development, 2007). Yet, a quarter of a large sample of older New Zealanders indicated that they were not participants of any community organisation, and another quarter were a member of only one (Koopman-Boyden & Waldegrave, 2009b). Similarly, in a study of older people living in Mexico, only 13% reported being members of community groups.

Group activities may be particularly helpful to older people in the context of a shift in roles, such as a movement away from being in paid employment and raising children to being retired and living alone. They may promote feelings of productivity and self-expression which have been identified as important to older people (Krause, 2005). Among New Zealand Māori, community activities may be particularly important, as the Kaumātua (respected older man or older woman) role often involves responsibilities and engagement in marae activities that are an integral part of Māori cultural identity (Waldegrave, 2009; Walden, 2004). A study of over 400 older Māori found that around two thirds reported engagement in marae

activities and around a third identified the marae and hui as key places where they spoke the Māori language (Walden, 2004).

Participating in community activities and membership with community groups, such as religious, cultural, and volunteer organisations are frequently associated with reduced risk of depression (Braam, Beekman, Tilburg, Deeg, & Tilburg, 1997; Doubova et al., 2010; Dulin, Gavala, Stephens, Kostick, & McDonald, 2012; Hong et al., 2009; Kim & Pai, 2009). Unfortunately however, most research investigating community ties tend to focus on one type of community involvement (e.g. church attendance, volunteering), and typology studies which do often include a measure of community ties do not investigate the impact of this separately from structural social integration as a whole. A general effect of community participation on depression among older people does not seem to have been established.

#### *Diversity of social ties.*

Those older adults who have more diverse social networks made up of numerous types of social ties are found to be less at risk for depression (Cheng et al., 2009; Doubova et al., 2010; Fiori et al., 2006, 2007; Golden, Conroy, & Lawlor, 2009; Golden, Conroy, Bruce, et al., 2009; Litwin & Shiovitz-Ezra, 2010; Sicotte et al., 2008). This is thought to be because diverse networks offer a variety of sources for social support (Fiori et al., 2007; Wenger, 1997). Wenger (1997), for instance, proposed that those with less diverse social networks may be at greater risk for depression with the occurrence of functional disability, because their limited available supports might withdraw and reliance on a small number of people for support could damage the older person's morale. One could add that in addition to social support, diverse networks also provide more opportunity for other psychosocial mechanisms through which social networks are thought to influence depression.

#### *Types of social interactions.*

Activity theory argues that different activities have differential effects on well-being (Lemon, Bengtson, & Peterson, 1972). Given the pathways through which social networks might influence depression (i.e. health behavioural, physiological, psychological), exercising with friends

intuitively would appear to produce greater benefits than simply watching television with friends, for example. Unfortunately, few studies have compared the impact of different types of social interactions on depression among older adults, especially in the context of other subcomponents of social networks and after controlling for important potential confounders such as functional disability.

One longitudinal study in the United States reported that specific activities did not predict depression risk and that it was the level of engagement (i.e. frequency of social interactions) that was important (Glass, Mendes de Leon, Shari, & Berkman, 2006). However, other studies have linked specific activities such as talking on the phone, volunteering, exercising with others, and attending both religious and nonreligious community events to lower levels of depression (Golden, Conroy, & Lawlor, 2009; Hong et al., 2009). In contrast to most other types of interactions, receipt of instrumental support has been associated with increased depression risk, especially when that individual has a relatively isolated social network (Fiori et al., 2006).

The differential effect of social interactions by face-to-face compared to non-face-to-face (e.g. mail, phone, email) on depression has not yet been determined. This would be of interest, especially given that adult children and grandchildren often do not live in close proximity to their older parents or grandparents, and that half of older adults have been reported to have the combination of face-to-face interaction and phone interaction as their main means of social interactions (Koopman-Boyden & Waldegrave, 2009b). Communication with ties by email will increasingly become a type of non-face-to-face social interaction among older people: In 2006, half of older New Zealanders between 65 and 74 years old reportedly lived in a house with internet access, more than double that reported in 2001 (Ministry of Social Development, 2010).

#### ***Frequency of social interactions.***

There is a consensus in the literature that, although social activity can decrease slightly with age, generally older adults continue to engage in regular social interactions. For example, the proportion of older New Zealanders having contact with their close family or friends on a daily basis

has been reported to be between 41 and 55% (Koopman-Boyden & Waldegrave, 2009b; Petrie, 2006). Over a third of older participants in the Enhancing Wellbeing in an Ageing Society (EWAS) survey reported having social interactions several times per week (Koopman-Boyden & Waldegrave, 2009b). Although the majority of older adults appear to be socially engaged, a small but significant proportion report much less frequent contact. For instance, out of participants of the EWAS survey, 14% reported having social interactions only once a week and 3% reported having none at all (Koopman-Boyden & Waldegrave, 2009b).

Frequency of social interactions is rarely examined in the context of late life depression. Like other subcomponents of social network structure, it predominantly tends to be measured as part of a composite measure of social integration. Significant variability in how frequency of interactions is measured also makes comparison of studies difficult. Nevertheless, a small number of studies have found that older adults who report higher frequencies of social interactions tend to have lower levels of depression, including up to six years later (Glass et al., 2006; Hong et al., 2009; van der Pas & Koopman-Boyden, 2009). Further support for the significance of social interaction frequency comes from success in studies using social activity participation in the treatment of late life depression (e.g. Bell, 2011; Greaves & Farbus, 2006; though see Findlay, 2003). For example, a qualitative study reported that a weekly social activity programme effectively reduced depression levels of community-dwelling older adults at risk of institutionalisation (Bell, 2011).

***Structural sub-components of social networks: Concluding Comments.***

Overall, it appears that diverse social networks involving at least moderate levels of social interaction are associated with reduced risk of depression among community-dwelling older adults, whereas social network size (i.e. the number of social ties) in and of itself may not be of great importance. Having a spouse can also act as a protective factor. It is possible that, at least in Western cultures, non-family social ties are an important protective factor relative to family ties, though further research is needed to clarify this relationship (e.g. after controlling for functional ability).

It remains to be investigated whether contact with social ties over the phone has a similar effect to face-to-face contact, which is relevant in a society where family are less likely to live close by and technologies are more widely used as a mode of communication. Research is also needed to investigate contact with grandchildren as potentially important. Also, no studies were found to have investigated the relationship between social integration and depression among New Zealand populations.

Finally, longitudinal investigations of the relationship between social integration and depression are lacking. There is preliminary evidence that increased levels of social interactions predict depression up to 14 years later (Chao, 2011; Glass et al., 2006; Hong et al., 2009). However, in order to understand the longitudinal relationship between social integration and depressive symptoms, further research is needed that investigates social integration as a whole construct and the strength of its predictive effect over time after controlling for important confounders such as functional disability.

#### **Reciprocity between depression and social networks.**

It is important to acknowledge that the mechanisms through which social networks influence depression are not necessarily one-way. Those experiencing depressive symptoms can be less inclined to engage socially with others and might be less appealing to their social ties (Barrera, 1986; Fiske et al., 2009). This could lead to social isolation in the form of reduced social interactions, fewer social ties, poorer quality of relationships, and limited access to social support. Obviously, the best way for research to account for a potentially reciprocal relationship is to ensure longitudinal data in which depression and social network related measures are regularly recorded and the reciprocity examined and accounted for. However, this is not always possible. What is encouraging to research on social influences of depression though, are findings from the few existing longitudinal studies that social network variables are stronger predictors of depression in later life than the other way around (in fact depressive symptomology has tended to not be a significant predictor of social network variables; Cacioppo et al., 2010; Maher, Mora, & Leventhal, 2006; Ramos, 2001). This suggests that, although depression may influence social networks and their functions, this

influence appears to be minimal in studies with older adult participants.

#### **4.4. Research Findings: Perceived Connectedness and Depression in Later Life**

This subsection describes research on the relationship between perceived connectedness, structural social integration, and depression and highlights the need for research to investigate perceived connectedness and structural social integration consecutively, so that the relationship between these two constructs can be empirically clarified.

Research has found that older people tend to be more satisfied with their social networks relative to younger adults, with the large majority perceiving themselves as connected (Schnittker, 2007). The Enhancing Wellbeing in an Ageing Society survey reported that in New Zealand, for instance, over 95% of older adult participants said that they were satisfied with their social networks (Koopman-Boyden & Waldegrave, 2009b). As one would expect, perceived connectedness among older adults has clearly been linked to decreased risk of depression in later life, whereas perceived isolation is associated with increased risk (Cacioppo et al., 2010, 2006; Chao, 2011; Cornwell & Waite, 2009; Doubova et al., 2010; Dupertuis, Aldwin, & Bosse, 2001; Fiori et al., 2006, 2007). This relationship appears to hold longitudinally, with perceived connectedness found to predict depression up to ten years later (Cacioppo et al., 2006; Heikkinen & Kauppinen, 2004; Hong et al., 2009; Tiikkainen & Heikkinen, 2005).

##### **Perceived connectedness and structural social integration.**

Perceived isolation and structural social isolation are distinct constructs that are particularly decoupled in older populations (Cornwell & Waite, 2009; Schnittker, 2007). Even those who have been structurally defined as socially isolated tend to report perceived connectedness rather than disconnectedness (Cornwell & Waite, 2009; Schnittker, 2007). The correlation between objective social isolation and perceived isolation has been reported to be only weak to moderate in strength (e.g.  $r = .25$ ,  $p < .001$ ; Fiori et al., 2007).

This disjunction between objective and subjectively defined social isolation is thought to be both because older people are more likely to perceive their networks positively irrespective of structural features of their

social networks, and because structural features do not indicate the quality of social relationships that tend to improve in older age. Research has indicated a positivity bias among older people in which they are more likely to view interpersonal relationships favourably (Charles, 2010). For example, compared to younger adults, older people have been shown to attend more to positive interpersonal events (Luong et al., 2010) and to be less likely to report feelings of anger following an interpersonal conflict (Birditt & Fingerman, 2003). This interpersonal positivity bias is thought to be a protective emotion regulation strategy (i.e. in addition to other protective strengths mentioned in section 3.4) that occurs in later life because with age older people become more skilful in engaging in these strategies (Charles, 2011), are more motivated to engage in them due to prioritising emotional well-being (as per socioemotional selectivity theory, Carstensen et al., 2003), and have shifted expectations as a means to cope with inevitable disruptions and loss that will occur to their social network (Rook, 2009; Schnittker, 2007).

In addition to a tendency for older people to perceive networks more positively, it is probable that measures of perceived connectedness capture the actual quality of interactions. Measures of structural integration are probably not good indicators of quality of social ties as older people may appear to be socially isolated relative to younger adults (e.g. fewer social ties, fewer social interactions) but their social ties have a tendency to be more emotionally rewarding. That is, measures of perceived connectedness but not structural integration are likely to capture actual improvements in quality of social ties with age. These differences are thought to arise out of the prioritisation of emotionally rewarding ties (and avoidance of emotionally unrewarding ones), accurate selection of social ties that will be emotionally rewarding, and strengths in interpersonal skills (Charles, 2010) thought to occur in older age. It has further been suggested that older adults' social partners facilitate higher quality social interactions by treating them more favourably in light of the older persons' advancing age (Fingerman & Charles, 2010). Thus, even if they are objectively defined as socially isolated because of having small numbers of social ties and interactions, actual and perceived higher quality relationships that older peoples tend to

possess will lead to greater levels of reported perceived connectedness relative to younger adults.

**The relationship between perceived connectedness, social integration and depression.**

One of the limitations to current understandings of the relationship between objective and subjective components of social isolation and depression stems from the fact that very little research has investigated the two components within the same study. Cornwell and Waite (2009) note a tendency for sociological research to focus on structural social integration and for psychological research to focus on perceived connectedness, with very little research investigating the effects of both on health simultaneously. Clearly, such research is warranted in the investigation of late life depression, as it could clarify the relationship between the two components and indicate whether one is a better target for interventions.

Overall, research has indicated that perceived connectedness is a stronger predictor of depression among older adults than social network size, frequency of social interactions, being married, or levels of received or provided social support (Chao, 2011; Cornman, Goldman, Gleib, Weinstein, & Chang, 2003; Dupertuis et al., 2001). However, these studies were examining only specific features of social networks or social support as one function of social networks, rather than the relationship between social integration as a whole construct, perceived connectedness and depressive symptoms. Nevertheless, the relative importance of perceived connectedness in determining depression risk supports the hypothesis that it facilitates the psychological pathways through which social network structure is thought to influence health (Berkman et al., 2000).

Only three studies were found that had investigated the relationship between structural social integration and perceived connectedness on depression among older adults within the same study (Cornwell & Waite, 2009; Fiori et al., 2006; Litwin, 2011). One, by Fiori et al. (2006) was a network typology study. They found that the relationship between social network type and depressive symptoms was partially mediated by perceived connectedness. Unfortunately, as it was a network typology study, mediation analyses were based on comparing each network type to the most

socially isolated network type, rather than looking at whether perceived connectedness mediated the effect of increasing levels of structural social integration on depressive symptoms. The second study, by Cornwell and Waite (2009), also found preliminary support for a mediation effect of perceived connectedness and, unlike the other study, were looking at a composite indicator of levels of structural social integration. They found that the relationship between structural social integration and depressive symptoms declined to non-significance with the inclusion of a measure of perceived connectedness. Unfortunately the authors did not investigate this further with a formal mediation analysis. Conversely, a network typology study by Litwin (2011) found that indicators of perceived connectedness were insignificant predictors of depression whereas having an isolated social network type was associated with increased risk of depression. However, Litwin (2011) examined perceived connectedness with family, friendship, and partner ties individually. Given that older people are thought to be flexible and evaluate their social networks positively overall, it may be that perceiving a particular aspect of social networks negatively does not impact depression, but that one's overall level of perceived connectedness does.

#### **Perceived connectedness and depression as distinct components.**

Given the cognitive nature of depression, those who are depressed may also be more likely to perceive their social networks negatively (Barrera, 1986). This raises the need for longitudinal studies when examining the relationship between perceived connectedness and depression, to ensure that perceived connectedness is indeed resulting in reduced levels of depression rather than lack of depressive symptoms simply correlating with more positive perceptions of social networks. Nevertheless, research has indicated that perceived connectedness and depression are not the same constructs: A significant proportion of those who perceive their networks as isolated are not depressed and vice versa. For example, Adams et al.'s (2004) study of over 200 older adults living in a United States independent living facility found that of those who reported the highest degrees of perceived isolation just over half were depressed. Cacioppo et al. (2010) also found that the relationship between perceived isolation and depression was not explained by general negativity.

#### **4.5. Concluding Comments and the Need for Further Research.**

Social networks offer opportunity for psychosocial mechanisms, such as social support and social interactions, which can act protectively against depression via physiological, health behavioural, and psychological pathways. Similarly, the lack of these psychosocial mechanisms in the form of structural social isolation can increase depression risk. Due to the influence of attributions on psychological mechanisms of social networks, one's perceived level of connectedness probably mediates the psychological pathways through which social networks act protectively against depressive symptoms.

Social network typology research has established that those who are structurally socially integrated, as indicated by individuals' social network structure, are at significantly lower risk for depression relative to those who are structurally socially isolated. However, whether or not certain features of social networks drive this association is yet to be established. A body of research has examined specific features of social networks and their influence on depression among older people. These studies have examined individual features, so their impact relative to other social network components is not yet clear. However, they have provided clues as to whether certain social network features used to define social integration are especially significant or unimportant when it comes to depression among older adults: Having frequent social interactions with a range of social ties and being married appear to be important predictors of depressive symptoms in studies of older adults. On the other hand, social network size does not appear to be important. This is thought to be because of a tendency for older people to have small but emotionally rewarding social networks because they facilitate especially emotionally fulfilling relationships and perceive their relationships more positively. It is also possible that contact with family is less important relative to contact with non-family ties, though findings of the relative unimportance of family ties may be confounded by functional disability or having few non-family ties. The relative influence of types of interactions, such as face-to-face versus non-face-to-face contact, also remains to be explored.

Structural social integration and perceived connectedness are rarely examined within the same study. This makes for a disjointed understanding of the relationship between the two and a consequent lack of empirical evidence for the proposed mediation effect of perceived connectedness on the psychological pathways of social networks on depression. Further research is needed to develop current understanding of the relationship between these two components and depressive symptoms among older people, as this would be relevant for intervention and prevention efforts.

Another limitation throughout the literature is the fact that most studies to date have been cross-sectional in design. Longitudinal research is needed to ensure that the direction of the relationship between social isolation and depression is clear. Longitudinal research could also help establish whether social isolation changes the course of depressive symptoms over time. The only longitudinal study that could be sourced for this review that had examined both structural aspects of social isolation and perceived connectedness was by Cacioppo, Hawkley, and Thisted (2010). These researchers tracked older adults over five years and found that perceived isolation predicted depression independent of objective measures of social isolation (social support and social network size). However, the sample size of this study was relatively small ( $N = 229$ ), sample participants were relatively young (50-68 years), and they did not examine for an interactive relationship between structural social integration and perceived connectedness on depression (e.g. testing for mediation).

A final comment on the need for future research relates to the absence of research in this area that has been conducted in New Zealand. No studies could be sourced that investigated the relationship between social integration and depression among either older New Zealanders generally or older Māori. A better understanding of this could both highlight important differences relative to social networks overseas, which could in turn help inform national prevention and treatment efforts, as well as demonstrate similarities that could support generalisability of existing social network research findings.

It is the purpose of the present study to extend understanding of the relationship between depression and social networks among older adults by

addressing gaps identified in the existing literature. This includes 1) investigating both social integration and perceived connectedness within the same study, 2) examining the impact of the various subcomponents of social network structure individually and in combination (in order to clarify relative importance to depression among older people) 3) controlling for the impact of important potential confounders such as functional ability, and 4) using longitudinal data from a large sample of older adults living in New Zealand, including a sub-sample of New Zealand Māori.

## **Chapter 5: The Present Research**

The present study examines the relationship between depression and social integration, as indicated by objective features of individuals' social networks and their perceived connectedness to their network, among a large sample of older New Zealanders. Analyses are both cross-sectional, by investigating baseline depression and social network variables, and prospective, by considering changes in depression from baseline to 18- and 36-month follow-up in the context of baseline social network variables.

### **5.1. Aims**

Previous chapters described depression in later life as a complex health problem in which older peoples' social networks are thought to play a key role. The general aim of this study is to contribute to current knowledge of depression among older people by exploring the relationship between social network variables and depressive symptoms among community-dwelling older adults living in New Zealand. Specifically, this thesis aims to improve current understanding around which features of older peoples' social network structure are particularly influential in terms of depression, to clarify the extent to which an individual's subjective evaluation of their social networks influences the effect of social network structure on depression, and to examine for further longitudinal evidence of the relationship between social networks and depression. The present study also has the opportunity to describe the social networks and depression prevalence of older people in New Zealand, including older Māori, of which there is limited availability of existing research. In addition to being included in the general sample, Māori data is investigated separately. This is because; a) understanding Māori health is a national priority given evident health inequality (Robson & Harris, 2007) and b) due to the small number of older Māori in the context of higher fertility and much higher mortality rates relative to the general population, data from the sample of older Māori used in the present study are especially unique and valuable for this purpose.

## 5.2 Research Questions

- 1) Which structural components of social networks have an influence on depression among community dwelling older people, and to what extent?
- 2) What is the significance of social network structure and perceived connectedness for depression
  - a) cross-sectionally?
  - b) in terms of predicting change in depression over time?
- 3) Does perceived connectedness partially mediate the relationship between social networks and depression?

## 5.3. Hypotheses

- 1) **Subcomponents of social network structure will differentially contribute to depression.**

As outlined in Section 4.3, being married, community ties, and having frequent social interactions have all been suggested by the literature to be important predictors of depression among community-dwelling older people, whereas research has suggested contact with family versus non-family ties and social network size may not be important predictors. Given that few to no studies have examined these various subcomponents of social network structure simultaneously, there is no specific expectation about the importance of these relative to one another in the context of depression scores. One exception is the number of social ties, which is expected to be the least important component of social networks. In addition, the disjunction between the common belief that family are important for the wellbeing of older people and research findings that family ties do not predict reduced depression risk is expected to be clarified: It is expected that contact with family (children or grandchildren) will have a greater impact on depression once the absence of non-family ties and functional disability (i.e. indicating the need for instrumental support typically provided by family) are controlled.

2) **Social network structure and perceived connectedness will significantly predict depression but perceived connectedness will be a stronger predictor.**

It is expected that both social network structure and perceived connectedness will predict depression scores, with higher levels associated with lower initial depression scores and decreased probability of depression scores increasing over time. This is expected to be true even after controlling for important demographic and health-related predictors in the general sample.

3) **The relationship between social connectedness and depression will be partially mediated by perceived connectedness.**

Current theoretical understandings of the mechanisms by which social networks are thought to influence health suggest that social network structure could protect against depression via psychological, health behavioural and physiological pathways (Berkman et al., 2000). The psychological pathways through which social network structure can benefit depression is thought to depend on the attributions an older person makes about their social networks. It is therefore anticipated that the effect of social network structure on depression will be mediated by perceived connectedness. It is expected that this mediation effect will be partial because health-behavioural and physiological pathways through which social networks could influence depressive symptoms are unrelated to attributions.

## Chapter 6: Methods

This research utilised existing data taken from a large sample of individuals at three waves of measurement; baseline, 18-month follow-up, and 36-month follow-up. The study examined how initial status of depression and within-person trajectories over time varied as a function of individuals' baseline level of social integration.

### 6.1. Participants and Procedure

#### The pre-existing data.

Pre-existing data from the University of Auckland Brief Risk Identification Geriatric Health Tool (BRIGHT) Trial was used. The BRIGHT trial investigated the effectiveness of a GP-sent birthday card questionnaire designed to improve case finding and subsequently reduce disability among older adults. The BRIGHT Trial was a randomised controlled trial. Randomisation (to receive the birthday card questionnaire or care as usual) was at the level of general practice, after practices had been stratified by size. Therefore, individuals were clustered at the general practice level. A telephone interview was administered at baseline (2007/8), 18-month follow-up (2009/2010), and 36-month follow-up (2011/2012). In addition, a self-completion postal questionnaire was completed at baseline.

Depression scores of those who received the birthday card questionnaire did not differ significantly from those in the treatment-as-usual control group across the three measurement points, as measured by the 15-item Geriatric Depression Scale at baseline,  $t(3564) = -1.06, p = .31$ ; 18-month follow-up,  $t(3294) = 1.51, p = .13$ ; and 36-month follow-up,  $t(2920) = 0.46, p = .65$ . Therefore, allocation to the questionnaire was not further considered in the present study.

#### Participants.

Participating general practices were located in Bay of Plenty, Canterbury, and Capital and Coast District Health Board (DHB) regions of New Zealand. Participants were community dwelling older adults aged 65 and over for Māori, and aged 75 and over for non-Māori (at baseline). Subjects

were attending participating general practices and had consented to participate in the BRIGHT Trial study. The younger age criterion for Māori participants was to ensure that the sample of older Māori was large enough, as high fertility and mortality rates mean that Māori are under-represented in older age groups (for instance it was estimated that 4% of the Māori population were over 65 in 2006, 28% of which were aged 75 or over, compared to 12% and 46% of the general population; Statistics New Zealand, 2011; Tang et al., 2007). The BRIGHT Trial did not include participants who were terminally ill, unable to communicate in English, or living in residential care.

In the present study, data from participants categorised as cognitively impaired at baseline, as indicated by a score of 6 or below on the Abbreviated Mental Test Score (AMTS; Hodkinson, 1972), and data from those with baseline scores below 12 on The Nottingham Extended Activities of Daily Living scale (NEADL; Nouri & Lincoln, 1987) were excluded. This was because the population of interest were non-clinical, community-dwelling, relatively independently living older people. As the NEADL does not have official cut-off scores, a score below 12 was chosen because this represented scores that were 3.29 standard deviations or more from the mean. This criterion excludes cases that are statistically significant outliers (Tabachnick & Fidell, 2013) and represent individuals that reported difficulty with 11 or more activities of daily living (i.e. practical outliers). Out of all BRIGHT Trial participants, 3645 met criteria for the present study before the exclusion of outliers.

Table 2 summarises demographic and health-related characteristics of the study sample. The large majority of participants were middle-old (aged between 75 and 84 years), were New Zealand European, had completed high school or a qualification after high school, and reported two or more sources of income. Females outnumbered males by 10% and participants were relatively equally distributed across the three DHB regions. Although considered a social network variable, it is also of demographic interest to note that approximately half of participants were married. As being unmarried correlated very strongly with living alone ( $r = .83, p < .001$ ), living status was not included due to redundancy. In terms of

Table 2

*Descriptive Demographic and Health Variables at Baseline for Participants Included in the Present Study*

Variable	Category	<i>N</i> Missing	% ( <i>N</i> )
Age	65 – 84	6	85 (3091)
	≥ 85		15 (548)
	<i>M</i> ( <i>SD</i> )		80 (4.51)
Gender	Female	0	55 (1996)
	Male		45 (1649)
Ethnicity	New Zealand European	14	75 (2729)
	Other European		17 (632)
	New Zealand Māori		5 (176)
	Other		3 (94)
Educational status	Primary school	142	14 (497)
	High school		46 (1608)
	Post high school		40 (1398)
DHB region	Bay of Plenty	0	32 (1157)
	Capital and Coast		33 (1208)
	Canterbury		35 (1280)
Income sources	None or one	496	27 (865)
	Two or more		73 (2284)
NZDep2006	<i>M</i> ( <i>SD</i> )	133	5 (2.72)
Alcohol use	Daily or almost daily	151	33 (1151)
	Weekly		15 (523)
	Monthly		13 (445)
	Never		39 (1375)
Ever smoked	Yes	397	46 (1506)
	No		54 (1742)
Exercise	Yes	218	48 (1787)
	No		52 (1640)
NEADL	<i>M</i> ( <i>SD</i> )	0	20 (2.10)

*Note.* NEADL = Nottingham Extended Activities of Daily Living Scale

health, the majority reported high levels of independence with activities of daily living (with most reporting difficulties with between none and 4 activities of daily living), approximately half reported that they exercised regularly, over half reported never drinking alcohol or drinking only monthly, and over half reported never having smoked.

Unfortunately, measurement of variables was largely inconsistent with census data. Therefore, it cannot be claimed unequivocally that this sample is representative of all community-dwelling, relatively independently living older people in New Zealand. Statistics New Zealand data suggests a representative sample as least with respect to age, gender, ethnicity, number of income sources, proportion married, and exercise, with the exception of a possible underrepresentation of those who identify with neither Māori nor European ethnicity: Specifically, the 2006 census data reported 80% of older people were between age 65 and 84 compared to 85% in the current sample, the gender distribution was identical (i.e. 55% female), approximately half were also married, an identical proportion (5%) identified as being of Māori ethnicity, and 80% identified as being of European ethnicity (compared to 92% in this sample who identified as either New Zealand European or 'Other European') (Tang, Boddington, & Khawaja, 2007). Earlier data compiled by Statistics New Zealand (2004) reports a similar proportion having no more than one source of income (17% compared to 21%) and reporting regular exercise (38% to just over 50% depending on age bracket, compared to 45%). The distribution of the sample across education categories is also similar to that reported in the Enhancing Wellbeing in an Ageing Society research project ( $N = 1680$ ; Koopman-Boyden & Waldegrave, 2009b, p. 59).

One hundred and seventy-six participants met criteria for the present study and identified as being of Māori ethnicity. Table 3 summarises demographic and health-related characteristics of Māori participants. Again, it is difficult to determine whether the sample is representative because most forms of measurement unfortunately do not marry up to census data. Census data from 2006 indicate that the sample is relatively representative of the older Māori population in terms age proportion (2% 85 years and over compared to 4%), but slightly higher proportion of females (54% female compared to 62% in census) (Tang, Boddington, Khawaja, & New Zealand.

Table 3

*Descriptive Demographic and Health Variables at Baseline for Participants**Included in the Present Study Whom Identified With New Zealand Māori**Ethnicity*

Variable	Category	<i>N</i> Missing	% ( <i>N</i> )
Age	65 – 84	0	98 (173)
	≥ 85		2 (3)
Gender	Female	0	54 (95)
	Male		46 (81)
Educational status	Primary school	11	11 (18)
	High school		51 (84)
	Post high school		38 (63)
DHB region	Bay of Plenty	0	19 (33)
	Capital and Coast		61 (107)
	Canterbury		20 (36)
Income sources	None or one	27	21 (32)
	Two or more		79 (117)
NZDep2006	<i>M (SD)</i>	6	6 (3.01)
Alcohol use	Daily or almost daily	11	14 (23)
	Weekly		15 (24)
	Monthly		19 (31)
	Never		53 (87)
Ever smoked	Yes	21	43 (66)
	No		57 (89)
Exercise	Yes	14	45 (73)
	No		55 (89)
NEADL	<i>M (SD)</i>	0	20 (2.16)

*Note.* NEADL = Nottingham Extended Activities of Daily Living Scale

Statistics New Zealand, 2007). A study of more than 400 older Māori aged 60 and over in 2004 reported a higher number having ever smoked (70% compared to 43%) but an almost identical proportion that did not drink alcohol (54% compared to 53%) (Walden, 2004).

### **Ethics.**

The current research obtained ethics approval from the New Zealand Ministry of Health Multi-region Ethics Committee (MEC/12/EXP/019) and the Massey University Human Ethics Committee: Northern (MUHECN 11/062).

## 6.2. Measures

### **Depression.**

Depression was operationalised using the 15-item Geriatric Depression Scale (GDS-15), which was administered at baseline, 18-month follow-up, and 36-month follow-up as part of the BRIGHT Trial computer-assisted telephone interviews. A copy of the GDS-15 (hereon referred to as GDS) as it was included in the BRIGHT questionnaires is provided in Appendix A. The GDS is a 15 item, *yes-no* format questionnaire asking about symptoms experienced in the past week. It was developed by Sheikh and Yesavage (1986) based on the original 30-item scale (Yesavage et al., 1982). A major advantage of the GDS is that it is specifically designed for use with older people (Sharp & Lipsky, 2002). For example, it contains fewer questions about somatic symptoms, which is helpful given frequent symptom overlap with medical illness.

The GDS is a widely used measure that has been validated in community populations (Watson & Pignone, 2003), with older adults of various levels of functional ability (Friedman, Heisel, & Delavan, 2005), and from various cultures (e.g. Malakouti, Fatollahi, Mirabzadeh, Salavati, & Zandi, 2006; Nyunt, Fones, Niti, & Ng, 2009). Internal consistency has been reported as an acceptable .75 (Friedman et al., 2005). In the present study, Cronbach's alpha coefficient was also .75.

In the current study, the GDS was treated as a continuous measure, scored as the total count of negative answers given by the respondent. For reasons outlined in section 3.2 and the fact that the GDS is a screening questionnaire rather than diagnostic interview, this study investigated depression largely from a symptomatology rather than diagnostic perspective. Cut off scores ranging from 3 to 5 have been taken to indicate clinically significant depressive symptoms. However, for descriptive and comparison purposes, the standard cut-off score of 6 was used to distinguish between depressed and non-depressed participants, scores of 6 to 10 to indicate mild to moderately depressed, and scores of 11 or more to indicate severe depression (Friedman et al., 2005). The sensitivity and specificity of cut-off scores from 3 to 6 in detecting major depression in community-

dwelling, primary care populations is 0.81 to 1.00 and 0.72 to 0.82 respectively (Friedman et al., 2005; Watson & Pignone, 2003).

### **Social Integration.**

In order to explore the relationship between social integration and depression as comprehensively as possible, this study utilised data from the Duke Social Support Index as well as a number of individual questions from the BRIGHT questionnaires. Three areas of social integration were examined: Structural social integration (as a whole), subcomponents of social network structure, and perceived connectedness. Table 4 details how these three components were measured. Structurally defined social integration and perceived connectedness were measured with the Duke Social Support Index (DSSI) subscales. In terms of subcomponents of social network structure, in addition to individual items from the DSSI and individual BRIGHT Trial questionnaire items, three composite measures were developed to measure social interaction frequency, social interaction frequency with children and grandchildren only, and proximity of children and grandchildren.

### ***Duke Social Support Index.***

The 11-item DSSI, is a shortened version of the original 35-item questionnaire that was developed by Koenig et al. (1993) specifically for use with older populations. A copy of the DSSI as it was included in the BRIGHT baseline self-completed questionnaire is provided in Appendix B. Despite its name, the DSSI assesses aspects of social networks other than social support. Two subscales have been identified within the measure which were termed the *social interaction* and the *subjective support* subscales (Goodger, Byles, Higginbotham, & Mishra, 1999; Koenig et al., 2003). Based on definitions developed according to reviewed literature (Chapter 4) and consideration of subscale items accordingly, the DSSI subscales were renamed the *structural integration subscale* and the *perceived connectedness* subscale. This is because the previously-called social interaction subscale includes an item unrelated to social interaction (i.e. asking about the number of local non-family ties) and the previously-called subjective support subscale is not limited to questions focused on social support but assesses more generally how one perceives and is

Table 4

*Measurement of Social Networks in The Present Study*

Construct	Measure <i>Relationship of interest with depression</i>
Social network structure	DSSI items 1 – 4: Structural integration subscale <sup>1</sup> <i>Overall impact. Impact relative to perceived connectedness</i>
Perceived connectedness	DSSI items 5 – 11: Perceived connectedness subscale <sup>1</sup> <i>Overall impact. Impact relative to social network structure</i>
Subcomponents of social network structure:	
Frequency of social interaction	DSSI items 2, 3, and 4 BRIGHT questionnaire items: Frequency of face-to-face contact with children. Item repeated for grandchildren BRIGHT questionnaire item: Frequency of phone, mail, or email contact with children. Item repeated for grandchildren <i>Overall impact<sup>2</sup>. Impact of individual items relative to each other</i>
Frequency of social interaction with children and grandchildren	Same as frequency of social interaction but with DSSI items excluded <i>Overall impact<sup>2</sup>. Potential interaction with number of non-family social ties (DSSI item 1) and functional ability<sup>3</sup>.</i>
Proximity of children and grandchildren	BRIGHT questionnaire item: Whether children live close by BRIGHT questionnaire item: Whether grandchildren live close by <i>Overall impact<sup>2</sup>. Impact of individual items relative to each other.</i>
Types of social ties	DSSI item 1 and 4 BRIGHT questionnaire items: Whether children / grandchildren live close by. BRIGHT questionnaire item: Married BRIGHT questionnaire item: Provision of daily care or assistance to other/s <i>Impact of individual items relative to each other.</i>

*Note.* 1 = renamed for the purpose of this study; 2 = using composite measures derived in the present study; 3 = as measured by the Nottingham Extended Activities of Daily Living Scale

Table 5

*Coding Schedule For DSSI Structural Integration Subscale Items*

Response	Code	
	Item 1 & 2	Item 3 & 4
0	1	1
1	2	1
2	2	2
3	3	2
4	3	2
5	3	2
6+	3	3

satisfied with their social network.

The structural integration subscale asks about the number of close non-family contacts (Item 1) and the weekly frequency of face-to-face social contact (Item 2), phone contact (Item 3), and attendance of meetings of clubs, hui, religious or other groups (Item 4). The respondent simply estimates the frequency of these activities in the last week, which then is coded into a score of 1, 2, or 3, as per Table 5, with a minimum subscale score of 4 and a maximum of 12. It should be noted that with four items, three of which focus on social interaction frequency, the structural integration subscale provides a limited measure of the various components that can define a persons' social network. Therefore, individual items from the BRIGHT questionnaires were used to supplement measurement of social network structure subcomponents (as per Table 4).

The perceived connectedness subscale asks about how understood (Item 5), useful (Item 6), and listened to (Item 7) that individual feels, as well as if they feel that they know what is going on (Item 8), have a definite role (Item 9), can talk about their deepest problems (Item 10), and are satisfied with their social contacts (Item 11). Responses to these questions are indicated on a 5-item Likert scale (1 = *None of the time*, 5 = *All of the time*, or for the satisfaction item; 1 = *Extremely dissatisfied*, 5 = *Satisfied all of the time*). The perceived connectedness subscale is scored by summing responses to the seven items, with a minimum subscale score of 7 and maximum of 35.

A large study by Powers, Goodger, and Byles, (2004) of Australian women aged 70-75 reported an acceptable internal reliability coefficient of .76 for the perceived connectedness subscale. The internal reliability coefficient for the structural integration subscale was only .58, though this has been attributed to the short length of the subscale (Goodger et al., 1999; see also McDowell, 2006) and that they are designed to have unique loading on the social network factor (so high intercorrelation between items is not desirable; Voils et al., 2007). For data used in the present study, Cronbach's alpha coefficients were .81 ( $N = 3308$ ) and .56 ( $N = 2757$ ) for the perceived connectedness and structural integration subscale respectively (with imputation alpha coefficients were .82,  $N = 3442$  and .62,  $N = 3345$ ). A confirmatory factor analysis was conducted to examine the validity of the two subscales for use with the present study sample data (see section 7.1.).

***BRIGHT Trial social network structure items.***

The BRIGHT Trial self-completion questionnaire and telephone interview questionnaires included items that were likely to contribute to a fuller picture of social network structure than the DSSI structural integration subscale alone. In particular, BRIGHT Trial questionnaire items assessed for the proximity of and frequency of contact with children and grandchildren (face-to-face and via phone, mail, or email), and whether or not the respondent provided 'daily care or assistance' to others. Appendix C summarises the items included in analyses.

***Social interaction frequency composite measure.***

To examine the relationship between the overall frequency of social interactions and depression, a composite measure of social interaction frequency was developed. The social interaction frequency composite measure was calculated by summing scaled scores to seven items recorded at baseline: DSSI item 2, 3 and 4, and the BRIGHT questionnaire items asking about frequency of face-to-face contact with children, frequency of face-to-face contact with grandchildren, frequency of non-face-to-face contact with children, and frequency of non-face-to-face contact with grandchildren. Raw responses to the DSSI items were scaled as per usual (Table 5). Raw responses to the non-DSSI items were scaled similarly, as per Table 6. All scaled scores ranged from 1 to 3. Scores on the social

Table 6

*Schedule For Scaling Responses to BRIGHT Items Regarding Frequency of Contact with Children and Grandchildren for Composite Social Interaction Frequency Score*

Response	Scaled score
'Monthly', 'Occasionally', or 'Never'	1
'Weekly'	2
'Daily or almost daily'	3

interaction frequency composite measure ranged from 7 to 21. Cronbach's alpha for this composite measure in the present study was an acceptable .75 ( $N = 3386$ )

***Social interaction frequency with children and grandchildren composite measure.***

To make a composite measure of frequency of contact with children and grandchildren, the social interaction frequency measure was repeated but with DSSI items excluded. Cronbach's alpha for the current sample for this measure was also an acceptable .75 ( $N = 3386$ ).

***Proximity of children and grandchildren composite measure.***

The two BRIGHT questionnaire items asking 'how many [children / grandchildren] live close by' were collapsed into one composite measure of proximity of children and grandchildren by summing responses, so that the measure ranged from 2 to 6. Cronbach's alpha for the current sample was .78 ( $N = 3425$ ).

**Descriptive and control variables.**

A variety of demographic and health-related variables could confound the relationship between depression and social support (see Section 3.5). The present study was therefore able to control for age, gender, ethnicity, educational status, DHB, number of sources of income, level of neighbourhood deprivation, functional ability with activities of daily living, alcohol use, having ever smoked, and exercise. Table 7 outlines how these were measured.

Table 7

*BRIGHT Trial Questionnaire Items Used to Measure Demographic and Health-Related Variables*

Construct	Item description Scoring method
Age	Age in years at baseline
Gender	Male; Female; Other / Refused
Ethnicity	New Zealand European; Other European; New Zealand Māori; Other
Educational status	Primary school, high school, qualification after high school
Geographical location	Bay of Plenty; Canterbury; Capital and Coast
Income sources	'What are your main sources of financial support? Do you have income from: Pension, Superannuation from another source, Investments, Other financial support' <i>None or one; Two or more</i>
Deprivation status	NZDep2006
Activities of daily living	Nottingham Extended Activities of Daily Living Scale
Alcohol use	'How often do you drink?' <i>1 = Daily or almost daily, 4 = Never</i>
Smoking	'Do you at present or have you ever smoked cigarettes?' <i>Never smoked; has smoked</i>
Exercise	'Do you exercise more than 30 minutes a day five times a week or more?' <i>Yes/No</i>

***Ethnicity.***

According to the New Zealand Census definition, ethnicity is defined as:

...the ethnic group or groups that people identify with or feel they belong to. Ethnicity is a measure of cultural affiliation, as opposed to race, ancestry, nationality or citizenship. Ethnicity is self perceived and people can belong to more than one ethnic group. (Statistics New Zealand, n.d.).

The BRIGHT Trial baseline questionnaire recorded ethnicity with the

question ‘Which ethnic group(s) do you belong to? (There may be one or more that apply to you)’. For the present study, 22 ethnicity categories were collapsed into; ‘New Zealand European’, ‘Other European’, ‘New Zealand Māori’, and ‘Other’. New Zealand Māori as an ethnic group refers to ‘all those who identified Māori as at least one of their ethnic group affiliations’ (Robson & Harris, 2007, p. 13). The ethnic group to which the individual identified as their primary ethnic group was used for the purposes of this analysis.

***Nottingham Extended Activities of Daily Living scale.***

The Nottingham Extended Activities of Daily Living (NEADL) scale is a functional measure of functional or physical disability and independence. A copy is provided in Appendix D. The NEADL has been validated among samples of predominately older adults, is comparable to other measures of physical health, ability, and independence, and has an excellent reported internal consistency coefficient of .90 (Green & Young, 2001; Harwood & Ebrahim, 2002; Lincoln & Gladman, 1992; University of Nottingham Institute of Work, Health & Organisations, n.d.). Cronbach’s alpha coefficient for the current sample was similarly .87.

The NEADL asks the respondent whether they have engaged in activities in the past few weeks, with responses selected from: ‘Not at all’, ‘With help’, ‘On your own with difficulty’, or ‘On your own’. The scale is made up of 22 items that pertain to activities from four domains: mobility, in the kitchen, domestic tasks, and leisure activities. A score of 0 is applied to a response to ‘Not at all’ or ‘With help’ and a score of 1 is given for a response to ‘On your own with difficulty’, or ‘On your own’. Thus, higher scores indicate greater levels of independence and physical ability. The current study included NEADL scores taken at all three waves of measurement.

***NZDep2006.***

The NZDep2006 is a socioeconomic index developed in the New Zealand context which aims to measure relative socioeconomic deprivation (Salmond, Crampton, & Atkinson, 2007; Salmond, King, Crampton, & Waldegrave, 2005). The NZDep2006 divides New Zealand into small ‘meshblock’ regions that are then ranked from 1 to 10 according to their

scores on nine 2006 census variables. Scores assigned to meshblocks represent 10<sup>th</sup> proportions with a scale from 1 to 10; a score of 10 indicates that a meshblock falls in the 10% with the most deprived NZDep scores and a meshblock score of 1 indicates that it falls in the 10% with the least deprived NZDep scores. An individual's NZDep2006 score is determined by their physical residential address meshblock score. The measure was developed particularly for use in New Zealand health research and validated with samples representative of New Zealand ethnic groupings. The BRIGHT study calculated NZDep2006 scores for all participants except for those who gave PO Box numbers for their address.

### **6.3. Analyses**

All analyses were conducted using the computer programme R, version 2.15.1. (R Core Team, 2012). Unless indicated otherwise, justifications for analytic procedures are referenced from the same text (Tabachnick & Fidell, 2013).

#### **Data screening.**

##### ***Missing values.***

Missing values analysis investigated whether data was missing at random (MAR) by testing for significant differences between participants with and without missing values on one variable and their outcomes on the other included variables. Missing values analysis also tested whether data were missing completely at random (MCAR) by examining whether those with missing values on one variable were also significantly more likely to have missing values on other variables. Where missing values were not MAR or not MCAR, imputation with the mean of non-missing items was deemed preferable where possible (given that this method is desirably conservative). To test for the effect of imputation, all regression analyses were re-run without imputation and results compared. Where imputation was not appropriate or possible, missing values were excluded from analyses. For those cases where non-imputed variables had large numbers of missing data, a missing data analysis assessed for any significant effect of missingness. This was done by dummy coding those variables (i.e. missing/not missing)

and re-running regression models with this included as a predictor. The criterion for a large number of missing data was set at equal or greater than 5% of the sample.

### ***Outliers.***

Univariate outliers for continuous variables were determined by examining scatterplots of variables and values that were 3.29 standard deviations from the mean. For categorical variables, the criterion of small proportions (i.e. less than 5%) belonging to a category level was taken to indicate an outlier level. Outlier values were addressed according to the nature of the variable (decisions detailed in Section 7.1).

Multivariate outliers were detected using the R package *mvoutlier*, version 1.9.8. (Filzmoner & Gschwandtner, 2012). Filzmoser, Maronna, and Werner's (2008) robust method uses an algorithm to identify multivariate outliers in transformed space based on principal component properties. This method is particularly well suited to datasets with a large number of variables and is more sophisticated than classical techniques (Filzmoser et al., 2008). A conservative alpha level of .001 was set for multivariate outlier detection. Unique properties of multivariate outliers relative to non-outliers were examined by dummy coding outliers against non-outliers and running a stepwise regression with outlier status as the dependent variable and all other variables used in analyses as independent variables.

### ***Assumptions of multivariate analyses.***

In order to check the assumptions of multivariate analyses, the distribution of residuals and expected normal probability plots for regression models were examined.

### ***Factor analysis on DSSI measure.***

To determine whether the hypothesised two factor model of DSSI was supported for use with the present study sample, a confirmatory factor analysis (CFA) using maximum likelihood estimation was run using the R package *Structural Equation Models (sem)*, version 3.0. (Fox, Nie, & Byrnes, 2012). This analysis was completed on non-imputed data with univariate and multivariate outliers excluded.

### ***Bivariate analyses.***

This initial stage of analysis helped address research questions 1) and 2) and

also determined which variables were significant and consequently would be included in the multivariate stage of analysis.

Graphical analysis (i.e. scatter plots) and standard statistical tests (i.e. correlations, *t*-tests, ANOVA tests) were used to examine the bivariate relationship between depressive symptoms and measures of social integration or demographic/health related variables at baseline. Bonferroni's correction for multiple comparisons was implemented (Hair et al., 1995). In cases where a Levene's Test for Homogeneity of Variances was significant for *t*-tests or ANOVA tests, Welch's adjustment for unequal variances was used (Hair et al., 1995; Welch, 1947, 1951).

### **Multivariate analyses.**

To address the three research questions outlined in Chapter 5, four stages of multivariate analyses were run:

- 1) A series of hierarchical linear regression models beginning with controls, in which depressive symptoms at baseline were increasingly explained by the sequential addition of social integration variables.
- 2) A series of longitudinal hierarchical linear regression models, conducted using the same process as 1) but with depression data 36-months later as the dependent variable.
- 3) A multi-level model for change then replicated Step 2).
- 4) A mediation analysis.

Details of the methods used for these four steps are described in the following subsections.

#### ***Baseline hierarchical linear regression models.***

With the aim to further address research questions 1) and 2), a multivariate linear regression model was developed to explain depression at baseline. This was done by conducting a taxonomy of three hierarchical regression models for both the general sample and data from Māori participants.

Model 1 was developed to include only significant health and demographic controls. All health and demographic predictors that were significant in bivariate analyses were included. Any health and demographic controls that were not significant in the multivariate model were then removed.

Model 2 was then developed in which social network variables (i.e.

the DSSI subscales and social network related BRIGHT items) were built onto Model 1. All of those social network variables found to have significant bivariate relationships with depression were added into the regression model, and then those that were insignificant were removed. Model 2 then represented only those social network predictors that significantly predicted depression in a multivariate model after controlling for health and demographic predictors determined by Model 1.

A final model (Model 3) was then run to examine for significant interaction effects suggested by the literature between contact with family ties and both contact with non-family ties and functional ability.

In order to address the clustering of participants by general practice, two considerations were made: For all regression models, robust standard errors were used to adjust standard errors for any clustering effect by practice (Diggle & Diggle, 2002). Validity of results was further checked by comparing results of the final model to the model replicated using multi-level modeling techniques in which participants were able to be nested by general practice (results of this in Appendix G).

#### ***Longitudinal hierarchical linear regression models.***

Research question 2) was then addressed longitudinally using multivariate linear regression to investigate whether baseline social network characteristics predicted change in depression at 18- and 36-month follow-up. This was done by extending regression Model 1 and Model 2 to include time-variant predictors.

#### ***Multi-level model for change.***

Longitudinal Models 1 and 2 were then run as multilevel models. This allowed for individuals to be nested in the times of measurement (Singer & Willett, 2003). This method accounts for the assumption of independence that is violated in simpler longitudinal regression models because of multiple measurements of the same individuals (Singer & Willett, 2003). Multilevel modeling analyses were done using the R package *nlme: Linear and nonlinear mixed effects models*, version 3.1.106 (Pinheiro, Bates, DebRoy, Sarkar, & R Core Team, 2012) and Maximum Likelihood methods of estimation. Methods of multilevel analysis were guided by Singer and Willett's (2003) text.

### ***Mediation analysis.***

Research question 3) was finally addressed using mediation analysis. The R package *mediation*, version 4.1.2. (Tingley, Yamamoto, Keele, & Imai, 2012), was used to test the hypothesized partial mediation of perceived connectedness on the relationship between social network structure and depressive symptoms. This mediation analysis was conducted according to Imai and colleagues' general approach (Imai, Keele, & Tingley, 2010; Imai, Keele, & Yamamoto, 2010a) which for the present study was essentially consistent with Baron and Kenny's (1986) well-known procedure. Health and demographic controls (selected according to what was found to be significant in the baseline multivariate regression model) were included. A sensitivity analysis examined for robustness of findings to a violation of the assumption of sequential ignorability (Imai, Keele, & Yamamoto, 2010b).

## Chapter 7: Results

Unless stated otherwise, reports of statistical significance in this chapter refer to a  $p$ -value of less than .05 and justifications for analytic procedures are based on Tabachnick and Fidell's (2013) text.

### 7.1. Data Screening

Data screening resulted in the exclusion of 51 participants and a remaining sample total of 3594 participants.

#### **Missing values.**

Missing values analyses confirmed that data could not be assumed to be missing completely at random (MCAR) and, for the majority of variables, could also not be assumed to be missing at random (MAR).

Missing baseline Geriatric Depression Scale (GDS) scores ( $n = 27$ ) were assumed to be missing at random, as practically and statistically there were not significant differences between participants with missing baseline depression scores and those without. Subsequently these were excluded from analyses. In terms of the Duke Social Support Index (DSSI) subscales, missing values were imputed with the mean of the non-missing items when less than half of an individual's subscale items had missing values ( $n = 340$  for structural integration subscale,  $n = 142$  for perceived connectedness subscale). When more than half of an individual's subscale items were missing ( $n = 340$  for structural integration subscale,  $n = 155$  for perceived connectedness subscale), missing values were excluded from analyses due to concerns of imputation unreliability. For other variables with missing values, imputation was not possible as there was no information on which this could be meaningfully, confidently, and conservatively based. Therefore, these missing values were excluded from analyses.

To investigate whether missingness had an effect on the robustness of multivariate results, variables with 184 or more missing values (i.e. 5% of sample  $N$ ) were dummy coded into 'missing/not missing' variables and included in regression models re-run in a missing values analysis (See 7.8). Variables with at least 184 data values missing were: DSSI structural

integration subscale ( $n = 336$ ), BRIGHT provision of daily care or assistance to others item ( $n = 268$ ), BRIGHT number of sources of income item ( $n = 493$ ), BRIGHT having never smoked item ( $n = 392$ ), and the BRIGHT exercise item ( $n = 215$ ).

### **Outliers.**

#### ***Univariate outliers.***

Once measurement errors had been corrected, there were no univariate outliers apparent in the data with two exceptions: Five participants were over 95 years at baseline, which is greater than three standard deviations from the mean ( $SD = 3.97$ ). Data from these participants were excluded from analyses. The alternative of transforming and including them was deemed undesirable because those aged over 95 are in the oldest end of the ‘oldest-old’ age bracket and thus may not be representative of the population of interest. Additionally, taking into account the meaning of the age variable, transformation could be both misleading and impractical. The second outlier was the unmarried status categories (widowed, divorced, single). Of those who were unmarried, 88% were widowed. Marital status was therefore collapsed into a dummy coded variable (married / unmarried) due to the small proportions belonging to the other unmarried categories.

#### ***Multivariate outliers.***

Robust methods to detect multivariate outliers (as defined by Filzmoser et al., 2008) resulted in 46 outliers. To determine which variables optimally predicted multivariate outlier status, a stepwise regression was run in which the dependent variable was outlier status (as a dummy coded variable: Outlier = 1, Non-outlier = 0) and all other variables were predictors. Participants with outlying data were more likely to have higher depression scores at baseline ( $M = 4.87$ ), 18-month follow-up ( $M = 5.93$ ), 36-month follow-up ( $M = 6.58$ ), have lower structural integration subscale scores ( $M = 8.11$ ), have no children (16%), be of non-European ethnicity (20% ‘other’, 9% Māori), be slightly older ( $M = 80.60$ ), exercise regularly (60%), and have lower NEADL scores at 18-month follow-up ( $M = 14.68$ ) and 36-month follow-up ( $M = 14.16$ ).

#### **Factor analysis of DSSI measure.**

Confirmatory factor analysis (CFA) on the Duke Social Support Inventory

(DSSI) using maximum likelihood estimation supported the hypothesised two factors and therefore the use of the two subscales with this sample. Details of this analysis are provided in Appendix E.

## 7.2. Testing the Assumptions of Multivariate Modelling

Figure 5 and Figure 6 show the P-P plot and the distribution of residuals for Model 2 in the baseline multivariate regression analysis (section 7.6). The same was repeated for Model 2 in the baseline multivariate regression analysis for Māori participants, and Model 2 for the longitudinal multivariate regression analysis at 18- and 36-month follow-up (not shown). These plots demonstrate how well the sample predicted a normal distribution in the population. Graphical examination was the most appropriate method of determining whether assumptions have been met in the present study given the large sample size. The plots indicated that the assumptions of multivariate testing were satisfied.

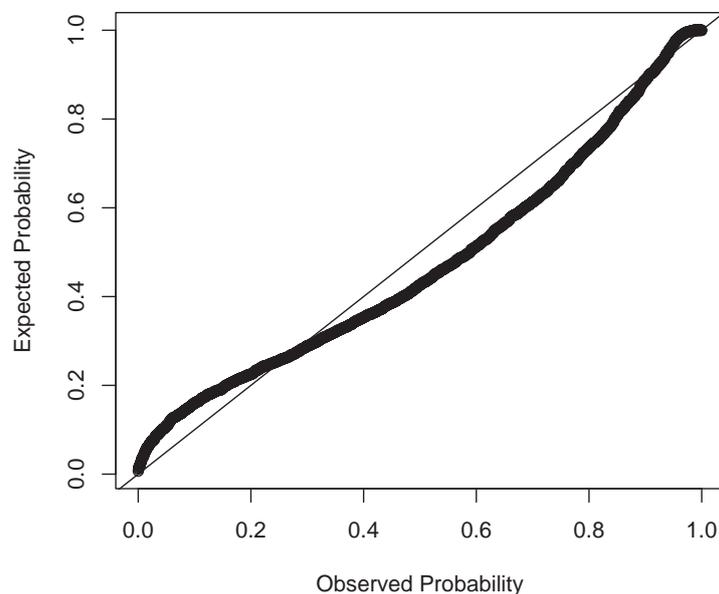


Figure 5. Expected normal P-P plot for regression baseline Model 2

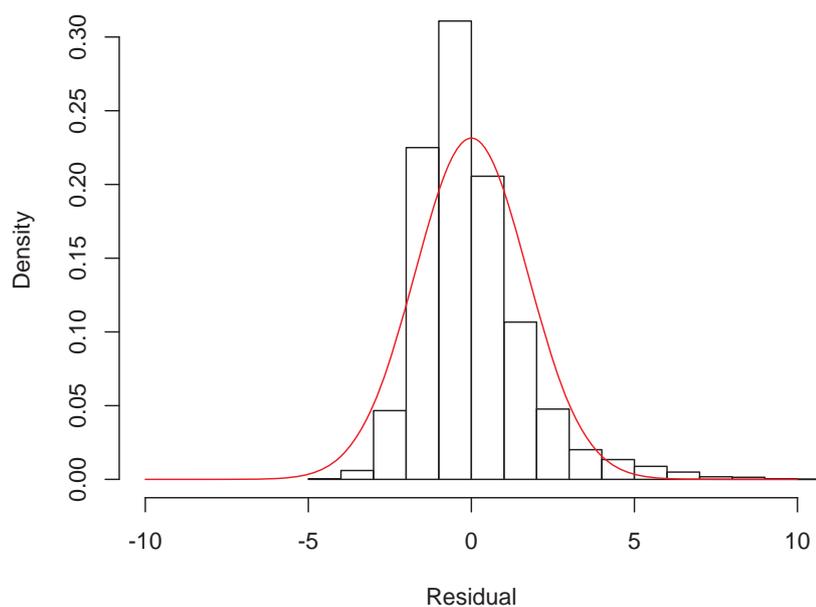


Figure 6. Residual histogram for baseline regression Model 2 with the Normal distribution curve

### 7.3. Descriptive Statistics

#### Baseline depression.

The mean GDS score for the sample was 1.79 ( $SD = 1.89$ ,  $Mdn = 1$ ). Ninety-five percent of the sample ( $N = 3424$ ) scored below 6, indicating no discernable depression, whereas 4.34% ( $n = 146$ ) scored in the mild to moderate depression range (6-10) and 0.36% in the severe depression range (11+,  $n = 13$ ). The more liberal criteria of a 3 to 5 point cut-off score indicated that between 7.82% and 25.57% met criteria for clinically significant depressive symptoms.

Figure 7 illustrates the distribution of depression scores at baseline. A Shapiro Wilks Test of normality found baseline GDS scores to be significantly different from the normal distribution ( $W = 0.81$ ,  $p < .001$ ). Tests of skewness and kurtosis indicated a distribution that is skewed to the right and leptokurtotic (skewness = 1.84, kurtosis = 4.99). Concerns of violations of normality assumptions are relatively minimal given that the Central Limit Theorem states that ‘...with sufficiently large sample sizes,

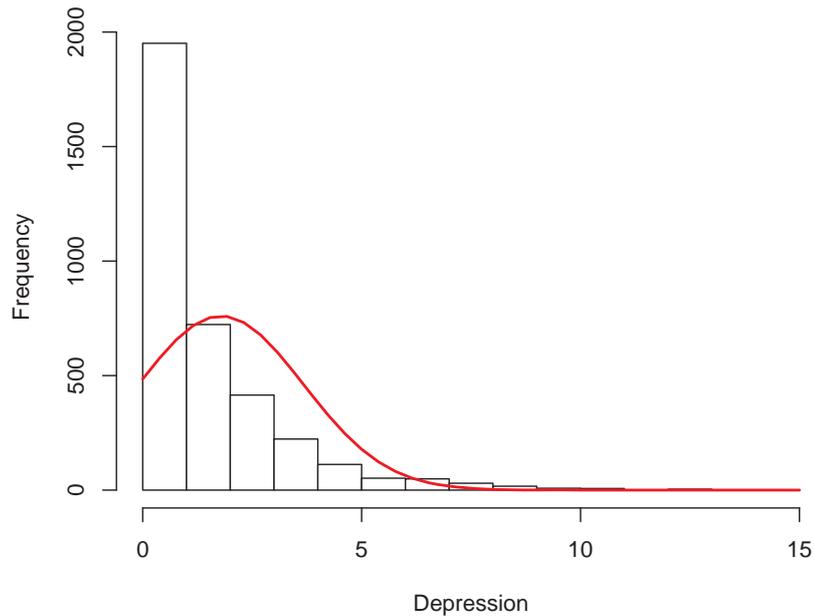


Figure 7. Distribution of GDS scores at baseline with a Normal distribution curve

sampling distributions of means are normally distributed regardless of the distributions of variables' (Tabachnick & Fidell, 2013, p. 78).

#### **Social network variables.**

Descriptive statistics for social network variables are summarised in Table 8. As the variables do not have official cut-off scores, the proportions scoring above and below one standard deviation from the mean are reported. Summary statistics for individual DSSI items and BRIGHT social network related variables are presented in Appendix F.

#### **7.4. Bivariate Relationships Between Depression Scores at Baseline and Social Network Related Variables**

A summary of results of bivariate analyses investigating the relationship between social network variables and depression is provided in Table 9. The structural integration subscale, perceived connectedness subscale, frequency of interaction composite scores, being married, and providing daily care and assistance to another person were all significantly related to GDS scores, whereas scores on the frequency of interaction with children or grandchildren and proximity of children or grandchildren were not.

Table 8

*Descriptive Summary Statistics for Social Network Variables*

Variable	Mean (SD)	1 SD below mean; above mean
Structural integration subscale	8.72 (1.73)	11% ; 18%
Perceived connectedness subscale	28.59 (3.68)	11% ; 15%
Subcomponents of social network structure:		
Frequency of social interaction composite measure	12.98 (2.56)	17% ; 17%
Frequency of social interaction with children and grandchildren composite measure	6.66 (1.99)	16% ; 18%
Proximity of children and grandchildren composite measure	5.14 (1.16)	8% ; 0%

A summary of results of bivariate analyses investigating the relationship between individual DSSI items and depressive symptoms are provided in Table 10. All DSSI items were significantly related to depressive symptoms at baseline, with the size of the relationship with depression between .38 and .52 for social network structure items and .26 and .74 for perceived connectedness items.

Table 11 summarises results of bivariate analyses investigating individual BRIGHT Items related to frequency of contact and proximity to children and grandchildren. Frequency of face-to-face and non-face-to-face (phone, mail or email) contact with grandchildren were significantly related to baseline depression scores. Contact with children and proximity to children or grandchildren were not significantly correlated with depression scores.

Table 9

*Results of Bivariate Analyses Examining the Relationship Between Social Network Related Variables and Depression (with Bonferroni's Correction for Multiple Comparisons)*

Variable	<i>r</i>	<i>p</i>
DSSI structural integration subscale	- .24	< .001
DSSI perceived connectedness subscale	- .15	< .001
Frequency of social interaction composite measure	- .09	< .001
Frequency of social interaction with children and grandchildren composite measure	- .03	.43
Proximity of children and grandchildren composite measure	.02	1.00
	<i>t</i> (df)	<i>p</i>
Married	4.68	< .001
Provide care	3.51	< .001

### **7.5. Bivariate Relationships Between Depression Scores At Baseline and Demographic and Health Related Potential Control Variables.**

The results of bivariate analyses on demographic and health related potential control variables are summarised in Table 12. Age at baseline, NZDep2006 status, NEADL score, having less than two sources of income, regular exercise, never having smoked, education and alcohol use were all significantly associated with depression scores, whereas practice, gender, geographic location, and ethnicity were not.

Post hoc tests (Tukey Honest Significant Differences) were conducted on significant ANOVAs. Given the significance of Levene's test for homogeneity of variances for the ANOVA results, post hoc tests were treated with caution and compared to practical differences across levels. All levels of the education category were significantly different from one

Table 10

*Results of Bivariate Analyses Examining the Relationship Between Individual DSSI Items and Depression (with Bonferroni's Correction for Multiple Comparisons)*

DSSI individual items	<i>r</i>	<i>p</i>
Number of local non-family ties	- .43	< .001
Frequency of face-to-face interactions	- .38	< .001
Frequency of phone interactions	- .38	< .001
Frequency of meeting attendance	- .52	< .001
Feels understood	- .57	< .001
Feels useful	- .74	< .001
Know what is going on	- .61	< .001
Definite role	- .60	< .001
Can talk	- .34	< .001
Satisfaction	- .26	< .001

Table 11

*Results of Bivariate Analyses Examining the Relationship Between Individual BRIGHT Social Network-Related Items and Depression (with Bonferroni's Correction for Multiple Comparisons)*

Individual BRIGHT items	<i>r</i>	<i>p</i>
Face-to-face interactions with grandchildren	.09	.02
Non-face-to-face interactions with grandchildren	.14	< .001
Face-to-face interactions with children	< - .01	1.00
Non-face-to-face interactions with children	.05	.64
Children living close by	.05	1.00
Grandchildren living close by	< - .01	1.00

another, so all were included in multivariate analyses as dummy coded variables (i.e. primary education/post-primary education; post-high school education/high school or primary education). For the alcohol use variable, those who reported never drinking alcohol had significantly higher depression scores than those who reported drinking more frequently. The more frequent categories did not differ significantly from each other. Therefore, that variable was dummy coded for multivariate analyses into those who reported drinking alcohol and those who did not.

Table 12

*Results of Bivariate Analyses Examining the Relationship Between Demographic and Health Related Potential Control Variables and Depression (with Bonferroni's Correction for Multiple Comparisons)*

Variable	<i>r</i>	<i>p</i>
Age	.05	< .001
NZDep2006	.04	< .001
Practice	< - .01	.34
NEADL	- .30	< .001
	<i>t</i> (df)	<i>p</i>
Gender	0.84 (3592)	1.00
Income sources	3.36 (1363) <sup>1</sup>	.01
Exercise	- 9.01 (3182) <sup>1</sup>	< .001
Never smoked	4.33 (3056) <sup>1</sup>	< .001
	<i>F</i> (df)	<i>p</i>
Geographic location	4.45 (2, 3591)	.14
Education	20.25 (2, 1269) <sup>1</sup>	< .001
Ethnicity	1.62 (3, 3576)	1.00
Alcohol use	11.24 (3, 1331) <sup>1</sup>	< .001

*Note.* NEADL = Nottingham Extended Activities of Daily Living; <sup>1</sup> with Welch's correction due to significance on Levene's test for homogeneity of variance

## 7.6. Baseline Multivariate Analyses on General Sample

A taxonomy of hierarchical multivariate linear regressions was run to examine the relationship between social network variables and depression after controlling for significant health and demographic variables among the general sample. Variables included in each model were those found to be significant in bivariate analyses (Sections 7.4 and 7.5). The frequency of social interaction composite measure was excluded due to overlap with the DSSI structural integration subscale (three items).

Three models were developed: Model 1 determined which demographic and health-related predictors significantly predicted depression at baseline in a multivariate model (so that these could be controlled for in Model 2 and 3). Model 2 examined the effect of social network related variables on depression scores after controlling for Model 1 predictors. Model 3 extended Model 2 by examining hypothesized interactions between specific social network variables (i.e. contact with family and both contact with other ties and functional ability). Final results for Model 1, Model 2, and Model 3 are presented in Table 13. For all regression models, robust standard errors have been used to adjust standard errors for any clustering effect by practice (Diggle & Diggle, 2002). In addition, Model 2 was compared to the model re-run as a mixed-effects model that is able to accommodate for nesting of participants by practice (Appendix G). Results of the mixed effects model were essentially identical to results of Model 2. The more simple regression models are preferred for reporting due to the clarity and communicability of results.

### **Model 1: Health and demographic predictors.**

When combined in a multivariate regression model, age at baseline, having post-high school as the highest form of education, NEADL scores, regular exercise, never drinking alcohol, and having never smoked were significant predictors of baseline depression scores. Consequently these variables defined Model 1. Having less than two sources of income, NZDep2006 status, and primary school as the highest form of education were not

Table 13

Results of Fitting a Taxonomy of Hierarchical Linear Regression Models with Health and Demographic Predictors Only (Model 1), Social Network Predictors (Model 2i, 2ii, and Final Model 2), and Hypothesised Interaction Effects (Model 3) to Depression Data (N = 3594)

Step	Predictors	Model 1		Model 2i		Model 2ii		Model 2		Interaction Model	
		$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$sr^2$	$\beta$
1	Age	.02*	.01	.01	.01	.01	.02*	.00	.02**		.02**
	Post-high school education (Primary or high school = 0, Post-high school = 1)	-.14*	-.13*	-.13*	-.13*	-.13*	-.16*	.00	-.17**		-.17**
	NEADL	-.26***	-.27***	-.27***	-.24***	-.24***	-.23***	.05	-.22***		-.22***
	Exercise (No = 0, Yes = 1)	-.40***	-.40***	-.40***	-.38***	-.38***	-.39***	.01	-.41***		-.41***
	Never drink alcohol (No = 0, Yes = 1)	.26***	.23**	.23**	.20**	.20**	.18**	.00	.21**		.21**
	Never smoked (No = 0, Yes = 1)	-.23***	-.24***	-.24***	-.21**	-.21**	-.15*	.00	-.18**		-.18**
2	Married (No = 0, Yes = 1)		-.32***	-.32***	-.43***	-.43***	-.35***	.01	-.35***		-.35***
3	Structural Integration <sup>1</sup>				-.18***	-.18***	-.13***	.01	-.15***		-.15***
4	Perceived Connectedness <sup>1</sup>						-.11***	.04	-.12***		-.12***
5	Frequency of contact with children or grandchildren : NEADL								.01		.01
	Frequency of contact with children or grandchildren: Number of local non-family ties								< -.01		< -.01
	Total R <sup>2</sup>	.13***	.14***	.14***	.17***	.17***	.22***		.22		.22
	Adjusted R <sup>2</sup>	.13***	.14***	.14***	.17***	.17***	.22***		.22		.22
	R <sup>2</sup> change		.01***	.01***	.03***	.03***	.04***		< .01*		< .01*

Note. NEADL = Nottingham Extended Activities of Daily Living Scale.  $sr^2$  = squared semipartial correlation. 1 = DSSI subscales. \*  $p < .05$ ;

\*\*  $p < .01$ ; \*\*\*  $p < .001$

significant predictors of baseline depression scores in the multivariate analysis. These variables were therefore excluded from Model 1 and subsequent models.

### **Model 2: Social network predictors.**

When social network related variables were added to Model 1, being married, the structural integration subscale, and the perceived connectedness subscale were all significant predictors of depression. Therefore, these define Model 2. Results of entering being married, social network structure, and perceived connectedness in sequence (2i, 2ii. and 2) are reported to show  $R^2$  change with the addition of each. Provision of daily care or assistance to others was insignificant and therefore excluded from Model 2 and subsequent models.

The final Model 2 explained 22% of the variance in depression scores, though the unique contributions of individual variables were small, ranging from less than 1% to 5%. Being married and the structural integration subscale each uniquely explained 1% of the variance in depression at baseline, and perceived connectedness subscale uniquely explained 4%.

### **Model 3: Interaction effects.**

There was no statistically significant interaction between the frequency of contact with children and grandchildren and the number of local non-family ties or NEADL scores.

## **7.7. Baseline Depression and Social Network Variables Among Māori Participants**

### **Descriptive Statistics on Māori Sample.**

Of the 172 participants who identified as being of Māori ethnicity, the mean GDS score was 1.85 ( $SD = 1.95$ ,  $Mdn = 1$ ). Ninety-four percent of the sample of older Māori ( $n = 163$ ) scored below 6, indicating no discernable depression, whereas 5.20% ( $n = 9$ ) scored in the mild to moderate depression range (6-10). No participants who identified as Māori scored in the severe range (11+). The more liberal criteria of a 3 to 5 point cut-off score indicated that between 9.09% and 27.84% met criteria for clinically

significant depressive symptoms. Summary statistics for social network variables among Māori participants are summarised in Table 14. Sixty-two percent reported being married (38% not married).

Like the general sample, a Shapiro Wilks test of normality found baseline GDS scores among Māori participants to be significantly different from the normal distribution ( $W = 0.81, p < .001$ ) and tests of skewness and kurtosis indicated a distribution skewed to the right and leptokurtotic (skewness = 1.73, kurtosis = 3.46).

Table 14

*Descriptive Summary Statistics for Social Network Variables among Māori participants*

Variable	Mean (SD)	1 SD below mean; 1 SD above mean
Structural integration subscale	8.49 (1.95)	16% ; 18%
Perceived connectedness subscale	28.50 (3.52)	16% ; 15%
Subcomponents of social network structure:		
Frequency of social interaction composite measure	13.59 (3.20)	19% ; 19%
Frequency of social interaction with children and grandchildren composite measure	7.38 (2.64)	20% ; 16%
Proximity of children and grandchildren composite measure	5.24 (1.16)	26% ; 0%

**Bivariate relationships between depression scores at baseline and social network related variables among Māori participants.**

Results on analyses investigating the bivariate relationship between baseline depression scores and social network variables among Māori participants are summarised in Table 15. Out of the social network variables, the DSSI subscales were the only social network related variables that significantly related to depression scores.

Table 15

*Results of Bivariate Analyses Examining the Relationship Between Social Network-Related Variables and Depression Among Māori Participants (with Bonferroni's Correction for Multiple Comparisons)*

Variable	<i>r</i>	<i>p</i>
DSSI structural integration subscale	- .29	< .01
DSSI perceived connectedness subscale	- .13	.03
Composite social interaction frequency score	- .09	.57
Composite family interaction frequency score	< - .01	1.00
Composite family proximity score	- .02	1.00
	<i>t</i> (df)	<i>p</i>
Married	0.82 (169)	1.00
Provide care	- 0.36 (154)	1.00

The results of bivariate analyses on demographic and health related variables among the sample of Māori participants are detailed in Table 16. Age and NEADL scores significantly predicted Māori participants' depression scores at baseline. NZDep2006 scores, practice, gender, having less than two sources of income, exercise, having never smoked, geographic location, education, and alcohol use did not.

To investigate the relationship between depression and social network variables after controlling for significant health and demographic variables among Māori participants, the steps used to generate Model 1 and Model 2 in the general sample were repeated with the Māori sample. Two hierarchical multivariate linear regression models were developed: First, demographic and health-related predictors that were significantly related to depression in bivariate analyses were regressed against depression and again those that were insignificant were removed (Model 1). Then, social network related variables that significantly predicted depression in bivariate analyses were added to this regressed model (Model 2). Table 17 summarises the results.

Table 16

*Results of Bivariate Analyses Examining the Relationship Between Demographic and Health Related Potential Controls and Depression Among Māori Participants (with Bonferroni's Correction For Multiple Comparisons)*

Variable	<i>r</i>	<i>p</i>
Age	.09	.01
NZDep2006	.06	1.00
Practice	< - .01	1.00
NEADL	- .25	< .01
	<i>t</i> (df)	<i>p</i>
Gender	- .50 (170)	1.00
Income sources	1.36 (143)	.17
Exercise	- 2.19 (156)	.33
Never smoked	1.69 (149)	1.00
	<i>F</i> (df)	<i>p</i>
Geographic location	.02 (2, 169)	1.00
Education	1.45 (2, 158)	1.00
Alcohol use	.87 (3, 157)	1.00

When combined in a multivariate regression model, age and NEADL scores remained significant predictors of baseline depression and therefore defined Model 1 for Māori participants. For Model 2, scores on the social network structure and perceived connectedness subscales significantly predicted baseline depression scores after controlling for age and NEADL scores. NEADL scores became an insignificant predictor in Model 2.

### **7.8. Longitudinal analyses**

#### **Data lost to follow-up.**

For data included in the present study, 9% (n = 315) were lost to follow-up at 18-months and 19% (n = 698) at 36-months. Reasons for participants being lost to follow-up in the BRIGHT trial were reported by Kerse et al.

Table 17

*Results of Fitting a Taxonomy of Hierarchical Linear Regression Models with Health and Demographic Predictors Only (Model 1) and Social Network Predictors (2ii and 2) to Depression Data From Māori Participants (N = 172)*

Step	Predictors	Model 1	Model 2ii	Model 2	$sr^2$
1	Age	.08*	.09*	.10*	.06
	NEADL	-.22**	-.13	-.10	.01
2	Structural integration		-.28**	-.23*	.06
3	Perceived connectedness			-.12*	.04
	$R^2$	.11***	.17***	.21***	
	Adjusted $R^2$	.10***	.15***	.19***	
	$R^2$ change		.06***	.04**	

Note. NEADL = Nottingham Extended Activities of Daily Living Scale.  $sr^2$  = squared semipartial correlation. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

(2013): At 18-month follow-up, 44% of those lost to follow-up died, 27% moved into residential care, 8% were not able to be contacted, 10% were unable to complete due to poor health, and 10% no longer wished to be involved. At 36-months follow-up, 42% of those lost to follow-up died, 25% moved into residential care, 13% were not able to be contacted, 4% were unable to complete due to poor health, and 15% no longer wished to be involved.

#### **Depression scores at follow-up.**

Descriptive summary statistics for depression scores at baseline, 18-month and 36-month follow up are presented in Table 18. Mean depression scores at 18-month and 36-month follow-up were significantly higher than at baseline, but not significantly different from each other.

Table 18

*Summary Statistics For Depression Scores At Baseline, 18-month, and 36-month Follow-up*

Measurement point	N	M (SD)	Test of mean difference <i>t</i> (df) correlation (in lower half)		
			Baseline	18-month	36-month
Baseline	3645	1.82 (1.94)	.	- 4.57*** (6973)	4.08*** (6590)
18-month	3334	2.05 (2.12)	.56***	.	.40 (6225)
36-month	2948	2.03 (2.05)	.50***	.57***	.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

#### **Time-variant predictors at follow-up.**

Mean NEADL scores at baseline, 18-month, and 36-month follow-up were all significantly different from one another, although when rounded the mean NEADL score for the three time periods were between 19 and 20. In terms of marital status, 5.47% ( $N = 160$ ) changed from being married to being unmarried. Of those who were previously unmarried at baseline 0.82% ( $N = 24$ ) were married at 36-month follow-up. Given the small number who became married, change in marital status was dichotomised into a dummy coded variable according to those who became unmarried and those who did not. There was no significant difference in depression scores between those who became unmarried and those who did not,  $t(177) = .54$ ,  $p = .59$ , and therefore this variable was excluded from multivariate analyses.

#### **Multivariate longitudinal linear regression models.**

Baseline multivariate regression Model 1 and Model 2 were fitted to the 18-month and 36-month follow-up data, with the addition of NEADL follow-up scores and baseline depression scores. Results of these regression analyses are presented in Table 19. Being married was only significant in predicting depression 18-months later whereas structural integration and perceived

Table 19

Results of Fitting a Taxonomy of Hierarchical Linear Regression Models with Health and Demographic Predictors Only (Model 1), Social Network Predictors (Model 2ii, and final Model 2) to Depression Data at 18-month and 36-month Follow-up (N = 3594)

Predictors	Baseline			18-month follow-up			36-month follow-up		
	Model 1	Model 2ii	Model 2	Model 1	Model 2ii	Model 2	Model 1	Model 2ii	Model 2
	$\beta$		$sr^2$	$\beta$		$sr^2$	$\beta$		$sr^2$
Age	.02*	.01	.02*	< .01	< .01	.01	.03***	.04***	.04***
Post-high school education <sup>1</sup>	-.14*	-.13*	-.16*	-.14*	-.15*	-.16**	-.14*	-.11	-.13*
NEADL baseline	.26***	-.24***	-.23***	< .01	< .01	< .01	.01	.02	.02
NEADL 18-month				-.18***	-.18***	-.18***	-.11***	-.10***	-.10***
NEADL 36-month							-.08***	-.07***	-.07***
Exercise <sup>1</sup>	-.40***	-.38***	-.39***	-.22***	-.21**	-.21***	-.14*	-.14*	-.14*
Never drink alcohol <sup>1</sup>	.26***	.20**	.18**	.01	-.01	-.01	.08	.07	.07
Never smoked <sup>1</sup>	-.23***	-.21**	-.15*	.07	.06	.08	< .01	.01	.03
Depression baseline				.55***	.54***	.51***	.47***	.44***	.41***
Married <sup>1</sup>									
Structural integration <sup>2</sup>									
Perceived connectedness <sup>2</sup>									
$R^2$	.13***	.17***	.22***	.39***	.40***	.40***	.29***	.30***	.31***
Adjusted $R^2$	.13***	.17***	.22***	.39***	.40***	.40***	.29***	.30***	.31***
$R^2$ change	.04***	.04***	.05***	<.01	<.01	.01	.01	.01	.01

Note: 1 = dummy coded as per Table 13. 2 = DSSI subscales. NEADL = Nottingham Extended Activities of Daily Living Scale.  $sr^2$  = squared semipartial

correlation. \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ . This Note also applies to Table 20.

connectedness predicted depression both 18-months and 36-months later. In terms of controls, education, exercise and NEADL scores were the only health and demographic controls that remained significant predictors of depression 18-months and 36-months later. Age was a significant predictor 36-months later only.

Model 2, which includes social integration variables after controlling for health and demographic predictors, predicted approximately 40% and 31% of variation in depression at 18- and 36-month follow-up respectively. The addition of social network predictors uniquely accounted for only 2% of the variance explained.

#### **Multilevel model for change.**

Multivariate longitudinal Models 1 and 2 were extended to account for nesting of individuals in times of measurement using multilevel techniques with Maximum Likelihood estimation (Singer & Willett, 2003). Results of fitting an unconditional means model (Model i), unconditional growth model (Model ii), the health and demographic predictor model (Model 1), and the structural integration predictor model (Model 2) are presented in Table 20. Age, NEADL, and the DSSI subscales were centred on their means. Results presented are in the form suggested by Singer and Willett (2003) including pseudo R summary statistics (see Singer & Willett, 2003, pp. 102–104).

The unconditional means model (Model i) indicated that individuals' true average depression score significantly varied over time and that individuals significantly varied from one another. The intraclass correlation coefficient calculated on outcome variance components (Singer & Willett, 2003, p. 96) estimated that 57% of variation in depression was attributable to inter-individual differences.

The unconditional growth model (Model ii) explained more variance than the unconditional means model and had a significant rate of change parameter estimate, supporting a model for change. The unconditional growth model predicted that 8% of within person variation in depression scores were systematically associated with linear time, in which the true depression score of an average older adult was 1.66 and the true average

Table 20

Results of Fitting a Taxonomy of Hierarchical Linear Multilevel Models for Change with Health and Demographic Predictors (Model 1), and Social Network Predictors (Model 2) to Depression Data (N = 3594)

Variable	Parameter	Model i	Model ii	Model 1	Model 2
Fixed Effects	Y <sub>00</sub>	1.94*** (.03)	1.66*** (.04)	1.51*** (.07)	1.74*** (.08)
Initial status	Y <sub>01</sub>			< -.01 (.01)	-.01 (.01)
	Y <sub>02</sub>			-.22* (.09)	-.19 (.08)
	Y <sub>03</sub>			-.30*** (.02)	-.27*** (.02)
	Y <sub>04</sub>			-.42*** (.09)	.38*** (.08)
	Y <sub>05</sub>				-.11*** (.03)
	Y <sub>06</sub>				-.13*** (.01)
	Y <sub>07</sub>				-.41*** (.09)
Rate of change	Y <sub>10</sub>		.15*** (.02)	.16*** (.03)	.13*** (.45)
	Y <sub>11</sub>			.02*** (.00)	.02*** (.00)
	Y <sub>12</sub>			-.02 (.04)	-.02 (.04)
	Y <sub>13</sub>			.02* (.01)	.02* (.01)
	Y <sub>14</sub>			.02 (.04)	.01 (.04)
	Y <sub>15</sub>				-.02 (.01)
	Y <sub>16</sub>				.01 (.01)
	Y <sub>17</sub>				.06 (.04)
Variance Components	$\sigma^2_\epsilon$	1.64	1.51	1.51	1.51
Level 1: Within-person	$\sigma^2_0$	2.18	2.17	1.68	1.37
Level 2: In initial status	$\sigma^2_1$		.10	.09	.09
In rate of change					
Pseudo R <sup>2</sup> statistics	$R^2_\epsilon$		.08	.08	.08
Goodness of fit statistics	$R^2_0$			.22	.37
	$R^2_1$			.07	.07
	AIC	32934.42	32849.08	32318.10	31929.01
	BIC	32955.56	32891.35	32416.74	32069.92

increase after 36 months was to 1.96. A substantial proportion of variance remained unexplained, supporting the introduction of predictors (i.e. Model 1 and Model 2).

Model 2 results indicate that higher scores on the structural integration subscale, perceived connectedness subscale, and being married at baseline, predicted lower initial depression scores. Residual variance explained increased 68% (up to 37% from 22%) with the addition of social network variables relative to health and demographic controls alone. Social network variables did not predict rate of change in depression across the three measurement waves.

In terms of health and demographic controls, based on Model 2 older adults who had lower NEADL scores and who reported regular exercise had significantly higher initial depression scores. Higher NEADL scores and older age significantly predicted rate of change, though the size of the prediction was negligible (only an increase in variance explained of 1%).

## **7.9. Investigation of Missing Data and Imputation**

Baseline regression Model 2 and Model 3, and longitudinal regression Model 2 at 18- and 36-month follow-up were re-run without imputation. Results of these regression comparisons are provided in Appendix H. Results without imputation were essentially identical to results with imputation. Most of the compared regression coefficients ( $\beta$ ,  $R^2$ , and adjusted  $R^2$ ) were identical and none differed by more than .09.

When variables with more than 5% of data missing were included as dummy-coded variables in the models, only missingness for the ‘having never smoked’ variable was significant and this was for Model 1 only ( $\beta = .27, p < .05$ ). Moreover, inclusion of this variable did not meaningfully change results: Total and adjusted  $R^2$  remained identical and all other coefficients were identical or less than .05 different from the model without missingness on the ‘having never smoked’ item.

### **7.10. Perceived Connectedness as a Mediator of the Relationship Between Structural Integration and Depression**

The hypothesised partial mediation effect of perceived connectedness on the relationship between structural integration and depressive symptoms was supported. The mediation effect was estimated to be -.05 and the direct effect -.13. Thus it was estimated that 29% of the effect of the structural integration on depressive symptoms was mediated by perceived connectedness.

According to Sobel's (1982) test, the mediation effect was significant ( $z = -8.51, p < .01$ ). A sensitivity analysis supported robustness to the ignorability assumption: It was estimated that the direction of the average causal mediation effect would be maintained as long as the sensitivity parameter was less than -.25 (for a comprehensive explanation of sensitivity analysis with examples see Imai, Keele, and Yamamoto, 2010b). The mediation analysis controlled for Age, education, NEADL scores, regular exercise, alcohol use, smoking, and marital status, as these were indicated to be potential confounders (as per baseline regression Model 2).

## Chapter 8: Discussion

The present study had three main hypotheses: 1) that subcomponents of older peoples' social networks would differentially contribute to depressive symptoms; 2) that structural integration and perceived connectedness, as objective and subjective indicators of social integration, would be significant predictors of depressive symptoms, with the latter being the stronger predictor; and 3) that perceived connectedness would partially mediate the relationship between structural integration and depression. Results support these hypotheses. However, the more detailed findings differed from expectations in many respects. Most surprising was the finding that social integration explained only a small amount of variability in older people's levels of depressive symptoms and did not predict variability in trajectories of depressive symptoms over time. Also contrary to expectations, though consistent with a number of existing studies, was the finding that even after controlling for functional disability and absence of non-family ties, social interaction with children or grandchildren did not significantly predict depressive symptoms.

This study builds on current understandings of depression in later life by a) providing evidence of a mediation effect of perceived connectedness on the relationship between structural social integration and depressive symptoms, b) shedding light on the longitudinal relationship between depression and social integration with a large observational sample, c) providing further support for the importance of non-family ties relative to family ties, and d) providing support for composite measures of social integration in depression research with older people. The current study was also of value because few studies have reported either prevalence rates of depressive symptoms among community-dwelling older New Zealanders or described the social networks of this population. There is especially a lack of research on depression prevalence and social networks among older Māori, despite Māori health being a national priority (Robson & Harris, 2007).

In this chapter, first depression prevalence findings and descriptive findings about the social networks of community dwelling older people in

New Zealand are outlined. The remainder of the chapter is organized in subsections according to the three primary hypotheses. Findings on the relationship between depressive symptoms and social integration are discussed in the context of current theory and pre-existing research that was reviewed in previous chapters. Implications of findings are then discussed and recommendations made.

### **8.1. Depression Prevalence Among Older New Zealanders**

The present study suggests that prevalence of depressive symptoms is similar among community-dwelling older New Zealanders relative to younger age groups. Results also indicate that prevalence rates are similar to that reported among older adults overseas.

The current study found that just fewer than 5% of the general sample scored in the clinical range of depression and less than 1% scored in the severe range (a score of 11 and over). Given the high reported sensitivity and specificity of the cut-off score, this could arguably be taken to be a diagnostic indicator of Major Depression (Friedman et al., 2005). This finding falls within the 1-5% prevalence range reported in studies overseas for Major Depressive Disorder among community-dwelling older people (Blazer, 2002; Djernes, 2006). Like studies overseas have found, the prevalence rate in the present study is at least similar to, if not less than, that reported for the general population. For instance, Te Rau Hinengaro estimated that Major Depression prevalence was 5.7% in the general adult New Zealand population (Wells, 2006). In terms of prevalence among older Māori, the current study found that just over 5% scored in the clinical range in the current study, compared to a rate of 6.9% reported in the general adult Māori population (Baxter et al., 2006). Of particular note, is that no Māori participants in the present study were in the severe range whereas approximately half of the incidences of depression in the general adult Māori population are estimated to be severe cases (Baxter et al., 2006).

In terms of clinically significant depressive symptoms, the more liberal cut-off scores (3 to 5) indicate that between 8 and 26% of the general

sample and between 9 and 28% of the Māori sample experienced clinically significant depressive symptoms. Again rates are comparable to international studies, which typically fall in the 10-25% range (Anstey et al., 2007; Blazer, 2002; Djernes, 2006; Weyerer et al., 2008). This is also in line with findings from another New Zealand study of primary care attending, middle-old adults in which 10% were reported to be experiencing clinically significant depressive symptoms using a GDS-15 cut-off score of 5 (Begg et al., 2006).

Although the current study did not provide clear evidence of *lower* prevalence rates among older adults relative to the general adult population, it does support the notion that community-dwelling older adults have at least similar prevalence rates and less severe depressive symptoms. This is despite age-related stressors such as biological vulnerability, declining physical health, and bereavement (Blazer & Hybels, 2005). Although the present study was based on a relatively healthy, non-clinical sample, included participants were not without such stressors: For instance, most participants reported difficulties with one or more (up to ten) activities of daily living and a large proportion were widowed. These prevalence findings support the cumulative evidence challenging stereotypes of older age as depressing and providing support for Strength and Vulnerability theory (Charles, 2010) that argues that older people possess protective strengths.

It is important to acknowledge that, although the majority of community-dwelling older people are not depressed, the fact that up to a quarter of older adults report clinically significant depressive symptoms is still important. As highlighted in Chapter 1 and 2, depressive symptoms among older people are associated with significant suffering and costs and ageing populations mean that, even though the majority are non-depressed, the number of older people experiencing depressive symptoms is expected to grow. Clearly, knowledge of risk and protective factors as potential targets of prevention and treatment efforts is needed.

### **Trajectories of depression over time and health and demographic protective factors.**

The present study found that on average, depressive symptoms slightly increased over a 36-month period (from an estimated true average GDS score of 1.66 to 1.96). This is consistent with two other longitudinal studies that found depressive symptoms increased with time among samples of older people (Glass et al., 2006; Hong et al., 2009). Despite a trend towards a small but significant increase in depressive symptoms, the present study found there was significant variability in individual depression trajectories over time. Unfortunately, despite the inclusion of a number of health, demographic, and social variables, very little of this individual variability was explained. Outside of social network related variables, which are discussed in subsequent sections, regular exercise, functional ability with activities of daily living, younger old age, and having post-high school education predicted lower depression scores cross-sectionally, and up to 36-months prospectively. However, these factors did not predict differences in individual rates of change. Being older and reporting higher levels of functional disability was found to predict a greater increase in depressive symptoms over time, but even these predictors explained little of the inter-individual variability.

Gender, ethnicity, number of sources of income, neighbourhood deprivation, and geographical location were not significant predictors of depressive symptoms. This supports the notion of a narrower gender gap among older adults (Qualls & Knight, 2006) suggesting that, when taking into account other demographic and health related variables, gender may not be a unique predictor of depression among older people. Other studies have also tended to find ethnicity to be unrelated to incidence of depression in older populations, and the current study provides further evidence for this in a New Zealand context. Findings of no relationship between income and neighbourhood deprivation, however, was contrary to expectations based on existing reviews (e.g. Djernes, 2006). This may be due to measurement; for instance the number of sources of income is probably not the best measure of income compared to average annual income.

It is interesting that for all models, cross-sectional and longitudinal, the explanatory power of health and demographic predictors were found to be low. For example, at baseline all of the significant health and demographic predictors combined in a linear regression model to explain depressive symptoms resulted in an adjusted  $R^2$  of .13 ( $p < .05$ ). The unique amount of variability explained by any one variable was usually 1% or less and never greater than 5%. This suggests that the contribution of health and demographic variables included in the present study to depressive symptoms may be exaggerated in current understandings of depression among older people, perhaps with the exception of functional ability as the strongest predictor. This also implies that there are other important risk or protective factors that the present study was not able to control for, such as history of depression, certain biological risks thought to be strongly related to depression in later life (e.g. cardiovascular disease; Blazer & Hybels, 2005; Djernes, 2006), or psychological factors (e.g. strengths in emotion regulation). The finding that being older remains a risk for depression even after controlling for relevant factors such as functional ability may indicate increasing biological risk for depression thought to occur with age (Blazer & Hybels, 2005; Charles, 2010). Future studies may benefit from including indicators of biological risk for depression, as well as investigating the predictive power of psychological strengths (e.g. in emotional regulation) that may be important protective factors among older people.

## **8.2. Social Integration and Isolation Among Older New Zealanders**

The current study found that, in line with existing research, most older people in the sample reported being socially integrated (as indicated by objective and subjective measures). Although the Duke Social Support Index (DSSI) does not have official cut-off points, the subscale means (9 for the structural integration subscale, 29 for the perceived connectedness subscale) were well above the subscales' mid-points (4.5 and 13.5 respectively). For the general sample and among Māori participants, 18% scored even greater than one standard deviation above the sample mean for

the structural integration subscale and 15% scored more than one standard deviation for the perceived connectedness subscale. Most (90%) reported having at least one local non-family tie, with over a third reporting five or more. The majority of people who had children and grandchildren lived close to them (78% and 64% respectively). The present study also indicated frequent social interactions, with the majority having between one and four face-to-face (69%) and more than five phone (61%) interactions, and most reporting attending at least one meeting (e.g. club, hui; 69%) in the last week. Of those with children, 78% reported at least weekly contact, with nearly a third having contact daily. Just over a third (35%) reported non-face-to-face contact with their grandchildren on at least a weekly basis. In terms of perceived connectedness, findings are consistent with reports from the Enhancing Wellbeing in an Ageing Society study (EWAS; (Koopman-Boyden & Waldegrave, 2009a): In the present study, 92% of the sample reported feeling satisfied with their social networks either all or most of the time, which is similar to over 95% of participants in the EWAS study who reported that they were satisfied with their social interactions. Overall, it appears that the large majority of community-dwelling older New Zealanders, like older adults overseas, are structurally socially integrated and perceive themselves as being so.

Although the present study supported the notion that older people generally are socially integrated, a proportion also appear to be socially isolated, especially in terms of objective measures of social network structure (Koopman-Boyden & Waldegrave, 2009a; Walden, 2004). In the current study, for both the social network structure and perceived connectedness subscales, 11% of the general sample and 16% of the Māori subsample scored more than one standard deviation below the mean. More specifically, 11% of the total sample reported having no close local ties, a tenth had no children or grandchildren, nearly a fifth reported having no face-to-face social interactions in the past week, a third to a half had occasional or no contact with children or grandchildren, and a third attended no meetings. Between 1 and 8% of the sample responded to the lowest response items on the perceived connectedness subscale. Six percent said

they were extremely or very dissatisfied with their social networks, a proportion similar to the 3-4% who reported dissatisfaction in the EWAS study (Koopman-Boyden & Waldegrave, 2009b).

**Perceived connectedness outweighs structural integration.**

Existing research has consistently reported that older adults tend to evaluate their social networks positively, even when they are objectively socially isolated (Cornwell & Waite, 2009; Schnittker, 2007). This was true for the current study, in that participants tended to indicate higher levels of perceived connectedness relative to objective indicators of isolation.

Unfortunately, the present study was unable to examine the processes through which older adults tend to perceive themselves as more connected. It could be due to a positivity bias, in which older people tend to perceive relationships especially positively (Charles, 2010; Schnittker, 2007). It could also reflect actual high quality of relationships due to socioemotional selectivity and interpersonal skills that are not captured by measures of structural integration (Carstensen et al., 2003; Charles, 2010). Future studies could help clarify which processes lead to the discrepancy between objective and subjective indicators of social integrations, by ensuring that measures are able to distinguish between quality and perceived quality of interactions. The inclusion of an objective indicator of relationship quality (e.g. number of negative and positive interactions, received support) would not only allow the researcher to tease out the difference between actual versus perceived quality of interactions, it would provide a measure of negative interactions that are of interest to researchers. Some social interactions may actually be harmful to an individual's well-being: Not all older adults' ties and interactions are positive, with some individuals suffering from conflict interactions, emotionally distant ties, unsupportive ties, and elder abuse (Krause, 2005). The impact of negative interactions on older adults' health, including depression, remains to be further explored. Ideally, research could investigate the impact of negative and positive interactions, measured objectively and in terms of perceived connectedness, within the same study.

### **8.3. The Relationship Between Components of Social Network Structure and Depression**

The current study sought to clarify the relative impact of features of social network structure on depression among older people. Most research to date has measured social networks as a whole construct, yet specific features of social networks may be more important in determining depression, and consequently be better targets for interventions. Research that has investigated specific features of older peoples' social networks, such as frequency of interactions and number of social contacts, has tended to study these in isolation without consideration of other social network components. The subsections below discuss findings on the relationship between specific features of social networks and depression.

#### **Network size.**

Socio-emotional selectivity theory argues, with empirical support, that older people tend to have smaller but more emotionally rewarding networks relative to younger people (Carstensen et al., 2003). Thus it was hypothesised that social network size would not be an important predictor of depressive symptoms. Contrary to expectations, however, the current study found that the number of local non-family ties was a significant predictor and that the size of the prediction was comparable to other objective indicators (e.g. items assessing frequency of interactions),  $r = -.43, p < .001$ . It is possible that this is due to how social network size was measured; the DSSI item used to indicate network size takes into consideration a tendency for older adults to have relatively small networks in the first place (the highest score on the item is obtained by reporting only three close non-family ties), so the significant relationship may actually be indicating that those with *especially* small networks are at higher risk of depression relative to those with networks that are of average size for the older population (i.e. 3 or more; Bowling, 1994; Cornwell & Waite, 2009; Koopman-Boyden & Waldegrave, 2009a; Wenger, 1991). This makes sense as those with especially small social networks (e.g. one or no close local ties) are unlikely to have their social needs met and subsequently be more vulnerable to

depression (Wenger, 1997). Like the Duke measure, it could of benefit for other composite measures to include an indicator of social network size that similarly distinguish those with an insufficiently small number of social ties (e.g. one or none).

#### **Types of social ties.**

##### ***Being married.***

Like other studies have found, married individuals were at significantly lower risk of depressive symptoms. Being married also predicted lower levels of depression 18-months later, even after controlling for other social network variables and demographic and health predictors. The strength of the prediction, although small, was comparable to the effect of regular exercise and greater than alcohol use, smoking, or educational status. When considering the relative size of the effect of being married on depressive symptoms and the nature of marital relationships (i.e. often especially close tie, a main source of social support and regular contact) it appears that marital status would be best kept as a separate component from composite measures of social integration as it could disproportionately weight measures.

Among older Māori, marital status was not a statistically significant predictor. However, this was probably due to the smaller sample size (i.e. low power to detect a significant effect), as those who were unmarried had higher depression scores at all three measurement points. Overall findings support the generalisability of existing international research, which collectively demonstrate the significance of being married to depression in later life across a variety of cultures (Anstey et al., 2007; Chao, 2011; Djernes, 2006; Hong et al., 2009; Ramos & Wilmoth, 2003; Vanderhorst & McLaren, 2005; Zunzunegui et al., 2005). Of note, this research added longitudinal findings that, although marital status predicted lower depression scores over three years, it did not alter the rate of change in depressive symptoms over this time.

##### ***Non-family ties vs family ties.***

Both proximity of family ties (children and grandchildren) and frequency of interactions with these ties were unimportant predictors of depression in the

current sample of older New Zealanders generally and older Māori ( $p > .05$ ). This was surprising because children and grandchildren are thought to be a central part of the lives of older New Zealanders (Koopman-Boyden & Waldegrave, 2009a; Ministry of Social Development, 2007; Stephens, 2008), and consequently were expected to be protective against depression.

Studies overseas have also found family ties did not predict lower levels of depression among older adults (Chao, 2011; Doubova et al., 2010; Fiori et al., 2006; Golden, Conroy, & Lawlor, 2009; Litwin & Shiovitz-Ezra, 2010). It was hypothesised in the present study that this was not because family ties are not protective against depression, but because those with high degrees of family contact may have higher levels of functional disability and fewer non-family ties. However, this hypothesis was not supported: There was no evidence of a link between either functional ability or number of non-family ties and contact with family in predicting depressive symptoms. In contrast, contact with non-family ties significantly predicted fewer depressive symptoms, suggesting that they are relatively important.

These findings are not to say that family relationships are unimportant to the wellbeing of older people or do not meet important social needs. What these findings do suggest, however, is that in the context of depression non-family ties are more influential whereby family ties are not indicated to be significant. Compared to family ties, non-family ties are often voluntary, friendships can represent particularly valuable sources of comradeship and emotional support, shared history and interests, are less likely to involve providing obligatory support, and are more likely to be reciprocal (Adams, 1986; Pinquart & Sorensen, 2001). Community ties could have further benefits of encouraging feelings of belonging, productivity, self-expression, and cultural identification (Johnson, 2005; Waldegrave, 2009; Walden, 2004). Such features could contribute to boosted self-esteem and morale, a sense of autonomy, and provide opportunity for positive experiences which could protect against depression (Adams, 1986). Perhaps these benefits are more pertinent to bolstering an older person from depressive symptoms than family relationships.

Social interventions aimed at improving depression may therefore be better to specifically target non-family ties, such as attendance of community groups and interactions with friends. The mechanisms through which non-family ties result in reduced risk of depression, however, have not been established. This has been identified as an important gap in friendship literature (R. G. Adams & Blieszner, 1994). Exploration of this was unfortunately beyond the scope of the present study but research into these mechanisms is needed to inform such interventions.

#### **Frequency of social interactions.**

The current study found that frequent social interactions were associated with fewer depressive symptoms. This adds to the small number of studies that have examined frequency of social interaction in the context of older adults (Glass et al., 2006; Hong et al., 2009; van der Pas & Koopman-Boyden, 2009). A composite measure of social interaction frequency, developed for the purposes of this study, had a small relationship with depressive symptoms ( $r = -.09, p < .05$ ). However, the size of the relationship for individual items, such as frequency of face-to-face and phone interactions ( $r = -.38, p < .001$  for both), were much larger. The discrepancy appears to be because the composite measure included items relating to family interactions. Composite measures of social interaction frequency used in depression research are therefore discouraged from including items relating to family contact, which have been suggested by the literature including in the present study, to be a relatively unimportant predictor of depression.

#### **Types of social interactions.**

In the present study, frequency of face-to-face interactions and phone interactions equally predicted depression. This is a valuable finding as no other study assessing the impact on face-to-face versus non-face-to-face interactions was found in the literature, yet older people tend to have social interactions both face-to-face and on the phone (Koopman-Boyden & Waldegrave, 2009b). Attendance of meetings (such as clubs, religious groups, or hui) was a slightly stronger predictor ( $r = -.52, p < .001$ ) of depressive symptoms. This may represent unique social benefits relevant to

depression risk, such as a sense of group belonging and engaging in shared interests. It is possible that the size of the reported relationship is exaggerated by benefits outside of social interaction, such as protective effects of private religiosity in the case of participation in religious community groups (e.g. Cruz et al., 2009).

Provision of daily care or assistance was not a predictor of depressive symptoms after controlling for other types of social interactions. This does not necessarily go against the notion that being a caregiver increases risk of depression, as the present study was not able to distinguish between caregiving and regular support that might not involve caregiving burden. In fact, bivariate analyses suggested that those who provided regular support had slightly lower depressive scores, which may be because, outside of caregiving stress and burden, providing regular support reinforces feelings of being useful and involved in one's social network. In the current study the feeling of being useful and having a definite role were two of the items in the perceived connectedness measure that had the strongest relationship with depressive symptoms ( $r = -.74$  and  $r = -.60$ ,  $p < .001$ ).

In some respects, findings on types of social interactions support the notion that some activities predict depressive symptoms whereas others do not (Hong et al., 2009), in that meeting attendance, and both phone and face-to-face interactions with non-family ties appear to be significant predictors of depression, whereas contact with family both face-to-face or non-face-to-face and potentially general provision of daily care do not. However, findings do not contraindicate the use of composite measures of social interaction, as the size of the relationship between depression and those significant predictors were similar, and when combined in a composite measure (i.e. with social network size to become the DSSI Structural Integration subscale) they significantly predicted depression. Therefore, composite measures of social interactions may be useful in predicting depression, if they exclude interactions with family ties.

Regrettably, the extent to which the relative impact of different types of social interactions could be investigated in the present study was limited. Given the different physiological, health behavioural, and psychological

pathways through which they might influence depression (Berkman et al., 2000), it would also have been of interest to see, for example, the relative effect of social interactions that were physically active, cognitively active, or more passive. It would also be of interest to clarify the pathways through which certain types of social interaction influence depression: To the author's knowledge, no published research has investigated psychological pathways such as feelings of belonging and usefulness in relation to engagement in different types of activities or with different social ties.

#### **8.4. Structural Social Integration and Depression**

As expected, structural integration as a whole construct was a significant predictor of depression. Higher scores on the DSSI Structural Integration subscale (renamed for the purposes of this study) significantly predicted lower depression scores at baseline, even after controlling for perceived connectedness, being married, and significant demographic (age, education) and health-related (activities of daily living, exercise, alcohol use, and smoking) predictors. This is consistent with findings from typology studies that more structurally integrated networks have lower levels of depressive symptoms (K. B. Adams et al., 2004; Cacioppo et al., 2010; Chan et al., 2011; Cheng et al., 2009; Doubova et al., 2010; Fiori et al., 2006, 2007; Golden, Conroy, & Lawlor, 2009; Golden, Conroy, Bruce, et al., 2009; Litwin & Shiovitz-Ezra, 2010; Schwarzbach et al., 2013; Sicotte et al., 2008).

The current study further validated a typology approach to social networks in depression research, as components of social network structure predicted depression to a relatively equal degree, with the exception, perhaps, of being married and contact with family. Overall this study suggests that in depression research with older adults, measures of social interaction frequency, number of social ties (especially differentiating those that are too small to meet an older persons social needs), contact with non-family ties face-to-face and non-face-to-face (e.g. on the phone), and attendance of group activities, should be included in a composite measure

used to capture overall degrees of social integration and in determining social network types. Doubts have been raised regarding the relevance of family ties, including in the present study (Chao, 2011; Doubova et al., 2010; Fiori et al., 2006; Golden, Conroy, & Lawlor, 2009; Litwin & Shiovitz-Ezra, 2010), implying that non-family ties are a better focus for composite measures of objective social integration in depression research. Moreover, marital status, which was a relatively strong predictor, may be better measured as a separate construct.

An important observation from results is the finding that, after the inclusion of controls, the size of the relationship between social network structure and depressive symptoms both cross-sectionally and prospectively was small, usually less than half that of functional disability. For instance, in the multivariate model at baseline structural integration uniquely predicted only 1% of the variability in depression and a total  $R^2$  change of .03 ( $p < .05$ ). In the baseline multivariate model with data from older Māori, structural integration uniquely predicted 6% of the variability in depression scores and a total  $R^2$  change of .06, which is a greater degree of prediction. However, the difference in prediction size between the general and Māori sample may be due to the inclusion of fewer control variables in the multivariate model for Māori data (as less were found to be significant in bivariate analyses probably because of the smaller sample size). Overall, the small predictive effect of social network variables suggests that current theory and literature may have inflated the importance of social networks in determining depression risk. This may be because many studies have not included important confounding variables, such as physical disability, in their models. For example, Vanderhorst and McLaren (2005) reported that after marital status, perceived social support explained 29% of the variance in depressive symptoms, but they did not include a control for physical disability or cognitive impairment.

In terms of longitudinal findings, higher levels of structural social integration significantly predicted fewer depressive symptoms up to 36-months later, but did not significantly predict differences in rate of change in depressive symptoms. That is, even though those with higher initial levels

of structural integration had lower levels of depressive symptoms at all three time-points, they were equally likely to experience the trend of a small increase in depressive symptoms. This implies a cross-sectional relationship contrary to the expectation that social integration would alter the course of depressive symptoms over time. The present study was one of the first known studies to investigate the longitudinal relationship between objectively defined social integration as a whole construct and depressive symptoms. Employment of multi-level methods for examining change also meant the current study was able to examine inter-individual variability in rate of change.

The present study's finding that social integration did not predict individual rate of change over time does not necessarily contraindicate social interventions aimed at changing risk for depression or course of depressive symptoms over time, as the current study was based on descriptive data. There is preliminary evidence that when an intervention targets social networks, depressive symptoms can change. For example, Greaves and Farbus (2006) examined an intervention aimed at increasing social participation and creative activities among older adults. They found the intervention was associated with a significant reduction in depression scores up to 12 months post-treatment. Semi-structured interviews with 26 of the participants, 5 of the carers, and 4 of the referring health professionals revealed that all thought the intervention had psychological benefits, and predominantly attributed these benefits to increased social interaction and the perceived quality of these interactions (Greaves & Farbus, 2006). Participants reported that engaging in new activities and interacting with new people helped them gain confidence, optimism, self-worth, willingness to engage in life, and improved their health behaviours (Greaves & Farbus, 2006). More research is needed to investigate the effectiveness of social interventions aimed at changing depression. There are a surprising lack of studies that have successfully changed social isolation among older people (Findlay, 2003), though the assumption is usually for interventions to target the social networks rather than perceived connectedness which may be a better target for intervention.

## **8.5. Perceived Connectedness as a Mediator of the Relationship Between Social Networks and Depression**

Although there are physiological and health-behavioural pathways through which social networks can influence health (Berkman et al., 2000), it is likely that psychological pathways, such as the feeling of belonging and being supported, rely on one's perception of their social networks as connected. Similarly, the psychological harms of having an isolated social network probably rely on one's perception of their social networks as isolated. The present study thus hypothesised that perceived connectedness would partially mediate the effect of social networks on depression. Empirical evidence for a mediation effect is minimal to date (Cornwell & Waite, 2009; Fiori et al., 2006). In fact, most research has not investigated structural social integration and perceived connectedness within the same study. The current study found that levels of perceived connectedness mediated just under a third (29%) of the effect of structural social integration on depressive symptoms. This mediation effect was significant according to Sobel's (1982) test;  $z = -8.51$ ,  $p < .01$  and controlled for significant health and demographic predictors.

The finding that perceived connectedness mediates the effect of social network structure on depression is support for theories that emphasise cognitive attributions in the etiology of depression. Often research on depression in later life fails to investigate the mechanisms through which social factors influence depression and this study has been able to shed some light on the role of attributions. This study suggests that clinicians could benefit from a better understanding of the causal mechanisms leading to depression. In this case, it implies that rather than a focus on the literal support network a person has, clinicians asking older people about their perceptions of their social networks and the value of this to them could be more important. An understanding of these mechanisms could also help to inform intervention development. At a wider level, this implies that providers of socially-orientated interventions for depression should attend not only to improving structural aspects of social networks such as

frequency of interactions, but also to help improving the attributions the older person makes about their social network. Further support for this comes from consistent findings, including in the present study, in which perceived connectedness is a greater predictor of depression relative to structural integration. Specific research investigating the effectiveness of interventions aimed at bolstering perceived connectedness is needed.

## **8.6. Conclusion: Study Implications and Recommendations**

The present study made four main findings that have implications in terms of informing research and intervention efforts for depressive symptoms among community-dwelling older adults: First was the finding that particular features of social networks did influence depressive symptoms more than other features. Second, the finding that perceived connectedness partially mediates the impact of structural social integration on depression and provides support for the theory that attributions about one's network are central to the relationship between social networks and depression. Third, the significance of social networks as a means to assess risk of depression in later life was challenged by the finding that the size of the predictive effect of both structural social integration and perceived connectedness was relatively small and longitudinally did not predict differences in rate of change in depressive symptoms. Fourth, findings were based on a sample of older New Zealanders and a subsample of older Māori, of which to date there is little knowledge about prevalence of depressive symptoms and the nature of social networks. Findings in these unstudied populations were generally consistent with international research, supporting generalisability of the findings.

### **Subcomponents of older peoples' social networks do differentially contribute to depressive symptoms.**

Being married, having frequent contact with non-family ties including attending group meetings (e.g. of cultural or religious community groups), having interactions face-to-face, and on the phone, and having at least three close ties were all found to predict fewer depressive symptoms. The size of

the predictive effect was similar among those variables found to be significant. This supports the use of typologies or other composite measures as single indicators of social integration in depression research among older people, because no particular feature is likely to dominate reported associations with depression. One exception to this is marital status, which had a relatively stronger predictive effect. It is therefore recommended that marital status be excluded from composite indicators. In support of this suggestion, a typology study by Fiori, Antonucci, and Akiyama (2008) found that inclusion of marital status in a network cluster analysis effectively resulted in a new network type in which one commonly found network type had become split according to whether or not individuals were married.

The current study found that proximity of children or grandchildren and contact with them both face-to-face and non-face-to-face were unrelated to depressive symptoms. This, combined with findings from a number of other studies reporting that family ties do not have a protective effect, suggests that contact with family ties should be excluded from composite indicators of structural integration and negates family-ties being part of social interventions for depression in later life. Instead, findings suggest that interventions aimed at enhancing non-family ties and using phone interactions (or other non-face-to-face means) to facilitate close, emotionally rewarding relationships could potentially be useful interventions for depression in later life and thus indicates further empirical investigation. There is preliminary evidence that non-family based social interventions are effective in the treatment of depression among community-dwelling older adults (e.g. Bell, 2011; Greaves & Farbus, 2006), though the lack of research on social interventions in general is surprising and clearly further investigation is needed (Findlay, 2003).

**Perceived connectedness does partially mediate the relationship between objective social integration and depression.**

The finding that perceived connectedness not only is a stronger predictor of depressive symptoms among older adults than structural social integration but also mediates the effect that structural social integration has on

depressive symptoms has important implications. First, it provides support for the hypothesis that the psychological pathways through which social networks are thought to influence health rely at least in part on one's perceived level of connectedness (Berkman et al., 2000). This is rare empirical evidence of the mechanisms by which structurally defined social integration are thought to influence depression. This finding also provides empirical support for cognitive theory on the aetiology of depression, which places emphasis on the role of attributions including attributions that an individual makes about their social relationships (J. S. Beck, 1995).

Although this study was not able to provide thorough investigation of all the mechanisms through which social networks influence health, it was able to provide some unique insight into at least one mechanism, perceived support. Further research is needed to explore other mechanisms that contribute to depression in later life, including those related to non-psychological (i.e. physiological and health behavioural) pathways. Currently, social research is based on theory that largely remains to be empirically investigated, and consequently is frequently criticised for investigating *what* relationships exist without understanding *how* they exist. Further research is also implicated in the area of treatment: Research findings to date indicate that perceived connectedness may be a better target for depression interventions among older people but it needs to be clarified whether interventions aimed at bolstering perceived connectedness (e.g. rather than the social networks themselves) are actually effective.

**Social integration was not a strong longitudinal predictor of depressive symptoms.**

One of the most surprising findings was that longitudinally the predictive effect of social network variables on depressive symptoms was small. After controls, structural social integration, being married, and perceived connectedness combined uniquely predicted only 2% ( $p < .001$ ) of the variability in depressive symptoms up to 36-months later. Moreover, a multi-level model for change found that social integration did not predict variability in individuals' rate of change in depressive symptoms over time. These findings suggest that, when left to their own devices, social networks

and perceived connectedness do not respond in a way that act strongly to protectively alter the course of depressive symptoms. Although the present study could not explicitly examine changes in social integration over time, a small number of other studies have tracked social networks and found them to be relatively stable (Ertel, Glymour, & Berkman, 2009; Voils et al., 2007; Weyerer et al., 2008). Of most relevance is a study by Voils et al. (2007), in which a group of over 300 depressed young-old adults were tracked over five years. They found that, despite fluctuating levels of depressive symptoms, social network size and interactions remained stable over time and perceived levels of support increased only slightly (Voils et al., 2007).

One inference from this is that other factors are probably better indicators of depression risk. For instance, a number of other studies found that functional ability or physical health measures explained substantially more variance in depression than social network measures (e.g. K. B. Adams et al., 2004; Fiori et al., 2006; Warren-Findlow, Laditka, Laditka, & Thompson, 2011), including increases in depressive symptoms over time (Hong et al., 2009). Another possibility is that social integration is a more significant predictor of depressive symptoms for some older people but not for others. Distinguishing between sub-types of depression profiles may be particularly valuable among older people for whom aetiology of depressive symptoms is especially heterogeneous (Blazer & Hybels, 2005). For instance, in the aetiology of late-onset depression, which is estimated to represent about half of incidences of depression among older adults, biological risk is thought to be paramount (Fiske et al., 2009). In these cases one's degree of social integration may be less influential. Further research is needed to compare the effect of social integration on depressive symptoms among those with previous history of depression or with or without other known biological risk factors such as cardiovascular disease.

**Generalisability of findings between older New Zealanders, older New Zealand Māori, and older people overseas.**

Overall findings support the generalisability of international research findings regarding the prevalence of depressive symptoms, and the relative importance of perceived connectedness, structural integration as a whole,

and specific features of social networks.

It should also be acknowledged that investigations on Māori data were constrained to the symptomatology framework of understanding depression. This is not necessarily conducive to Māori conceptualisations of depressive symptoms, such as the Te Whare Tapa Wha approach (Durie, 1985), which was unfortunately outside of the scope of the present study. It is possible that, although the same relationship between social networks and depression were effectively found among the general New Zealand sample, this does not imply that older Māori experiences of depression and the effectiveness of social interventions aimed at addressing depressive symptoms would be equally suited to a Māori and non-Māori population. Currently there are clear barriers to primary and secondary care among Māori that need to be understood and subsequently addressed (Baxter, 2008). For instance, only 39% of Māori with a mood disorder were found to have had contact with a healthcare provider in the last 12 months (Baxter, 2008). Kaupapa Māori research is required to seek understandings of best practice for detection and management of social isolation and depressive symptoms among older Māori.

#### **Study strengths and limitations.**

The current study was able to investigate the relationship between depressive symptoms and structural integration, in particular the social network components used to define structural integration, and perceived connectedness among community-dwelling older adults. Findings shed light on the relative importance and relationship between components of social integration, which has implications in terms of measurement of social integration and potentially informing the focus of social interventions for depressive symptoms in that population.

Although most independent, community-dwelling older adults are not depressed, there are a small but significant number of depressed older adults and up to a quarter who experience clinically significant levels of depressive symptoms, both of which are associated with significant suffering and costs to the individual and community. Social factors such as social isolation and perceived isolation are thought to play a key role in the

aetiology of depressive symptoms, and social integration is thought to be a significant protective factor. Objective social integration (as defined by social network structure) and perceived connectedness are particularly disjointed among older adults: Although older adults are more vulnerable to social isolation as it is objectively defined relative to younger adults, they tend to report higher levels of perceived connectedness. The present study found that structural social integration significantly predicted fewer depressive symptoms up to 36-months later, with the exclusion of family ties which have been found by a number of studies including this one to not predict depressive symptoms in older people. However, perceived connectedness was an even stronger predictor, and was actually found to mediate nearly a third of the effect that structural social integration had on depressive symptoms. Longitudinally, however, social networks and levels of perceived connectedness did not impact the course of depressive symptoms, suggesting that without intervention levels of social integration may not respond to act protectively against depression and that other factors such as biological contributors or functional disability may be better indicators of depression risk.

These research findings suggest that family-ties should be excluded from composite measures of structural social integration, indicated that perceived connectedness would be a better target for social interventions than social networks themselves, and challenged the feasibility of social integration to predict depression risk. Findings also support the generalisability of international research findings regarding the significance of social integration to a New Zealand and New Zealand Māori context, though cultural considerations are no doubt needed when designing and evaluating interventions.

A major strength of this research was that perceived connectedness and structural social integration were examined within the same study, including longitudinally. The large sample size enabled a number of important confounding variables such as functional ability to be controlled for, which have often been missed in pre-existing research and allows for relative confidence in the reported relationships between social variables

and depression. A unique and valuable feature of the present study was the availability of follow-up data up to three years later for depressive symptoms, using a high quality indicator of depressive symptomatology well suited to the population. The status of depressive symptoms and social integration, and the relationship between these factors, had also not been established to date among older New Zealanders, and New Zealand Māori specifically. This is especially valuable in the context of an ageing population in New Zealand in which understanding the health needs of older people is paramount.

This study was not without a number of limitations that require acknowledgement and can hopefully be addressed by future research. Most notably, the present study utilised a pre-existing dataset for which the present study's research questions were not the focus. This meant that measures were restricted to what was available. For instance, social integration was only measured at baseline, so caution is still required regarding the direction of the relationship between depressive symptoms and social integration. It could also not be assessed whether levels of social integration changed over time in a way that was relevant to the course of depressive symptoms. Measures of structural indicators of social integration also relied on self-report, which may have been influenced by one's perceived level of connectedness and depressive symptoms. Reports by significant others, where possible, may be more reliable indicators or could be used as an indicator of self-report reliability. A final limitation in terms of measurement is that the level to which perceived connectedness indicated actual quality of relationships versus the tendency for older people to evaluate their relationships more positively is unclear. Future studies are implicated to investigate these two potential factors within the construct of perceived connectedness and their relative effect on depression among older people.

As prior-mentioned, social research has been criticized for neglecting the study of the mechanisms through which social networks impact health (R. G. Adams & Blieszner, 1994). Qualitative research discussing with older people the meaning of social contact, ties, and their

relationship with depressive symptoms are needed. Such studies are largely non-existent. The present study was able to shed light on one small mechanism, perceived connectedness, which is argued to facilitate the psychological pathways through which social networks influence depression. Future researchers are urged to focus not only on *what* relationships exist, but to examine for empirical evidence for theory on *how* social networks influence depression among older adults.

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## Appendix B

### The Duke Social Support Inventory (Short Form)

*Taken directly from the BRIGHT trial questionnaires.*

The following questions are about your social support network:

1. Other than members of your family, how many persons in your local area do you feel you can depend on or feel very close to?

Number of people:

2. How many times during the past week did you spend time with someone who does not live with you, that is, you went to see them or they came to visit you or you went out together?

Number of times:

3. How many times did you talk to someone, friends, relatives or others on the telephone in the past week (either they called you, or you called them)?

Number of times:

4. About how often did you go to meetings of clubs, hui, religious meetings, or other groups that you belong to in the past week?

Number of times:

5. Does it seem that your family and friends (i.e. people who are important to you) understand you?

None of the time	<input type="checkbox"/>
Hardly ever	<input type="checkbox"/>
Some of the time	<input type="checkbox"/>
Most of the time	<input type="checkbox"/>
All of the time	<input type="checkbox"/>

6. Do you feel useful to your family and friends (people important to you)?

None of the time	<input type="checkbox"/>
Hardly ever	<input type="checkbox"/>
Some of the time	<input type="checkbox"/>
Most of the time	<input type="checkbox"/>
All of the time	<input type="checkbox"/>

7. Do you know what is going on with your family and friends?

None of the time	<input type="checkbox"/>
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- Hardly ever
- Some of the time
- Most of the time
- All of the time

8. When you are talking with your family and friends, do you feel you are being listened to?

- None of the time
- Hardly ever
- Some of the time
- Most of the time
- All of the time

9. Do you feel you have a definite role (place) in your family and among your friends?

- None of the time
- Hardly ever
- Some of the time
- Most of the time
- All of the time

10. Can you talk about your deepest problems with at least some of your family and friends?

- None of the time
- Hardly ever
- Some of the time
- Most of the time
- All of the time

11. How satisfied are you with the kinds of relationships you have with your family and friends?

- Extremely dissatisfied
- Very dissatisfied
- Somewhat dissatisfied
- Satisfied most of the time
- Satisfied all of the time

## Appendix C

### Summary of BRIGHT Trial Self-Completion Questionnaire or Telephone Interview Questionnaire Items Used As Indicators of Social Network Subcomponents

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Construct	Item
	<i>Response scoring</i>
Proximity of children and grandchildren	'How many [children / grandchildren] live close by?' <i>1. No children; 2. Children, none close by; 3. Children, at least one close by</i> <i>Same scoring for grandchildren item</i>
Frequency of interaction with children and grandchildren	'How often do you normally see or visit with one of your [children / grandchildren]?' and 'How often do you normally have phone, mail, or email contact with one or more of your grand/children?' <i>1. Daily; 2. Weekly; 3. Monthly; 4. Occasionally, never, or no children</i> <i>Same scoring for grandchildren items</i>
Provision of care to others	'Do you provide care or daily assistance for someone else?' <i>Yes / No</i>
Marital status	'Can you please tell be if you are:' <i>Married; single; divorced/separated; widow or widower</i>

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## Appendix D

### The Nottingham Extended Activities of Daily Living Scale

*Taken directly from the BRIGHT trial questionnaires.*

#### Instructions:

The following questions are about whether you are able to do particular activities. We want to know whether you do them:

On your own  
On your own with difficulty  
With help  
Not able to do the activity

**Scoring:** 1 – on my own; on my own with difficulty  
2 – with help; no

#### 1. Mobility

1. Do you walk around outside?
2. Do you climb stairs?
3. Do you get in and out of the car?
4. Do you walk over uneven ground?
5. Do you cross roads?
6. Do you travel on public transport?


#### 2. In the kitchen

1. Do you manage to feed yourself?
2. Do you manage to make yourself a hot drink?
3. Do you take hot drinks from one room to another?
4. Do you do the washing up?
5. Do you make yourself a hot snack?


#### 3. Domestic tasks

1. Do you manage your own money when you are out?
2. Do you wash small items of clothing?
3. Do you do your own housework?
4. Do you do your own shopping?
5. Do you do a full clothes wash?


#### 4. Leisure activities

- Do you read newspapers or books?
- Do you use the telephone?
- Do you write letters?
- Do you go out socially?
- Do you manage your own garden?
- Do you drive a car?


## Appendix E

### Results Of Confirmatory Factor Analysis For The Duke Social Support Inventory (Short Form)

Confirmatory factor analysis (CFA) using maximum likelihood estimation investigated the hypothesised two factor model of the Duke Social Support Inventory (DSSI). This analysis was completed on non-imputed data using the R package *Structural Equation Models (sem)*, version 3.0, ((Fox et al., 2012). Univariate and multivariate outliers (detailed in section 7.1) were excluded.

#### **Sample size and missing data.**

Of the 3594 participants, 916 had missing values on one or more variables. With those cases deleted, confirmatory factor analysis was conducted on responses of 2678 older adult participants. The ratio of cases to the 11 observed variables is 243:1.

#### **Normality.**

Distributions of the 11 item variables were examined for skewness. All items were significantly different from the normal distribution ( $W = .68$  to  $.85$ ,  $p < .001$ ) and negatively skewed (skewness =  $-.30$  to  $-1.64$ ), except for item four, which was positively skewed (skewness =  $.64$ ). Deletion of variables or variable transformation was not performed, as the DSSI is already published and in use and maximum likelihood estimation has been identified as appropriate with non-normal samples with sample sizes larger than 2,500 (Hu, Bentler, & Kano, 1992).

#### **Linearity, multicollinearity and singularity.**

Differences in skewness for variables suggested the possibility of curvilinearity for some pairs of variables. Examination of all pairwise scatterplots was impractical so a spot check on a sample of 6 plots was run, with an emphasis on those expected to be among the worst (e.g. Item 1 with a negative skew of  $-1.11$  against Item 4 with a positive skew of  $.64$ ). No significant curvilinear relationships were identified, supporting the assumption of linearity. Multicollinearity and singularity did not appear to be a threat in this data as no variables were very highly correlated.

### CFA model estimation.

Results of the model are summarised in Figure F1. Note that the variance of factor 1 and 2 were fixed at 1 for the model. The comparative fit index (Bentler, 1990) was .97 (i.e greater than the .95 cut off) and the root mean square error of approximations (Browne & Cudeck, 1993) was .03 (i.e. less than the .10 cut-off), both of which indicated a good fitting model. Additionally, all residuals were close to zero and the standardised root mean square residual (SRMR) was .03, less than the .08 cut-off.

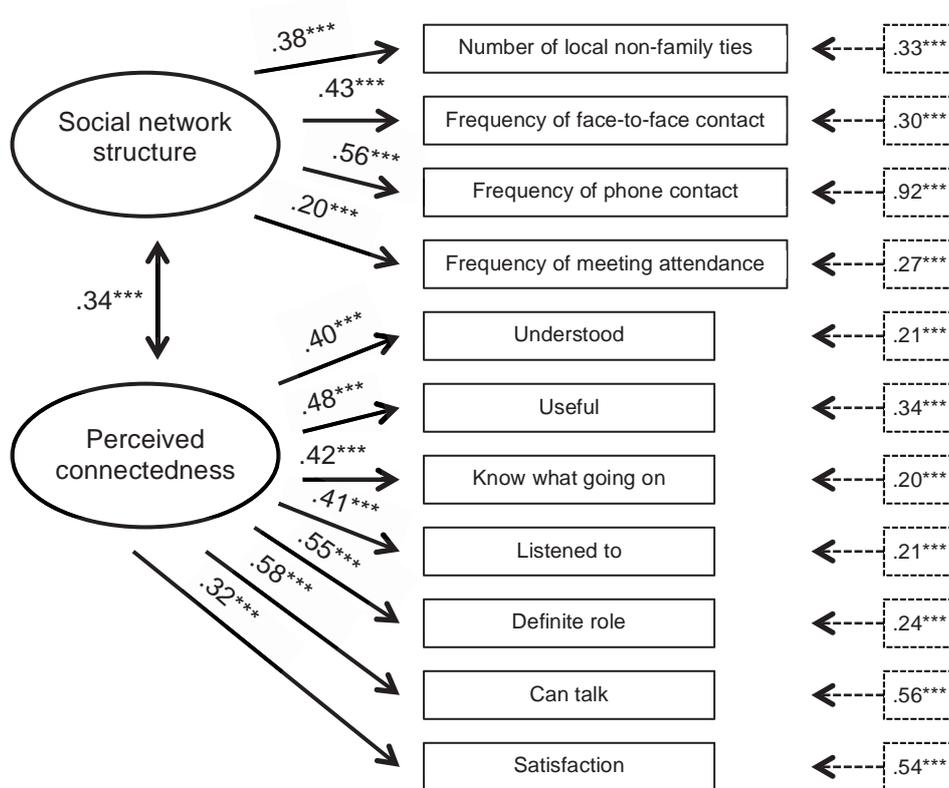


Figure AF1. Confirmatory factor analysis model for Duke Social Support Index with two hypothesised factors of social network structure and perceived connectedness.

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

## Appendix F

### Summary Statistics for DSSI items and BRIGHT Social Network related items

Item	Mean <sub>1</sub> (SD)	Proportions <sup>2</sup>	
DSSI Item 1: Number of local non-family ties	2.49 (0.68)	0 1 - 4 5 +	11% 55% 35%
DSSI Item 2: Frequency of face-to-face social interactions	2.37 (0.69)	0 1 - 4 5 +	19% 69% 12%
DSSI Item 3: Frequency of phone social interactions	2.41 (0.64)	0 1 - 4 5 +	3% 36% 61%
DSSI Item 4: Frequency of attendance of meetings of clubs, hui, religious or other groups	1.52 (0.59)	0 1 - 4 5+	31% 63% 6%
DSSI Item 5: Feels understood	4.21 (0.64)	1. None of the time 2. Hardly ever 3. Some of the time 4. Most of the time 5. All of the time	<1% 1% 8% 60% 31%
DSSI Item 6: Feels useful	3.78 (0.79)	1. None of the time 2. Hardly ever 3. Some of the time 4. Most of the time 5. All of the time	1% 3% 19% 52% 25%
DSSI Item 7: Feels that they know what is going on	3.93 (0.64)	1. None of the time 2. Hardly ever 3. Some of the time 4. Most of the time 5. All of the time	<1% 1% 18% 65% 15%
DSSI Item 8: Feels listened to	4.13 (0.64)	1. None of the time 2. Hardly ever 3. Some of the time 4. Most of the time 5. All of the time	<1% 1% 11% 62% 26%
DSSI Item 9: Definite role	4.17 (0.77)	1. None of the time 2. Hardly ever 3. Some of the time 4. Most of the time 5. All of the time	1% 2% 13% 49% 6%

DSSI Item 10: Can talk	3.90 (0.97)	1. None of the time 2. Hardly ever 3. Some of the time 4. Most of the time 5. All of the time	2% 6% 21% 41% 30%
DSSI Item 11: Satisfaction	4.24 (0.82)	1. Extremely dissatisfied 2. Very dissatisfied 3. Somewhat dissatisfied 4. Satisfied most of the time 5. Satisfied all of the time	2% 4% 3% 52% 40%
BRIGHT Childr/en close by		No children No close child Child/ren close	8% 20% 72%
BRIGHT Grandchild/ren close by		No grandchildren No close grandchildren Grandchild/ren close	10% 32% 58%
BRIGHT Frequency of face-to-face interactions with child/ren	2.55 (1.10)	1. Daily 2. Weekly 3. Monthly 4. Occasionally / Never	17% 42% 10% 31%
BRIGHT Frequency of phone or email interactions with child/ren	2.07 (1.00)	1. Daily 2. Weekly 3. Monthly 4. Occasionally / Never	31% 47% 6% 16%
BRIGHT Frequency of face-to-face interactions with grandchild/ren	3.09 (1.03)	1. Daily 2. Weekly 3. Monthly 4. Occasionally / Never	6% 29% 13% 51%
BRIGHT Frequency of phone or email interactions with grandchild/ren	3.13 (1.01)	1. Daily 2. Weekly 3. Monthly 4. Occasionally / Never	6% 29% 12% 53%
BRIGHT Provision of daily care or assistance to others		No Yes <i>To spouse</i> <i>To other</i>	71% 29% 19% 10%

Note. <sup>1</sup> = DSSI structural integration subscale items scaled as per Table 5; <sup>2</sup> = raw scores

## Appendix G

### Summary of Comparison of Results of Baseline Linear Regression Models with Multilevel Linear Regression Models Adjusting for Nesting of Participants by General Practice

Table AG1

*Comparison of Baseline Regression Model 1 (Health and Demographic Predictors Only) with Model Re-run as a Multilevel Regression Model Adjusting for Nesting of Participants by General Practice*

Predictors	Baseline	
	Model 1	Model 1 with mixed effects
	$\beta$	$\beta$
Intercept	5.31	5.28
Age	.02	.02
Post-High school Education <sup>1</sup>	- .14	- .15
NEADL	- .26	- .26
Exercise <sup>1</sup>	- .40	- .40
Never drink alcohol <sup>1</sup>	.26	.25
Never Smoked <sup>1</sup>	- .23	- .23
Random effects:		
Practice Mean GDS Score (Intercept)		.02
Residual		2.96
Model Fit Statistics:		
AIC		12019
BIC		12073
Deviance		11967

Note: 1 = Dummy coded variables as per Table 13. NEADL = Nottingham

Extended Activities of Daily Living Scale. This note applies to all tables in Appendix

G.

Table AG2

*Comparison of Baseline Regression Model 2 (Social Network Related Predictors and Health and Demographic Controls) with Model Re-run as a Multilevel Regression Model Adjusting for Nesting of Participants by General Practice*

Predictors	Baseline	
	Model 2	Model 2 with mixed effects
	$\beta$	
Intercept	9.39	9.74
Age	.02	.02
Post-High school Education <sup>1</sup>	- .16	- .16
NEADL	- .23	- .23
Exercise <sup>1</sup>	- .39	- .38
Never drink alcohol <sup>1</sup>	.18	.19
Never Smoked <sup>1</sup>	- .15	- .16
Married <sup>1</sup>	- .35	- .35
Structural integration subscale	- .13	- .13
Perceived Connectedness subscale	- .11	- .11
Random effects:		
Practice Mean GDS Score (Intercept)		.01
Residual		2.70
Model Fit Statistics:		
AIC		10919
BIC		10991
Deviance		10895

**Appendix H**  
**Summary of Comparison of Results Using Imputed Versus Non-  
Imputed Data**

Table AH1.

*Summary of Results Comparing Baseline Model 2 (Social Network Related Predictors and Health and Demographic Controls) Using Imputed Versus Non Imputed Data*

Predictors	Baseline			
	Model 2 with imputation		Model 2 without imputation	
	$\beta$	$F$ (df)	$\beta$	$F$ (df)
Age	.02*		.02**	
Post-High school Education <sup>1</sup>	- .16*		- .17**	
NEADL	- .23***		- .22***	
Exercise <sup>1</sup>	- .39***		- .38***	
Never drink alcohol <sup>1</sup>	.18**		.21**	
Never Smoked <sup>1</sup>	- .15*		- .21**	
Married <sup>1</sup>	- .35***		- .34***	
Structural integration subscale	- .13***		- .12***	
Perceived Connectedness subscale	- .11***	52.76*** (9, 2821)	- .12***	47.66*** (9, 2500)
Total $R^2$ (Adjusted Total $R^2$ )		.22 (.21)		.21 (.21)

Note: 1 = Dummy coded variables as per Table 13. NEADL = Nottingham

Extended Activities of Daily Living Scale; \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ . This note

applies to all tables in Appendix H.

Table AH2

*Summary of Results Comparing Baseline Model 3 (Baseline Model 2 Plus Hypothesised Interaction Effects) Using Imputed Versus Non Imputed Data*

Predictors	Baseline			
	Model 3 with imputation		Model 3 without imputation	
	$\beta$	$F$ (df)	$\beta$	$F$ (df)
Age	.02*		.02**	
Post-High school Education	-.17*		-.16*	
NEADL	-.22***		-.22***	
Exercise	-.41***		-.40***	
Never drink alcohol	.18**		.20**	
Never Smoked	-.15*		-.24***	
Married	-.35***		-.34***	
Structural integration subscale	-.15***		-.13***	
Perceived Connectedness subscale	-.12***		-.13***	
Frequency of contact with grand/children : Number of local non-family ties	< .001		.01	
Frequency of contact with grandchildren : NEADL	.01	44.74*** (11, 2742)	.01	38.70*** (11, 2379)
Total $R^2$ (Adjusted Total $R^2$ )		.22 (.22)		.22 (.22)

Table AH3

*Summary of Results Comparing Model 2 at 18-Month Follow-up (Social Network Related Predictors and Health and Demographic Controls) Using Imputed Versus Non Imputed Data*

Predictors	18-month follow-up			
	Model 2 with imputation		Model 2 without imputation	
	$\beta$	$F$ (df)	$\beta$	$F$ (df)
Age	.01		.01	
Post-High school Education	-.16**		-.15*	
NEADL baseline	< .01		.01	
NEADL 18-month	-.18***		-.18***	
Exercise	-.21***		-.20***	
Never drink alcohol	.01		-.01	
Never Smoked	.08		.07	
Depression at baseline	.51***		.51***	
Married	-.14*		-.16*	
Structural integration subscale	-.04*		-.04*	
Perceived Connectedness subscale	-.05***		-.04***	
		96.93*** (11, 2617)		80.00*** (11, 2314)
Total $R^2$ (Adjusted Total $R^2$ )		.40 (.40)		.40 (.39)

Table AH4

*Summary of Results Comparing Model 2 at 36-Month Follow-up (Social Network Related Predictors and Health and Demographic Controls) Using Imputed Versus Non Imputed Data*

Predictors	36-month follow-up			
	Model 2 with imputation		Model 2 without imputation	
	$\beta$	$F$ (df)	$\beta$	$F$ (df)
Age	.04***		.04***	
Post-High school Education	-.07		-.12	
NEADL	.02		-.02	
NEADL 18-month	-.04*		-.05*	
NEADL 36-month	-.06***		.04**	
Exercise	.05		.04	
Never drink alcohol	.08		.06***	
Never Smoked	.01		-.03	
Depression baseline	.23***		.23***	
Depression 18-month	.40***		.40***	
Married	-.02		-.03	
Structural integration subscale	-.09***		-.09***	
Perceived Connectedness subscale	-.04***		-.04***	
		81.22*** (13, 2315)		70.84*** (13, 2054)
Total $R^2$ (Adjusted Total $R^2$ )		.40 (.40)		.41 (.40)