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Predictors of and Changes in Older Adult Loneliness in New Zealand.

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

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New Zealand.

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Abstract

Objectives: Despite increasing numbers of longitudinal studies addressing loneliness in recent years, the ways in which variables influence changes in loneliness over time are not well understood. The aim of this study is to explore how levels of reported loneliness change over time in a sample of older adult New Zealanders.

Method: This study utilises longitudinal data collected for the Health, Work and Retirement Study (HWR) study. Data were collected in 2010, 2012, and 2014 via postal survey. All analyses were conducted with respondents who participated in at least two of the three data waves (N=2,839). Participants were aged 48 to 85 in 2010.

Results: Males were more likely to be lonely, as were those with higher depression scores. High SES, social support, Māori ethnicity, older age and good health were related to lower loneliness levels. Multi-level modelling was used to examine the relationship of predictors to loneliness and changes in loneliness over time. There was a slight reduction in loneliness over time on average, however this decrease was less pronounced for those with higher levels of depression and higher social support. Individuals with activity limitations increased in loneliness over time. An increase in depression over time was related to higher loneliness scores, whereas increases in SES and social support resulted in lower levels of loneliness.

Conclusions: Findings are discussed in relation to a model of the development and maintenance of loneliness in older adults. Implications for addressing loneliness in this group will be highlighted.
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Introduction

Statement of the Problem

In accord with many other countries, New Zealand has an ageing population. The 65+ age group is projected to make up over one-quarter of New Zealand’s population from the late 2030s, compared with 12 percent in 2005 (Statistics New Zealand, 2006). Social and health problems among older adults are therefore increasingly significant, as a greater proportion of New Zealanders are affected.

An important issue that is relevant to older adults is loneliness. Whilst being alone can be a positive experience, being lonely has negative connotations. A meta-analysis found that between 5 to 15% of older adults report frequent loneliness (Pinquart & Sörensen, 2001). A recent study of older adults aged 65 to 101 found that 7.7% of participants were severely or very severely lonely, while another 38.3% were moderately lonely (Dahlberg & McKee, 2014).

Loneliness has been linked to health outcomes including morbidity, illnesses and disorders in a number of studies (Luo, Hawkley, Waite, & Cacioppo, 2012). Such findings remind us of the importance of social interaction to our health and wellbeing and that we are essentially social beings.

Many studies have investigated the predictors and consequences of loneliness (e.g. Cohen-Mansfield, Shmotkin, & Goldberg, 2009; Luo, Hawkley, Waite, & Cacioppo, 2012; Tilvis et al., 2012). Additionally, studies have revealed that loneliness is complex and dynamic and may become prominent when one deals with major life events or changes in functioning (e.g. Dahlberg, Andersson, McKee, & Lennartsson, 2015; Jylha, 2004). Only a handful of studies (e.g. Cohen-Mansfield et al., 2009; Dykstra, van Tilburg, & de Jong Gierveld, 2005; Honigh-de
Vlaming, Haveman-Nies, Bos-Oude Groeniger, de Groot, & van ’t Veer, 2014) have investigated how loneliness changes over time among older adults and what variables relate to changes in loneliness over time. Understanding loneliness in older adults in a temporal sense could enable prevention or early intervention for those identified as being at high risk of becoming problematically lonely. Testing relevant theories of older adult loneliness, with a focus on temporal changes and key variables could inform the theoretical literature. There is more to be learned about how loneliness comes and goes in the lives of older adults and the factors that influence these changes.

**Study Purpose and Scope**

The purpose of this study is to explore how reported loneliness changes over time in a sample of older adult New Zealanders. To achieve this goal the focus is on identifying relevant variables that relate to changes in loneliness over time. Variables shown to be related to loneliness in previous research, including socio-demographic characteristics and health and social engagement variables will be investigated in terms of their relationship to changes in loneliness over time. Relevant life-course theory regarding social relations will be utilised to provide context. Quantitative longitudinal methods will be used as such methods are well suited to examining changes in loneliness over time. These methods enable exploration of the complex relationships that exist between multiple variables and how they change and relate to each other over time.

**Background**

**Defining Loneliness**

A consistent definition of loneliness allows the construct to be operationally defined and measured, and allows comparisons across different studies and minimisation of overlap with
similar constructs. The literature makes important distinctions between the concept of loneliness and that of social isolation. Social isolation refers to the objective state of having minimal contact with other people; while loneliness refers to the subjective state of negative feelings associated with perceived social isolation, a lower level of contact than that desired or the absence of a specific desired companion (Wenger, Davies, Shahtahmasebi, & Scott, 1996).

Pinquart and Sörensen (2001) note two types of definitions of loneliness in the literature. The first focuses on the subjective experience of having few contacts, whereas the second focuses on the discrepancy between perceived relationships and desired relationships. The second type is more comprehensive and such cognitive discrepancy models take into account the fact that some individuals may not feel lonely despite few social contacts and that others feel lonely despite high levels of social contacts (Peplau, Miceli, & Morasch, 1982).

de Jong-Gierveld (1998) uses a cognitive, multidimensional approach to define loneliness:

“Loneliness is a situation experienced by the individual as one where there is an unpleasant or inadmissible lack of (quality of) certain relationships. This includes situations in which the number of existing relationships is smaller than is considered desirable or admissible, as well as situations where the intimacy one wishes for has not been realized. Thus loneliness is seen to involve the manner in which the person perceives, experiences, and evaluates his or her isolation and lack of communication with other people;” (cited in de Jong Gierveld, 1998, p. 73).

**Loneliness and Theory**

Various theories have been applied to loneliness research such as Disengagement Theory (see Eggermont & Vandebosch, 2001), and Attribution Theory (see Newall et al., 2009).
Disengagement Theory is not pursued further here as the theory has been strongly criticised (e.g. Hochschild, 1975), in particular because it is non-falsifiable and alternative occurrences are often portrayed as failures to disengage. The theory portrays older adults as passive subjects of the social process of disengagement, as opposed to proactive, positive agers, who make choices about their social lives. Attribution Theory is not explicitly discussed herein however this theory underlies the work of Peplau and Perlman (1982), which informs key aspects of a model that is considered here; de Jong-Gierveld’s Integrated Theoretical Model.

Three theories are discussed in further detail below, namely, Socio-Emotional Selectivity Theory, the Convoy Model, and de Jong-Gierveld’s Integrated Theoretical Model. The first two theories are included because they are supported by empirical research, view the older adult as agentic, and do not have conflicting tenets. De Jong-Gierveld’s Integrated Theoretical Model is discussed as it highlights specific variables relating to the development of loneliness and their interaction that could contribute to and broaden the ageing literature. All theories discussed have a temporal focus which aligns with the theme of the present research; changes in loneliness over time.

**Socio-Emotional Selectivity Theory**

The theory of socio-emotional selectivity (Carstensen, Isaacowitz, & Charles, 1999) argues that the perception of time is essential to the selection and pursuit of social goals. Three tenets underlie the theory. First, social interaction is viewed as essential to human survival and as having an evolutionary basis. This is supported by research suggesting that lonely individuals have higher mortality rates (Tilvis et al., 2012). Second, humans are perceived as purposeful and motivated by goals. Research shows that many older adults are not lonely (Pinquart & Sörensen, 2001) suggesting they are capable of meeting their social goals. Third, the selection
of goals must come before action and the selection process is influenced by the perception of time as either vast or limited.

Social goals can be classified into two categories: those related to knowledge acquisition and those related to emotion regulation. Knowledge related goals refer to behaviour aimed toward learning about the world. Emotion related goals involve behaviour directed at regulating emotions, using social contact with others as well as higher level desires, such as the search for meaning and social connectedness. Goals from either category may compete at times and the choice of preferred goal relates to one’s perception of time. When one’s time is considerable, such as for young adults, a focus on the future is adaptive and knowledge related pursuits are likely. An example is a young student who studies alone often without becoming lonely due to having a knowledge-based focus. When time is limited as in old age, a present focus develops and consequently emotion related goals such as spending time with family come to prominence. If an older adult is isolated from family and emotion related goals such as a desire to have social contact with family exists, loneliness is more likely to develop. Due to a change in goal selection, older adults’ social networks decrease in size but increase in quality by becoming more emotionally meaningful (Carstensen, Gross, & Fung, 1997). This is supported by research suggesting that the quality of social contacts is important to mitigating loneliness (Pinquart & Sörensen, 2001).

The predictability of interactions with familiar contacts results in positive emotions being elicited more reliably and provides a sense of meaning. This suggests that those with low social support and few familiar contacts would experience less positive emotion and could be more prone to depression and loneliness. This explanation is supported by research findings linking social support, depression and loneliness (e.g. Dahlberg et al., 2015; Pinquart & Sörensen, 2001).
Social Convoy Model

The social convoy model (see Antonucci, Ajrouch, & Birditt, 2014) is a framework for understanding social relations across the life course. According to the model, individuals are surrounded by supportive others who move with them throughout the life course. These relationships vary in closeness, quality, function and structure. The structure, function and quality of convoys are influenced by personal and situational characteristics. Convoys are viewed as influential to health and wellbeing.

Several key tenets of the model have influenced the study of social relations. First, social relations are understood as multi-dimensional. The quality of relations is important, whereas a focus on quantity was common in early research. As mentioned earlier, Socio-Emotional Selectivity Theory also values the quality of social relations and high quality, meaningful social support has been found to mitigate loneliness (Pinquart & Sörensen, 2001). Second, the structure of relations requires a focus on specific members, (i.e. partner, siblings) as opposed to broad categories such as ‘family’. The importance of focusing on specific members of social groups to understanding how loneliness develops is typified in research that indicates living with a partner has a stronger link to loneliness than does living with one’s adult children (de Jong-Gierveld, Dykstra, & Schenk, 2012). Third, social relations are viewed as increasing in significance over time as they build on previous experiences. This tenet complements the similar component of Socio-Emotional Selectivity Theory which states that over time individuals increasingly choose emotion focused goals which yield more meaningful albeit less numerous, social relationships. Both theories suggest that many older adults have the capacity and desire to mitigate loneliness in this way. Finally, the experience of social relations may be understood objectively and subjectively and from multiple perspectives. Much of the loneliness research recognises these complexities and research in the cross-cultural domain
(e.g. de Jong-Gierveld et al., 2012), studies with a physiological focus (e.g. Doane & Adam, 2010), as well as qualitative research (e.g. Ballantyne, Trenwith, Zubrinich, & Corlis, 2010) lie alongside one another to broaden the understanding of loneliness in older adults.

**de Jong-Gierveld’s Integrated Theoretical Model**

de Jong Gierveld and Tesch-Römer (2012) proposed an integrated theoretical model of loneliness. The model is proposed in the context of cross-cultural research, however it contains important insights that can be applied to other loneliness research. The authors observed that despite greater social integration in Eastern Europe, (e.g. multiple generations living in one dwelling), loneliness ratings are higher than in Western Europe, where fewer family members reside together. A cross-country review (de Jong Gierveld, Dykstra, & Schenk, 2012) showed that older adults living with children were not less lonely and that only the existence of a partner had a consistent effect on the intensity of loneliness. This is an example of how the Integrated Theoretical Model complements tenets of the Social Convoy Model, as this finding suggests loneliness is multidimensional and highlights the importance of relationship quality. The integrated theoretical model is an attempt to explain such findings by viewing the individual within a wider societal context.

The integrated theoretical model of loneliness consists of two broad categories that influence loneliness; the individual perspective and the societal perspective. The individual perspective acknowledges that loneliness is a social phenomenon with a cognitive and emotional basis. The model makes use of three theoretical conceptual approaches that have been influential and originate from the work of Peplau and Perlman (1982): Specifically, loneliness resulting from unfulfilled social needs, unmet social expectations and poor living conditions.

The idea that loneliness results from unfulfilled social needs is sometimes called the ‘deficit approach’. Similarly, Weiss (1973) distinguished between emotional loneliness, which may
result from the loss of an intimate partner; and social loneliness, which may result from a lack of family or friends to provide social integration. The structure (size and type of social ties) and quality (emotionally satisfying relationships) of the social network are emphasised. These aspects of the Integrated Theoretical Model have clear links to Socio-Emotional Selectivity Theory where emotion focused goals and meaning is emphasised, and the Social Convoy Model, with its multidimensional focus (structure and quality of relationships).

In contrast, loneliness resulting from unmet social expectations acknowledges the cognitive experience of the lonely person. Not only is the presence of social relations important, the discrepancy between one’s expectations and (perceived) reality influences loneliness. From this cognitive process a cycle of loneliness may develop; loneliness may lead to hyper-vigilance to perceived social threats. Consequently, lonely individuals are more likely to expect negative social experiences and to behave in a way which leads to ineffective social interactions, and hence social isolation (Cacioppo & Hawkley, 2009). The notion of hyper-vigilance to perceived social threats may relate to evolutionary processes (Cacioppo, Cacioppo, & Boomsma, 2014). Such a notion is supported by Socio-Emotional Selectivity Theory which posits that social interaction is essential to human survival and has an evolutionary basis.

The final theoretical approach advanced by de Jong-Gierveld’s Integrated Theoretical Model views loneliness as resulting from poor living conditions. Loneliness is related to socio-demographic factors such as health and income, with deficits in both resulting in greater loneliness (Pinquart & Sörensen, 2001). Poor living conditions may reduce opportunities for social support. Financial difficulties and stress are also considered important to this approach. Such factors may explain the differences between loneliness in Eastern and Western Europe mentioned earlier and result from income differences. Additionally, feelings of loneliness are related to indicators of subjective well-being like depressive symptoms (Cacioppo, Hughes,
Waite, Hawkley, & Thisted, 2006). Hence, poor living conditions may lead to negative experiences, negative affect and loneliness.

The three theoretical elements of the de Jong-Gierveld model discussed above interact to form the individual level of the integrated theoretical model of loneliness. Figure 1 illustrates the connections between social integration, individual social expectations and quality of living conditions in the emergence of loneliness. The level of social integration is relevant to the fulfilment of social needs and hence, the prevention of loneliness. However, individual social expectations impact the evaluation of the relationship within the social network. In this way, social needs and social expectations interact. Finally, the quality of living conditions influences social needs and the quality of social relations. However, the impact of poor living conditions on loneliness may be mediated by negative affect. Ageing influences the components of the model. Social integration may become more fragile due to age-related losses such as the death of a partner or friends. As the socio-emotional selectivity theory posits, social expectations change with age as ties to familiar persons increase in importance. Health issues and lack of independence are more common in old age and social support needs may increase.
Figure 1. The interaction between social integration, individual social expectations and living conditions in the emergence of loneliness, from de Jong-Gierveld and Tesch-Römer (2012).

The integrated theoretical model of loneliness also encompasses the societal level of influences on loneliness; however this will be discussed only briefly as the focus herein is how loneliness develops and changes for the individual within a social context, as opposed to wider societal factors. The societal level of the model posits that the strength of the social welfare system, the demographic composition and the cultural norms and values of a society, all impact upon the individual level components of the model discussed previously and consequently, influence loneliness. The model allows social relations to be understood from multiple perspectives, much like the Social Convoy Model posits. The societal level of the Integrated Theoretical Model provides a judicious reminder that individual level processes occur within a wider societal context. As a result, research methods and findings should be interpreted with this in mind and generalisation across societies and cultures made with caution.
Conclusion

Three key theories of social relations are particularly helpful to provide structure, direction, and context to empirical loneliness research: Socio-emotional selectivity theory, the social convoy model, and de Jong-Gierveld’s integrated theoretical model of loneliness. Generally, the theories are complementary and contain a temporal component which makes them suitable for examining changes in loneliness over time.

Correlates of Loneliness

The previous section outlined theories useful for examining how loneliness changes over time. In the following section variables that have been found to be related to loneliness in cross-sectional studies will be examined.

Age

Age is often measured and expected to relate to loneliness. Relevant studies look at the ‘young old’ who are aged around 60 or 65-70, through to the ‘oldest old’ who are aged 80 and over. A meta-analysis conducted by Pinquart and Sörensen (2001) found that in the youngest participants (mean age ≤ 60 years), loneliness decreased significantly with increasing age. For those with a mean age between 60 and 80 years old there was no relation between age and loneliness, and in those with a mean age over 80 years old loneliness significantly increased with age.

Gender

Most studies find greater loneliness in older women. Pinquart and Sörensen (2001) found that older women appeared to experience more loneliness than older men when they conducted a meta-analysis. However, on average gender by itself explained only 0.6% of the variance of loneliness in the studies included in the meta-analysis. A measurement issue became apparent
as studies using the UCLA Loneliness Scale and single item indicators showed a gender relationship, whereas studies using the de Jong-Gierveld scale did not reveal a significant gender difference. The authors did not speculate as to why the difference between the measures was apparent. They did note that their overall finding that women were more lonely than men may have been due to a previously proposed explanation (Perlman & Peplau, 1982) of a greater willingness in women to admit to socially unacceptable feelings than men. In the meta-analysis married samples supported the gender difference whereas non-married samples (single, widowed, divorced) showed non-significance in gender differences. The authors note that because higher loneliness in older women compared to men is apparent in married respondents, women’s higher level of loneliness cannot be exclusively attributed to their larger probability of being widowed (Hobbs & Damon, 1996).

**Socio-Economic Status**

Another socio-demographic variable frequently examined in loneliness research is Socio-Economic Status (SES). Pinquart and Sörensen’s (2001) meta-analysis showed that those who had lower SES reported more loneliness. This relationship was significantly stronger in studies using a single loneliness item than for those using validated loneliness scales. The authors did not propose an explanation for this difference however it may relate to the proposal that use of a single item measure may be subject to bias as loneliness is stigmatised in society (de Jong Gierveld, 1998).

Both high income and education were associated with lower reported levels of loneliness. A New Zealand study by Stephens, Alpass, Towers, and Stevenson (2011) also highlighted a link between SES and loneliness. They analysed responses of a representative postal sample of 6,662 adults aged 55 to 70 to questionnaires relevant to retirement and well-being. This study also used a single item to measure loneliness. The Social Provisions Scale (Cutrona, Russell, &
Rose, 1986) was used to measure social support, and a single question measured social isolation. The social network was measured using the Practitioner Assessment of Network Type instrument (PANT) (Wenger & Tucker, 2002). Berkman’s ecological model of ageing (Berkman, Glass, Brissette, & Seeman, 2000) was used to determine how social context variables such as SES contribute to social network type. Social network type was found to relate to social support, health and loneliness. SES influenced social network type and perception of social support. Higher SES resulted in perception of more support and less loneliness. Self-contained and private-restricted networks were negatively related to social support. Respondents embedded in these network types were lonelier. To summarise, respondents with lower SES were more likely to be embedded in social network types that resulted in greater loneliness and poorer mental and physical health.

**Quantity, Quality, and Sources of Social Contact**

In addition to socio-demographic variables, measures of social engagement are frequently found to relate to loneliness. Pinquart and Sörensen (2001) found in their meta-analysis that lower quality of contact is more closely associated with loneliness than lower quantity of social contacts. The quality of social contacts is more closely linked to loneliness when loneliness is assessed through direct questions than when it is assessed with the UCLA Loneliness Scale or the de Jong-Gierveld scale.

The authors explained this relationship by referring to the specific aspects of negative relationship quality (e.g., not feeling understood), as well as the level of emotional support as being central to the experience of loneliness. They propose that the emotional aspects of social contacts are more closely linked to loneliness when it is assessed through direct questions than when it is assessed with the UCLA Loneliness Scale or the de Jong-Gierveld scale as these measures also include self-rating of one’s outgoingness and perceived lack of
companionship. Because being outgoing does not necessarily imply that the contacts one finds are also positive and supportive (Rook & Pietromonaco, 1987, cited in Pinquart & Sorenson, 2001), this trait might not necessarily counteract loneliness.

It seems intuitive that the source of social contact should be important to loneliness. One would expect close family members to have a stronger relationship to loneliness than friends or acquaintances. However, the children or other relatives of older adults may live a greater distance away and have less frequent contact than their friends. A review of research (Pinquart & Sörensen, 2001) found the negative association between loneliness and contact with friends and neighbours, is stronger than between loneliness and contact with family. The authors found that quality or quantity of social contact did not affect the association, however, they acknowledge few studies were available for this final comparison and the result should be interpreted with caution (Pinquart & Sörensen, 2001). This finding suggests that it is possible to have frequent contact with family and still be lonely. A lonely person may well seek family first to reduce loneliness; however this may be less effective than increased contact with friends and neighbours.

Health

Many studies on the topic of loneliness focus on health as an outcome variable. As mentioned previously, loneliness has been linked to negative health outcomes. The negative effects have been demonstrated for both mental and physical health. Regarding mental health, van Beljouw et al. (2014) examined loneliness in 249 older adults aged over 65 with a mean age of 75.2 years with depressive symptoms defined by scoring greater than 6 on the Patient Health Questionnaire-9 (Spitzer, Kroenke, & Williams, 1999). Loneliness was measured with the de Jong-Gierveld Loneliness Scale. A cut-off score of ≥3 was used to distinguish not lonely from lonely people. Among these depressed respondents, 87.8% experienced loneliness and 48.6%
felt severely lonely (cut-off score of ≥9). Older people with depressive symptoms who were severely lonely suffered from worse mental ill-health than not/mildly lonely older adults. Severe loneliness was associated with more severe depressive symptoms, a current major depressive disorder, a current or past dysthymic episode, and more feelings of anxiety. Additionally, a lower self-rated quality of life was related to perceiving severe feelings of loneliness.

Previous research by Alpass and Neville (2003) also linked loneliness to depression in older adults. A sample of 217 males aged 65 to 89 years were surveyed using the UCLA Loneliness Scale, the Geriatric Depression Scale, the Social Support Questionnaire-6, and a self-rated physical health question. Findings revealed that poorer self-rated health was related to higher levels of depressive symptomatology. Those who reported higher levels of loneliness reported higher depression scores and this was the strongest relationship among the variables studied.

Further evidence of the importance of loneliness to health outcomes was demonstrated by La Grow, Neville, Alpass, and Rodgers (2012). This group found lower scores on both physical and mental health self-report measures for severely and moderately lonely participants than for not lonely participants. Participants were 332 community-based New Zealanders aged 65 to 98 years and the de Jong-Gierveld Loneliness Scale was utilised. Fifty two percent of the sample were either moderately or severely lonely. In this study age, gender and partner status were not related to loneliness.

Loneliness has also been linked to poorer outcomes for objectively measured physical health in adults of all ages. For example, loneliness has been found to be a risk factor for increased vascular resistance and blood pressure (J. T Cacioppo et al., 2002), fragmented sleep (J. T.
Cacioppo et al., 2002) and diminished immunity (Pressman et al., 2005), among other ailments (see Cacioppo & Cacioppo, 2014, for a review).

Cognitive decline is another health issue that is related to loneliness. The subjective experience of chronic loneliness has been related to greater cognitive decline in older adults than those who are not lonely (Tilvis et al., 2004). Similarly, the risk for developing Alzheimer’s dementia has been found to develop more rapidly in lonely elders, and has been found to increase the clinical expression of dementia despite similar neuropathology in non-lonely Alzheimer’s patients (Wilson et al., 2007).

Mortality is another common outcome measure in loneliness research. Stek, Vinkers, and Gussekloo (2005) showed that loneliness on its own does not affect mortality rates, however it significantly increases mortality rates in the elderly when it co-exists with depression. The authors speculate that the effect on mortality may be mediated through altered immune or physiological responses.

Another study that used mortality as an outcome measure was conducted by Lyyra and Heikkinen (2006), who measured perceived social support using the Social Provisions Scale in 206 Finnish adults who were all aged 80. The authors separated social support into assistance-related and non assistance-related support groups. Women with the least non-assistance related social support were more likely to die than other participants even when baseline socio-demographics, psychological and physiological health were accounted for. The social support types were not significant predictors of mortality in men.

A more recent study investigated social isolation, social activity and perceived loneliness and how they relate to each other and mortality (Tilvis et al., 2012). Results indicated a mortality rate of 29.9% in people who were not lonely nor socially isolated nor inactive but 52.9% in the
lonely, socially isolated and inactive. Both social inactivity and self-reported loneliness emerged as independent mortality risk indicators, whereas social isolation did not. The authors concluded that social inactivity and self-reported loneliness and their combination, particularly, are significant risk factors for mortality in older adults, whereas social isolation is not. This study highlights the difference between social isolation, which is a measure of actual contact with other people, and loneliness, which concerns one’s perception of their social interactions. Such results underline the cognitive theoretical background to the loneliness concept and its importance to health outcomes and mortality. Indeed, this study showed that thoughts about loneliness were more destructive than lack of contact with others.

**Conclusion**

A variety of variables have been shown to relate to loneliness in empirical research. There are inconsistencies across studies which may be due to cultural, generational or measurement differences. Such inconsistencies demonstrate the complexity of loneliness and its correlates. The following section reviews some of these variables and their relation to loneliness in the context of longitudinal research.

**Longitudinal Research**

**Loneliness and Health**

Many studies of loneliness measure health as a predictor or outcome variable due to its relevance to loneliness for older adults. This section reviews recent longitudinal studies of ageing that measure health variables and demonstrates the complexity of the relationship between loneliness and health.

A large longitudinal study of mortality, health and loneliness was conducted in the USA by Luo et al. (2012). The aim was to examine the mechanism of loneliness on mortality and whether
health variables were mediators of the loneliness effect on mortality. Data were collected in 2002, 2004 and 2006 with participants aged 50+ at baseline; 1620 participants remained at the end of the study. A three item loneliness measure was adapted from the UCLA Loneliness Scale and has been shown to have good psychometric properties (Hughes, Waite, Hawkley, & Cacioppo, 2004). The three-point response scale for each item ranged from “hardly ever or never” to “often.” A loneliness scale was created by summing scores on the three items. It ranged from 3 to 9 with higher values indicating a greater degree of loneliness. Results indicated that loneliness lead to increased mortality risk. Controlling socio-demographics, social relationships, and health behaviours, older adults with the highest loneliness levels were 1.96 times more likely to die within 6 years than those with the lowest loneliness levels. Using cross-lagged models, loneliness predicted increases in depressive symptoms, modest decreases in self-rated health and increases in functional limitations over two years, even when the reciprocal effects of these health measures on loneliness were taken into account. This suggests a causal direction where decrements in emotional and physical health are mechanisms through which loneliness leads to increases in mortality risk.

The main methodological issue in the study was a change from using interviews to questionnaires to collect data in the middle of the study. This is potentially problematic as loneliness is stigmatised in society (de Jong Gierveld, 1998), and using interviews for data collection could introduce social desirability bias that may only occur using a face to face interview (Luo et al., 2012). Participants may under-report loneliness in an interview. As the later part of the study used questionnaires to measure loneliness, this may have fostered more honesty in the participants and may have resulted in an increase in loneliness scores. Changing the data collection method in a longitudinal study may invalidate the results with regard to how loneliness changes over time.
Rather than focus on mortality as an outcome variable, Nummela, Seppänen, and Uutela (2011) examined the effect of loneliness and change in loneliness on self-rated health (SRH). The 2815 participants were aged 55 to 79 at baseline and were followed-up three years later. Never or seldom experiencing loneliness was a strong predictor for good SRH at follow-up. Among male participants, those experiencing decreasing loneliness had almost the same likelihood of having good health at follow-up as those who never or seldom experience loneliness. Such findings may suggest that interventions to reduce loneliness could benefit self-rated health. However, the authors note that the findings did not reveal whether decreased loneliness resulted in improved health or whether deteriorating health resulted in increased loneliness. They point to a probable bi-directional relationship between the variables.

The study had a large sample and controlled for a variety of factors relevant to health and loneliness. The authors noted some selective dropout; the less healthy people and the more lonely people were more likely to drop out of the study and the selective dropout may have caused downward bias in the results. Another issue was the short follow-up time. The frequency in the groups whose loneliness increased or decreased (7–8% men; 8–9% women) is slightly lower than in the group whose loneliness was chronic (11% men; 14% women). Therefore, three years might not be a long enough time to find out the negative effects on health after loneliness has increased, and a longer study period could provide more accurate insights.

A recent study investigated changes in loneliness and depression (Cacioppo, Hawkley, & Thisted, 2010). Cross-lagged analyses indicated that loneliness predicted subsequent changes in depressive symptomatology, but not vice versa, and that this temporal association was not attributable to demographic variables, objective social isolation, dispositional negativity, stress, or social support.
Changes in Loneliness over Time

Recent research has utilised a longitudinal approach to explore how loneliness changes over time. These studies focus on changes in the prevalence of loneliness in older adults and predictors of changes in loneliness over time. Longitudinal studies illustrate that loneliness is not necessarily a stable state for older adults. Understanding factors that predict increases or decreases in loneliness would aid efforts to intervene with at risk individuals or groups. Some of the key findings from the longitudinal research literature in this area are discussed herein.

The predictors of change in loneliness would be expected to be similar to the correlates of loneliness. These correlates can be categorised into three domains as outlined by Dahlberg et al. (2014), namely, socio-demographic factors, health factors, and social factors. Most studies measure factors from all or some of these domains in an effort to explain their complex relationship to changes in loneliness.

A study by Cohen-Mansfield et al. (2009) of 1147 older adults aged 75 to 94 at baseline examined predictors of loneliness from all of the three domains: demographic, social engagement and health. The researchers studied an Israeli community based sample and found a significant increase in the mean level of loneliness over a 3.5 year period. The study used a single loneliness question asking participants about the frequency of loneliness they had experienced over the last month with ratings from 0 to 3. When comparing those who became lonely between wave 1 and wave 2 to those who remained not lonely, independent predictors of becoming lonely were financial difficulties and female gender. The researchers also examined reductions in loneliness and found that independent predictors of loneliness diminishing completely were male gender and being married. The authors pointed out that increasing and decreasing loneliness over time are not a mirror image of each other. For example, they found that financial difficulty contributes to loneliness development, however
lack of financial difficulty did not alleviate loneliness, whereas being married did. Limitations of the study include a 50% attrition rate of respondents between the two waves, no measure of social network size, and interviews for data collection which could result in social desirability bias.

A similar longitudinal study by Dahlberg et al. (2014) examined loneliness in older adults with a focus on gender differences. The sample consisted of 587 respondents aged 70 to 95 at baseline. Two waves of data were collected with a six year gap between waves. A one question item was used to measure loneliness. Analyses were separated into groups of: total sample, women, and men. For the total sample, predictors of loneliness were: loneliness at baseline, depression, and recent widowhood; for women - widowhood, depression, mobility problems, and mobility reduction; for men - low social contacts and social contact reduction predicted loneliness. Widowhood predicted loneliness for women and men in this study and this finding can be compared to the result of the Cohen-Mansfield et al. (2009) study, which found that marriage was an independent predictor of loneliness diminishing completely over time. While these variables are not the opposite of each other, widowhood involves loss and the potential for grief. Such findings do suggest that the marital relationship protects against loneliness.

Unlike the Cohen-Mansfield et al. (2009) study, there was a low attrition rate for the Dahlberg et al. (2014) research. Another contrast to the Cohen-Mansfield et al. (2009) study was that Dahlberg et al. (2014) did include a measure of the amount of social contact. In line with the Cohen-Mansfield et al. (2009) study, Dahlberg et al. (2014) found a general increase in loneliness over time and also identified the fluctuating nature of loneliness. Nearly half of those reporting frequent loneliness at baseline did not report it at follow-up. Interestingly, Dahlberg et al. (2014) pointed out that disclosing loneliness may be more acceptable in women than men, (see Pinquart & Sörensen, 2001), which could affect gender based results.
Whilst the Cohen-Mansfield et al. (2009) research utilised interviews for data collection, Dahlberg et al. (2014) conducted telephone interviews at baseline and mostly face to face interviews at follow up; the mixed methods being a potential limitation of the study.

Dahlberg et al. (2014) highlighted the dynamic nature of loneliness over time despite a general increase over time in many studies. They encouraged methodological improvements to gather more information about such change. Specifically, the importance of utilising more than two data collection points was encouraged to examine the causal relationship between loneliness and depression. Indeed, increasing the number of data points would improve the ability to determine any potential causal relationship between loneliness and any relevant variable, including health in general.

Despite most longitudinal studies having few data points, these studies do provide useful information about trends in loneliness. Dykstra et al. (2005) used longitudinal methodology with 2,925 participants in the Netherlands and found that older adults generally became lonelier over time. Those who lost their partner by death had the greatest increase in loneliness. Other variables showing greater increase in loneliness over time were the oldest old, the partnered, and those with better functional capacity at baseline. The authors found that those who reported declines in functional capacity showed an increase in loneliness and this was particularly so for those with high functional capacity at baseline. The authors did not provide an explanation for this relationship, however one possible explanation is that those with higher functional capacity may have been more active and mobile and reduction of their functional capacity may have had a greater impact on their social lives, resulting in greater loneliness. Importantly, improvements in functional capacity and network expansion lead to less loneliness, suggesting some scope for interventions to alleviate loneliness.
In contrast, another longitudinal study showed little change in loneliness over time. Honigh-de Vlaming, Haveman-Nies, Bos-Oude Groeniger, de Groot, and van ’t Veer (2014) studied 4,773 Dutch older people aged over 65 with a mean age of 73.8 years and found that overall and across municipalities, loneliness estimates using the de Jong-Gierveld Loneliness Scale did not significantly differ between 2005 and 2010. However, among the sub-group with activity limitations, loneliness was higher in 2010 compared with 2005. This is in contrast to research mentioned above by Dykstra et al. (2005) who found greater increases in loneliness for those with better functional capacity at baseline. Honigh-de Vlaming et al. (2014) propose a possible explanation for their results by highlighting that people with activity limitations may have more difficulty engaging in society in recent years than previously. They point to the disappearance of small, close shops inhibiting independence for those with activity limitations (Naaldenberg et al. 2011, cited in Honigh-de Vlaming et al. 2014) and government policy that calls for individual responsibility and independent living up till an older age (Ministry of Health, Welfare and Sport, 2011, cited in Honigh-de Vlaming et al. 2014). The apparently contradictory results regarding functional capacity between the two studies may be due to the Dykstra et al. (2005) study having more data points and thus providing a more complex and realistic picture of the changes in loneliness over time. Although these studies appear to provide contradictory results, the Dykstra et al. (2005) study did demonstrate increased loneliness for those who experienced decreased functional capacity over time, which is in line with the results of Honigh-de Vlaming et al. (2014). The most accurate conclusion to draw from the studies may be that activity limitations do relate to greater loneliness; however those with low activity limitations will experience greater increases in loneliness than most due to the impact on loneliness of inevitable losses to their functional capacity as they age. Essentially, they ‘have more to lose’ in terms of functional capacity. Indeed the concept of loss may be central to
loneliness development. Loss of personal and social resources has previously been linked to the onset of loneliness (Aartsen & Jylha, 2011).

Honigh-de Vlaming et al. (2014) also found that individual socio-demographic and health characteristics were explanatory factors for variation in loneliness over time, whereas municipal characteristics were not. There are various explanations for these results. It is possible that this study is an example of how using few data points can provide a simplified picture of change in loneliness over time. Perhaps participants’ loneliness status increased and decreased between 2005 and 2010 and that much of this change was not measured. It is also possible that changes in loneliness may be stable over many years and that little change occurs for most people over a five year period.

Jylha (2004) examined changes in loneliness over a longer period in a sample of 366 older adults aged 60 to 89 years at baseline. A longitudinal analysis showed that loneliness increased with age. Over a 10-year period, loneliness increased most in those who, at baseline, were married and living alone with their spouse. The authors concluded that loneliness does increase with age, not because of age per se, but because of increasing disability and decreasing social integration. The authors noted that future studies should measure loneliness more often to gather more information about changes in loneliness, as their study took measurements only once every 10 years. Importantly, this study measured loneliness with a single item: “Do you feel lonely?” with three response options. This method of measuring loneliness may be subject to bias as loneliness is stigmatised in society (de Jong Gierveld, 1998). A single item measure does have benefits as it is easy to use in clinical and research settings and is generally acceptable to people as it asks directly about feelings of loneliness. However, the question presumes an understanding of the concept of loneliness by
participants, when it is likely that the nature of the concept will vary among different people and over time (Luanaigh & Lawlor, 2008).

A study by Aartsen and Jylha (2011) focussed on loss of social and personal resources and how these affect loneliness. The sample consisted of 469 participants aged 60 to 86 at baseline. Similarly to Dahlberg et al. (2014), this study focussed on gender differences in loneliness. As with the research by Jylha (2004), a single item loneliness question was used to measure loneliness. Face to face interviews were used except for one year where telephone interviews were conducted. Compared to most studies, this one had a longer follow-up and more data collection points. Participants were followed for 28 years and the interval between waves was 7 to 10 years.

For this study the participants were not lonely at baseline. This allowed the researchers to investigate the onset of loneliness and variability over the long follow-up period. As expected there was high attrition, which is a potential limitation of lengthy follow-up. At baseline there were 469 participants, however only 31 remained at final follow-up 28 years later. Such attrition also lead to the final follow-up sample being healthier and younger when compared to the baseline population.

Results showed that baseline levels of social and psychological resources did not predict onset of loneliness. This suggests loss of resources leads to loneliness onset, which is in line with a cognitive concept of loneliness that involves an evaluation of one’s situation. Interestingly, losses in personal resources were an even stronger predictor of loneliness than losses in social resources. This also points to the importance of cognition, which is an integral part of the personal factors studied such as increased depression, feelings of uselessness, and increased
nervousness. Losing a partner was associated with increased loneliness; a finding also apparent in the study by Dykstra et al. (2005).

For Aartsen and Jylha (2011), gender differences were explained by higher exposure to risk factors for women, such as widowhood. Dahlberg et al. (2014) extended this area of the research and found that loneliness was predicted by different factors for men and women. They also extended the research to provide more detailed information about the finding that reduced social activities lead to increased feelings of loneliness (Aartsen & Jylha, 2011). Dahlberg et al. (2014) found that a similar concept, reduced social contacts, resulted in significantly increased loneliness for men.

A potential limitation of the research by Aartsen and Jylha (2011) is the large period of time between follow-up measures, which may be problematic in causality research. The authors noted they could not rule out the possibility that onset of loneliness might have lead to lower mood or increased irritability. They completed additional analyses testing whether onset of loneliness between the second and third measurement could be predicted by changes in risk factors during the first 10 years, which added validity to the conclusions. Ideally, research into changes in loneliness in older adults should collect data frequently. The participants need to be followed-up for a long period; however, the attrition of participants and the effect on the sample size is a relevant consideration.

Wenger and Burholt (2004) studied older adults longitudinally using quantitative and qualitative methods, with a focus on changes in loneliness and social isolation. Participants were aged 85 to 102 by the end of the study and 47 participants remained from the initial 534. Data were collected every eight years for 16 years. A loneliness measure was created for the study, which raises the problem of comparability to other studies. However, a single item
loneliness measure was also included to allow comparison. Higher levels of loneliness appeared to be measured by the composite measure than by the single item measure. The authors found that the single item measure appeared to under-represent participants who had no obvious reason to be lonely and might therefore not want to admit to loneliness. The discrepancies between the measures were greatest for those who were married and those who lived with adult children. The authors concluded that the composite measure had succeeded in overcoming tendencies to deny loneliness and avoid stigma.

The results indicated a complex relationship between loneliness and social isolation. In general the results suggested that loss and stability were key to loneliness or lack of it; a similar conclusion to the findings of Aartsen and Jylha (2011), who focussed on loss in loneliness onset. The authors raised hypotheses based on the results including: recent widowhood increases loneliness and isolation risk; and deterioration in health, mobility, vision, or hearing increases loneliness risk. Importantly, loneliness was always seen as a negative concept, whereas social isolation was not - as some participants preferred to be alone.

A similar study with a larger sample was conducted by Victor and Bowling (2012), who explored loneliness and changes in loneliness among participants in Great Britain. Of an initial 999 participants aged 65 to 74 at baseline, 287 of 583 survivors responded to follow-up. Unlike Wenger and Burholt (2004), only one follow-up was conducted, in this case eight years after baseline resulting in less information about changes in loneliness over time. A single item self-rating of loneliness was used to allow comparison to other studies. The authors noted the likely underestimation of loneliness this method provides but state that their measure compensates for this shortcoming by providing direct perceptions as to how participants feel about their experience of loneliness. However, as noted by Wenger and Burholt (2004), participants do not accurately rate their loneliness on a single item measure; rather, they
attempt to deny loneliness and avoid stigma; particularly if they feel there is not an obvious reason for their loneliness.

The findings from Victor and Bowling (2012) were generally consistent with similar studies. They found 9% of participants reported severe loneliness and 30% reported they were sometimes lonely. The authors separated participants into five loneliness groups: unchanged loneliness, never lonely, always lonely, increased loneliness, and decreased loneliness. At follow-up, 60% of participants had a stable loneliness rating, with 40–50% rating themselves as never lonely, and 20–25% rating themselves as persistently lonely; 25% demonstrated decreased loneliness, and approximately 15% demonstrated worse loneliness. Changes in loneliness were linked with changes in marital status, living arrangements, social networks, and physical health. Importantly, improvements in physical health and improved social relationships were linked to reduced levels of loneliness. The authors mention an additional group can be used when dealing with multiple data collection points: the fluctuating loneliness group, as introduced by Wenger and Burholt (2004).

As in similar studies (e.g. Aartsen & Jylha, 2011) loss of social resources rather than initial baseline levels lead to increased loneliness. Unlike Wenger and Burholt (2004), Victor and Bowling (2012) studied a national sample rather than a specific area and there was less attrition of the sample. The authors concluded that people can “recover” from loneliness and improve their health and social lives. They noted their data correspond to those of Dykstra et al. (2005), who suggested that older adults can recover from loneliness not only by the enhancement of their social network, but also, less obviously, by improvements (and treatment) of their chronic health problems—both physical and mental.
The research discussed above by Wenger and Burholt (2004), Aartsen and Jylha (2011), Dahlberg et al. (2015), and Victor and Bowling (2012) highlights the importance of loss of resources to the experience of loneliness. Conservation of resources theory (Hobfoll, 1989) is a stress model that can provide a framework for interpreting these findings. The theory posits that people strive to retain, protect and build resources and that what is threatening to them is the potential or actual loss of these valued resources. Resources are categorised as object resources, conditions, personal characteristics and energies. Social support is said to facilitate the preservation of these resources. Those who lack resources attempt to employ what resources they have, often producing self-defeating consequences. The model also emphasises cognitive strategies to cope with the stress caused by threats to resources. Shifting the focus of attention and re-evaluating resources are common strategies people use. Applying the model to loneliness and the research discussed above, loss of personal or social resources may result in stress and loneliness. The extent to which people become lonely depends upon the type of resource lost, the social support available to them, and the cognitive strategies they use to cope with the stress the loss of resources creates.

**Conclusion and Future Directions**

There are a growing number of longitudinal studies that examine changes in loneliness over time. Many of these studies only take a single follow-up measure of loneliness, or take measures infrequently over a period of many years. Such studies do not capture detailed information about fluctuations in loneliness over time, as much change information is lost due to infrequent measurement over time. Another issue with many of the studies is the means of measuring loneliness. Often, loneliness is measured with a single question asking if the participant is lonely. Such measurement is thought to lead to social desirability bias and result in under-reporting (Wenger & Burholt, 2004). Another issue apparent in some studies is
variation between data collection via interview and by postal questionnaire. Social desirability may also play a role in how people answer questions about loneliness face to face as compared to via questionnaire (Luo et al., 2012). Consistency with one or other method within a study is necessary.

Most of the variables measured in loneliness research can be grouped into three domains: Health factors, socio-demographic factors, and social engagement factors. These domains provide an organising structure for measuring and discussing loneliness concepts and relationships.

Social engagement is frequently measured in loneliness research and is sometimes labelled social networks or social integration. Variables measuring this concept include contact with friends, family, community involvement, social isolation, social activity, and social contacts. Other variables may affect social engagement such as mobility and functional capacity. Socio-demographic factors such as age and gender are also measured and provide information about large segments of the population. In addition to these domains, health factors are measured as predictor or outcome variables due to the important relationship between loneliness and health, along with the importance of health issues for older adults and wider society.

Despite increasing numbers of longitudinal studies addressing loneliness in recent years, the ways in which variables influence changes in loneliness over time are not well understood. As discussed, various socio-demographic, social engagement, and health variables have shown to be related to loneliness and changes in loneliness. Addressing some of the measurement issues mentioned such as infrequent or insufficient data collection points would increase knowledge of the complex and dynamic nature of loneliness in older adults.
Research Design

In previous chapters it was established that loneliness is problematic for some older adults and that loneliness has negative health consequences. A multidimensional definition of loneliness incorporating emotional and cognitive elements allows description and understanding of the complexities of social relations and loneliness. Three theories are particularly useful for examining loneliness over time: socio-emotional selectivity theory, the convoy model, and the integrated theoretical model of loneliness. Empirical research has identified several variables that are related to loneliness. The number of longitudinal studies examining changes in loneliness over time is increasing, however the results across studies are often contradictory. This may relate to cultural or methodological differences among studies and a number of these issues were identified in the research literature. How loneliness changes over time for older adults is as yet not well understood and addressing measurement issues and utilising life-course theories of social relations to explore loneliness could improve the knowledge base.

Incorporating aspects of existing theories of social relations and existing empirical findings, a hypothetical model of the emergence and maintenance of loneliness in older adults will be discussed. Research questions and hypotheses will be derived from the model and tested.

Figure 3 represents an attempt to describe the ways in which relevant variables relate to loneliness using aspects of existing theories, in particular the integrated theoretical model of loneliness. In the model, the quality of living conditions concept impacts on the level of social integration. Living conditions are described by de Jong Gierveld and Tesch-Römer (2012) as being formed by factors such as a deprived neighbourhood. They point to evidence that people living in deprived neighbourhoods are lonelier than people living in well-off neighbourhoods (Scharf, Phillipson, & Smith, 2005, cited in de Jong Gierveld and Tesch-Römer, 2012).
SES may relate to living conditions due to availability of financial resources. A lack of resources could cause interpersonal conflict, resulting in not getting help when help is needed (Hobfoll, 1989). Low SES and finances would not only reduce quality of living conditions but could also result in stress, negative interactions among residents and negative affect. Negative social interactions may impact subjective wellbeing when financial resources are low (Krause, Newsom, & Rook, 2008, cited in de Jong Gierveld and Tesch-Römer, 2012). Feelings of loneliness are related to depressive symptoms (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006). Researchers de Jong Gierveld and Tesch-Römer (2012) argue that due to such a relationship between loneliness and depressive symptoms, poor living conditions may lead to negative experiences and also give rise to loneliness.

Household composition may relate to quality of living conditions and loneliness. This is supported by research showing that despite more people residing together under one roof in Eastern Europe, greater loneliness is evident than in Western Europe where less people reside together. (Fokkema, De Jong Gierveld, & Dykstra, 2012). This is also supported by a tenet of the integrated theoretical model which states that relationship quality is more important to mitigate loneliness than relationship quantity. An example of household composition impacting living conditions would be an older person feeling as though they are a burden on their children because they live with their children.

Health decreases with age (Baltes, Mayr, Borchelt, Maas, & Wilms, 1993). Health variables may also impact the quality of living conditions. The integrated theoretical model posits that as people age, health issues increase and independence decreases leading to increased social support needs. Loneliness can result from unfulfilled social needs as outlined in the deficit approach of the model. An example of health issues affecting the living situation would be if the older adult required care from their partner or family they reside with, thereby putting
pressure on resources, time, and relationships and possibly causing tension within the home. Mental health problems and depression could result in interpersonal communication problems and frustration for residents.

The level of social integration / engagement is likely to be related to a variety of variables. SES may impact on the level of social integration by limiting opportunities for social contact. This is supported by research finding that lower living standards are related to diminished opportunities for social support (Stephens, Alpass, & Towers, 2010). For example, financial constraints may reduce transport options and make it difficult to afford recreational or social opportunities with friends.

Household composition could impact living conditions; for example crowding is related to unhealthy living conditions (see Krieger & Higgins, 2002).

Older adults with disease and disability have significantly lower levels of participation in social activities than healthy older adults (Jang, Mortimer, Haley, & Graves, 2004). An example of health impacting social engagement includes the person requiring more time at home to recover from or manage health problems, which could limit social engagement opportunities.

Similarly, disability or activity limitations could impact social engagement if the person was unable to drive or walk without assistance as social opportunities with others could be missed.

Mental health issues could also impact social engagement. For example, research has demonstrated that depressed people have inferior social skills compared to non-depressed people (Segrin, 2000). Such deficits may impact attempts at social engagement.

Age is related to social engagement. For example, older people not only interact with fewer people, they interact primarily with people who are well known to them (Field & Minkler, 1988, cited in Carstensen, Isaacowitz, & Charles, 1999). Socio-emotional selectivity theory
would suggest that age could impact on social engagement, as older adults view time as limited and therefore have emotion related goals, and different goals regarding social relations. The older participants should have fewer but closer support people, whereas younger participants may have a larger support network with a greater number of less-close friends. The oldest old may be affected severely when members of their small, close social convoy pass away.

Gender may relate to social engagement. Research suggests that older women have larger and more multifaceted social networks than men, with more friends (Antonucci, 1994).

Widowhood impacts social engagement as demonstrated in longitudinal research finding that widowhood related to long-term decreases in interaction with children and other relatives (Ferraro & Barresi, 1982, cited in Ferraro, 1984). Friendships are also relevant as those widowed for a short time have more friendship participation than married persons or those widowed for a long time (Ferraro, Mutran & Barresi, 1984, cited in Ferraro, 1984).

Marriage status may relate to social engagement. Widowed and never married older adults have larger helping networks than married older adults (Barrett & Lynch, 1999), and the sibling relationship has been found to be more important for the morale of non-married than married older adults (Wilson, Calsyn & Orlofsky, 1994, cited in Pinquart, 2003). Indirect evidence of a relationship between marriage status and social engagement comes from research finding that friends may be more important for the never-married than for the widowed and divorced, who are more likely to have adult children as a primary source of support (Cantor, 1979, cited in Pinquart, 2003).
The availability of social support resources should facilitate social engagement. The structure, function and quality of these supports will be important according to the social convoy model (Antonucci, Ajrouch, & Birditt, 2014).

Activity limitations or functional ability has been shown to relate to loneliness and this may be due to the impact of social engagement. Jylha (2004) found subjects with functional disability were more likely to report loneliness than others, and they were also more likely to become lonely in the future. The authors noted that social integration is also an important factor and that this is probably partly related to functional ability. Activity limitations may also relate to living conditions. Low SES is related to disability in older adults (Coppin et al., 2006) and low SES is likely linked to deprived living conditions.

The importance of individual social expectations should be recognised within the model. This is where the cognitive experience of the individual is vital. Social needs and social expectations interact in the formation or prevention of loneliness. This means two people with the same living conditions and level of social engagement may or may not experience loneliness due to their differing social expectations. The maintenance of loneliness is also important and the integrated theoretical model suggests that loneliness may persist due to the lonely person experiencing hyper-vigilance in social situations which could impact on their ability to interact with others successfully, thus sustaining loneliness.
Figure 2. Hypothesised relationship of socio-demographic, health, and social engagement variables to loneliness incorporating the individual level of de Jong-Gierveld’s integrated theoretical model.

Figure 2 describes possible interactions between loneliness and various relevant variables. The question of how these variables relate to loneliness over time likely involves even more complex relationships between the variables. Many of the variables negatively impacting on integration and loneliness in Figure 2 can reasonably be expected to increase in frequency or intensity as one ages. For example, older adults can expect to experience an increasing
number of health problems as they get older as health decreases with age (Baltes et al., 1993). Health problems may result in older adults having less control over their living situation or household composition as they may have to live with other family members. Such a change in living situation is not always detrimental; evidence of a relationship between health and living situation comes from research with a Spanish sample of older adults which found that sharing living arrangements with children was associated with low depressive symptomatology and good self-rated health (Zunzunegui, Béland, & Otero, 2001).

As health problems increase, activity limitations are likely to increase with them. Widowhood is more likely as the person gets older. In these ways the older person’s social integration becomes more fragile over time.

Socio-emotional selectivity theory states that the social support network shrinks in size but increases in quality as older people select supports who meet their emotion-related goals, due to their perception of time as finite. This support group may successfully meet social needs, however for those who survive through to the old-old stage of life, losses become more likely as members of their support group die or other barriers to interaction arise, such as the many variables in Figure 2. Because the small support group is of high quality and the meaning within the relationships has increased due to the accumulated experiences shared over an extended period of time; the loss of these supports will result in loneliness and there will be fewer social resources available to assist the person to combat loneliness. For these reasons, it is hypothesised that as the number of variables negatively impacting loneliness increase over time, loneliness will increase over time.
Key Variables and the Present Study

The present study will undertake a secondary analysis of previously collected longitudinal questionnaire data. This means the choice of variables is limited to those in the original dataset and selection of variables that best represent constructs of interest for the present study is the objective. The variables are discussed below with reference to relevant theories previously discussed.

Demographic Variables

Age

The present data has age available as a continuous variable. The general trend in the literature is for greater age to be associated with greater loneliness (Cohen-Mansfield et al., 2009; Dahlberg et al., 2014; Dykstra et al., 2005; Jylha, 2004; Stephens, Alpass, Towers, & Stevenson, 2011). However authors have noted that this trend may be due to factors associated with age rather than age per se. For example, de Jong Gierveld and van Tilburg (1999) noted in their research that despite a significant correlation between age and loneliness, further analysis revealed that cohesion variables, socio-economic indicators and health were much more decisive in explaining differences in loneliness intensity than age. Similarly Jylha (2004) reported that loneliness increased with age, however this was not because of age per se, but because of increasing disability and decreasing social integration.

Greater age is generally associated with greater loneliness. Many factors in the proposed model of loneliness may impact social engagement to a greater extent as one ages, such as increased activity limitations and health problems (Baltes et al., 1993).
Employment

Employment status is considered a vital predictor of many aspects of well-being (Alpass, Neville, & Flett, 2000). Employed or previously employed older adults may have had more opportunity to build nonfamily social contacts through their employment than homemakers (Pinquart & Sörensen, 2001). Work often provides more than income, it structures life-style, offers status and identity, and provides a network for social interaction. (Buss & Redburn, 1983; Hayes & Nutman, 1981, cited in Hansson, Briggs, & Rule, 1990). Research on retirement and the number of support people in the support network have yielded mixed results. Atchley and Barusch (2004) found few differences between the number of supports available for retirees and comparable workers. Other research has found retirees are more likely to report lower available social support compared to workers (Blom et al., 2007). Retirees who have decreased social support networks report higher levels of depression and loneliness (Gall, Evans, & Howard, 1997). These studies suggest employment may be relevant to loneliness in older adults and this may be due to differences in the social network of employed and retired older adults.

Gender

The link between gender and loneliness has produced contradictory findings (Dahlberg & McKee, 2014). Where women are found to experience more loneliness than men, it is often thought to be due to increased risk factors such as widowhood (Victor, Scambler, Bowling, & Bond, 2005). Others found higher loneliness in older women compared to men among married respondents (Pinquart & Sörensen, 2001), and note that as a result women’s higher level of loneliness cannot be exclusively attributed to their larger probability of being widowed (Hobbs & Damon, 1996).
Dykstra et al. (2005) found that partner status was important to the link between gender and loneliness. Men and women with a partner had similar loneliness scores however unpartnered men were lonelier than unpartnered women.

Studies that report higher loneliness in women than men are particularly interesting considering research suggests that older women have larger and more multifaceted social networks than men, with more friends (Antonucci, 1994). However this may explain Dykstra et al.’s (2005) finding that unpartnered men were lonelier than unpartnered women as women may have had more social resources beyond the intimate relationship to draw on and meet their social needs thus protecting against loneliness.

**Ethnicity**

Ethnicity is dichotomised in the present study to Māori and non-Māori groups. This enables exploration of any patterns in loneliness specific to Māori or any cultural differences. Māori culture can be considered a collectivist culture. For example, family as opposed to the state is the main support system for Māori, and the family provides a strong sense of identity and purpose (Durie, 1998). Accordingly, Māori culture cherishes interdependence as opposed to independence (Durie, 1998). Māori may place more importance on the social network and may have larger social networks than non-Māori (Kumar & Oakley Browne, 2008). As a result, Māori participants may have greater social resources to support them and protect them against loneliness.

**Socio-Economic Status (SES)**

The literature suggests that lower SES is related to higher loneliness (Cohen-Mansfield et al., 2009; Pinquart & Sörensen, 2001; Christine Stephens et al., 2010). One way SES has been found to impact loneliness is via social network type. People low in SES tended to be embedded in social network types that related to low social support and greater loneliness.
and poorer mental and physical health (Stephens et al., 2011). This finding fits with research suggesting that lower living standards are related to diminished opportunities for social support (Christine Stephens et al., 2010). SES may be a factor which limits social support and social engagement leading to unmet social needs in the proposed model of loneliness. The Integrated Theoretical Model posits that social needs that go unmet result in unmet individual social expectations, thereby beginning a cognitive process of loneliness.

Health Variables

Self-Rated Physical Health

Poor self-rated health has been associated with greater loneliness (Dykstra et al., 2005; Kaasa, 1998; La Grow et al., 2012; Nummela et al., 2011; Paúl & Ribeiro, 2009). Self-rated health should not be confused with objective physical health as they may be fundamentally different constructs. For example, having a number of diagnosed chronic health problems is not inevitably correlated with a subjective rating of ill health (Vaillant & Mukamal, 2001). However, health, whether reported subjectively or objectively measured, decreases with age (Baltes et al., 1993).

Socio-emotional selectivity theory suggests that people with severe health problems or terminal health problems might view their time remaining alive to be short and so have emotion-focused goals, and hence high social needs. If social expectations are not met due to illness or mobility issues, for example attending hospital often or having activity limitations, loneliness may increase. Additionally, the integrated theoretical model (de Jong Gierveld & Tesch-Römer, 2012) states that health problems result in increased social needs in their own right.
Empirical evidence suggests that loneliness is related to poorer self-reported health (e.g. La Grow, Neville, Alpass, & Rodgers, 2012), therefore loneliness and poor self-rated health will be highly correlated.

**Depression**

Depression has been linked to loneliness (Alpass & Neville, 2003; Dahlberg & McKee, 2014; Luo et al., 2012; van Beljouw et al., 2014).

Relating depression to the theories of loneliness, people with depression may struggle with social engagement. As previously mentioned, people with depression have inferior social skills on average (Segrin, 2000), which could impede social integration. Depressed adults may lack social resources; indeed Alpass and Neville (2003) found that larger social network size and greater satisfaction with networks was related to lower depression scores. Such a lack of social resources could mean social needs go unmet which is a risk factor for loneliness (de Jong Gierveld & Tesch-Römer, 2012).

Socio-emotional selectivity theory suggests that the predictability of interactions with familiar contacts results in positive emotions being elicited more reliably and provides a sense of meaning (Carstensen et al., 1999). This process may be disrupted for depressed people as they elicit fewer positive, caring responses and more negative, rejecting responses from others (Gotlib, 1992).

**Activity Limitations**

Pinquart and Sörensen (2001) found that higher everyday competence is associated with less loneliness. They defined everyday competence as factors such as mobility, activities of daily living (ADL), and sensory ability. The authors concluded that disabilities hinder social contacts and competence deficits hinder the ability to utilise useful distraction activities. Jylha (2004)
found that loneliness increased over time due to increasing disability and decreasing social integration. Similarly, Dykstra et al. (2005) studied changes in functional capacity and discovered that declines in functional capacity were associated with increased loneliness over time. Aartsen and Jylha (2011) also emphasised the importance of a loss of capacity in the onset of loneliness. In their sample personal resource losses were predictive of loneliness onset whereas baseline personal resources were not.

Viewed in light of loneliness theory, people with activity limitations may struggle to maintain a healthy convoy as there may be transport or mobility issues limiting social contact. Social needs may go unmet resulting in social expectations going unmet and increasing loneliness. Indeed the importance of loss of personal resources (e.g. Aartsen & Jylha, 2011) or functional capacity (e.g. Dykstra et al., 2005) impacts loneliness regardless of baseline levels of the resources (e.g. Dykstra et al., 2005). This relationship between loss and loneliness emphasises the role of cognition encompassed by the social expectations component of the proposed model. Older adults may ‘miss what they once had’ and this may relate to greater loneliness.

**Social Variables**

**Social Support**

Both social support quantity and quality have proven to be relevant to loneliness (Dykstra et al., 2005; Stephens et al., 2011). For example, Dykstra et al. (2005) observed that social network size was inversely associated with loneliness.

Evidence that the quality of social support relates to loneliness is apparent from research on social networks. Stephens et al. (2011) examined social support in older adults and found that social network type was associated with loneliness and subsequent mental and physical health. Self contained and private-restricted networks were negatively related to social
support. Respondents embedded in these network types were lonelier. Locally integrated and wider community focused networks were positively related to social support and associated with less loneliness.

Further evidence of the importance of relationship quality was evident in research by Antonucci, Fuhrer, and Dartigues (1997). Although loneliness was not explicitly measured, relationship quality was more predictive than social network size for outcomes including mortality and both physical and mental health.

Generally, support quality has been more relevant to loneliness than quantity (Pinquart & Sörensen, 2001), although some quantity of social support is of course a pre-requisite for the existence of social support quality. Hence, there is an important link between the two.

Socio-emotional Selectivity Theory provides an explanation for the research findings regarding quality and quantity of social support. The theory posits that due to a change in goal selection, older adults’ social networks decrease in size but increase in quality by becoming more emotionally meaningful (Carstensen, Gross, & Fung, 1997). The predictability of interactions with familiar contacts results in positive emotions being elicited more reliably and provides a sense of meaning.

**Living Alone**

Wenger, Davies, Shahtahmasebi, and Scott (1996) found that living alone was associated with loneliness. Jylha’s (2004) research revealed that household composition was independently associated with loneliness. People who were living with their spouse only were the least lonely in the cross-sectional analysis. However, in the longitudinal analysis, those living alone or with someone else rather than their spouse only were more likely to recover from loneliness than those living with their spouse only. de Jong Gierveld et al. (2012) found that older adults living
alone were the most lonely, whereas those living with a partner were the least lonely. Living with others protected people from loneliness, however not to the extent that living with a partner did. An earlier study by de Jong Gierveld and van Tilburg (1999) yielded the same findings.

Most of the studies above have found that living alone is linked to high loneliness scores. This highlights the importance of household composition to loneliness. The proposed model suggests that household composition can relate to loneliness by impacting living conditions and social engagement. Living with others may protect against loneliness by providing a handy source of social engagement. Research has shown that living with one’s partner is the most protective household composition regarding loneliness (de Jong Gierveld et al., 2012; de Jong Gierveld & van Tilburg, 1999). This is in line with Socio-Emotional Selectivity Theory which posits that older adults seek a few emotionally meaningful and close contacts and their bond grows stronger over time.

**Research Questions and Hypotheses**

Based on the theoretical and empirical literature reviewed in the previous chapters the following research questions and hypotheses will be addressed:

What is the trend in loneliness over time?

\[ H1: \text{Loneliness will increase over time} \]

What demographic, health and social engagement factors relate to loneliness?

\[ H2: \text{Loneliness will be positively related to age; Loneliness will be negatively related to employment, and SES. Māori will be less lonely than non-Māori.} \]

\[ \text{Gender will not be related to Loneliness.} \]
H3: Loneliness will be positively related to depression; Health will be negatively related to loneliness.

H4: Loneliness will be positively related to living alone and activity limitations; Social support will be negatively related to loneliness.

How do baseline demographic, health and social engagement factors relate to change in loneliness over time?

H5: high age at baseline will be positively related to subsequent loneliness. Employment at baseline and Māori ethnicity will be negatively related to subsequent loneliness. Baseline SES will be negatively related to subsequent loneliness. Gender will not be related to subsequent Loneliness.

H6: baseline depression will be positively related to subsequent loneliness. Baseline health will be negatively related to subsequent loneliness.

H7: Living alone at baseline will be positively related to subsequent loneliness. Baseline activity limitations will be positively related to subsequent loneliness; Baseline Social support will be negatively related to subsequent loneliness.

How do changes in demographic, health and social engagement factors relate to change in loneliness over time?

H8: Loss of employment will be related to increased loneliness. A change to household composition from living with others to living alone will be related to increased loneliness. Decreases in SES will be related to increased loneliness.
H9: Increases in depression will be related to increased loneliness. Decreases in health will be related to increased loneliness.

H10: Increases in activity limitations will be related to increased loneliness. Increases in social support will be related to reduced loneliness.
Method

Data Source

The present study involves a secondary analysis of data collected for the Health, Work and Retirement survey (HWR) (Alpass et al., 2007), and the New Zealand Longitudinal Study of Ageing (NZLSA). The HWR research programme was created to examine the impact of the transition from work to retirement on older adults’ health and wellbeing over time. The NZLSA aimed to establish a nationally representative longitudinal study of the health, wealth and social factors that contribute to positive ageing in New Zealand, and to compare the data gathered with similar studies around the world to inform public policy and practice. These research programmes form part of a larger research programme called the Health and Ageing Research Team (HART) longitudinal cohort.

The longitudinal ageing study has collected, and is continuing to collect data by postal survey on various aspects of health and wellbeing, social support and context, work and retirement, income and assets, and demographic information. The questionnaire used includes referenced measures and questions created specifically for the longitudinal ageing study. New participants have joined the longitudinal research programme at various data waves.

All participants were sent a packet containing a survey questionnaire, an introductory letter and a reply paid envelope via standard post. A post card thanking participants who had returned the questionnaire, and reminding those who hadn’t yet returned it to do so, was posted 2-3 months after the initial packet. Existing cohort participants who did not respond within three months of the final reminder were followed up by phone contact by the research team using telephone contact details provided previously.
A total pool of 4339 older New Zealanders were invited to participate in the first NZLSA postal data collection wave in 2010, and comprised (1) HWR participants who participated in the 2008 data collection wave, (2) HWR participants from 2006 who consented to re-enter the study, (3) participants from a related cross-sectional study of retirement planning at Massey University, (4) participants from a pilot study conducted on the NZLSA survey questionnaire, and (5) New Zealanders randomly selected from the New Zealand Electoral Roll to increase the numbers of respondents at the younger (i.e., 50-54) and older (i.e., 70-84) age groups. A total of 3311 (76%) from the pool completed the 2010 questionnaires.

Existing participants were re-surveyed in subsequent waves if they: 1) had responded to at least one prior survey wave; 2) were not identified as lost to contact (i.e., post had been previously returned to sender and/or phone contact confirmed that no current postal address was available), and; 3) had not formally withdrawn from participation nor recorded as deceased (either via contact to the study or from the NZHI mortality register).

Māori over-sampling was specifically undertaken during participant selection for NZLSA (both for prior studies and new participants) to combat the historically poor research participation rates found in older ethnic minority populations (Moreno-John et al., 2004). Reflecting the procedure established for the HWR study, in each case a general population subsample was first randomly selected from those on the electoral role eligible for the study (e.g., aged 50-84) then, using a “Māori-descent” indicator on the roll, a Māori sub-sample was selected.

Target sample sizes were determined by a review of recommendations from other large scale health-focused longitudinal studies, response rates obtained in a pilot study, and Dillman’s (2000) guidance for power adequacy in representative postal surveys. Based on response rate expectations and sampling size, the HWR study is anticipated to have greater than 90% power.
to detect a moderate effect, at alpha .05, for 15 independent variables (Bornstein, Rothstein, Cohen, & Pollack, 1990, cited in Towers, 2007).

Participants

The present study investigates survey data collected from the 2010, 2012, and 2014 data collection waves of the HART longitudinal cohort. New participants joining the study after the 2010 wave are not included. The interval between each data collection wave was approximately two years. The target age range of the community-based sample is New Zealanders aged 50-84. All participants were originally identified via equal probability random sampling from the New Zealand Electoral Roll, a compulsory voting register of New Zealand adults over 18 years of age that currently covers 98% of the adult population of the country. Due to the nature of the electoral role, 34 participants (1% of sample) were aged under 50 at the first wave and were aged 48 or 49. Table 1 displays the demographic characteristics of the baseline sample in comparison with the age-matched New Zealand population.

Table 1

Demographic Characteristics of the Sample in Comparison with the Age-Matched New Zealand Population.

<table>
<thead>
<tr>
<th>Variable</th>
<th>2010 Sample</th>
<th>2013 Census³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1485 (44.9%)</td>
<td>659721 (48%)</td>
</tr>
<tr>
<td>Female</td>
<td>1820 (55.1%)</td>
<td>714111 (52%)</td>
</tr>
<tr>
<td>Age⁴</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48, 49</td>
<td>34 (1%)</td>
<td></td>
</tr>
<tr>
<td>50-59</td>
<td>914 (27.7%)</td>
<td>574854 (42%)</td>
</tr>
<tr>
<td>60-69</td>
<td>1429 (43.2%)</td>
<td>451257 (32.8%)</td>
</tr>
<tr>
<td>70-79</td>
<td>797 (24.1%)</td>
<td>265581 (19.3%)</td>
</tr>
<tr>
<td>80+</td>
<td>127 (3.8%)</td>
<td>155,949 (11.4%)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>2486 (75.2%)</td>
<td>1,017,861 (74.1%)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Count (Percentage)</td>
<td>Total (Percentage)</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Māori</td>
<td>609 (18.4%)</td>
<td>109,386 (8%)</td>
</tr>
<tr>
<td>Pacific Peoples</td>
<td>43 (1.3%)</td>
<td>44,934 (3.3%)</td>
</tr>
<tr>
<td>Other ethnicity</td>
<td>110 (3.3%)</td>
<td>237,342 (17.3%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education</th>
<th>Count (Percentage)</th>
<th>Total (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No qualification</td>
<td>867 (26.2%)</td>
<td>361,584 (26.3%)</td>
</tr>
<tr>
<td>Secondary school</td>
<td>744 (22.5%)</td>
<td>407,034 (29.6%)</td>
</tr>
<tr>
<td>Post sec / trade</td>
<td>866 (26.2%)</td>
<td>265,443 (19.3%)</td>
</tr>
<tr>
<td>Tertiary</td>
<td>793 (24%)</td>
<td>185,850 (13.5%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Employment status</th>
<th>Count (Percentage)</th>
<th>Total (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working full or part time</td>
<td>1739 (54.2%)</td>
<td>704,784 (51.3%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Partner status</th>
<th>Count (Percentage)</th>
<th>Total (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partnered</td>
<td>2380 (72%)</td>
<td>800,091 (58.2%)</td>
</tr>
<tr>
<td>Widowed</td>
<td>369 (11.2%)</td>
<td>164,712 (12%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income</th>
<th>Count (Percentage)</th>
<th>Total (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20,000</td>
<td>1121 (36.1%)</td>
<td>133,203 (14.5%)</td>
</tr>
<tr>
<td>20-30,000</td>
<td>532 (17.1%)</td>
<td>120,240 (13.1%)</td>
</tr>
<tr>
<td>30-50,000</td>
<td>762 (24.5%)</td>
<td>254,364 (27.8%)</td>
</tr>
<tr>
<td>50,000+</td>
<td>691 (22.2%)</td>
<td>407,808 (44.5%)</td>
</tr>
</tbody>
</table>

Note: a Census data represents New Zealanders aged 50 and over. b Some participants (1%) were aged under 50 due to the nature of the electoral role. c Qualification is based on highest qualification gained. d Census income data represents people aged 45 and older.

As previously mentioned, the response rate for the first wave was 76% and 3305 of 3311 participants were included. The second wave included 2697 participants (81% response rate) and the third wave included 2036 participants (62% response rate). Some of the non-responders may have died, become seriously ill or been unable to participate for other reasons. 1894 participants completed all three waves of the study, 2839 completed at least two waves and 466 completed only the first wave.
Sample Description

A random sample of those completing more than two waves was selected from the much larger group of participants who completed two or more waves of the study to allow similar N for the T1 (first wave) only and 2+ waves comparison groups. Two by two Chi-square tests for independence (with Yates Continuity Correction) were conducted to compare those who completed only the first wave and those who completed two or more waves. An alpha level of .05 was chosen for the Chi square analyses.

Chi square tests for independence are non-parametric tests for categorical variables, therefore normally distributed data are not required. Distinct groups are necessary and no participant can appear in more than one cell of the cross-tabulation. When there are only two groups on both of the variables, use of Yates’ continuity correction is recommended (Mayers, 2013).

Variables were divided into two groups by median split to enable analyses. As displayed in Table 2 and discussed further in Appendix B, Age, Māori ethnicity, activity limitations, education, SES, partner status, social support, health, living alone and depression were significant predictors of dropout after the first wave. Gender, income and loneliness were non-significant variables.

Table 2

Comparison of Participants Who Completed the First Wave Only and Participants Who Completed at Least Two Waves.

<table>
<thead>
<tr>
<th>Variable</th>
<th>completed multiple waves %</th>
<th>N</th>
<th>$x^2$</th>
<th>df</th>
<th>Sig (p)</th>
<th>Effect size (phi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>38</td>
<td>907</td>
<td>16.30</td>
<td>1</td>
<td>.000</td>
<td>-.14</td>
</tr>
<tr>
<td>Non-Māori</td>
<td>54</td>
<td>928</td>
<td>4.97</td>
<td>1</td>
<td>.026</td>
<td>-.08</td>
</tr>
</tbody>
</table>

52
<table>
<thead>
<tr>
<th></th>
<th>&lt;=64</th>
<th>54</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>65+</td>
<td>46</td>
</tr>
<tr>
<td>Activity limitations</td>
<td>847</td>
<td>11.77</td>
</tr>
<tr>
<td>Low</td>
<td>57</td>
<td>45</td>
</tr>
<tr>
<td>High</td>
<td>915</td>
<td>17.85</td>
</tr>
<tr>
<td>Education</td>
<td>47</td>
<td>65</td>
</tr>
<tr>
<td>Low</td>
<td>913</td>
<td>10.29</td>
</tr>
<tr>
<td>High</td>
<td>856</td>
<td>7.25</td>
</tr>
<tr>
<td>SES</td>
<td>48</td>
<td>58</td>
</tr>
<tr>
<td>No Partner</td>
<td>913</td>
<td>10.29</td>
</tr>
<tr>
<td>Partner</td>
<td>43</td>
<td>54</td>
</tr>
<tr>
<td>Social support</td>
<td>901</td>
<td>10.39</td>
</tr>
<tr>
<td>Low</td>
<td>46</td>
<td>57</td>
</tr>
<tr>
<td>High</td>
<td>800</td>
<td>8.64</td>
</tr>
<tr>
<td>Physical health&lt;sup&gt;b&lt;/sup&gt;</td>
<td>46</td>
<td>57</td>
</tr>
<tr>
<td>Low</td>
<td>932</td>
<td>5.71</td>
</tr>
<tr>
<td>High</td>
<td>897</td>
<td>17.25</td>
</tr>
<tr>
<td>Living alone</td>
<td>52</td>
<td>42</td>
</tr>
<tr>
<td>Not alone</td>
<td>932</td>
<td>2.30</td>
</tr>
<tr>
<td>Alone</td>
<td>839</td>
<td>1.68</td>
</tr>
<tr>
<td>Depression</td>
<td>47</td>
<td>52</td>
</tr>
<tr>
<td>Gender</td>
<td>51</td>
<td>56</td>
</tr>
<tr>
<td>Male</td>
<td>932</td>
<td>2.30</td>
</tr>
<tr>
<td>Female</td>
<td>839</td>
<td>1.68</td>
</tr>
</tbody>
</table>
Comparison of the T1 only group to participants completing multiple waves indicates that the participants who completed multiple waves were younger, fewer were Māori, they were healthier and more physically able, had higher education, higher SES, more were partnered, had more social support, fewer lived alone, and were less depressed. This means the results of the study may underestimate the extent of loneliness in the population. The analyses do not account for death and some of those who did not return for multiple waves may have died. Increased loneliness has been linked to mortality (Tilvis et al., 2012), therefore it is likely that those who died between waves would have been lonelier than survivors. This is another reason that the present study may underestimate the extent of loneliness in the population. Nevertheless, the sample size and the oversampling for Māori participants ensured the inclusion of sufficient older respondents, Māori, respondents with poor health, low education, low SES, single respondents and those with low social support to adequately represent the population.

**Measures**

Socio-demographic information was sought from participants including age, gender, ethnicity, education, employment status, marriage status and widowhood. In addition, the following variables were measured.
Loneliness

Loneliness was measured using the de Jong-Gierveld Loneliness Scale Short Form (de Jong-Gierveld & Kamphuis, 1985) which is a 6 item version of the original 11 item scale. Both measures yield a uni-dimensional loneliness score and contain subscales for emotional and social loneliness. The main loneliness scale can also be categorised into: “Not lonely”, “Moderately lonely”, “Severely lonely”, and “Very severely lonely”. A higher score indicates higher loneliness, with scores ranging from 0 to 6.

The Loneliness Short Form is a reliable (0.70-0.76 Cronbach’s Alpha coefficient) (de Jong Gierveld & Van Tilburg, 2006) measure and reliability does not differ across age groups. Congruent validity has been demonstrated with the standard and short-forms yielding correlations of between .93 and .95; also stable across age groups (de Jong Gierveld & Van Tilburg, 2006).

The positive items of the scales assess feelings of belongingness (e.g., “I can rely on my friends whenever I need them”). The negative items consider aspects of missing relationships (e.g., “I experience a sense of emptiness around me”). Response categories were yes, more or less, and no. The “more or less” answer is considered an indicator of loneliness as respondents are reluctant to admit to items describing social network deficits, given the stigma associated with loneliness (Dykstra et al., 2005). The internal consistency of the loneliness short form for the 2010 sample was Cronbach’s alpha .77. For measures with fewer than ten items the mean inter-item correlation can be a more accurate measure of reliability (Pallant, 2010). The short form for the 2010 sample yielded a mean inter-item correlation of .38 which is considered adequate (Pallant, 2010).
**Socio-Economic Status**

Socio-Economic Status was measured using the Economic Living Standards Index – Short Form (ELSI-SF) (Jensen, Spittal, & Krishnan, 2005). The instrument measures economic standard of living, specifically, the material aspect of wellbeing that is reflected in a person’s consumption and personal possessions. For example, one item asks if the main rooms of the house are kept warm and whether the cost of doing so prevents this. The measure can be used to produce a total score or to derive relevant SES categories. The ELSI Short Form is highly correlated with the ELSI (r= .98+). Regarding reliability, the internal consistency of the ELSI-SF is 0.88 (Jensen et al., 2005). Higher scores reflect better living standards and scores range from 0 to 31. The measure can also be used categorically.

**Physical Health**

Self-rated physical health was measured by question one of the SF-12 Health Survey (Ware, Kosinski, & Keller, 1996) which asks participants directly about the state of their health on a five point likert scale: “In general, would you say your health is Excellent, Very good, Good, Fair, or Poor”. Higher scores indicate better health.

**Depression**

Depression was measured with the 10 item version of the Center for Epidemiological Studies Depression Scale (CES-D-10) (Radloff, 1977). Items include depressed mood, feelings of guilt, worthlessness and helplessness, psychomotor retardation, loss of appetite and sleep difficulties. Responses are based on the frequency of occurrence during the past week. The measure has good internal reliability (Cronbach’s Alpha = 0.86), and test-retest reliability (ICC=0.85). The measure correlates (r=0.71) with the mental health subscale on the SF-36 indicating construct validity (Miller, Anton, & Townson, 2008). A higher score indicates greater depressive symptomatology and scores range from 0 to 30.
Activity Limitations

Two items from the SF-12 were used to measure activity limitations. These items ask about limitations in daily activities due to health status: “The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so how much? 1. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling or playing golf. 2. Climbing several flights of stairs.” Response options are “not at all”, “yes a little” and limited “a lot”. These items make up the physical functioning subscale of the SF-12. Scores range from 2 to 6 and a low score represents poor physical functioning or high activity limitations.

Social Support

The 24-item additive Social Provisions Scale (Cutrona et al., 1986) provides a total social provisions score containing 6 sub-scales or “provisions”: 1. Attachment, a sense of emotional closeness and security, usually provided by a spouse or lover; 2. Social Integration, a sense of belonging to a group of people who share common interests and recreational activities, usually obtained from friends; 3. Reassurance of Worth, acknowledgement of one’s competence and skill, usually obtained from co-workers; 4. Reliable Alliance, the assurance that one can count on others for assistance under any circumstances, usually obtained from family members; 5. Guidance, advice and information, usually obtained from teachers, mentors, or parent figures; 6. Opportunity for Nurturance, a sense of responsibility for the well-being of another, usually obtained from one’s children. The measure asks respondents to rate the degree to which their social relationships are currently supplying each of the provisions on a four point likert scale (1 = strongly disagree to 4 = strongly agree). A higher score indicates more support or provision of these social functions. For scoring purposes, the negative items are reversed and summed together with the positive items to form a score for each social provision. A total social support
score ranging from 24 to 96 is also formed by summing the six individual provision scores. Internal consistency for the total scale score is relatively high, ranging from .85 to .92 across a variety of populations. Factor analysis has confirmed a six-factor structure that corresponds to the six social provisions (Cutrona et al., 1986, p. 48).

**Living Alone**

This variable was measured by a question asking whether the participant lives alone.

**Education**

The questionnaires asked participants for their highest qualification. The options were: No qualification, secondary school (school certificate, University entrance, NCEA), post-secondary certificate/trade diploma, and university degree. Highest level of education was chosen as the best variable to measure education. As education is unlikely to change for many years prior to measurement for older adults, this measure captures sufficient information and minimises the number of different responses to be analysed.

**Ethnicity**

Participants were asked to identify their ethnicity using an adaptation of the 2006 Census question asking which ethnic group they identify with most. Participants can choose one only.

**Employment**

Employment was measured on the data collection questionnaire asking “please indicate your current employment status” and the following eight response options: full-time work, part-time work, retired – no paid work, full-time homemaker, full-time student, unable to work due to health or disability, unemployed and seeking work, and other. The present study dichotomised this data by categorising those working full or part-time as ‘employed’ and all other categories as ‘not employed’.
Other Demographic Variables

Date of Birth was used to calculate age. The Marital Status question included same-sex relationships and enabled creation of a variable to separate those with a partner and without. Widowhood was determined by selection of ‘widower’ on the marital status question and this enabled determination of changes in the variable over time from changes on the answer at any of the three waves.

Data Analysis

Descriptive statistics and multi-level modelling were used to describe and interpret the data. This section contains data analysis decisions and rationale. The results section shows the specific steps taken in analyses and the results obtained.

All analyses were conducted with respondents who participated in at least two of the three data waves (N= 2839). The mean age of this group at baseline was 64.2 with an age range of 48 to 85. Descriptive statistics include mean and standard deviations of relevant variables.

Multi-level modelling was used to examine the relationship of predictors to loneliness and changes in loneliness over time. This method was chosen as it enables analysis of datasets with missing data which is common in longitudinal research. Multi-level modelling is discussed in more detail in the following section.

Multi-level Linear Modelling

Multi-level Linear Modelling (MLM) is often used for research designs where data are organised at more than one level, also known as nested data. For example, test scores of children (level one) can be examined in relation to test scores of whole classrooms (level two). MLM also allows analysis of repeated measures, thus it is popular in longitudinal research. In such an application, repeated measures on psychological instruments at multiple data waves
can be nested within participants. Stated another way, measurement occasions or observations (level one) are set as the lowest level of analysis with participants (level two) the grouping variable (see Figure 3). Thus, MLM provides an alternative to univariate or multivariate analysis of repeated measures (Tabachnick & Fidell, 2007).

**Figure 3.** Visual representation of a two level repeated measures multilevel model with observations nested within participants.

**Assumptions of MLM**

MLM is an extension of multiple linear regression and accordingly has similar limitations and assumptions such as linearity, normality, an absence of multicollinearity or singularity, and requires consideration of outliers. An advantage of MLM over repeated measures ANOVA is that there is no requirement for complete data over occasions (although it is assumed that data are missing at random). Nor is there need for equal numbers of cases or equal spacing of data points (Tabachnick & Fidell, 2007). This is a useful attribute of MLM particularly for longitudinal research where participants drop out of the study or it is not possible to space measurements equally in time between hundreds of participants.
Another advantage of MLM is that independence of errors is not required. With repeated measures, measurements made close in time are likely to be more highly correlated than measurements made farther apart in time (sphericity). Sphericity is not a problem because MLM tests trends for individuals over time. Time can also be entered as a predictor, for example age of participant (Tabachnick & Fidell, 2007).

As with any other statistical technique, there are some specific requirements that must be satisfied. For example, it is important that the outcome data collected at each time point be measured on a common metric, so that changes across time reflect growth and not changes in measurement scale (Bryk & Raudenbush, 1987). Large sample sizes are necessary even if there are only a few predictors. Increasing sample size increases power while smaller effect sizes and larger standard errors decrease power (Tabachnick & Fidell, 2007).

Multicollinearity is another issue for consideration. Correlated predictors are even more problematic in MLM than in linear regression. Because the effects of correlated predictors are all adjusted for each other, the chance of their regression coefficients being statistically significant decreases. For this reason, having a relatively small number of relatively uncorrelated predictors is ideal. If interactions are formed, predictors are bound to be correlated with their main effects. The problem of multicollinearity between interactions and their main effects can be solved by centering (Tabachnick & Fidell, 2007). Centering involves subtracting a mean from each predictor score, which changes raw scores to deviation scores. Centering is most commonly performed on level-1 predictors. Centering DVs is unusual because it is likely to make interpretation difficult. Centering around the grand mean reduces multicollinearity when interactions are introduced and produces models that are easily transformed back into models based on raw scores (Tabachnick & Fidell, 2007).
Raudenbush and Bryk (2002) provide a guide for conducting MLM analyses. First, a series of standard multiple regression analyses are run, starting with the most interesting predictor and adding predictors in order of importance. Then, predictors that do not enhance prediction are dropped unless they are components of cross-level interactions.

The MLM analyses are presented in the ‘Results’ section along with rationale for the sequence of steps utilised.
Results

Descriptive Statistics

This chapter presents results from univariate analysis on key study variables, exploratory regression and preliminary analyses in preparation for conducting the multilevel models. Central components of multilevel modelling are then explained along with rationale for the analytic decisions made. Finally, the multilevel models are presented with the most relevant results graphically represented.

Univariate Analyses

Mean and standard deviation statistics for the study variables appear in Table 3. The mean loneliness scores at each wave show that loneliness decreased at T2 and then increased at T3, though not as high as the mean score at the initial wave. 27.2% of participants demonstrated no change to their loneliness scores at any point in the study as displayed in Table 4.

Table 3

*Descriptive statistics for respondents who participated in at least two waves.*

<table>
<thead>
<tr>
<th>Variable</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loneliness (0-6)</td>
<td>1.9(1.8)</td>
<td>1.7(1.8)</td>
<td>1.8(1.7)</td>
</tr>
<tr>
<td>Age (48+)</td>
<td>64.2(7.8)</td>
<td>66.4(7.9)</td>
<td>67.6(6.1)</td>
</tr>
<tr>
<td>SES (0-31)</td>
<td>23.5(6.4)</td>
<td>24.0(6.2)</td>
<td>24.9(5.8)</td>
</tr>
<tr>
<td>Social support (24-96)</td>
<td>79.6(10.1)</td>
<td></td>
<td>79.2(9.7)</td>
</tr>
<tr>
<td>Depression (0-30)</td>
<td>6.4(4.8)</td>
<td>6.6(4.9)</td>
<td>6.1(4.8)</td>
</tr>
<tr>
<td>Health²(1-5)</td>
<td>2.4(.92)</td>
<td>2.5(.94)</td>
<td>2.4(.88)</td>
</tr>
<tr>
<td>Activity limitations (2-6)</td>
<td>5.0(1.2)</td>
<td>5.0(1.2)</td>
<td>5.0(1.2)</td>
</tr>
</tbody>
</table>

*Note.*²Self reported health.
Table 4

Descriptive percentages for respondents who participated in at least two waves.

<table>
<thead>
<tr>
<th>Variable</th>
<th>T1 % Yes</th>
<th>T2 % Yes</th>
<th>T3 % Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (male)</td>
<td>44.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living alone</td>
<td>18.9</td>
<td>19.5</td>
<td>14.5</td>
</tr>
<tr>
<td>Employed&lt;sup&gt;a&lt;/sup&gt;</td>
<td>54.2</td>
<td>38.4</td>
<td>20.7</td>
</tr>
<tr>
<td>Māori</td>
<td>16.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partner</td>
<td>73.6</td>
<td>66.9</td>
<td>51.5</td>
</tr>
<tr>
<td>Widower&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10.5</td>
<td>11.1</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Note. <sup>a</sup>Employed full or part-time. <sup>b</sup>Widower with no current partner.

Self-reported health and activity limitations remained stable across the four year study period.

SES increased slightly over time and unsurprisingly the number of participants employed reduced over time. Social support and depression were slightly lower at T3 than T1 and fewer participants lived alone at the final wave compared to the prior waves. The number of participants living alone was lowest at the final wave.

**Multi-level Models and Preliminary Analyses**

This section describes steps taken in constructing the multi-level models including preliminary tasks and analyses to inform model development.

**Preliminary Analyses**

First, a random sample of 16 participants was selected (as suggested by Singer & Willett, 2003) and individual empirical growth plots were examined. Singer and Willett (2003) note that this is a useful way to develop an initial understanding of the data. Loneliness was plotted on the Y axis and time on the X axis. Two participants had scores of “0” on the loneliness scale at all
measurements, six had decreasing loneliness and six had increasing loneliness. The variation in scores for each individual was low, the greatest change from T1 to T3 was 3 loneliness points.

Parametric Ordinary Least Squares regression models were then plotted for each of the random sample of 16 participants (see Figure 4). The results revealed great heterogeneity in change in loneliness over time. For some, loneliness increased, for some it was stable, and for some it declined. The average rate of change revealed a slight decrease in loneliness over time.

The next step was to change the format of the data. IBM Statistical Package for the Social Sciences (SPSS) was used for all analyses. The default data layout in SPSS is the “wide” or person-level data set. This was changed for the multi-level analyses to a person-period or “long” data set (see Singer & Willett, 2003). Loneliness was initially coded as three variables,
one for each data wave. These variables were collapsed into a single loneliness variable with three levels corresponding to each data wave.

Next, a decision was made about the functional form of the growth trajectory. Singer and Willett (2003) note that when there are only a few waves of data, it is difficult to argue for anything except a linear change individual growth model. The authors note that when making decisions on which trajectory to select for modelling change it is often wise to postulate a simple linear model as this aids interpretation. This approach assumes that any deviations from linearity result from either outliers or measurement error. The assumption of linearity was adopted for the analyses herein.

**Centering**

After determining the functional form, the time variable was coded to represent linear time. Time can be represented in many ways in growth modelling to answer various questions. This is often called ‘centering’, that is determining the point where time equals ‘0’ which affects the interpretation of the intercept (Singer & Willett, 2003). In the present study, time was coded with the first wave of data collection coded ‘0’, the second coded ‘2’, and the final coded ‘4’. This was done because each data collection wave was separated by a period of two years, so time in this study is equal to years since the beginning of the study. This means the intercept represents the initial status loneliness score when the predictor variables are at their means.

Following the coding of time to years, the predictors were centered. Grand mean centering was employed for all of the predictors including the dichotomous predictors. This results in a mean of zero and is achieved by subtracting each score from the grand mean score of the sample. There is no change to the standard deviation when grand-mean centering is employed. Centering simplifies computational analyses and simplifies interpretation of
estimates. Grand means were obtained from the person-level dataset as opposed to the person-period dataset. This ensures the means are not affected by missing data at various waves (Singer & Willett, 2003).

If predictors are centered the intercept represents the average value of the predictors. If predictors are not centered the intercept represents predictors at score 0. This also applies to dichotomous predictors. If all predictors including dichotomous ones are centered, the estimates (i.e. intercept and slope/time) are exactly the same as the unconditional growth model. Because of this comparability, many researchers routinely centre all time invariant predictors, even dichotomies around their grand means so that the parameter estimates that result from the inclusion of additional predictors hardly change (Singer & Willett, 2003).

Exploratory Analyses

Prior to conducting multi-level modelling, exploratory regression analyses were conducted to find the variables that predicted the most variance in loneliness, following the recommendations of Raudenbush and Bryk (2002). Some variables were not included in analyses due to multicollinearity in regression analysis. For example, living alone and partner status were highly correlated. As a result, partner status was not included in further analyses as Dykstra et al. (2005) have previously examined this variable in a similar study. These authors found that respondents with a partner had generally lower levels of loneliness. However, those living with a partner showed a stronger increase in loneliness over time than those who were single. Exploratory analyses also revealed that depression and mental health were highly correlated and depression was retained as it explained more variance in the loneliness variable.
A multi-level model was also run with the predictors transformed to improve normality. The most appropriate transformations were employed to improve normality of the distribution of each variable. Tabachnick and Fidell (2007) note that with large samples determination of the significance of skewness and kurtosis is best achieved by looking at the shape of the distribution instead of using formal inference tests and this approach was utilised with the present data. Substantial positive skew was apparent for the loneliness and depression variables. Logarithmic transformation was applied to these variables and improved skew. SES, social support, and mental health variables were substantially negatively skewed and reflect logarithmic transformation was applied and improved skew. The choice of transformation was informed by guidelines from Pallant (2010). Age was normally distributed and did not require transformation.

The same variables were significant in the transformed analysis as the non-transformed analysis and signs (+) were unchanged for the significant variables after transformation. A problem with undertaking analyses using transformed variables is interpretability of results, with the interpretation of estimates problematic due to the various transformations. In the current study the analysis using transformed variables resulted in a poorer model fit at -2 Log likelihood of 22401 compared to 22014 for the raw score MLM. Due to these factors, all MLM analyses were conducted in raw score form.

Initial regression analyses revealed some multivariate outliers identified by Mahalanobis distance. The MLM was run with these 16 outliers removed to investigate their impact on the model. There was no change to the significance of the variables. The model fit was slightly better at 21959 compared to 22014 for the model that included outliers. As there was little impact on the model the outliers were retained in all analyses. This avoided the problem of removing participants from the analyses because their scores were ‘different’ from the norm.
There may be a systematic reason for different scores and including them in analyses provides a true representation of the sample. Also, deleting outliers can then result in further outliers being identified by Mahalanobis distance which can result in a needless reduction to the sample size if they are subsequently deleted.

The Multilevel models were created based on previous research by Dykstra et al. (2005) as a model for the data analysis. Random intercepts models were used in the analyses. This is the most straightforward approach and allows the Y intercept to vary. Scores on the dependent variable for each individual observation are predicted by the intercept which varies across groups. Slopes remain fixed meaning different predictor groups have the same slope. The slope is derived from the ‘Time’ variable which shows the average rate of change on the dependent variable between each wave for the combination of predictors entered in the model.

**Estimation**

Two main estimation methods are common in multilevel modelling; Maximum Likelihood (ML) and Restricted Maximum Likelihood (REML). Maximum likelihood estimates are guesses for the values of the unknown population parameters that maximise the probability of observing a particular sample of data (Singer & Willett, 2003). Singer and Willett (2003) note that ML and REML use different methods to describe the fit of the model. ML describes the fit of the entire model whereas REML describes the fit of only the random effects. This means ML can be used to compare models with different fixed effects whereas REML cannot. Despite ML being less sensitive than REML when testing random effects, ML is used in all MLM analyses herein as it enables comparison of models with different fixed effects.
**Error Covariance Structure**

An error (or residual) covariance matrix contains hypotheses about residual variances and covariances (Singer & Willett, 2003). The models were run with various common covariance structures often used in longitudinal research as recommended by Singer and Willett (2003) to see which structure yielded the best fit to the data. Measures of model fit examined were -2 Log Likelihood, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) statistics. A low value on these statistics indicates better model fit. A table of the results for various covariance structures appears in Appendix A.

The structure with the best fit to the data was the Heterogeneous Autoregressive error covariance matrix. This is a first-order autoregressive structure with heterogeneous variances. The correlation between any two elements is equal to $\rho$ for adjacent elements, $\rho^2$ for two elements separated by a third, and so on (IBM Knowledge Center, 2011). This structure is often more realistic than a structure that assumes independence between observations, as some correlation between repeated observations is likely in longitudinal studies. The analyses in the present study utilise a Heterogeneous Autoregressive repeated error covariance structure and a Scaled Identity structure for the random effect covariance. Scaled Identity structure assumes no relationship between variance elements. This random effect covariance structure is recommended by Heck, Thomas, and Tabata (2014), as no random effects were entered in the models.

**Fitting the Multilevel Models**

The multilevel models had two levels. Level 1 was the level of the observations and level 2 was the level of the participant. Data from observations were nested within participants. Model 1 is an empty or null model and the following models add explanatory variables as fixed effects.
The constant or intercept represents initial status as time was centered on the first wave of data collection. Other than Model 5, the predictor variables or independent variables were centered. When the IVs are centered the intercept represents the estimated value of the DV when all the IVs are at their mean. When the IVs are not centered, the intercept represents the value of the DV when all the IVs are 0. Table 4 displays the results of the multilevel models.

**Model 1: Unconditional Means Model**

Fitting the unconditional means model is the first step of longitudinal MLM. This model does not describe change in the outcome over time, it describes and partitions the outcome variation. Hypothesis tests determine whether there is sufficient variation at each level to warrant further analysis. If a variance component is zero, there is little point in trying to predict outcome variation at that level. If a variance component is non-zero, then there is variation at that level that could be explained (Singer & Willett, 2003).

Model 1 is a null model, specifying only a constant. Its parameter estimate is the mean loneliness score of 1.818 (see Table 4) for the sample of 2831 eligible respondents who participated in at least two waves. The variance at the respondent level 1.751 was larger than that at the level of individual observations 1.323 = (1.369 + 1.451 + 1.149 / 3). This indicates that the variation in loneliness scores between respondents was larger than the variation across time for individual respondents. Level 2 (respondent level) variance was significant which suggests there is sufficient variation in intercepts across individuals.

The Intra-class Correlation Coefficient (ICC), describes the proportion of the total outcome variation that lies “between” people (Singer & Willett, 2003).

\[
\text{ICC} = \frac{\text{level 2 variance}}{\text{level 2 variance} + \text{level 1 variance}}
\]
The proportion of variance in loneliness scores that is between individuals is:

\[ \text{ICC} = \frac{1.751}{(1.751 + 1.323)} = 0.570 \text{ or 57\%} \]

Table 4

*Fixed Effects Estimates and Variance-Covariance Estimates for Models of the Predictors of Loneliness*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.818** (.031)</td>
<td>1.849** (.035)</td>
<td>1.884** (.027)</td>
<td>1.887** (.026)</td>
<td>1.886** (.026)</td>
</tr>
<tr>
<td>Time</td>
<td>-.017 (.009)</td>
<td>-.019* (.009)</td>
<td>-.022* (.009)</td>
<td>-.020* (.009)</td>
<td></td>
</tr>
<tr>
<td>Time characteristics</td>
<td>Social support</td>
<td>-.073** (.003)</td>
<td>-.082** (.003)</td>
<td>-.080** (.003)</td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>.087** (.006)</td>
<td>.098** (.007)</td>
<td>.101** (.007)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>-.030** (.004)</td>
<td>-.027** (.005)</td>
<td>-.030** (.004)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>-.365** (.062)</td>
<td>-.372** (.073)</td>
<td>-.344** (.060)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>.257** (.047)</td>
<td>.305** (.055)</td>
<td>.247** (.045)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.015** (.004)</td>
<td>-.016** (.004)</td>
<td>-.015** (.004)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>-.043 (.032)</td>
<td>-.062 (.037)</td>
<td>-.065* (.032)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity limitations</td>
<td></td>
<td>.039 (.024)</td>
<td>.007 (.028)</td>
<td>.015 (.027)</td>
<td></td>
</tr>
<tr>
<td>Living alone</td>
<td>-.009 (.064)</td>
<td>-.015 (.074)</td>
<td>-.017 (.063)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>.044 (.055)</td>
<td>.062 (.065)</td>
<td>.081 (.056)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender * living alone</td>
<td></td>
<td>.125 (.127)</td>
<td>.125 (.127)</td>
<td>.119 (.123)</td>
<td></td>
</tr>
<tr>
<td>Time 1 characteristics *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Time*social support</td>
<td>.006** (.001)</td>
<td>.003* (.001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Time*depression</td>
<td>-.007* (.002)</td>
<td>.005* (.002)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Time*SES</td>
<td>-.002 (.002)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Time*Māori .006(.024)
Time*gender -.029(.018)
Time*age .001(.002)
Time*health .011(.012)
Time*activity limitations .022*(.009) .028*(.009)
Time * living alone .004(.024)
Time * employment -.012(.021)

Changes at Time 2 or Time 3
Change social support -.047**(.004)
Change depression .085**(.006)
Change SES -.029**(.006)
Change health .010(.032)
Change activity limitations .023(.024)
Change living alone status .145(.081)
Change employment status .070(.048)

Variance Level of observations
T1 1.369** 1.363** 1.160** 1.106** 1.131**
    (.072) (.072) (.059) (.055) (.056)
T2 1.451** 1.449** 1.544** 1.508** 1.371**
    (.108) (.108) (.082) (.080) (.077)
T3 1.149** 1.153** 1.375** 1.310** 1.072**
    (.066) (.066) (.071) (.066) (.057)
ARH1 rho .172** .171** .189** .169** .147**
Model 2: Unconditional Growth Model

Model 2 addresses the research question: What is the trend in loneliness over time? This model includes time as a predictor and is considered unconditional as no other predictors are included. An estimate of the trend of the dependent variable over time is provided.

Time is calculated as the number of years since the first point of measurement. Its parameter estimate indicates a decrease of -0.017 points (see Table 4) on the loneliness scale with each data collection wave. The introduction of time does not lead to a reduction of the variance in loneliness at the respondent level 1.752 or at the level of observations 1.322 = (1.363 + 1.449 + 1.153 /3).

The unconditional growth model appears in Figure 5. It indicates a slight reduction in loneliness over time.
Model 3: T1 Characteristics and Relationship to Differences in Loneliness.

Model 3 examines the relationship between initial conditions, that is predictor variables measured at the first wave (T1), and differences in loneliness. Model 3 addresses the research question: What initial demographic, health and social engagement factors relate to loneliness? Stated differently: Do initial conditions predict differences in loneliness?

Calculating the intercept for each predictor is straightforward. As the model uses random intercepts and fixed slopes, the predictor estimate is added to the intercept (IV estimate + Intercept = IV intercept estimate). As shown in Table 4, the coefficient for gender suggests that male participants would have an estimated mean loneliness initial score of \((1.884 + .257) = 2.141\). The time estimate is then subtracted from the intercept at each wave to provide the parallel slope across predictors.

Figure 6 displays the Model 3 results. Gender has the highest loneliness estimate meaning males experienced more loneliness than any other predictor group. Depression also yielded a
higher than average loneliness score, meaning those scoring high on depression had high loneliness scores. High SES and greater age resulted in loneliness slightly below the mean. Those with high levels of social support and good health had even lower loneliness than these groups. Māori participants had considerably lower loneliness scores than the average participant and the other predictor groups.

![Model 3](image)

*Figure 6. A comparison of statistically significant T1 predictor variables and their relative impact on loneliness.*

**Model 4: Interactions Between T1 Characteristics and Time.**

Model 4 examines predictor variables at the first wave (T1) and their interaction with the time estimate. This addresses the research question: Do changes in loneliness differ for different categories of older adults? Stated another way: What demographic, health and social engagement factors relate to change in loneliness over time?

Because this model involves interactions with time the estimates relate to the time estimate or slope. Time in these models is the rate of change of loneliness between waves. As shown in
Table 4, the estimate for the true rate of change between waves for the average participant is -0.022. As the predictors are all interactions with time the intercept for all of the predictors is the same. To calculate the slope for the various predictors the predictor estimate is added to the time estimate to give the rate of change for the predictor (predictor estimate + time = predictor slope).

Figure 7 shows the results for Model 4. Participants high in initial activity limitations were the only group to increase in loneliness over time. Depression at T1 had the shallowest negative slope and therefore reduced the least in loneliness at each wave. This means those who were initially depressed experienced more loneliness than the average participant over time, however their loneliness did reduce over time. Those with high initial social support were slightly less lonely than the depression group however they were still lonelier than the average participant.

Figure 7. The impact on loneliness of interactions between statistically significant T1 predictors and time.
Model 5: Changes in Predictors over Time and their Effects on Loneliness.

Model 5 examined the impact on loneliness of changes in the initial predictors over time, taking into account baseline levels of the predictors. This model addresses the research question: How do changes in demographic, health and social engagement factors affect loneliness?

The change scores for model 5 were derived by creating various variables in SPSS. First, 100 was added to each continuous predictor value. Then the T1 value was subtracted from the T2 value to derive the first change score and the T1 value was subtracted from the T3 value to derive the second change score. This resulted in change scores unaffected by sign (e.g. $3 + 100 = 103$) – $(2 + 100 = 102) = 1$). This example indicates an increase of one point in the predictor between T1 and T2. This resulted in two change values per predictor for each participant (excluding missing data). Data were set out in long form and a T1 change score variable of 0 was created as there was no change at T1. Changes were calculated in comparison to baseline to account for baseline levels of the predictors. Previous research by Dykstra et al. (2005) measured the impact on loneliness of changes in predictor variables using the same approach.

The derived change scores enabled multilevel modelling of each instance of change of a predictor from baseline at each wave. The estimates represent the change to the intercept (or average initial loneliness score) explained by the predictor groups. The estimates are added to the constant to reveal the impact that changes in the predictor has on the initial loneliness estimate. The slopes or rates of change are parallel for the groups as Time is modelled as a fixed effect. This method was valuable as it incorporated change between each wave and the approach was not largely affected by missing data (N=2815). The simpler approach of using a single change score between T3 and T1 for each participant was not maintained as this
resulted in a much reduced sample due to less participation in the T3 wave (N = 1661). This approach also misses valuable change data occurring in the middle of the study.

Dichotomous change predictor scores were created in the same way as the continuous change predictor scores. Dichotomous predictors had change scores of either 0, +1 (appearance of predictor in comparison to baseline) or -1 (disappearance of predictor).

Non-significant results from Model 4 were not included in Model 5 for reasons of parsimony.

As displayed in Figure 8 and Table 4, participants who experienced increases in depression experienced the greatest loneliness. Increases to SES and social support resulted in levels of loneliness which were lower than that of the average participant.

*Figure 8. Changes from baseline of statistically significant predictor variables and their impact on loneliness.*
Discussion

The primary goal of the present study was to explore how reported loneliness changes over time in a sample of older adult New Zealanders. Variables shown to be related to loneliness in previous research, including socio-demographic characteristics, health and social engagement variables, were investigated in terms of their relationship to changes in loneliness over time. Prominent theories of loneliness were discussed and used to develop a hypothesised model of the development and maintenance of loneliness in older adults. Quantitative longitudinal methods were used. These methods enable exploration of the complex relationships that exist between multiple variables and how they change and relate to each other over time. Results supported some of the hypotheses but contradicted others in important ways.

The Trend in Loneliness over Time

It was hypothesised that loneliness would increase over time for the older adult sample (H1: Loneliness will increase over time). Results contradicted these expectations and instead a slight decrease in loneliness over time was apparent. Descriptive statistics showed that loneliness decreased sharply at T2 and then increased to a level below the initial wave. Previous research by Dykstra et al. (2005) reported a trend of increasing loneliness over time. Similarly to the current study, Dykstra et al. also reported the lowest mean loneliness score at the second wave followed by increasing loneliness scores at the following two waves. The Dykstra et al. study spanned a seven year period whereas the present study spanned four years. Had the present study followed the participants for a longer period it is possible that the participants may have increased in loneliness near the end of the study. This possibility is supported by the fact that the average age of participants at the final wave in Dykstra et al.’s study was 73.8 compared to 67.6 at the final wave of the present study. Age was generally not a significant predictor of loneliness in the present study, however in Model 3 greater age at T1
was associated with loneliness slightly below the mean for the sample. In contrast, greater age significantly predicted greater loneliness in Dykstra et al.’s study which had an older sample by the final wave and followed participants for longer. These results support the findings of a meta-analytic review (Pinquart & Sörensen, 2001) that found in the youngest participants (mean age ≤ 60 years), loneliness decreased significantly with increasing age. For those with a mean age between 60 and 80 years old there was no relation between age and loneliness, and in those with a mean age over 80 years old loneliness significantly increased with age.

Although Dykstra et al. (2005) followed-up participants for longer resulting in a higher mean age by the final wave, the studies had many similarities. Both studies had similar samples in terms of partner status and gender, though the present study had lower mean ratings of self-rated health. One difference between the studies is that Dykstra et al. used the 11 item loneliness scale whereas the present study used the 6 item scale, however the scales are highly correlated which facilitates comparability.

The common finding of increasing loneliness over time may relate to age related losses. Previous researchers (Jylha, 2004) have noted that loneliness may increase over time, not because of increasing age per se, but because of increasing disability and decreasing social integration. This view aligns with Conservation of Resources Theory which states that loss of resources leads to increased stress. The extent to which people become lonely depends upon the type of resource lost, the social support available to them, and the cognitive strategies they use to cope with the stress the loss of resources creates. The Integrated Theoretical Model of loneliness predicts a similar relationship between age and loneliness. The model predicts decreasing health and independence as older adults age resulting in increased social support needs. Loneliness results from unfulfilled social needs.
Although the overall trend for the sample in the present study did not support the view that loneliness increases over time due to age related losses, the following sections examine specific variables relating to loneliness and show that loss remains an important concept.

Another explanation for the different trends in loneliness over time between the present study and research by Dykstra et al. is cultural differences. Dykstra et al. studied Dutch older adults whereas the present study’s sample consisted of New Zealanders with oversampling undertaken for Māori participants who represented 16.8% of the sample. Previous research has demonstrated cultural differences in loneliness, for example Eastern European countries have been found to have higher loneliness ratings than Western European countries despite greater co-residence in Eastern Europe (de Jong-Gierveld et al., 2012). de Jong Gierveld and Tesch-Römer (2012) incorporated cultural aspects in their Integrated Theoretical Model of loneliness. They note that cultural norms may act as a reference system for individual expectations, moderating the link between social expectations and loneliness. One culture may value the older adults living with their children whereas another may value autonomy and self-reliance. Such differences are thought to result in different levels of loneliness.

Dutch and New Zealand culture are both considered Western cultures, however there are likely to be differences between the two. Additionally, the oversampling of Māori participants likely included more participants with strong filial norms (see Durie, 1998) in the New Zealand study. Indeed, Māori participants were significantly less lonely than non-Māori in the present study. The Integrated Theoretical Model also considers the nature of the welfare system, societal wealth and demographic composition of the population as impacting social integration and loneliness. Such factors likely contribute to different findings regarding the trend in loneliness over time across countries.
Factors Relating to Loneliness

The second research question asked which demographic, health and social engagement factors relate to loneliness. Regarding demographic variables, it was hypothesised that loneliness would be positively related to age but negatively related to employment, SES and Māori ethnicity. Gender was predicted to be unrelated to loneliness. Age was discussed in the previous section due to its importance regarding changes in loneliness over time. Employment was not a significant predictor of loneliness which was contrary to the hypothesis. Over 54% of the sample were employed full or part-time at T1. One explanation found in previous research is there are few differences between the number of supports available for retirees and comparable workers (Atchley & Barusch, 2004). However other research has found retirees are more likely to report lower available social support compared to workers (Blom et al., 2007).

SES was negatively related to loneliness as hypothesised. Previous research has reported similar findings with low SES being related to high loneliness (e.g. Cohen-Mansfield et al., 2009; Pinquart & Sörensen, 2001; Stephens et al., 2011). Research has demonstrated that people low in SES are embedded in social network types that result in greater loneliness and poorer health (Stephens et al., 2011) and that lower living standards are related to diminished opportunities for social support (Christine Stephens et al., 2010). SES may be a factor which limits social support and social engagement leading to unmet social needs. The Integrated Theoretical Model posits that social needs that go unmet result in unmet individual social expectations, thereby beginning a cognitive process of loneliness. The theory of conservation of resources highlights the stress resulting from a threat to social resources. Social support facilitates preservation of resources. If low SES is related to diminished opportunities for social support, there may be insufficient social support to facilitate preservation of resources.
Male gender was associated with the highest loneliness scores. In contrast, much of the previous research has found that older women are lonelier than older men (Cohen-Mansfield et al., 2009; Pinquart & Sörensen, 2001), often thought to relate to their higher exposure to widowhood (Aartsen & Jylha, 2011; Victor, Scambler, Bowling, & Bond, 2005). On the other hand high loneliness in women compared to men has been apparent in married respondents leading some to conclude that women’s higher level of loneliness cannot be exclusively attributed to their larger probability of being widowed (Hobbs & Damon, 1996; Pinquart & Sörensen, 2001). One explanation for higher loneliness in women is that women are more willing to disclose loneliness as they find it more acceptable to do so than men (Dahlberg et al., 2015; Pinquart & Sörensen, 2001). As mentioned, these previous studies and explanations are at odds with the finding that males reported higher loneliness scores than females in the present study. However, Dykstra et al. (2005) also found high loneliness in men. Their results showed unpartnered men were the loneliest group whereas partnered men and women had similar loneliness levels. The present study did not examine partner status due to multicollinearity with living alone status, however living alone is a reasonable indicator of partner status in older adults. A gender by living alone interaction was conducted however did not reach significance indicating that living situation did not predict differences in loneliness for males and females and possibly that partner status did not predict these differences either. The findings were similar between the two studies in that males were lonelier than females, however, as the present study did not examine partner status directly it is not clear if the same pattern of loneliness occurred regarding gender and partner status. Further research could examine gender and loneliness across cultures. It is possible that the often found tendency for women to be more willing to report loneliness may be culture or cohort specific.
Ethnicity was hypothesised to be negatively related to loneliness. The results concurred as Māori participants had considerably lower loneliness scores than the average participant and the other predictor groups. A literature search did not yield any previous research addressing loneliness in Māori. However, scholars have noted that Māori may place more importance on the social network and may have larger social networks than non-Māori (Kumar & Oakley Browne, 2008). Māori culture can be considered a collectivist culture and Māori culture cherishes interdependence as opposed to independence (Durie, 1998). For example, family as opposed to the state is the main support system for Māori, and the family provides a strong sense of identity and purpose (Durie, 1998). Māori culture fosters respect of elders and intergenerational living is the norm. Older Māori rarely resort to residential care and instead reside with whānau (family). These cultural differences may relate to differences in the social network types of Māori compared to non-Māori. Further research using Wenger’s PANT instrument could specify any differences in the social network types of Māori and non-Māori which could aid in explaining the finding of lower loneliness in Māori participants. Additionally, measuring the size of Māori versus non-Māori social networks could explain whether the amount of support people or the nature of the social network is most important to prevent loneliness in Māori older adults.

As Māori culture is collectivist in nature, a holistic model of health called TeWhare Tapa Whā (Durie, 1998) has been proposed to explain the elements of Māori health. The metaphor of a Wharenui (meeting house) is used where the four walls that support the house are the four main elements of Māori health: tahawairua (spiritual health), tahahinengaro (mental health), tahatinana (physical health) and tahawhanāu (family health). All four elements are required for wellbeing. This model highlights the importance Māori culture places upon interdependence, for example the health of one’s family is considered as important as one’s own physical health.
to overall wellbeing. Spiritual health is also emphasised in contrast to mainstream health models. Māori cultural values are unique and may relate to unique social networks that protect against loneliness.

Regarding health variables, it was hypothesised that loneliness would be positively related to depression and negatively related to self-reported health. Depression was positively related to loneliness in the present study. Previous studies have noted a positive relationship between loneliness and depression (e.g. Alpass & Neville, 2003; Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006; Dahlberg & McKee, 2014; Luo et al., 2012; van Beljouw et al., 2014). One way that depression could increase loneliness is by hindering social engagement. People with depression have inferior social skills on average (Segrin, 2000), which could impede social engagement. Socio-emotional selectivity theory suggests that the predictability of interactions with familiar contacts results in positive emotions being elicited more reliably and provides a sense of meaning (Carstensen et al., 1999). This process may be disrupted for depressed people as they elicit fewer positive, caring responses and more negative, rejecting responses from others (Gotlib, 1992).

Depressed adults lack social resources; indeed Alpass and Neville (2003) found that larger social network size and greater satisfaction with networks was related to lower depression scores. Such a lack of social resources could mean social needs go unmet which is a risk factor for loneliness as outlined in the Integrated Theoretical Model of loneliness (de Jong Gierveld & Tesch-Römer, 2012). Additionally, failure to have social expectations met is thought to be a key contributor to loneliness, and is incorporated in some definitions of loneliness (de Jong Gierveld, 1998; Perlman & Peplau, 1982).
Self-rated physical health was negatively associated with loneliness as predicted. These findings are echoed in other loneliness research (e.g. Dykstra et al., 2005; Kaasa, 1998; La Grow et al., 2012; Luo et al., 2012; Nummela, Seppänen, & Uutela, 2011; Paúl & Ribeiro, 2009). Socio-emotional selectivity theory suggests that people with severe health problems or terminal health problems might view their time remaining alive to be short and so have emotion-focused goals, and hence high social needs. Additionally, the integrated theoretical model (de Jong Gierveld & Tesch-Römer, 2012) also states that health problems result in increased social needs. The model also predicts high loneliness for those whose social expectations do not meet their social reality. An alternative explanation for the finding is that people with poor health withdraw themselves from social opportunities. They may prefer to be alone due to pain or stigma associated with their health issues. Further research on the social preferences and loneliness of people with low self-reported health could inform the literature about the validity of such alternative explanations.

It was hypothesised that loneliness would be positively related to living alone and activity limitations and negatively related to social support. Surprisingly, living alone was not related to loneliness. Generally, previous research has found that living alone is positively associated with loneliness (de Jong Gierveld et al., 2012; de Jong Gierveld & van Tilburg, 1999; Wenger et al., 1996). It is unclear why living alone was a non-significant predictor in the present study. There may be a cultural aspect to this finding as people with a collectivist culture (e.g. Māori) may experience more loneliness when living alone than people from an individualistic culture. This would be expected due to the cultural norms of interdependence and the family focus of collectivist cultures such as Māori culture (Durie, 1998).
Activity limitations were not related to loneliness which was in contrast to the hypothesis. Previous research has found that higher everyday competence, a very similar construct, is associated with less loneliness (Pinquart & Sörensen, 2001).

As predicted, social support was negatively related to loneliness. Both social support quantity and quality have proven to be relevant to loneliness (Dykstra et al., 2005; Stephens et al., 2011). For example, Dykstra et al. (2005) observed that social network size was inversely associated with loneliness. Pinquart and Sörensen (2001) found in their meta-analysis that lower quality of contact is more closely associated with loneliness than lower quantity of social contacts. The social support measure used in the present study focused on key social needs being met with an emphasis on network quality. Socio-emotional Selectivity Theory posits that due to a change in goal selection, older adults’ social networks decrease in size but increase in quality by becoming more emotionally meaningful (Carstensen et al., 1997). The predictability of interactions with familiar contacts results in positive emotions being elicited more reliably and provides a sense of meaning. Conservation of Resources Theory states that social support facilitates the preservation of resources, thereby reducing stress. The present research supported these theories and added further evidence that social support is important to the prevention of loneliness. Further research could assess the types of resources that are most important for preventing loneliness in older adults.

**Baseline Characteristics and Changes in Loneliness over Time**

The third research question asked how baseline demographic, health and social engagement factors relate to change in loneliness over time. This involved the interaction between baseline characteristics and the time estimate. The time estimate was equivalent to the rate of change in loneliness between waves. Age was expected to be positively related to subsequent loneliness, Māori ethnicity, employment and SES at baseline were expected to be negatively
related to subsequent loneliness, and gender was not expected to be related to loneliness. Results showed that none of these baseline demographic variables were significantly associated with changes in loneliness over time.

Dykstra et al. (2005) asked the same research question using the same method with similar variables. They found that older respondents increased in loneliness more than younger respondents over time. This finding was discussed in the preceding section regarding the trend in loneliness over time.

Baseline health variables were expected to relate to subsequent loneliness. (H6: baseline depression will be positively related to subsequent loneliness. Baseline health will be negatively related to subsequent loneliness). Results showed that baseline depression was associated with higher than average loneliness over time. The interaction revealed that baseline depression was still associated with a decrease in loneliness over time, however depressed participants did not decrease in loneliness as much as non-depressed participants. That depression and loneliness are so closely linked lends support to the idea that cognitive appraisal is a key part of loneliness generation and maintenance. As suggested by Cacioppo and Hawkley (2009) loneliness can involve a cycle of hyper-vigilance to perceived social threats which results in expectations of further negative social experiences and behaviour which leads to ineffective social interactions and isolation. Such negative thinking is also likely amongst depressed people and social apathy and withdrawal could maintain the cycle of loneliness over time.

Baseline health was not significantly related to the rate of change in loneliness over time which was analogous to the findings of Dykstra et al. (2005). The integrated theoretical model posits that as people age, health issues increase and independence decreases leading to increased
social support needs. Loneliness can result from unfulfilled social needs as outlined in the
deficit approach of the model. The fact that poor health at baseline was not related to
subsequent loneliness suggests that these participants were either able to have their social
needs met, or were able to cope or adjust to them not being met. These participants may have
had more social support in the form of family or carers due to their greater severity of health
problems. As social expectations play a role in the development of loneliness, those with
health problems at baseline may have had time to reduce their social expectations based on
the expected impact of their health problems over time. Reduced social expectations would
result in reduced loneliness.

Baseline characteristics of living alone status and activity limitations were hypothesised to be
positively related to subsequent loneliness and baseline social support was expected to be
negatively related to subsequent loneliness. Living alone at baseline was not a significant
predictor of subsequent loneliness. This finding fits with that of Jylha (2004) who found that
those living alone or with someone else rather than their spouse only were more likely to
recover from loneliness than those living with their spouse only. Perhaps those living alone at
baseline had sufficient freedom to socialise with others. Of course some of those living alone
at baseline may have met a new partner over the subsequent years. Those living alone at
baseline may also have been more likely to move in with other family members as they aged
due to a lack of other day to day support. They may have had low social expectations or
learned to cope with loneliness over time.

Baseline activity limitations was the only variable to relate to an increase in loneliness over
time. Not only were people with high activity limitations at baseline lonelier than those with
low activity limitations at baseline, their loneliness increased over the subsequent years, unlike
the other baseline variables. In contrast, Dykstra et al. (2005) found that people with better
initial functional capacity (similar to low activity limitations) increased in loneliness more than those with poorer initial functional capacity (similar to high activity limitations). The results of Dykstra et al. may have been due to those with low initial activity limitations having more to lose than those who were already hindered by activity limitations. Some of the highly functional participants may have experienced health problems that resulted in functional losses. Again the concept of loss may be relevant where barriers to social needs result in unmet social expectations. However, the present study yielded the opposite result for activity limitations. One explanation for the difference may be measurement differences. Dykstra’s measure of functional capacity was more comprehensive and measured not only motor skills such as walking but fine motor skills such as dressing and cleaning the house.

Baseline social support was associated with higher than average loneliness over time. Social support was still associated with a decrease in loneliness over time, however participants with high social support did not decrease in loneliness as much as participants with low social support. Interestingly, Dykstra et al. (2005) used the same method to examine initial social network size and found that this variable was not a significant predictor of subsequent loneliness. This supports previous research suggesting that social network quality is more important than quantity (Pinquart & Sörensen, 2001). The present research finding of high initial social support being related to higher loneliness over time supports the view that loss of resources can result in loneliness. Importantly, the high initial social support may result in these participants having higher expectations of future social support. If future social support was lower than expected, loneliness could result as loneliness is thought to emerge when social expectations go unmet (see Peplau & Perlman, 1982). People with high social support may have higher social expectations than those that do not usually have such support, making them more prone to loneliness when support is not available. The social network type of the
individual may be important to the relationship between social support and loneliness as demonstrated previously (Stephens et al., 2011).

**Changes in Predictors and Changes in Loneliness over Time**

The final research question asked how changes in demographic, health, and social engagement factors relate to changes in loneliness over time. Loss of employment, loss of living companions, and reduced SES was expected to relate to increased loneliness. Results revealed that of these variables only SES was significantly related to changes in loneliness. Increases to SES were related to decreased loneliness. Previous studies note that lower SES is related to higher loneliness (Cohen-Mansfield et al., 2009; Pinquart & Sörensen, 2001; Christine Stephens et al., 2010). Dykstra et al. (2005) did not incorporate a measure of SES in their research. The present finding supports the trend for SES being inversely associated with loneliness and suggests that increases to SES over time are related to significant reductions in loneliness in older adults.

Increases in depression and decreases in health were expected to relate to increased loneliness. Increases in depression were associated with increased loneliness. Among the predictor groups, increases in depression yielded the greatest loneliness. Research by Cacioppo, Hawkley, and Thisted (2010) indicated that loneliness predicted subsequent depressive symptomatology, but not vice versa. In the present study increases in depression occurred prior to the increases in loneliness. Importantly, the present study does not discount the findings of Cacioppo et al. as the initial loneliness of participants is not taken into account. Those increasing in depression over time in the present study may have experienced high levels of loneliness prior to the beginning of the study. The present finding supports Conservation of Resources Theory as loss of personal or social resources may result in stress and loneliness. The extent to which people become lonely depends upon the type of resource
lost, the social support available to them, and the cognitive strategies they use to cope with the stress the loss of resources creates. Increased depression could be particularly harmful to the older adult by starting a cycle that is difficult to escape from as depression is related to poor social skills (Segrin, 2000) and unhelpful cognitive strategies (Abela & D’Allesandro, 2002). Poor social skills may hamper efforts to gain social support and unhelpful cognitive strategies may perpetuate loneliness (and depression) due to the importance of social expectations and the cognitive component of loneliness. Older adults experiencing depression or negative life events may be a particularly fruitful target for interventions to prevent loneliness and the other negative outcomes that are associated with loneliness such as health problems.

Changes in self-reported health were not significantly associated with changes in loneliness. Dykstra et al. (2005) found that those who report increased health over time tend to become less lonely, but the effect on loneliness of improvements in health was not as marked as that for declines in health.

Increases in activity limitations and decreases in social support were expected to relate to increased loneliness. Results revealed that changes in activity limitations were not significantly related to changes in loneliness. In contrast, increases in social support were indeed related to reduced loneliness.

Although changes in activity limitations did not predict changes in loneliness in the present study, research has yielded a link between similar variables. Dykstra et al. (2005) found that those who report increased functional capacity over time tended to become less lonely, but the effect on loneliness of improvements in functional capacity were not as marked as that for declines in functional capacity. As previously mentioned, the different findings may relate to
different ways of measuring functional capacity and activity limitations between the two studies.

Increases in social support at the various waves were associated with reduced loneliness. As discussed earlier, high social support at baseline was associated with increased loneliness. This suggests that those with high social support at baseline may have experienced reduced social support over time. Dykstra et al. (2005) found that high social network size at baseline was not associated with subsequent loneliness. They also observed less loneliness in those who increased the size of their social network and increased loneliness in those who reduced the number of social network members. These results suggest that the relationship between social support and loneliness changes over time. The results suggest that social support quality may be a better predictor of loneliness than network quantity, and that social support losses can result in increased loneliness and increases in social support can ameliorate loneliness. This suggests interventions targeted at increasing social support for older adults could improve loneliness outcomes and other important outcomes associated with loneliness.

**Research Design Considerations**

The methods used in the present study were largely modelled on those used by Dykstra et al. (2005). Where possible, similar constructs were examined to allow comparison between the two studies. Additionally, new variables were analysed to expand the literature on the topic of older adult loneliness. Dykstra et al. (2005) examined four data collection waves whereas the present study examined three data waves. A greater number of data waves is preferred as more change data is available along with the potential for more complex analyses such as modelling non-linear growth trajectories (i.e. quadratic). The differing number of waves may have accounted for some of the inconsistent findings between the two studies. Importantly,
both studies expand the literature as many loneliness studies simply include ‘before and after’ data collection waves.

The length of a longitudinal study is another important consideration. There are benefits and disadvantages to both short and long studies. Dropout, and in older adult samples death, are assured to result in reduced sample size as the amount of time from baseline increases. This can make some statistical analyses unavailable. The present study had a duration of four years and some dropout was evident.

The relatively young age of the sample should be considered when comparing the current study to similar research. The present sample represents the ‘young-old’ and ‘middle-old’, with fewer participants considered ‘old-old’ (80+). Research on the ‘young-old’ age group is helpful as this group may undergo important life changes such as retirement. Interventions with this group may yield the greatest gains if they can learn ways of preventing loneliness over the coming years.

The outcome measure used in the present study was the Loneliness Scale Short Form. Although less comprehensive than the full scale, the psychometric compatibility of the two measures is very good and the short form is often used in large scale research where participants must fill out multiple measures. The inclusion of a single question “how lonely are you?” with a likert response scale would have been useful for comparison with other studies which use such a measure. This was not a possibility as such a question was not included in the data collection waves which are historical. The use of a reliable scale such as the Loneliness Scale is considered preferable as it is less subject to social desirability bias. Use of a single item loneliness measure is thought to lead to social desirability bias and result in under-reporting (Wenger & Burholt, 2004). The use of interview methods may result in social desirability bias
As people may answer questions about loneliness differently face to face as compared to via questionnaire (Luo et al., 2012). These biases are thought to be due to the stigma associated with loneliness (de Jong Gierveld, 1998).

As is common is longitudinal research, the participants who remained in the study beyond the first wave were of higher SES. They also had more social support, higher education, were healthier and fewer were Māori. Although over-sampling for Māori participants may have helped to provide more accurate results despite drop-out for this group, the impact of attrition bias remains important in this study as it does in all longitudinal research with older adults.

Perhaps the most controversial analytic issue applies to the final analysis presented in Model 5. This model utilises change scores to estimate the impact of changes in predictor variables over time on loneliness. Whilst the use of change scores in empirical research is quite common (e.g. Dykstra et al., 2005), and has its supporters (e.g. Tisak & Smith, 1994) some authors advise against its use (e.g. Edwards, 2001). One issue highlighted by those who advise against the use of change scores is the need to adjust for baseline values of the predictors. In the present study an adjustment was made to incorporate baseline values and prevent bias.

Another issue is regression towards the mean (Barnett, van der Pols, & Dobson, 2005). This is the phenomenon where an extreme initial value will tend to be closer to the average on its second measurement and if extreme at second measurement, then closer to average at first measurement. This is related to the issue of measure reliability. If a measure was perfectly reliable and accurate, then regression to the mean would not be a problem as there would be no measurement error. No psychometric or behavioural measurement is completely reliable or accurate. As a result of these limitations and the controversy in the literature, the findings presented in model 5 should be interpreted with caution. Further research using more
complex methods such as latent growth modelling could help determine the validity of the findings.

**Future Directions**

The findings of the present study are applicable to older adult New Zealanders, whilst recognising that the ‘oldest old’ group are less well represented. As discussed, there are a number of parallels and differences to the findings of international research. Further research with New Zealand samples could help determine if cultural or national differences systematically relate to these differences to foreign studies or if cohort or measurement issues are relevant. The most apparent results that are at odds with many other studies are that males were most lonely and that Māori were least lonely. Further research with Māori participants could reveal if Māori tend to use different cognitive processes to ward off loneliness or if greater social support aids in the mitigation of loneliness. Kaupapa Māori research using qualitative methods could be used to investigate the meaning of loneliness for Māori.

Future research would benefit from investigating the general trend in loneliness over a longer period of time as the result in the present study of decreasing loneliness over time is somewhat unique. More complex statistical methods such as latent growth modelling with a greater number of data waves could enable new insights by identifying underlying patterns in the data regarding changes in loneliness over time. Such an approach would eliminate the potential problems associated with using change scores to derive information about changes in the variables over time.
Conclusion

The present study examined the relationships between social engagement variables, health and demographic variables and changes in loneliness over time in a New Zealand sample of older adults. A model of the development and maintenance of loneliness in older adults was proposed. Key findings included a trend of slightly decreasing loneliness over time and with increasing age, a finding contrary to most studies. This finding challenges the assumption that people become lonelier as they get older.

Male gender and depression were associated with the greatest loneliness whereas high SES, social support, good health and Māori ethnicity were associated with lower than average loneliness. Interactions with Time showed that high activity limitations, depression and social support resulted in greater than average loneliness over time. Changes in the predictor variables over time suggested that increases to depression result in increased loneliness whereas increases in SES and social support result in lower than average loneliness. Some of the findings aid in cementing previously observed findings whereas others call some commonly held assumptions about older adults into question. In particular, assistance for depression, a greater focus on the circumstances of older males, ensuring sufficient financial resources, managing health problems and ensuring adequate social support can ameliorate loneliness in older adults and its devastating sequelae.
References


Honigh-de Vla


## Appendix A

Comparison of covariance structures

**Table A 1**

*Comparison of common covariance structures using Model 3 data*

<table>
<thead>
<tr>
<th>Repeated covariance</th>
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Note. Information criteria presented in smaller is better form.

Appendix B

Comparison of Participants Who Completed the First Wave Only and Participants Who Completed at Least Two Waves

Of those sampled, 38% of Māori completed more than two waves whereas 54% of non-Māori completed multiple waves. Māori versus non Māori status did predict dropout after the first wave and this was significant with a small effect size using Cohen’s (1988) criteria, $x^2 (1, n = 907) = 16.30, p = .00, \phi = -.14$.

Age was divided by median split into two groups, age <=64 and 65+. Of those sampled, 54% of the younger group completed multiple waves whereas 46% of the older group completed multiple waves. Age did predict dropout after the first wave and this was significant with a very small effect size, $x^2 (1, n = 928) = 4.97, p = .026, \phi = -.075$.

Activity limitations predicted dropout after the first wave and this was significant with a small effect size, $x^2 (1, n = 847) = 11.77, p = .001, \phi = .12$. 57% of the low limitations group completed multiple waves whereas only 45% of the high limitations group completed multiple waves.

Education predicted dropout after the first wave and this was significant with a small effect size, $x^2 (1, n = 915) = 17.85, p = .000, \phi = .14$. 47% of the low education group completed multiple waves, whereas 65% of the high education group completed multiple waves.

SES measured by the ELSI short form at the first wave predicted dropout after the first wave and this was significant with a small effect size, $x^2 (1, n = 856) = 7.25, p = .007, \phi = .094$. 48% of the low SES group completed multiple waves, whereas 58% of the high SES group completed multiple waves.
Marriage status was recoded into partner and no partner groups. Partner status predicted dropout after the first wave and this was significant with a small effect size, $\chi^2 (1, n = 913) = 10.29$, $p = .001$, $phi = .109$. Forty three percent of those with no partner completed multiple waves whereas 54% of those with a partner completed multiple waves.

Social support predicted dropout after the first wave and this was significant with a small effect size, $\chi^2 (1, n = 901) = 10.39$, $p = .001$, $phi = .110$. Of the low social support group 46% returned to the study, 57% of the high social support group returned to the study.

Physical health measured by the physical health subscale of the SF-12 predicted dropout, $\chi^2 (1, n = 800) = 8.64$, $p = .003$, $phi = .106$. 46% of the less healthy group returned whereas 57% of the healthy group returned.

Living alone at T1 did predict dropout after the first wave and this was significant with a very small effect size, $\chi^2 (1, n = 932) = 5.71$, $p = .017$, $phi = -.081$. 52% of those not living alone returned whereas 42% of the living alone group returned.

Depression at T1 predicted dropout after the first wave and this was significant with a small effect size, $\chi^2 (1, n = 897) = 17.25$, $p = .000$, $phi = -.141$. 57% of the low depression group returned and 43% of the high depression group returned.

Chi square indicated no significant association between gender and participation in more than two waves of the study, $\chi^2 (1, n = 932) = 2.30$, $p = .13$, $phi = .05$. Income at wave 1 was also a non-significant predictor, $\chi^2 (1, n = 839) = 1.68$, $p = .195$, $phi = .047$. The overall loneliness score on the full loneliness scale was a non-significant predictor, $\chi^2 (1, n = 902) = 2.82$, $p = .093$, $phi = -.058$. 