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**Purpose in Life, Sleep, and Loneliness in Later Life: A Cross-Sectional Study of
Older New Zealanders**

A thesis presented in partial fulfillment of the requirement for the degree of
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Abstract

Background: Loneliness and sleep issues are increasingly prevalent in older adults and negatively affect their physical, mental, psychosocial health and well-being. In New Zealand (NZ), one in four people is projected to be aged 65 years or older by 2050. This unprecedented demographic shift presents significant challenges for social support and healthcare systems, particularly as older adults become more vulnerable due to physical decline, retirement and bereavement. Despite growing concern, limited research examines how sleep and loneliness interact to influence later life outcomes. There is evidence suggesting that purpose in life (PiL defined as a meaningful direction or goal that motivates and guides human behaviour) may help individuals adopt healthy behaviours (e.g., sleep), engage in social participation, and enhance emotional well-being, including loneliness. The present study investigates the relationship between PiL and loneliness, and tests whether sleep health mediates this relationship.

Methods: Analyses were conducted of data from the 2022 NZ Health, Work and Retirement Study, which included 5,514 older adults aged between 55–93 years. Bivariate analyses examined associations between loneliness (scored on the De Jong Gierveld Scale), PiL (Life Engagement Test), sleep status (self-reported duration and satisfaction), and key sociodemographic and health variables. Multivariate regression was used to identify independent predictors of loneliness. Mediation analyses tested whether sleep quality or duration mediates the relationship between PiL and loneliness.

Results: Poor sleep outcomes were associated with increased scores on the loneliness scale. PiL, mental health, socioeconomic status (SES), age, living arrangement, ethnicity, and gender were all independently associated with loneliness. For example, a 1-point increase in PiL test corresponded to a 0.85-point decrease in loneliness score. Sleep satisfaction partially mediated the relationship between PiL and loneliness, such that individuals with higher PiL were more likely to report greater sleep satisfaction, which, in turn, contributed to less lonely. The mediation effect of sleep duration was statistically significant but negligible.

Conclusion: The present study supports prior research findings that higher levels of PiL are associated with reduced levels of loneliness. This thesis contributes to the literature by highlighting the mediating role of sleep in this relationship. These findings will inform

future research examining the interactions between psychosocial well-being and sleep health, as well as guide practices that build and maintain PiL, promote sleep health, and combat loneliness, enabling older adults to age with purpose and independence.

Keywords: Loneliness, purpose, sleep health, older adults, New Zealand, quantitative

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List of Abbreviations

BDI	Beck Depression Inventory
BMI	Body Mass Index
ADL	Activities of daily living
AD	Alzheimer's disease
CVD	Cardiovascular diseases
CES-D	Centre for Epidemiologic Studies Depression Scale
EEG	Electroencephalogram
HDSQ	Hopelessness Depression Symptom Questionnaire
LiLACS NZ	Life and Living in Advanced Age: A Cohort Study in New Zealand
LET	Life Engagement Test
MCI	Mild cognitive impairment
New Zealand	NZ
NREM	Non-rapid eye movement
PiL	Purpose in Life
PSG	Polysomnography
PSQI	Pittsburgh Sleep Quality Index
QOL	Quality of Life
REM	Rapid eye movement
RLS	Restless legs syndrome
SD	Standard deviation
SES	Socioeconomic status
SF-12	Short-Form Health Survey
UCLA	University of California, Los Angeles
UK	United Kingdom
US	United States
WHO	World Health Organisation

Introduction

Ageing, Ageing Population, Healthy Ageing

Advances in healthcare have led to a significant increase in life expectancy, resulting in a rapidly growing global ageing population. Currently, approximately 830 million people worldwide are aged 65 or older (van Teutem, 2024). According to United Nations data, this figure is projected to more than double, reaching 1.7 billion by 2054 (United Nations Department of Economic and Social Affairs, 2024). In NZ, one in every six people was aged 65 years or over in 2022, and this is projected to increase to one in four by 2050 (Stats NZ, 2022). This unprecedented ageing population, combined with longer periods of retirement, decreasing marriage and fertility rates, and increasing divorce rates, poses significant challenges to healthcare and social care systems (Khan et al., 2024; Mount et al., 2019). While the older population is a vital demographic that enriches our society, they often face substantial social and health-related issues (Pedersen & Moloney, 2024). Consequently, maintaining physical and emotional health and psychosocial well-being, and adopting healthy lifestyles, have become critical for purposeful and independent ageing.

In response to the increased ageing population, healthy ageing has become the focus of the World Health Organisation's (WHO) policy framework on ageing. This approach recognises that it is necessary to shape policies worldwide to embrace healthy ageing principles, ensuring that quality of life in old age begins well before one reaches that phase of life (Pedersen & Moloney, 2024). Aligning with the WHO framework, NZ has developed the Healthy Ageing Strategy (Associate Minister of Health, 2016) and Better Late Life - He Oranga Kaumātua 2019 to 2034 Strategy (Office for Seniors, 2019). These strategies reflect the NZ government's vision of older people living well in age-friendly communities. The community supports overall well-being as New Zealanders age through enhancing social connections, developing a sense of purpose, promoting mentally stimulating activities and psychological well-being (Associate Minister of Health, 2016). While the WHO framework and NZ strategy provided a broad vision for healthy ageing, understanding specific physiological and psychosocial challenges faced by older adults is essential to maintain a better quality of life in their later years.

Physiological and Psychosocial Changes among Ageing Population – Loneliness, Sleep and Purpose in Life (PiL)

In 2023, the US Surgeon General declared loneliness an ‘silent epidemic’ (pp. 365), and the WHO formed an International Commission to investigate loneliness as a pressing global health threat (Ng, 2024; Office of the U.S. Surgeon General, 2023). Older adults have been identified as more susceptible to experiencing loneliness than younger adults due to factors such as retirement, bereavement, and declining health (Franssen et al., 2020). Research indicates that both social and emotional loneliness can exacerbate a range of adverse health outcomes, including increased mortality rates and chronic illnesses (Leigh-Hunt et al., 2017).

Sleep is a critical component of overall health for older adults (Lavoie et al., 2018). A systematic review of existing literature by the American National Sleep Foundation indicated that older adults who sleep between six and nine hours per night scored higher for cognition, physical health, and quality of life than older adults with shorter or longer sleep durations (Hirshkowitz et al., 2015; Miner & Kryger, 2020). Sleep deprivation has been associated with immune-related and cognitive diseases, such as chronic inflammation and an increased risk of cardiometabolic, neoplastic, autoimmune, and neurodegenerative diseases (Garbarino et al., 2021). However, as we age, sleep duration and quality have been found to decrease, and many older adults experience reduced total sleep time, increased sleep disturbances, and primary sleep disorders, such as insomnia and sleep apnoea (Mander et al., 2017).

Loneliness and sleep disturbances are increasingly prevalent among older adults and negatively impact their health and well-being (Kim et al., 2022). Critically, a meta-analysis of the relationship between sleep and loneliness demonstrated that the association between sleep problems and loneliness appears bidirectional (Hom et al., 2020). Similarly, Simon and Walker (2018) identified a unique, cyclical relationship between sleep disturbances and feelings of loneliness and social withdrawal that warrants further exploration among older adults. Despite this, there is limited literature on how they interact with one another and collectively impact older adults’ health and well-being. In NZ, disturbed sleep has been identified as a problem affecting approximately one-third of older New Zealanders (Gibson et al., 2023). Yet the relationship between sleep and loneliness in this population remains under-researched. Sleep and psychological health are important

areas to explore in the ageing population, as both sleep loss and loneliness are closely linked to poor physical health, depression, and cognitive decline in older adults (Gibson et al., 2016; Gibson et al., 2020; Paine et al., 2019). Recent literature indicates that a sense of purpose may serve as a protective factor against loneliness and sleep problems among older adults (Musich et al., 2020).

Purpose in life (PiL) is fundamental to human beings and motivates and guides human behaviours. PiL is defined as a meaningful direction or goal that gives individuals a sense of meaning and fulfilment (Frankl, 1984). Recent studies have shown that PiL levels are linked to multiple aspects of physical and psychological health, healthcare utilisation and expenditures, and quality of life among older populations (Musich et al., 2018; Musich et al., 2021). For instance, the English Longitudinal Study of Ageing (over 6,000 participants aged 65 years and over) demonstrated that a higher level of PiL in older adults predicts positive change in health, behavioural and social outcomes over four years (Steptoe & Fancourt, 2019). Pfund et al. (2022) indicated that establishing and maintaining a sense of purpose may provide a meaningful framework for older adults to engage in their communities, foster social connections and reduce psychological distress. Consequently, PiL could be a potential modifiable factor in combating loneliness (Irving et al., 2017). Interestingly, a strong sense of purpose is also linked to reduced sleep disturbances. For instance, individuals who report feeling meaningful to their present and past life and having clear goals and direction in their daily living tend to experience more restorative sleep than those who do not (Kim et al., 2015; Turner et al., 2017).

This thesis aimed to explore the relationships among PiL, sleep, and loneliness, and the potential mediating effect of sleep on the relationship between PiL and loneliness among older adults in NZ. By investigating these connections, the research aims to illustrate the significance of maintaining and cultivating purpose in later life. The thesis findings will inform future research and practice regarding longitudinal inquiry and approaches to help older people achieve better sleep, reduce loneliness, and maintain PiL, thereby promoting overall well-being and achieving healthy ageing.

Literature review

This literature review examines existing research on loneliness, PiL, and sleep among older adults. It explores the causes of loneliness in later life, how loneliness, PiL, and sleep vary across populations, and factors that contribute to different levels of loneliness, PiL, and sleep. It further explores the negative consequences of loneliness and sleep problems on older adults' health and well-being. Additionally, the positive impact of PiL on physical, cognitive, psychosocial health and healthy behaviours. Finally, it addresses the interaction among PiL, loneliness, and sleep, and its potential underlying mechanisms, and identifies key gaps in the literature that this thesis aims to address.

Loneliness

Before launching into a review of the literature on loneliness, it is important to consider how it is defined and measured. Weiss (1973) made a distinction between social and emotional loneliness. Emotional loneliness is defined as the discrepancy between an individual's desired and attained levels of social relationships. Consequently, emotional loneliness is a subjective, distressing feeling that arises when social needs are not met by the quantity and quality of one's social relationships (Hawkley & Cacioppo, 2010). In contrast, social loneliness is an objective state due to a lack of meaningful social connections or participation in social activities (World Health Organisation, 2023). Social loneliness or social isolation is defined as the time individuals spend alone and results from a lack of involvement and integration into a social network (Nakou et al., 2025).

Type of Loneliness

Social (Isolation) and Emotional Loneliness. Some studies showed there were positive associations between social isolation and loneliness. However, Shankar et al. (2013) demonstrated that after adjustment for sociodemographic factors (including age, gender, marital status, material resources, education, household income) and health (including depression, diagnosed of cardiovascular diseases (CVD), diabetes, smoking and physical activity) variables, this relationship was attenuated, although social isolation was still significantly positively related to emotional loneliness. On the contrary, Beridze et al. (2020) noted that social isolation does not always lead to emotional loneliness, as some individuals may not perceive their limited social connections as problematic. Thus, living

alone and having fewer family and friends does not necessarily mean feeling lonely (Franssen et al., 2020). In addition, a recent study revealed that chronic social isolation was associated with subsequent emotional loneliness, but not vice versa (Zhang et al., 2023). Older adults can be socially isolated without feeling lonely, but they can also feel lonely despite having a strong and diverse social network (Nakou et al., 2025).

Situational and Chronic Loneliness. Situational loneliness tends to occur when individuals experience stressful life events, such as losses in their social networks due to retirement or bereavement. Both of these experiences are particularly prevalent in later life (Shiovitz-Ezra & Ayalon, 2010). Chronic loneliness is a persistent and enduring emotional condition that extends beyond temporary feelings of loneliness. It is characterised by ongoing dissatisfaction with one's social relationships and support networks (Shiovitz-Ezra & Ayalon, 2010). Compared to situational loneliness, chronic loneliness tends to have more negative effects on physical, mental, and psychosocial health and well-being. Hajek et al. (2025) conducted a systematic review, meta-analysis, and meta-regression of 17 studies, indicating that approximately 20.8% of older adults experience chronic loneliness, with females reporting higher levels than males (21.7% vs. 16.3%). They identified that for older adults, bereavement, such as loss of friends and spouse, often has a prolonged adverse effect and contributes to chronic loneliness, which, in turn, may contribute to adverse physical and psychological outcomes (Szabó et al., 2020). Thus, situational and chronic loneliness can be intertwined among older adults.

Measurement of Loneliness

The most used measures of loneliness are the single-item measure from the Centre for Epidemiologic Studies Depression Scale (CES-D), the University of California, Los Angeles (UCLA) Loneliness Scale, and the De Jong Gierveld Loneliness Scale (Sutin et al., 2022). These measures differ fundamentally in their conceptualisation and assessment of loneliness. The single-item measure asks individuals how often they have felt lonely within a specific time period, such as the past week (Radloff, 1977). This brief approach offers the quickest assessment but provides less depth and may be susceptible to stigma effects, where participants underreport loneliness when asked directly (Hajek et al., 2025). The UCLA Loneliness Scale has various versions, uses a 3- or 4-point rating scale (1 = hardly ever or never; 2 = some of the time; 3 = often; 4 = always) with questions such as "How much of the time do you feel left out?" These items capture subjective experiences

and perceptions of social disconnection without explicitly mentioning the word “loneliness”. However, the UCLA Loneliness Scale treats loneliness as a unidimensional construct, which has been subject to criticism (Beridze et al., 2020). The De Jong Gierveld Scale addresses this limitation by adopting a multidimensional approach. Available in both an 11-item version and a 6-item short form. The scale distinguishes between emotional loneliness (the absence of intimate relationships) and social loneliness (the absence of a broader social network), based on Weiss's (1982) theoretical framework (De Jong Gierveld & Van Tilburg, 2006). This distinction has important implications for research findings. A meta-analysis by Pinquart and Sörensen (2001) found no significant gender differences in studies using the De Jong Gierveld Scale. However, women reported higher loneliness than men when assessed with the UCLA Loneliness Scale and single-item indicators. These divergent findings suggest that the choice of measurement instrument can substantially influence reported prevalence rates and patterns of loneliness across different populations.

Loneliness and Ageing

Loneliness is one of the most pressing and rapidly intensifying public health challenges of our time. The prevalence of loneliness is increasing globally, with older adults tending to report higher rates than younger populations. Worldwide, approximately 40–60% of older adults experience loneliness (Bekhet & Zauszniewski, 2012; Cacioppo et al., 2015). In Europe, around 40% of young adults (19–34 years) and middle-aged adults (35–49 years) report feeling lonely, rising to approximately 50% among older adults aged 50–65 years old (Franssen et al., 2020). In NZ, the trend is similarly concerning. The General Social Survey data indicated that 42% of New Zealanders felt lonely at least a little of the time in 2020, compared with 39% in 2018 (Stats NZ, 2021). Among adults aged 65 and above, 20.5% reported feeling lonely at least some of the time in 2021, an increase from 16.5% in 2018 and 13.9% in 2014 (Stats NZ, 2022). More recent research by Age Concern found that 59% of New Zealanders aged 65 and above felt lonely in the past month, with 30% feeling lonely most or all of the time (Pedersen & Moloney, 2024). Given these figures, it is important to examine the variability in loneliness prevalence across contexts. However, loneliness prevalence varies considerably across populations and studies. A meta-analysis by Sutin et al. (2022) found that loneliness rates ranged from 9.8% in the Midlife Development in the United States Study (US population) to 47.1% in the Survey of Health, Ageing and Retirement in Europe (Israel population), suggesting that

methodological differences, measurement approaches, and timing of data collection could contribute to data variations.

When using different measurement approaches, studies have shown that loneliness increases with age (Barnes et al., 2022; Franssen et al., 2020; Shankar et al., 2013; Szabó et al., 2024). For instance, Franssen et al. (2020) used the De Jong Gierveld Loneliness Scale to investigate the prevalence of loneliness and how demographic, social, and health-related factors were associated with loneliness among the European population. They demonstrated that loneliness increases with age, with prevalence rates among young (19–34 years), early (25–49 years) and late middle-aged (50–65 years) adults was 39.7%, 43.3%, and 48.2%, respectively. Living alone, less frequent neighbour contact, perceived social exclusion, psychological distress, and worse psychological and emotional well-being were consistently associated with loneliness among all age groups (Franssen et al., 2020). In NZ, the 2021 General Social Survey, using the De Jong Gierveld Loneliness Scale, also revealed that loneliness increases and differs among older adults. Around 11% feel lonely all, most, or some of the time among adults aged 65–74 years, and this increased to 14.2% among those aged 75 years or older (Stats NZ, 2021). In addition, Bekhet and Zauszniewski (2012) used a single item asking participants whether they felt lonely. They also showed that the old-old age cohort (ages 85 and older) reported the highest level of loneliness (30.8%) compared to younger age groups in a sample of 314 older adults from 29 retirement communities in the United States (US). Similarly, Barnes et al. (2022) used the UCLA-3 Loneliness Scale to investigate the prevalence of loneliness among older adults aged 65 and over in the US. They found that the oldest age category (≥ 85 years) had the highest proportions of both emotional loneliness and social isolation compared to the other age groups (64–69, 70–74, 75–79, 80–84). Therefore, with different measurement methods, these studies consistently show that as age increases, feelings of loneliness also increase.

Some studies have shown that the relationship between age and loneliness is more complex than a simple linear progression and that it is not directly associated with age (Dahlberg et al., 2018; Hawkey et al., 2022). For instance, Pinquart and Sörensen (2001) conducted a meta-analysis of 149 studies from multiple countries and identified a nonlinear relationship between loneliness and age. They indicated that there is no relationship between age and loneliness among older adults aged 60–80 years. Only among participants

aged 80 or older did loneliness increase significantly with age. In a study of loneliness across adulthood in the United Kingdom (UK), Victor and Yang (2012) identified a U-shaped relationship between loneliness and age. They found that those under 25 and over 55 years of age reported more frequent loneliness than those in the 25–44-year age group. Similarly, Hawkley et al. (2022) examined 2,477 US residents aged 18 to 89 years using data from the National General Social Survey. They found higher levels of loneliness among young adults (<30 years), middle-aged individuals (50–60 years), and very old individuals (>80 years). Taken together, these studies consistently demonstrated a complex, nonlinear relationship between age and loneliness. Different life stages bring distinct vulnerabilities and transitions that may contribute to loneliness levels across the life course. Stephens and Phillips (2022) highlighted that although people may experience loneliness at any stage of life, older people are often perceived as a vulnerable group because they are more likely face multiple concurrent changes, such as the loss of their partner and friends, reduced social networks, a decline in health, and restrictions on mobility.

Importantly, not all older adults are lonely, and the literature has identified a range of risk factors for loneliness that may vary in prevalence at different ages (Cacioppo & Cacioppo, 2018). The complexity of these findings underscores the need to examine not only the numbers but also the broader implications of loneliness among older adults. For instance, studies have shown that the significance of loneliness among older adults extends beyond physical health, personal psychological distress, impacting individual health and well-being, healthy behaviours, social cohesion, and healthcare expenditures and utilisation across all demographic groups (Shiovitz-Ezra & Ayalon, 2010). Understanding these broader implications sets the stage for examining the factors contributing to loneliness in later life. Importantly, Hawkley et al. (2022) demonstrated that actual levels of health and socioeconomic status (SES) have a greater impact on loneliness than relative comparisons to age-matched peers. Given the growing global interest in alleviating the burden of loneliness, it is crucial to identify the sources of loneliness and how loneliness vary by gender, ethnicity, culture, SES, and health characteristics.

Factors Contributing to Loneliness in Older Adults

Gender

Gender differences in loneliness among older adults showed inconsistent patterns across studies. Most studies have found that females report a higher prevalence than males (Cacioppo et al., 2015; Pinquart & Sörensen, 2001; Shiovitz-Ezra & Ayalon, 2010; Sulandari et al., 2024). For instance, Beridze et al. (2020) found that higher loneliness was significantly associated with female gender among Northern and Southern European populations. Similarly, Hajek et al. (2025) reported that females showed higher chronic loneliness than males, with estimated prevalences of 21.7% among women and 16.3% among men. However, Bekhet and Zauszniewski (2012) found that the differences in loneliness between women and men were not significant in a sample of 314 older adults from 29 retirement communities in the US. Some studies have even reported contrasting findings. In NZ, Szabó et al. (2024) demonstrated that male participants reported higher levels of late-life social and emotional loneliness using the Health Work and Retirement Life Course History Study. Moreover, marital status appeared to moderate gender differences in loneliness (Szabó et al., 2024). Pinquart and Sörensen (2001) indicated that gender differences in loneliness were observed only in heterogeneous marital-status samples and in married samples. They did not observe significant gender differences in non-married samples. One potential explanation is that older married women are more likely than married men to take on a caregiving role for their spouse. Thus, even among married women, there is a greater risk of loneliness when they are providing care, which prevents them from pursuing nonfamily social contacts and activities (Pinquart & Sörensen, 2001).

These mixed findings also appear to reflect important distinctions between measurement methods and different types of loneliness. Pinquart and Sörensen (2001) demonstrated in their meta-analysis of 149 studies that women aged 60–80 reported higher loneliness than men, when loneliness was measured by the UCLA Loneliness Scale and single-item indicators. However, there were no significant gender differences in studies using the De Jong Gierveld Scale (Pinquart & Sörensen, 2001). Moreover, Shankar et al. (2013) indicated that while loneliness was higher among women, social isolation was not significantly associated with gender. Barnes et al. (2022) showed that males were more likely to rate themselves as socially isolated, while females were more likely to be lonely

or to experience both loneliness and social isolation simultaneously. While gender differences in loneliness appear to be shaped by marital status, caregiving responsibilities, and differences in measurement scales, ethnicity is another important sociodemographic factor that may influence loneliness levels.

Ethnicity

Studies have consistently shown that minority ethnicity is a risk factor for loneliness. However, findings on the association between ethnicity and loneliness in later life are mixed. Some studies found no significant differences in racial or ethnic differences in loneliness among older adults (Hawkley et al., 2022), whereas others have found that Hispanic and Black ethnicity showed higher loneliness levels compared to White ethnicity (Dahlberg et al., 2022; Taylor et al., 2024). Taylor et al. (2024) explained that minority ethnic groups may experience an accumulation of structural disadvantages, leading them to feel lonely in later life. For instance, ethnic minority groups tend to live in more deprived urban neighbourhoods, where infrastructure and security are lacking (Cotterell et al., 2025). Additionally, minority ethnicities are more likely to report experiencing racial and sex discrimination, migration trauma, homelessness, financial instability, and a lack of employment and educational opportunities throughout their lives (Taylor et al., 2024).

In NZ, a few studies have compared loneliness between the Indigenous Māori population and the majority non-Māori population, and those that have reported mixed findings. For example, Lay-Yee et al. (2022) drew on data from the Life and Living in Advanced Age: A Cohort Study in New Zealand (LiLACS NZ) between 2010 to 2015, comprising 254 Māori and 398 non-Māori adults aged 80 years and over. They found that the prevalence of loneliness was consistently higher among Māori than non-Māori, at 39.8% versus 28.1% in 2010 and 29.6% versus 19.5% in 2015. These findings, however, were not replicated in two studies using the longitudinal NZ Health, Work, and Retirement (NZHWR) study. Neville et al. (2018) used the 2013 NZHWR cohort, comprising 614 males aged 60 years and over (31% Māori). Szabó et al. (2024) used the 2016 NZHWR cohort, comprising 613 older adults aged 65–81 years (48% male; 38% Māori). Both Szabó et al. (2024) and Neville et al. (2018) found no significant differences in loneliness between Māori and non-Māori groups. One potential explanation is that, despite the Māori population experiencing socioeconomic disadvantage across the life course, Māori older adults may experience the same level of loneliness as non-Māori older adults due to their

collective or familism cultural values as protectors. Māori older adults tend to have strong relationships with their relatives, and their social networks with close and extended family members provide social support and care (Szabó et al., 2024). Furthermore, the LiLACS cohort is of advanced age. Their health and well-being might be quite different from those of the younger older adults in the NZHWR. With Māori have lower life expectancy, Māori participants in the LiLACS might have worse health than non-Māori, which could affect emotional well-being (e.g., loneliness). More studies are needed regarding the relationship between ethnicity and loneliness.

Social Factors (Marital Status, Living Arrangement, Social Contacts and Networks)

Research consistently supports the critical role of social factors in loneliness among older adults. Dahlberg et al. (2018) investigated the risk factors of loneliness among 2,000 older Swedish adults aged 70 years or older between 2004 and 2014. They identified that social-related factors (e.g., marital status, social contacts and support) played a significant role in determining loneliness levels. Specifically, being widowed had the highest likelihood of loneliness compared with being married. Unmarried/divorced respondents were also more likely to report loneliness than married respondents. In addition, individuals who lacked access to social support (e.g., help from friends and family) and had fewer social contacts were significantly more likely to report loneliness than those with access to social support and an integrated social network (Dahlberg et al., 2018). Similar patterns have been observed in NZ. Among older NZ men aged 60 years or older, Neville et al. (2018) found that those who were not partnered were twice as likely to identify as lonely as those who were. Moreover, those who lived alone were more than twice as likely to report feeling lonely as those who lived with a partner. More recently, another NZ study included both females and males, confirmed these findings, indicating that those who were partnered reported lower levels of emotional loneliness (Szabó et al., 2024).

Among these social factors, living arrangements have emerged as a particularly important consideration in understanding loneliness among older adults. Living alone is increasingly common among the ageing population today due to sociodemographic shifts, such as declining marriage and childbirth rates, rising divorce rates, and longer life expectancy. Consequently, living arrangements can serve as tangible markers of loneliness (Nakou et al., 2025). Nevertheless, living alone does not inherently equate to being lonely.

For instance, an older adult who lives alone may maintain an active social life, whereas another living with others may still feel profoundly lonely without having a meaningful social network (Cacioppo & Cacioppo, 2014). Therefore, it is the complex interplay of multiple social factors that influences feelings of loneliness.

Socioeconomic status (SES), Income, and Education

Studies have shown that SES is associated with increased loneliness. Childhood and later-life SES negatively predicted late-life emotional and social loneliness (Neville et al., 2018; Pinquart & Sörensen, 2001; Szabó et al., 2024). However, Szabó et al. (2024) demonstrated that a complex relationship exists between gender, ethnicity, SES, and loneliness. Their study showed that Māori scored significantly lower on both childhood and late-life SES than non-Māori respondents among NZ older adults. However, better childhood SES was only associated with lower later-life emotional loneliness for men, but not for women. The authors suggested that women may face different barriers to converting early advantages into later life protection against loneliness. For instance, even women from advantaged childhoods often faced limited career opportunities, more caregiving and family responsibilities due to gender inequalities. Such gender-based inequalities have lasting effects on individuals' social and emotional well-being as they age (Pinquart & Sörensen, 2001).

The most frequently used indicators of SES are education and income. A systematic review by Shiovitz-Ezra & Ayalon (2010) demonstrated that education was a significant predictor of loneliness among older adults. However, Szabó et al. (2024) demonstrated that education had different effects on social (positive) and emotional (negative) loneliness among NZ older adults. Education appears to serve as a protective factor against emotional loneliness and an exacerbating factor for social loneliness. One potential explanation is that highly educated individuals may be more likely to engage in more solitary activities, such as reading, writing, and learning. Consequently, their preference for independent pursuits and tighter social circles may contribute to higher levels of social loneliness (Szabó et al., 2024). Additionally, Szabó et al. (2024) demonstrated that the impact of education was moderated by gender, with higher levels of education associated with lower levels of later-life emotional loneliness among older men only, not among women. Highly educated men may develop fewer but deeper social relationships, enabling them to derive greater emotional support from their limited

connections, thereby protecting against emotional loneliness (Sulandari et al., 2024). This suggests that for highly educated men, relationship quality compensates for reduced quantity, creating a pattern where fewer but deeper connections meet their emotional needs while leaving them more socially isolated in broader community contexts (Pinquart & Sörensen, 2001). On the other hand, Taylor et al. (2024) demonstrated that, when examining income and education separately, income alone accounted for racial-ethnic differences in loneliness, whereas education did not. This implied that lower income (e.g., financial hardship) may be a more important driver of loneliness than education among older adults.

Loneliness and Health – Bidirectional Relationship

Physical Health and Psychological Well-being

Numerous studies have shown that loneliness is associated with all-cause mortality and morbidity among older adults (Nakou et al., 2025; Shiovitz-Ezra & Ayalon, 2010). Loneliness may increase a person's risk of a wide range of adverse health outcomes and premature death, such as CVD, physical and cognitive functional decline and mental disorders (Courtin & Knapp, 2017; Roddick & Chen, 2021). Shiovitz-Ezra and Ayalon (2010) found that loneliness predicted all-cause mortality over a four-year follow-up period among older Americans, even after controlling for demographic and clinical characteristics (age, gender, level of education, medical conditions, functional impairments, and depression). More recently, Hong et al. (2023) conducted a longitudinal study among 13,752 older Americans (average age 67 years) to investigate how changes in loneliness over a four-year follow-up period were associated with 32 indicators of physical, behavioural, and psychosocial health outcomes. They demonstrated that for physical health outcomes, participants in the highest (versus lowest) level of loneliness had 43% higher risk of all-cause mortality, 25% increased risk of lung disease, a 13% increased risk of chronic pain, and worse self-rated health. Nevertheless, social and emotional loneliness can have distinct adverse effects on health and well-being. For instance, Shankar et al. (2017) demonstrated that only emotional loneliness was related to physical disabilities. Social loneliness was not associated with the decline in physical function among older adults. Additionally, Hong et al. (2023) demonstrated that social isolation was a stronger predictor of mortality risk, whereas emotional loneliness was a stronger predictor of psychological outcomes (i.e., sense of purpose, positive affect, life

satisfaction, optimism, mastery, health mastery, depression, depressive symptoms, hopelessness, negative affect, perceived constraints, and financial mastery). Therefore, loneliness and social isolation may have independent effects on various health and well-being outcomes. These nuanced findings underscore the importance of distinguishing between different types of loneliness and social isolation, as they could operate through different mechanisms and predict distinct physical health and psychological well-being outcomes among older adults.

Multimorbidity was also associated with loneliness, which, in turn, impacts older adults' physical function. A systematic review by Hajek et al. (2025) used meta-analysis and meta-regression, including 17 studies. Their results indicated that poorer self-rated health and chronic conditions can contribute to feelings of loneliness among older adults. For instance, diagnosed CVD and diabetes are positively associated with loneliness (Shankar et al., 2013). Moreover, Shiovitz-Ezra and Ayalon (2010) conducted a longitudinal study using data from the Health and Retirement Study with the US older population to explore the relationship between loneliness and physical health. Participants were classified as either not lonely, experiencing chronic loneliness (i.e., reporting loneliness across all three waves: 1996, 1998, 2000) or situational loneliness (i.e., reporting loneliness in one wave only). Their results showed that participants with more medical conditions and greater functional impairment rated themselves as chronically lonely. They also discovered that the negative impact of loneliness on individuals' physical function was more significant among chronically lonely older individuals than among those who experienced situational loneliness (Shiovitz-Ezra & Ayalon, 2010).

Some studies failed to find a link between physical health and loneliness but did find a significant association between psychological well-being and loneliness. In a sample of retired older adults in Ohio, US, Bekhet and Zauszniewski (2012) found no significant differences between those who reported loneliness and those who did not in overall self-perceived health and indicators of physical health (i.e., functional status and number of chronic conditions). However, they identified significant differences in mental health, including anxiety and depressive symptoms, between lonely and non-lonely participants. Older adults who reported feeling lonely had higher anxiety and depressive symptoms scores than those who did not (Hong et al., 2023; Shiovitz-Ezra & Ayalon, 2010). Nevertheless, Dahlberg et al. (2018) conducted a longitudinal study, following Swedish

older adults aged 70 years plus for over two decades, and demonstrated that both physical functions (i.e., activities of daily living (ADL) and mobility) and psychological distress (i.e., depressive symptoms and poor mental health) were significantly related to loneliness. Psychological distress was the strongest predictor. For example, respondents who reported severe psychological distress were 36.6% more likely to report loneliness than those without psychological distress in 2004 and 20.7% in 2014. Overall, both physical health and psychological well-being predict loneliness, but more psychological indicators are associated with loneliness than physical health indicators across different age groups and countries (Barnes et al., 2022; Franssen et al., 2020; Neville et al., 2018).

Cognitive Well-being

There is a growing body of empirical evidence demonstrating that loneliness is associated with negative cognitive outcomes in older adults. Cacioppo and Hawkley (2009) indicated that loneliness not only impacts physical health, but also triggers adverse cognitive responses, including brain inflammation, diminished immunity, and increased risk of neurodegenerative diseases (Cacioppo et al., 2015). Hajek et al. (2025) found that chronic loneliness can contribute to adverse cognitive function and mental health outcomes among older adults, such as an increased risk of dementia. The association between loneliness and cognitive health appeared to be bidirectional. Cacioppo and Cacioppo (2014) examined the relationships among loneliness, social isolation, and cognitive functioning. They conducted a longitudinal analysis using the English Longitudinal Study of Ageing data, which included follow-up questionnaires every two years over four years. Their results demonstrated that participants with poor cognitive function showed higher loneliness and social isolation scores four years later. Moreover, higher loneliness accelerated cognitive decline and dysfunction during four years of follow-up. Using the same database, Shankar et al. (2013) also demonstrated that loneliness was significantly associated with poor performance on verbal fluency, immediate recall and delayed recall among older adults with poorer cognitive function. Together, these findings suggest that the relationship between loneliness and cognitive health is bidirectional and mutually reinforcing. Loneliness may accelerate cognitive decline, and poor cognitive function can also increase feelings of loneliness. This compounding cycle poses significant risks for older adults' overall health and well-being.

Health Behaviours

Research has increasingly demonstrated that loneliness is not only associated with physical, cognitive, and psychological well-being but also an important determinant of health behaviours. Holt-Lunstad et al. (2015) conducted a meta-analytic review of 70 studies involving nearly 3.5 million individuals. They found that participants with higher loneliness levels were less likely to consistently engage in weekly moderate-to-vigorous physical activities or consume five daily servings of fruit and vegetables, and more likely to smoke. Kobayashi et al. (2018) also found that loneliness was negatively associated with successful smoking cessation and potentially contributes to a higher overweight/obesity rate and body mass index (BMI). The relationship between loneliness and alcohol consumption appears more complex. Although a recent survey found that 65% of adults aged 45 years and older who had been diagnosed with drug and alcohol abuse reported being lonely, the direct relationship between alcohol consumption and loneliness remains unclear (Bamberger et al., 2015). Canham et al. (2015) found that being lonely was associated with reduced alcohol use frequency (4-7 days per week) compared to non-lonely individuals. However, loneliness was not associated with moderate drinking (1-3 days per week), at-risk drinking or binge drinking among American community-based adults aged 50 years and over. Adebisi et al. (2024) did not find a significant association between loneliness and alcohol consumption among older Chinese adults. Moreover, Hong et al. (2023) demonstrated that greater loneliness was associated with a 16% increased risk of subsequent sleep problems among older adults aged 65 and over. Zhang et al. (2022) indicated that socially isolated older adults were more likely to report a greater prevalence of loneliness and pain, and more chronic diseases compared to their socially integrated counterparts, which, in turn, increased their risks of sleep difficulty. Overall, these findings highlight that loneliness is associated with a broad range of unhealthy behaviours and physical health consequences among older adults.

Life Satisfaction and Quality of Life (QOL)

Several studies explore the association between loneliness and life satisfaction among older adults. Sulandari et al. (2024) conducted a systematic review and meta-analysis of 78 studies. They found that older adults who reported lower levels of loneliness were almost three and a half times more satisfied with their health and well-being than those with higher levels of loneliness. Additionally, a stronger association between loneliness and life

satisfaction was found among female participants. In NZ, Lay-Yee et al. (2022) demonstrated that lonely people were much more likely to have lower levels of life satisfaction and mental-health-related quality of life (QOL) among both Māori and non-Māori older adults. Beridze et al. (2020) investigated the impact of loneliness on QOL among Northern and Southern European populations aged 50 years and older, including 2,995 Swedish and 4,154 Spanish older adults. The results indicated that at baseline, QOL was negatively correlated with loneliness among Northern and Southern European populations. They also found that baseline loneliness was associated with decreased QOL at two years of follow-up. However, the association was not statistically significant in Spanish older adults. Additionally, the association was strongest in subjects aged 65 years or less and those with no chronic diseases.

Summary

The work summarised so far highlights that loneliness is highly prevalent among older adults. With global ageing, both the number and proportion of older adults who experience loneliness continue to increase. Social and emotional loneliness not only negatively impacts older adults' physical health, cognitive function, and psychosocial well-being but also adds extra pressure on families and already overstretched healthcare systems. These two types of loneliness are perceived differently and have distinct effects on individuals' health and well-being. Additionally, chronic loneliness tends to have more adverse effects on health and well-being compared to situational loneliness. Older adults are particularly vulnerable to loneliness due to life transitions such as retirement, changes in social roles, bereavement, and declining health. As people age, loneliness tends to increase, especially among adults aged 80 and older. The vulnerability among older adults is compounded by their declining health status, reduced social support, networks, and resources.

Multiple factors predict loneliness in later life, including physical health, cognitive function, psychological well-being, and sociodemographic characteristics. Complex interplay between gender, ethnicity, marital status, living arrangement and SES influences loneliness in older adults. Loneliness increases the risk of poor health, psychological distress, and unhealthy behaviours, while better health, well-being, life satisfaction, and quality of life are also associated with lower levels of loneliness. Loneliness is complex. Recent research indicates that having a sense of purpose and engaging in healthy

behaviours (e.g., sleep) contribute to emotional health (e.g., loneliness) and could be key to understanding loneliness. The role of PiL and sleep health as key factors in loneliness is under-researched in healthy ageing research.

Purpose in Life (PiL)

Purpose transforms how we experience life. Ryff (1989) conceptualises purpose as having meaning, direction, and goals, and holding beliefs that give life its purpose. Frankl (1984) defines purpose as an intention or a goal to be fulfilled or achieved. Individuals with higher PiL tend to have clear life goals and a sense of direction, feeling that there is meaning in their past, present, and future lives. These purposeful individuals maintain objectives for living, with beliefs that help them make sense of and guide their emotions, behaviours, and experiences (Boyle et al., 2010). PiL demonstrates consistent associations with positive ageing and enhanced well-being. Research on ageing and longevity has identified that purpose plays a significant role in older adults' physical, cognitive, and psychological health, as well as promotes engagement in healthy behaviours and social participation (Irving et al., 2017; Kim et al., 2020; Windsor et al., 2015). However, as people age, life events such as retirement, loss of societal roles, decreased social contact, and emotional distress (for example, due to poor health and bereavement) tend to negatively impact their PiL (Pinquart & Sörensen, 2001; Pinquart, 2022; Pfund et al., 2022). This raises an important question: how does purpose change in older adulthood?

Studies on age-related changes in PiL presents mixed findings. Some studies suggest that purpose levels remain relatively stable across the lifespan with changes being small (Ribeiro et al., 2020). For instance, people with high PiL in midlife tend to maintain high PiL in later life (Ko et al., 2016; Willroth et al., 2021), suggesting continuity in individual differences over time. However, other research indicated that older adults consistently report significantly lower levels of PiL compared to midlife and younger adults (Ryff & Singer, 2008). Multiple studies have documented negative correlations between PiL and age among US and European older populations (Hedberg et al., 2010, 2011; Hill et al., 2015). For example, Weston et al. (2021) conducted a longitudinal study with 7,452 older adults from the Health and Retirement Study US population (average age 65 years) and found that, on average, participants showed a decline in their sense of purpose over the eight-year study period. Specifically, the slope estimate of -0.09 suggests that participants' sense of purpose decreased by 0.09 units per assessment wave (measured

every four years), indicating a gradual decline in PiL as older adults age. This declining pattern appears particularly pronounced among the oldest-old. Hedberg et al. (2010) followed Swedish participants aged 85 to 103 years for five years using Crumbaugh's (1968) Purpose in Life scale, which consists of 20 items on a 7-point Likert scale with sum scores ranging from 20 to 140. According to Crumbaugh's interpretation, scores of 113 and above suggest "the presence of definite purpose," while scores between 92–112 represent felt indecision about PiL. The majority of participants in this study scored below 112, indicating uncertainty about their sense of purpose. The researchers also found that physical health and psychological well-being were significantly associated with PiL scores among older adults. Similarly, Nakamura et al. (2022) found that purpose subsequently decreased with age among the US population. Young-old (aged 65–74 years) had the highest PiL level, followed by middle-old (aged 75–84 years), and oldest-old (aged 85 and over) had the lowest PiL level.

On the contrary, some studies showed that the decline in purpose is not universal across all older adults. A follow-up study by Hedberg et al. (2011) demonstrated that PiL scores decreased significantly only for women over the five-year period, while the decrease for men was not significant, suggesting gender differences in purpose trajectories. Furthermore, Chen et al. (2020) identified several factors that serve as strong antecedents of purpose among older adults, including indicators of psychological distress (e.g., depressive and anxiety symptoms, hopelessness), psychological well-being (e.g., positive affect, sense of worthwhileness), and social connection (e.g., number of close relatives) (Steptoe & Fancourt, 2019). These findings highlight considerable inter-individual variability in the change of PiL among older adults (Hill & Weston, 2019). The mixed evidence regarding purpose trajectories in later life suggests that while some decline may be normative, it is neither inevitable nor uniform across all individuals. Therefore, understanding PiL and its determinants can help us better comprehend health and well-being among older adults.

PiL and Loneliness

Recent studies have demonstrated a strong association between loneliness and PiL. For example, Chen et al. (2020) conducted an eight-year longitudinal study of middle-aged female nurses and found that higher levels of loneliness in 2008 and 2013 were associated with lower PiL in 2016. Similarly, Hong et al. (2023) reported that elevated loneliness was

associated with reduced PiL over a four-year follow-up period among older American adults. Both studies found that loneliness is an antecedent of PiL. Studies also demonstrated PiL's impact on psychosocial well-being, including loneliness. Kim et al. (2022) found that older adults with higher levels of PiL have better social relationships, such as more frequent contact with friends and lower loneliness. However, they found little or no evidence of an association between PiL and other social factors (e.g., living with a spouse/partner, contact with their children, and other family). Particularly compelling is evidence that, even when participants rated their relationships with their partners as high quality, they nevertheless reported greater loneliness when they had less PiL (Kim et al., 2022; Mittelman et al., 2023). This suggests that the protective effect of purpose operates somewhat independently of social relationship factors. PiL may be more fundamental to emotional well-being than social relationships alone and having PiL is an ongoing need that extends throughout older age, which protects against the development of loneliness.

Large-scale research provides compelling evidence that PiL might serve as a protective factor against loneliness. Sutin et al. (2022) conducted a meta-analysis involving 135,227 individuals ages 18-109 from 36 cohorts (both longitudinal and cross-sectional) across North America, South America, Europe, and the Middle East, revealing that higher PiL was consistently linked to lower concurrent loneliness across all cohorts, even after controlling for sociodemographic factors. This negative association remained robust, suggesting that PiL plays a universal role in supporting psychological well-being (Sutin et al., 2022). The protective effect was especially pronounced among individuals experiencing severe psychological distress, indicating that PiL may be particularly beneficial during periods of heightened vulnerability. Moreover, among the 28 longitudinal cohorts examined, 24 showed that participants with greater purpose at baseline were protected against developing loneliness during follow-up periods, even among those who were not lonely initially. Specifically, for every one standard deviation (SD) increase in PiL, there was nearly a 20% decreased risk of incident loneliness (Sutin et al., 2022). Evidence from NZ supports these international findings, Neville et al. (2018) demonstrated that among men over 60 years old, feeling more purposeful was associated with reduced loneliness. These patterns strongly suggest that purpose serves as a protective factor against the onset of loneliness, not merely a correlate of current emotional states.

Mechanisms Linking PiL and Loneliness

The protective relationship between PiL and loneliness is theorised to operate through several interconnected pathways that work both directly and indirectly to support psychological well-being in older adults. First, a higher level of PiL is considered to directly protect against psychological distress, which, in turn, lowers the risk of loneliness (Pinquart, 2002). Ryff's (1989) Psychological Well-being Model identifies PiL as one of the six components of well-being and highlights its role as a critical psychological resource. Empirical evidence supports this protective function. For instance, Kim et al. (2022) followed a US population over a four-year period and found that people with the highest (versus lowest) levels of PiL had a 43% reduced risk of depression. This reduction in psychological distress subsequently decreases the development of loneliness in later life (Dahlberg et al., 2018). By fostering emotional well-being and resilience, PiL acts as a buffer against the psychological vulnerabilities that often precipitate feelings of loneliness (Chen et al., 2020; Nakamura et al., 2022; Long et al., 2020).

Second, PiL could also reduce loneliness indirectly by enhancing social engagement and improving relationship quality (Chen et al., 2020; Kim et al., 2022; Nakamura et al., 2022). This association operates through behavioural pathways. Life Engagement Theory suggests that individuals with higher PiL are more likely to participate in meaningful activities and cultivate relationships. As a result, they frequently engage in social activities and maintain strong interpersonal connections (Scheier et al., 2006). For instance, older men with high PiL reported less loneliness, mainly because they were more socially active (Neville et al., 2018). Similarly, older adults who maintain PiL through volunteering or mentoring enhance their social roles and community involvement. This also reduces the risk of loneliness and psychological distress (Pynnönen et al., 2024). Over time, individuals with greater PiL tend to develop more supportive and less stressful relationships. Weston et al. (2021) found that adults with greater support and less social strain were more likely to increase or maintain PiL. This suggests a mutually reinforcing cycle between purpose and psychosocial well-being. This behavioural mechanism aligns with Frankl's (1984) assertion that purpose motivates action and with Ryff's (1989) Psychological Well-being Theory, which conceptualises purpose as involving goal-directedness and intentionality in life.

Third, the relationship between PiL and social factors is considered bidirectional, creating a reinforcing cycle that affects loneliness. Social relationships not only benefit from purpose but also actively shape and maintain it, which, in turn, influences psychological well-being and experiences of loneliness (Burrow & Hill, 2020). Evidence suggests that social connection influences PiL levels. Chen et al. (2020) found that older adults with fewer close relatives and friends showed lower PiL levels and experienced greater loneliness. Conversely, meaningful social engagement could enhance PiL. Warner et al. (2024) demonstrated that older Chinese adults who volunteered during the COVID-19 pandemic had significantly lower UCLA Loneliness and De Jong Gierveld Loneliness Scale scores, and lower levels of stress and depressive symptoms compared to non-volunteers. Similar results were obtained among Japanese older adults (Mayers et al., 2024). This relationship becomes particularly salient during retirement, when traditional work-based sources of purpose diminish. Retired older adults typically experience reduced structured social contact from work while simultaneously having increased leisure time. Under these circumstances, meaningful daily social interactions and community participation may become primary sources of purpose (Chen et al., 2020). Pfund et al. (2022) conducted a longitudinal study investigating the relationship between social participation and PiL among Swiss older adults aged 60 and older. They found that on days when individuals reported more positive social interactions, they felt more purposeful, even after accounting for health, employment, and relationship status. Importantly, employment status moderated this association. Daily social interactions were more strongly associated with daily PiL for unemployed or retired individuals. This finding suggests that retirement may create a condition that makes positive social interactions and relationships particularly critical for maintaining PiL among older adults.

Factors Contributing to PiL in Older Adults

Given the evidence for the relationship between PiL and loneliness, it is important to understand factors that might contribute to PiL in older adults.

Gender and Ethnicity

Research consistently reveals significant gender differences in how PiL manifests and changes among older adults. Among Swedish older adults, women reported lower PiL compared to men. This gender disparity becomes more pronounced over time (Hedberg et

al., 2010). In their longitudinal study, Hedberg et al. (2011) found that only women had a significant decline in PiL after a five-year follow-up. For men, the decline was not statistically significant. The stability of PiL is consistent with and extends upon research by Hill et al. (2015) with the US population, who also found that PiL did not change over three years for most older men (aged 58–89). However, the mechanism underlying these gender differences in baseline levels and decline rates remains unclear. Some researchers suggested that there are differences in the determinants for PiL between males and females. Older women's PiL might be more heavily impacted by multiple aspects of their physical, emotional, and psychosocial health and well-being during the ageing process. Consequently, potentially makes them more vulnerable as they age and experience health-related decline (Hedberg et al., 2010). For instance, general health, loneliness, and attitude toward one's own ageing were associated with PiL in both males and females. However, musculoskeletal symptoms, happiness, agitation, satisfaction with life, and acceptance of ageing were significantly associated with PiL score only in women (Hedberg et al., 2010, 2011, 2013). These results suggested that women's sense of purpose may be more comprehensively affected by various aspects of psychological well-being.

The sources and expressions of PiL differ by gender and ethnicity. For instance, research indicated that older women experience PiL both through their daily activities and in their interactions with a spiritual world, which facilitates a positive view of their lives (Hedberg et al., 2010). In contrast, older men tend to experience PiL through reflective talking about their past and earlier work experiences (Hedberg et al., 2013). Furthermore, Māori tend to find their purpose through their cultural identity. Studies showed that Māori with higher cultural efficacy and active identity engagement are more likely to engage with Te Ao Māori (the Māori world) and are significantly linked with higher PiL, better well-being, self-esteem, and life satisfaction, and decreased psychological distress (Houkamau et al., 2024; Matika et al., 2017). These findings collectively suggest that PiL is not a uniform experience but is shaped by the intersection of gender, ethnicity, and cultural identity.

Social Factors (Marital Status and Social Integration)

There are limited studies on the relationship between social factors and PiL among older adults, though emerging evidence highlights the importance of social and relational factors. AshaRani et al. (2022) conducted a systematic review on PiL in older adults. They

identified only two studies that demonstrated an association between marital status and PiL. Both studies indicated that being married is associated with a higher level of PiL (Woods et al., 2016). Moreover, social integration (e.g., social relationships, participation, and family relations) also plays an important role in maintaining PiL. Chen et al. (2020) found that individuals who lived alone, had fewer close friends and relatives, and showed lower levels of PiL, suggesting that social connectedness contributes to older adults' sense of purpose. Additionally, Pfund et al. (2022) demonstrated that within-person variability in PiL is connected to the quality of social interaction. Positive social interactions may help older adults maintain a sense of purpose, particularly after retirement. Individuals with higher purpose tend to structure their time differently. For instance, individuals with a higher purpose spend less time alone or watching television and more time engaging in social activities and physical exercise (Pfund et al., 2022). This pattern suggests that purpose not only benefits from social connection but also motivates individuals to seek out and maintain meaningful social engagement, creating a mutually reinforcing cycle between purpose and social integration.

Purpose and Health

Physical Health

Ageing research has illuminated the association between PiL and mortality and physical health among older adults. Cohen et al. (2016) conducted a meta-analysis of ten prospective observational studies, involving a total of 136,265 participants. They demonstrated that higher PiL is associated with a reduced risk of all-cause mortality and cardiovascular events. Hill and Turiano (2014) further demonstrated that PiL predicted mortality among older adults. Their data showed that for each one SD increase in purpose, the risk of dying over the next 14 years diminished by 15%. Additionally, among the 569 deceased participants (approximately 9% of the sample), they scored significantly lower on PiL even after controlling for psychological well-being factors. Importantly, the longevity benefits are not conditional on participants' age, years of work, or employment status, suggesting that higher PiL buffers against mortality risk across the lifespan.

Beyond mortality, research has examined PiL's relationship with specific health outcomes, revealing a nuanced pattern of association. Kim et al. (2022) demonstrated that among the US population, over a four-year follow-up period, participants in the highest

(versus lowest) purpose quartile had a 46% reduced risk of mortality, 23% reduced risk of stroke, 17% reduced risk of lung disease, and 28% reduced risk of limited physical functioning. They also had fewer chronic conditions and higher self-rated health. However, findings are not uniform across diseases or populations. Sone et al. (2008) found that among Japanese older adults, the absence of PiL was not significantly associated with cancer mortality, suggesting that PiL may have differential protective effects depending on the specific health condition or cultural context. On the contrary, Chen et al. (2020) found little evidence that physical health was associated with subsequent PiL in later life. Although physical illness might lead to reduced social roles, limited activities, and changes in lifestyles and goals, the potential negative impact of physical health on PiL might be buffered if the individuals can maintain meaningful life engagement (Chen et al., 2020).

The relationship between PiL and physical function reveals a similar complex pattern. Kim et al. (2017) showed that PiL was associated with changes in grip strength and walking speed and both indicators were significantly associated with all-cause mortality among older adults. After controlling for sociodemographic factors (age, gender, race/ethnicity, marital status, education level, and total wealth), each 1-SD increase in purpose was associated with a 13% decreased risk of developing weak grip strength and a 14% decreased risk of developing slow walking speed. However, after adjusting for additional covariates (e.g., health factors, depressive symptoms, and health behaviours), the association between PiL and physical functions did not reach statistical significance. This pattern suggests that the relationship between purpose and physical function operates, at least in part, through intermediary mechanisms such as psychological health and health behaviours.

Cognitive, Mental, and Psychological Health

Several studies have demonstrated PiL's protective effects on cognitive function. Windsor et al. (2015) found that older adults who scored higher on a sense of purpose also performed better on cognitive tests (episodic memory and processing speed). A high sense of PiL predicted a lower risk for both mild cognitive impairment (MCI) and Alzheimer's disease (AD) during a seven-year follow-up of 951 individuals over 65, even after controlling for socioeconomic, physical, and psychosocial factors (Boyle et al., 2010, 2012). The protective mechanism appears to operate at the neurological level. PiL reduced the deleterious effects of AD pathology, thereby providing neural reserve and protecting

cognitive function in older adults (Lewis et al., 2017). Recent research has expanded the understanding of PiL's protective effects against cognitive decline. An integrative review by Ribeiro et al. (2020) included twenty-seven articles and revealed strong associations between high PiL scores and lower risk of AD, disability, and sleep disorders in older adults. Given the close relationship between sleep and cognitive health (Mander et al., 2017), this suggests another pathway: higher PiL might lead to better sleep, which in turn protects against cognitive decline and neurodegenerative diseases in older adults (Lewis et al., 2017; Stephens & Gatchel, 2018).

The relationship between PiL and mental health is complex. Pinquart (2002) reviewed 70 studies and found that higher PiL corresponds to lower depression and depressive symptoms, indicating purpose may protect against mental health challenges (Windsor et al., 2015). However, longitudinal studies show a more nuanced reality. Hedberg et al. (2011) found no baseline differences in PiL between depressed and non-depressed older adults, but those diagnosed with depression experienced significantly reduced PiL after five years. Clinically diagnosed depression had a stronger negative effect on PiL than self-rated depressive symptoms. These results suggest that while initial PiL levels may be similar across depression statuses, mental health challenges can deteriorate older adults' sense of purpose over time. Purpose may also help older adults cope with mental and psychological distress (Musich et al., 2021).

Health Behaviours

Emerging research has demonstrated that PiL influences lifestyle choices and health behaviours among older adults. Hill et al. (2019) found that individuals with higher PiL were more likely to engage in strenuous and moderate physical activity and to consume more vegetables, which, in turn, were associated with better self-rated health and sleep quality. Importantly, these associations remained stable across ethnicity, culture, and personality, suggesting the universal influence of purpose on health behaviours. Longitudinal studies spanning five to ten years have consistently documented PiL's protective role in maintaining healthy behaviours. Higher PiL older adults showed a significantly higher likelihood of not smoking (Kim et al., 2022), drinking moderate amounts of alcohol, remaining physically active (Hooker & Masters, 2016), sustaining a healthy BMI (Kim et al., 2020), and experiencing better sleep quality (Hill et al., 2017; Kim et al., 2020). They also demonstrated a lower likelihood of future drug misuse and

developing sleep problems (Kim et al., 2019; 2020). The magnitude of these effects is substantial. Participants in the top quartile of PiL had a 24% lower likelihood of becoming physically inactive, a 33% lower likelihood of developing sleep problems, and a 22% lower likelihood of developing an unhealthy BMI compared to those in the lowest quartile. These findings extend even to health behaviours during public health crises. Kang et al. (2021) demonstrated that having a stronger sense of PiL was associated with lower loneliness and greater intentions to engage in COVID-protective behaviours such as handwashing and maintaining social distance.

The relationship between PiL and health behaviours appears to be bidirectional rather than unidirectional. Yemiscigil and Vlaev (2021) identified a bidirectional relationship between PiL and physical activity in a longitudinal study of US older adults with a nine-year follow-up. They demonstrated that individuals with higher PiL were more likely to engage in physical activity, and that physical activity simultaneously helped maintain PiL over time. Similarly, Nakamura et al. (2022) examined 61 predictors, including physical health, health behaviours, and psychosocial well-being factors, over a four-year period to identify factors that might lead to changes in PiL four years later. The results showed that engaging in frequent physical activities at baseline increased PiL four years later, while participants with sleep problems at baseline experienced decreased PiL four years later. These findings suggest that health behaviours not only result from having a sense of purpose but also sustain and strengthen it over time.

Summary

To summarise, PiL emerges as a crucial psychological resource that profoundly influences health, well-being, and healthy behaviours throughout the ageing process. While purpose tends to decline with advancing age, research demonstrates substantial inter-individual variability in PiL. There are significant gender disparities, with women consistently reporting both a lower average level of purpose and a steeper decline in purpose with age than men do. The health implications are far-reaching, with higher purpose consistently associated with reduced mortality risk, lower rates of CVD and chronic conditions, better physical and cognitive functioning, decreased psychological distress, and greater engagement in health-promoting behaviours.

Recent ageing and longevity research has illuminated that the critical relationship between PiL and loneliness appears to be a mutually reinforcing cycle (Pynnönen et al., 2024). On one side, loneliness and psychological distress reduce one's sense of purpose (Chen et al., 2020). The reverse pathway is equally powerful. For instance, individuals with a greater sense of purpose maintain better mental health over time, and this protective association extends to reduced loneliness (Neville et al., 2018). Additionally, better physical health among purposeful individuals facilitates social interactions that protect against loneliness (Kim et al., 2022). Psychological distress (e.g., depressive symptoms, anxiety symptoms, and hopelessness) moderates the association between PiL and loneliness. Specifically, the negative association between PiL and loneliness is stronger among participants experiencing severe distress, suggesting that purpose may be most critical when individuals are most vulnerable (Sutin et al., 2022).

This cyclical relationship creates both vulnerability and opportunity for intervention. Importantly, emerging evidence suggests that sleep may serve as a critical mechanism linking PiL to loneliness among older adults. Kim et al. (2022) found that older adults with higher PiL were less likely to develop sleep problems and maintained better sleep quality over time. This relationship may be particularly relevant for loneliness, as good sleep quality provides individuals with the energy, emotional regulation, and psychosocial resources necessary for meaningful social engagement (Stephens & Gatchel, 2018). Furthermore, poor sleep has been shown to impair social cognition and reduce motivation for social interaction (Simon & Walker, 2018), potentially undermining the protective effects of purpose. Therefore, understanding how sleep functions as a potential mediating pathway between PiL and loneliness represents a critical gap in the literature that could inform interventions to combat loneliness among older adults. The following section examines the evidence on sleep among older adults and its relationship to health, well-being, and loneliness.

Sleep

Sleep is a ubiquitous phenomenon, accounting for about one-third of life and is crucial to physical, mental, and psychosocial health (Grandner, 2017). Circadian rhythms are 24-hour physiological cycles that serve as the primary sleep regulatory system and control sleep-wake patterns. Sleep alternates between non-rapid eye movement (NREM) and rapid eye movement (REM) stages, each serving distinct and complementary

functions. NREM sleep is a restorative phase crucial for physical restoration, immune system strengthening, metabolic regulation, and memory consolidation. REM sleep plays a vital role in emotional regulation, brain development, learning, and integrating new memories with existing knowledge (Stephens & Gatchel, 2018). Sleep is critical for how we function during waking. The complexity and multifaceted functions observed within and between these sleep stages emphasise that sleep is fundamental to human health and function. Consequently, disruptions to sleep architecture or duration can negatively impact daytime cognitive performance, emotional well-being and social functioning (Miner & Kryger, 2020). Adequate sleep is essential not merely for rest but for optimal waking life.

Sleep measurement in research ranges from objective and subjective approaches. Polysomnography (PSG) is the gold standard for sleep assessment, providing comprehensive and precise data. PSG captures detailed brain activity through electroencephalogram (EEG), eye movements, muscle tone, heart rhythm, breathing patterns, and blood oxygen levels. The detailed multi-system recording allows accurate mapping of sleep architecture into sleep stages, identification of subtle sleep disturbances, and diagnosis of sleep disorders (Zdanys & Steffens, 2015). For research and home-based monitoring, practical tools like actigraphy monitors, which use wrist-worn devices that track movement patterns to infer sleep-wake rhythms over time (Stephens & Gatchel, 2018).

While these physiological measurement tools provide valuable data, the field is increasingly moving toward multidimensional sleep health frameworks that recognise sleep as complex and holistic. Sleep health encompasses not just duration and stages, but also regularity, timing, subjective satisfaction, and daytime functioning that may be influenced by physical, cognitive, and psychosocial health and well-being, as well as environmental factors (Miner & Kryger, 2020). This shift acknowledges that good sleep is not merely the absence of detectable pathology on an EEG that detects abnormal brainwave patterns, but rather a dynamic aspect of health and well-being shaped by biological, cognitive, and psychosocial factors that cannot be captured by a single measurement (Duffy et al., 2015).

Sleep Problems in NZ

In NZ, self-reported insomnia symptoms and sleeping problems are prevalent. It was estimated that approximately one-quarter of NZ adults were suffering a current sleep problem (Paine et al., 2005). In 2001, a random sample of 4,000 NZ adults aged 20–59 completed a national survey (72.5% response rate). The study estimated 27.2% of the population (33.0% for Māori and 26.4% for non-Māori) experiencing a current sleep problem. The top three sleep complaints were never or rarely waking refreshed, difficulty getting back to sleep, and difficulty falling asleep (Paine et al., 2005). Recently, the NZ Sleep Census 2024, part of a worldwide study with 20,000 participants, found that 60% of New Zealanders reported feeling unrested upon waking, despite sleeping 7–8 hours per night. Additionally, 40% get less than six hours of sleep (Sealy, n.d.). Jones (2022) analysed 2013/2014 NZ Health Survey data from 13,309 adults aged 15 or older. Of these, 22% were aged 65 or older. Older adults experienced significantly higher rates of sleep disturbances and poor sleep quality (27.8%) compared to younger adults (19.4%). These findings highlight that sleep issues affect all age groups but are more common among older adults.

Sleep and Ageing

Sleep physiology, disorders, architecture and circadian rhythms are important considerations when examining how sleep changes with ageing. While these topics will be mentioned briefly, they fall outside the scope of this thesis, which focuses primarily on the subjective reports of sleep duration and quality.

There are normal changes in sleep architecture throughout the lifespan, including variations in time spent in sleep stages and shifts in circadian timing (Stephens & Gatchel, 2018). Older adults tend to report feeling sleepy earlier in the evening and waking earlier in the morning compared to young adults (Miner & Kryger, 2020). Ageing is also associated with structural changes in sleep architecture that can negatively impact sleep health. Compared to younger adults, older adults spend more time in bed but less time asleep, characterised by taking more time to fall asleep, and more frequent and long awakenings, and reduced sleep efficiency. Furthermore, the proportions of rich REM sleep and deep slow sleep wave are also measured to reduce with age (Mander et al., 2017). The cumulative impact of these age-related sleep changes extends beyond nighttime rest.

Daytime sleepiness is a critical indicator of inadequate sleep quality and overall health in the older population. Older adults report experiencing daytime sleepiness more frequently than younger age groups (Hirshkowitz et al., 2015). Consequently, daytime sleepiness can significantly compromise older adults' physical functioning, psychological well-being and emotional health.

Sleep Duration Changes with Age

The National Sleep Foundation recommends 7 to 8 hours of sleep for adults aged 65 and older. Research indicated that sleep between 6 and 9 hours is linked to better cognition, health, and quality of life compared with shorter or longer sleep durations (Hirshkowitz et al., 2015; Miner & Kryger, 2020). McLay et al. (2021) used the interRAI-HC assessment form (i.e., a standardised tool for assessing the health status of older adults) and found that, among NZ older adults (aged 65 and over), 12.4% of women and 12.7% of men reported shorter sleep. Meanwhile, 4.6% of women and 7.6% of men reported excessive long sleep. Similarly, Gibson et al. (2023) analysed NZ Health Survey data and showed that over 10% of older adults have short or long sleep duration. Poorer health was linked with atypical sleep patterns. Having three or more health conditions was associated with shorter sleep, while lower physical activity was associated with longer sleep duration. A lower Short-Form Health Survey (SF-12) score—which measures physical and mental health, with lower scores indicating poorer health—was associated with both short and long sleep durations (Gibson et al., 2023). A recent Chinese study also found that sleep duration is linked to successful ageing in adults over 60, defined as being free of major chronic disease, without physical impairment, with good cognition, good mental health, and life engagement (Tian et al., 2024).

Sleep Quality Changes with Age

Older adults may spend the same amount of time in bed, but it takes them longer to fall asleep, and they spend more time fully conscious (Miner & Kryger, 2020). They are also more likely to be awakened by environmental factors, such as noise, light, or temperature, and often have difficulty returning to sleep (Zdanys & Steffens, 2015). This results in more sporadic sleep and less deep sleep (Stephens & Gatchel, 2018). Overall, older adults experience higher rates of poor sleep quality and sleep disturbances with age (Lavoie et al., 2018). Thus, both sleep duration and quality tend to decrease among older adults.

Sleep Disorders in the Older Adults

Beyond these normative age-related changes, older adults are increasingly vulnerable to clinical sleep disorders. Several primary sleep disorders contribute to poor sleep among older adults. Insomnia is the most common sleep disorder among older adults. Symptoms of insomnia included difficulties initiating or maintaining sleep, occurring at least three nights per week for more than three months (Miner & Kryger, 2020). Sleep apnoea also increases with advanced age and is characterised by repeated pauses in breathing or reduced airflow during sleep (Lavoie et al., 2018). Restless legs syndrome (RLS) also increases in prevalence and severity with advancing age. RLS is a sensorimotor disorder characterised by unpleasant sensations in the limbs that cause an irresistible urge to move during sleep (Miner & Kryger, 2020). These sleep disorders, along with disrupted circadian rhythms and age-related changes in sleep regulation, all contribute to fragmented sleep patterns and reduce both the quantity and quality of sleep among older adults.

Factors that Impact Sleep in Older Adults

As we age, changes in physical, cognitive, and psychosocial health can significantly impair sleep. Smagula et al. (2016) reviewed 21 population-based studies with prospective sleep outcomes data and identified multiple factors that impact sleep in older adults. They concluded that being female, having a depressed mood, and physical illness are general risk factors for later-life sleep disturbances. Less robust evidence implicated factors such as lower physical activity, African American race, lower SES, previous manual work, widowhood, poor marital quality, loneliness, perceived stress, preclinical dementia, long-term use of benzodiazepines or sedatives, low testosterone, and inflammatory markers as potential predictors of poor sleep health in older adults. The session below will provide an overview of the complex interplay among sociodemographic, physical, mental, cognitive, psychosocial, and environmental factors on sleep in older adults. They are interrelated with many realms of waking life, and therefore it is important to meditate on them.

Sociodemographic Factors (Gender and Ethnicity)

Research has produced mixed findings on gender differences in sleep among older adults, but several consistent patterns have emerged. Smagula et al. (2016) and Grandner (2017) found that older women have a higher prevalence of sleep disturbances, such as

nighttime disruptions and daytime tiredness, compared to men in the same age range. This pattern persists after controlling for demographics, socioeconomics, and health variables. Recent data from the NZ Sleep Census 2024 support these findings. Women were more likely than men to have trouble falling asleep and staying asleep (33.0% vs. 25.3%) and to report current sleep problems (Sealy, n.d.). Women also reported shorter sleep durations, more sleep symptoms, and higher rates of insomnia (Lavoie et al., 2018). Conversely, men showed higher rates of obstructive sleep apnoea, reduced REM and slow-wave sleep, and more frequent diagnoses of REM behaviour disorder (Grandner, 2017). Despite these well-documented gender differences in sleep patterns and disorders, limited research has examined the underlying mechanism(s) driving these disparities. Some studies explained that older women face a higher risk of insomnia, which might be due to hormonal changes (i.e., menopause) and greater vulnerability to psychological distress, such as depression (Smagula et al., 2016). On the other hand, men with a higher risk of breathing-related sleep issues appear linked to both lifestyle factors (e.g., alcohol consumption and smoking) and their anatomical and physiological differences from women (Zdanys & Steffens, 2015).

Beyond gender, ethnicity also plays a significant role in shaping sleep outcomes, with minority groups tending to experience poor sleep globally. Grandner (2017) indicated that Asian and African American populations are more likely to experience short sleep duration compared to non-Hispanic White Americans. Specifically, Asian older adults are four times more likely to report very short sleep (<6 hours), and African Americans were 60% more likely to report longer sleep latency and greater sleep difficulties than non-Hispanic Whites. These disparities remained significant even after controlling for numerous socioeconomic and demographic factors. Grandner (2017) suggested that these findings may reflect the impact of long-term socioeconomic disadvantages disproportionately experienced by minority populations, which can negatively affect physical, mental, and sleep health. For instance, research has shown that living in neighbourhoods with greater social cohesion is associated with better sleep health and higher self-reported sleep duration (Billings et al., 2020). Cohesive communities tend to have lower crime rates, higher perceived safety, higher SES, and greater social capital, as well as neighbours who have better social relationships, connections, and trust (Stephens & Bakhshandeh Bavarsad, 2025). Conversely, social fragmentation, neighbourhood disadvantage and disorder have been associated with shorter sleep duration, lower sleep quality, and greater sleep difficulties across diverse populations, particularly among

underrepresented minority groups such as Blacks, Hispanics/Latinos, and Native Hawaiian and Pacific Islanders (Grandner, 2017). Together, these findings suggest that ethnicity, environmental safety, community cohesion, and SES interact to shape sleep health.

In the NZ context, studies comparing Māori (NZ indigenous population) and non-Māori sleep problems have yielded contradictory results. Paine et al. (2005) found that Māori reported higher rates of current (33.0%) and chronic (28.6%) sleep problems than non-Māori participants (26.4% and 24.6%, respectively). In contrast, Gibson et al. (2016) demonstrated the opposite pattern in their sample aged 79–90, with non-Māori participants reporting higher rates of current sleep problems (31.7%) than Māori participants (26.3%). The contrasting findings might be the younger age of participants in Paine et al.'s (2005) sample. Additionally, the inconsistency may also reflect cultural variations in how sleep and sleep problems are perceived, understood, and reported. Qualitative research conducted by Crestani et al. (2024) suggests that concepts of sleep, rest, and disordered health are not universally defined, but are shaped by cultural values, beliefs, and lived experiences. What is considered a sleep problem in Western clinical frameworks may not align with how indigenous or minority communities conceptualise disrupted sleep. In NZ, Māori understand health and well-being through holistic frameworks, such as Te Whare Tapa Whā. Physical health is deeply connected to their spiritual health, family and community relationships (Pitama et al., 2017). For example, Māori participants viewed sleeplessness not solely as a problem, but as a potential opportunity for cultural or spiritual connection (Crestani et al., 2022). Furthermore, Māori with poor health are less likely to complete the full questionnaire that includes the sleep questions, suggesting that survey non-response itself may be culturally and health-related (Gibson et al., 2016). Overall, while ethnic minorities generally experience poorer sleep health linked to socioeconomic disadvantage and neighbourhood factors, the inconsistent findings underscore the complexity of these relationships and the importance of culturally appropriate assessment methods.

Physical and Mental Health

Alongside sociodemographic factors, physical and mental health conditions represent another critical determinant of sleep quality in older adults. Sleep disturbances are identified as more common in older adults because ageing is associated with an increasing prevalence of multimorbidity and polypharmacy. Multiple chronic health

conditions and the use of various medications could negatively impact sleep quality (Miner & Kryger, 2020). Various studies have indicated that older adults with multimorbidity have poor sleep quality and a higher prevalence of sleep disorders compared to those without multimorbidity. The 2003 National Sleep Foundation survey findings showed that among people aged 65 years and older without comorbid illness, 36% reported a sleep problem. This percentage increased to 52% among individuals with one to three comorbid conditions and to 69% among those with four or more comorbid conditions (Miner & Kryger, 2020). Recently, Su et al. (2025) reported that the prevalence of poor sleep quality among Chinese older adults was 1.30 times higher among those with multimorbidity than among those without. The prevalence of poor sleep quality increased with the number of chronic conditions. Moreover, older adults with less optimal physical health are more likely to experience sleep problems. For instance, older men with lower testosterone levels tend to have higher body weight and BMI, which may contribute to sleep-disordered breathing and lower sleep efficiency and quality (Barrett-Connor et al., 2008).

Mental health conditions further compound the relationship between physical health and sleep. Phelan et al. (2010) investigated potential factors that negatively affect sleep quality among ageing women. They found that women with better baseline mental health had lower odds of disrupted sleep quality at the 10-year follow-up. Higher depression scores and more illnesses at baseline were also associated with greater odds of having disrupted sleep, suggesting that reducing depression symptoms may lead to improved sleep quality over time. Interestingly, baseline anxiety and subjective health were not significantly predictive of changes in sleep quality (Phelan et al., 2010). However, Barczi and Teodorescu (2016) showed that anxiety is significantly associated with sleep disturbances. They argued that common chronic conditions in older adults, including pain syndromes, arthritis, digestive disease, heart disease, lung disease, renal and urologic disease, and cancer, can disrupt sleep both through their direct physical symptoms and complications, and through the anxiety that arises from living with and managing these conditions (Barczi & Teodorescu, 2016). Overall, physical illness and poor mental health significantly contribute to sleep disturbances and poor sleep quality among older adults, with the cumulative effects of multiple chronic conditions and their medications further exacerbating sleep difficulties.

Cognitive and Psychosocial Factors

Beyond physical and mental health, cognitive and psychosocial factors also play a crucial role in influencing sleep quality among older adults. Seo et al. (2024) conducted a longitudinal study examining how social support, social strain, loneliness, and cognitive function affect older adults' sleep quality. They found that participants with higher baseline cognitive function had significantly better sleep quality at both baseline and four-year follow-up. Additionally, higher baseline social support was positively correlated with sleep quality at baseline and at the four- and eight-year follow-ups. They further demonstrated that loneliness mediated the relationship between social support and sleep quality. Individuals with less social support might experience increased feelings of loneliness and consequently worse sleep quality. In addition, Hawkley et al. (2010) demonstrated that more socially isolated individuals had poorer sleep quality and reduced daytime functioning, without a decrease in sleep duration, compared to participants who were not socially isolated. Phelan et al. (2010) demonstrated that women with higher baseline psychological well-being had lower odds of disrupted sleep quality at the 10-year follow-up. More specifically, five out of the six psychological well-being dimensions (PiL, positive relationships with others, environmental mastery, personal growth, and self-acceptance) predicted disrupted sleep quality in women, but baseline autonomy was not a significant predictor. Overall, these findings collectively highlight that cognitive function, psychological well-being and social relationship play a critical role in determining sleep health among older adults.

Environmental Factors

Sleep is not only impacted by pathophysiological, psychological, and behavioural factors, but also by our environment, culture and society. Social-ecological models help explain the factors associated with poor sleep health at individual, social, and societal levels (Gibson et al., 2023; Grandner, 2017). Cappuccio and Miller (2017) found that aspects of Western society, such as longer working hours, more shift work, 24/7 commodity availability, widespread technology, and 24-hour global connectivity, make sleep behaviours increasingly socially and environmentally driven and affected by interpersonal and societal factors (Grandner, 2017). Older adults are more sensitive to environmental stimuli and hence are more at risk of sleep problems (Aliabadi et al., 2017). For instance, the overstimulating modern environment, characterised by noise pollution and increased

exposure to artificial light, screen-based technology such as televisions and smartphones, and the constant availability of stimulating digital content, can delay sleep onset and suppress melatonin production, further disrupting older adults' age-sensitive circadian rhythms (Billings et al., 2020). Consequently, we are experiencing increasing trends of reduced sleep duration below recommended ranges for optimal health and well-being, alongside greater sleep disturbances and daytime dysfunction (Garbarino et al., 2021; Tay et al., 2024). Additionally, older adults often have undiagnosed and unmanaged sleep disorders, all of which together negatively impact their health and well-being.

Health Risks Associated with Sleep Problems among Older Adults

Mortality and Physical Health Consequences of Poor Sleep

Older adults are at increased risk of atypical sleep duration, poor sleep quality, and insomnia symptoms, which, in turn, predict worse self-reported health, CVD, cognitive decline, depression, disability, institutionalisation, and death (Lavoie et al., 2018). Sleep duration is significantly associated with all-cause mortality and morbidity. Both Cappuccio et al. (2010) and Shen et al. (2016) conducted meta-analyses of prospective cohort studies that included Asian, US, and European populations. Sleep duration was associated with all-cause mortality in a U-shaped pattern. Short sleep duration was associated with a 10%–12% increased mortality risk, while long sleep duration was associated with a 30%–38% increased mortality risk (Cappuccio et al., 2010). However, a systematic review and meta-analysis by García-Perdomo et al. (2019) found no significant association between short sleep duration (<7 hours) and mortality. The inconsistency in findings may partly reflect methodological limitations in early research. Caputo (2025) criticised Cappuccio et al.'s (2010) study for lacking clear definitions of sleep duration, such as shorter sleep duration ranging from 5 to 7 hours. To address these definitional inconsistencies, Caputo (2025) conducted a literature review of 10 selected studies that used standardised definitions (short sleep: 6 hours or less, and long sleep: 9 hours or more). Their analysis confirmed that both short and long sleep durations increase the risk of all-cause mortality and CVD, supporting the U-shaped relationship identified by Shen et al. (2016).

Sleep quality also shows associations with physical health among older adults. Zhu et al. (2023) examined longitudinal changes in sleep quality, physical health status, and life satisfaction among 1,856 Chinese older adults aged 60 years and over across three time

points (2011, 2014, and 2018). The study revealed a nonlinear decline across all three domains over time, along with complex reciprocal relationships. Sleep quality in 2011 and 2014 significantly predicted both life satisfaction and sleep quality in 2014 and 2018, respectively. However, the reciprocal relationship was asymmetric: while life satisfaction in 2011 did not significantly influence sleep quality in 2014, life satisfaction in 2014 did significantly predict both sleep quality and life satisfaction in 2018. This temporal asymmetry may reflect the cumulative nature of life satisfaction's influence on sleep. Additionally, the impact of psychological factors on sleep health may only become apparent after individuals have maintained psychological well-being for an extended period as they age. Interestingly, physical health status showed a time-dependent influence pattern. While health status in 2011 significantly predicted sleep quality in 2014, health status in 2014 did not significantly affect sleep quality in 2018 (Zhu et al., 2023). This shift suggests that factors affecting older adults' physical and sleep health become increasingly complex over time. As individuals age, variables such as social relationships, mental, cognitive, and psychosocial well-being, and functional independence potentially become more influential than physical health status alone in determining sleep quality in later years (Stephens & Gatchel, 2018).

Cognitive, Mental and Psychosocial Consequences of Poor Sleep

Reduced sleep duration has been shown to impair working memory, cognitive functions, and memory consolidation, thereby reducing work efficiency, increasing work-related incidents and injuries, and contributing to drowsy driving among older adults (Grandner, 2017). Zhong et al. (2019) reported that sleep affects cognitive function in older adults, as slow-wave sleep can activate learning-related neurons and enhance memory consolidation. Unfortunately, older people tend to have less slow-wave sleep due to their increased cortical thinning during ageing process. Cortical thinning is the gradual reduction of the outer layer of the brain that is responsible for higher-order cognitive functions. Poor sleep can accelerate brain degenerate during older adults and negatively impact their cognitive functions, such as reduced ability in learning and memory (Zhong et al., 2019). Additionally, sleep disturbance and cortical thinning reinforce one another. When we are awake, neurotoxic substances accumulate in our brain, and the toxic level increases throughout the day. These neurotoxic substances are cleared during sleep. Therefore, poor sleep quality and sleep disturbances disrupt the clearance of neurotoxic deposition in our

brain, and the accumulation of these toxins accelerates cortical thinning, increases the risk of MCI, and the development of AD (Zhong et al., 2019). Moreover, research demonstrated that the complex relationship between sleep, mental health, and psychosocial well-being is bidirectional (Miner & Kryger, 2020; Phelan et al., 2010; Tay et al., 2024; Yuan et al., 2020). While shorter sleep duration is associated with poor mental health, sleep disruptions are also a common diagnostic feature of many mental health disorders, such as depression (Lan et al., 2024). Older adults with sleep disorders often show increased mood and psychosocial disorders, such as increased feelings of loneliness, reduced social participation, and increased social isolation (Simon & Walker, 2018).

Sleep problems have been linked to negative outcomes across multiple domains, including physical and mental health, cognitive function, and psychosocial well-being (Grandner, 2017; Stephens & Gatchel, 2018). Given the prevalence and consequences of sleep problems in older populations, understanding the relationship between sleep and psychosocial outcomes such as loneliness represents an important area of inquiry for reducing both sleep problems and loneliness in older populations, ultimately promoting healthy ageing.

Sleep and Loneliness: A Bidirectional Relationship

Extensive research has demonstrated a significant association between sleep and loneliness among older adults. Azizi-Zeinalhajlou et al. (2022) conducted a systematic review including five cross-sectional and six longitudinal studies, demonstrating that both subjective loneliness and objective social isolation are associated with sleep disturbances and poor sleep quality. For instance, Hong et al. (2023) demonstrated being lonely was associated with a 16% increased risk of subsequent sleep problems. The English Longitudinal Study of Ageing showed that baseline loneliness was associated with increased odds of reporting short sleep duration and more sleep problems at four-year follow-up among older adults aged 50 years and over (Shankar, 2020). More specifically, lonelier older adults experienced greater wake after sleep onset, longer sleep onset latency, and lower sleep efficiency than those who reported being less lonely (Hawkey et al., 2010; John-Henderson et al., 2021). This vulnerability appears particularly pronounced among individuals with poor physical health, as socially isolated older adults with chronic diseases were found to be especially at risk for sleep difficulties (Zhang et al., 2022). Loneliness may therefore create a compounding effect on health and well-being by

negatively influencing on sleep. Stephens and Gatchel (2018) explained that the loss of regular routine and social contact after retirement may increase feelings of loneliness and negatively affect sleep health. Loneliness may promote unhealthy sleep behaviours, such as napping and irregular bedtimes, which can disrupt nighttime sleep quality. Poor sleep quality may subsequently affect physical health, psychosocial well-being, and life satisfaction, further reducing opportunities for social participation among older adults. (Miner & Kryger, 2020).

An increasing body of empirical evidence shows the reciprocal effects between loneliness and sleep (Azizi-Zeinalhajlou et al., 2022; Hom et al., 2020). Griffin et al. (2020) examined these bidirectional effects over an eight-year longitudinal study and found that higher levels of loneliness were correlated with greater sleep disturbance at baseline, with reciprocal effects between loneliness and sleep across time points. Similarly, Zawadzki et al. (2013) conducted a longitudinal study examining sleep quality and loneliness over time and concluded that poor sleep quality predicted increases in loneliness over subsequent weeks, with the relationship operating in both directions. However, Yu et al. (2018) argued that after controlling for covariates (e.g., age, gender, education, healthy behaviours, chronic disease, cognitive functioning, and depressive symptoms), the association between loneliness and sleep quality was no longer significant. Moreover, Griffin et al. (2020) conducted a systematic review and meta-analysis of 27 articles on the association between loneliness and various sleep outcomes, including quality, duration, insomnia symptoms, adequacy, satisfaction, and changes in sleep. They found that loneliness correlated only with self-reported sleep disturbance, not with sleep duration (Griffin et al., 2020). Evidence from NZ supports this nuanced pattern. Lonelier and more social isolated older adults showed higher rates of insufficient sleep. However, excessive sleep incidents were not significantly different between lonely and non-lonely older adults (McLay et al., 2021). These mixed findings suggest that the underlying mechanisms linking loneliness to short and long sleep duration may differ and the relationship between loneliness and sleep is likely dependent on which specific aspects of sleep are examined and which confounding factors are considered.

While most existing research has examined how loneliness affects sleep outcomes and their reciprocal effects, a growing body of research has investigated whether sleep health influences and predicts loneliness levels, though with mixed findings. Hom et al.

(2017) conducted a series of cross-sectional and longitudinal studies investigating how sleep health impacts loneliness. In their cross-sectional studies, greater insomnia symptom severity was significantly associated with greater loneliness, even after controlling for anxiety, but not after additionally controlling for depression. In their first longitudinal study, changes in sleep pattern, measured by a single item from the Beck Depression Inventory (BDI; Beck et al., 1961), significantly predict loneliness at 1-month and 6-month follow-ups. However, this significant finding was not maintained when controlling for baseline loneliness severity and depression symptoms. Interestingly, greater loneliness symptoms did not predict BDI sleep problem severity at either the 1-month or 6-month follow-up, suggesting that pre-existing loneliness and depression may be a robust predictor of subsequent loneliness (Griffin et al., 2020). Despite prior research demonstrating that loneliness may predict sleep problems, Hom et al.'s (2017) studies highlight the difficulties in establishing a temporal relationship between sleep and loneliness. The bidirectional nature of the association between sleep and loneliness may create cyclical patterns, in which sleep problems lead to increased loneliness, and subsequently, loneliness can exacerbate sleep problems. In their second longitudinal study, which investigated which insomnia symptoms, measured by four-items from the Hopelessness Depression Symptom Questionnaire (HDSQ; Metalsky & Joiner, 1997), predicted loneliness five weeks later. The results indicated that HDSQ insomnia symptoms (i.e., difficulties falling asleep and sustaining sleep, and problems with early waking) significantly predicted loneliness, even after controlling for baseline loneliness and anxiety symptoms, but not after controlling for depression. Possible explanations might be the highly overlapping nature of insomnia and depression. Additionally, insomnia is a common depression symptom (Hom et al., 2017).

Additional research has demonstrated that sleep-deprived individuals experience greater loneliness and social isolation (Jarrin et al., 2014; Medic et al., 2017; Simon & Walker, 2018). A follow-up study by Simon et al. (2022) further supported the idea that sleep deprivation has a negative impact on both individuals and societies. They found that one night of sleep loss significantly decreased the desire to help others, as measured by a standardised helping questionnaire. Additionally, four consecutive nights of reduced sleep duration were associated with reduced tendency to help others in day-to-day interactions. At the national level, one hour of lost sleep opportunity (inflicted by the transition to Daylight Saving Time) reduces real-world altruistic helping through donation giving (Simon et al., 2022). Social Cognition and Motivation Theory explained that individuals

with sleep deprivation have impaired social cognition (i.e., impairment in the social cognition network in the brain), reduced social motivation, and compromised mood regulation. These deficits may make individuals more likely to withdraw from social situations and appear less socially attractive to others, ultimately contributing to greater social isolation and heightened feelings of loneliness (Simon et al., 2022). However, most current studies focus on young and middle-aged adults, leaving a significant gap in our understanding of how sleep impacts feelings of loneliness, specifically among older adults.

Limited research has directly examined which specific sleep aspects and problems serve as risk factors for loneliness in older populations. Jia and Yuan (2020) conducted a face-to-face questionnaire survey with 1,658 rural older adults in Shandong Province, China. Sleep was assessed using the Pittsburgh Sleep Quality Index (PSQI), and loneliness was assessed using the UCLA Loneliness Scale. The PSQI quantifies subjective sleep ratings in seven different domains: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunctions. The sum of the scores of the seven components is used to compute the global sleep quality score, ranging in value from 0 to 21. Higher the values for the global and component scores, indicating more severe sleep problems (Buysse et al., 1989). Jian and Yuan (2020) demonstrated that an increase in the odds of loneliness was associated with an increase in the global component score. Specifically, older adults with higher PSQI component scores for sleep quality, sleep latency, sleep duration, use of sleeping medication, and daytime dysfunction were significantly associated with a higher score of loneliness. Although individuals with higher scores of habitual sleep efficiency and sleep disturbance had a higher score of loneliness, these associations were not statistically significant. Similarly, Chang et al. (2023) demonstrated that among 1,262 Chinese Hakka older adults aged 60 and older, irregular sleep was positively associated with loneliness. Conversely, Hawkey et al. (2010) found that only sleep quality and daytime dysfunction, but not sleep duration, were related to loneliness among older adults. These mixed findings highlight the complex relationship between different aspects of sleep and their differential impact on loneliness. The mechanisms linking sleep and loneliness remain unclear. Further research is needed to disentangle these relationships, particularly among older adults, where both sleep problems and loneliness are highly prevalent.

Sleep, Loneliness, and PiL

Sleep impacts loneliness, and both sleep problems and loneliness are prevalent among older adults. However, interventions targeting sleep and loneliness in older adults have shown limited effectiveness. Recently, studies on the relationship between PiL and sleep among older adults have received particular attention, with consistent findings across multiple studies.

The US Health and Retirement Study, which included 13,770 adults aged 50 and older, showed that PiL was positively associated with sleep problems among older adults. Over nine years of follow-up, individuals in the highest quartile of purpose were significantly more likely than those in the lowest quartile to report no sleep problems (Kim et al., 2019, 2020). More specifically, each unit increase in purpose (on a 6-point scale) was associated with 16% reduced odds of reporting sleep disturbances (i.e., assessed using a modified form of the Jenkins sleep scale to assess feeling rested, difficulty falling asleep, difficulty staying asleep, and waking up too early) over the four-year follow-up. Importantly, the association between purpose and sleep disturbances remained after adjusting for sociodemographic (i.e., age, gender, education, race/ethnicity), behavioural, psychological, and health covariates (Kim et al., 2015). Turner et al. (2017) also provided longitudinal evidence of the relationship between PiL and sleep disorders among older American adults. Their results revealed that higher levels of PiL were associated with better sleep quality, a lower risk of sleep apnoea, and reduced RLS symptoms at baseline, one-year, and two-year follow-up. Turner et al. (2017) proposed that higher PiL may reduce sleep disorders through physiological and psychological pathways. Physiologically, individuals with higher PiL tend to engage in health-promoting behaviours, such as greater intake of fruit and vegetables, regular physical activities, and better sleep hygiene, all of which may reduce RLS symptoms (Hill et al., 2019; Kim et al., 2020). Additionally, an active lifestyle can contribute to a healthy body weight and a lower BMI, which in turn reduces the risk of developing sleep apnoea (Barrett-Connor et al., 2008). Psychologically, higher PiL has been associated with reduced neurodegeneration, lower levels of depression and anxiety, and emotional regulation, all of which may also reduce RLS symptoms and improve overall sleep health (Lewis et al., 2017; Windsor et al., 2015).

There are limited studies have shown associations between PiL, sleep, and loneliness. Kim et al. (2022) indicated that higher PiL was associated with reduced risk of

sleep problems, and lower loneliness and depressive symptoms during a four-year follow-up among US adults aged 50 and over. While PiL and sleep appear to reduce psychosocial distress and improve well-being, PiL's typical decline with ageing poses challenges (Hupkens et al., 2018; Kim et al., 2021; Willroth et al., 2021). Maintaining PiL potentially contributes to a slower decline in physical function and reduced incidence of age-related conditions (e.g., CVD, cognitive decline), which in turn support better sleep quality (Kim et al., 2021) and social well-being and relationships, thereby reducing loneliness (Neville et al., 2018; Mittelman et al., 2023). Studying the relationship between PiL and loneliness and the potential mediating effect of sleep on loneliness can therefore help us understand the complex circumstances of older adults' physical, cognitive health, and psychosocial well-being. Such insights may have important implications for combating loneliness and promoting healthy ageing.

Summary

This literature review has highlighted the importance of establishing and maintaining PiL in later life and its potential to improve health and well-being among older adults. Psychological distress (i.e., loneliness) and sleep problems (i.e., atypical sleep duration and poor sleep quality) have been shown to negatively impact older adults' physical, cognitive, and psychosocial health and well-being. However, the evidence on how PiL, sleep, and loneliness interact and collectively contribute to health outcomes in older adults remains limited. Furthermore, the underlying mechanisms remain poorly understood, as they likely involve complex, multiple pathways. For instance, different aspects of sleep may have different impacts on psychological health outcomes and the directionality of the relationship between sleep and loneliness warrants further examination.

The studies outlined above have made important contributions to the literature but remain somewhat limited. First, the factors contributing to loneliness in older age require further understanding. Both PiL and sleep health are associated with loneliness, yet how they relate to one another and whether sleep mediates this relationship have received limited research attention. Second, there is a lack of empirical evidence specifically examining these relationships within the context of NZ's older adult population. This thesis therefore aims to address these critical gaps in the literature by exploring how PiL

influences sleep and loneliness among NZ older adults, and by examining the potential mediating effect of sleep on the relationship between PiL and loneliness.

Aim and Objectives

Present Study Aim

The present thesis aims to assess the relationship between PiL and loneliness and the mediating effects of sleep quality and duration, while controlling for known predictors of loneliness found in the literature. The aims will be met through the analysis of the NZ Health, Work and Retirement (NZHWR) data. The thesis aims are:

1. To describe the distribution and patterns of PiL, sleep parameters (duration and quality), and loneliness among community-dwelling older adults aged 55 years and above in NZ.
2. To examine the associations between PiL, sleep, and loneliness among community-dwelling older adults aged 55 years and above in NZ.
3. To investigate the independent predictors of loneliness while controlling for the key sociodemographic factors (age, gender, ethnicity, marital status, living arrangement, SES) and health-related factors (chronic conditions, physical health status, mental well-being, physical activity levels, QOL measures) among NZ's older adult population.
4. To investigate whether sleep parameters (duration or quality) mediate the relationship between PiL and loneliness among community-dwelling adults aged 55 years and above in NZ?

Hypotheses

1. Poor sleep outcomes (characterised by poor sleep quality and inadequate sleep duration) will be associated with higher levels of loneliness.
2. Higher levels of PiL will be associated with lower levels of loneliness.
3. Sleep outcomes (duration and quality) will mediate the relationship between PiL and loneliness, such that individuals with higher levels of PiL will have better sleep outcomes (higher satisfaction and adequate duration) and lower levels of loneliness.

Methodology

This section describes the two essential components of the methods used in this thesis: the data source and the data analysis. The data were drawn from the NZ Health, Work and Retirement (NZHWR) Study, a large-scale longitudinal investigation led by Massey University's Health and Ageing Research Team (HART).

The Health, Work and Retirement (HWR) Study

This thesis utilised cross-sectional data from the 2022 wave of the NZHWR study. Launched in 2006, the NZHWR is a biennial postal survey that examines the transition from work to retirement and its impact on health and well-being among older adults aged 55 years and over residing in Aotearoa/NZ (Phillips, 2022; Neville et al., 2018). The 2022 survey used standardised questionnaires comprising 119 questions in total. Through comprehensive questionnaires, participants provide detailed information about their ageing experiences across multiple dimensions, including physical, emotional, and cognitive health, life satisfaction, family support, social capital and participation, community and healthcare services, and sociodemographic characteristics. A key strength of the NZHWR dataset is its diverse, randomly selected cohort drawn from the electoral roll, which ensures that the findings represent a wide range of older adults. This population-based sampling approach enhances the generalisability of the study findings to the broader population of older New Zealanders (Health and Ageing Research Team, 2018).

Procedure

The 2022 data collection involved a 32-page postal survey administered between 12th September and 30th November 2022. The 2022 cohort comprised two distinct participant groups. The first group is the 2022 'existing' cohort, comprising participants who enrolled in the study at earlier waves and completed previous surveys in 2006, 2009, 2014, 2016, 2018, and 2020. The second group included newly recruited participants aged 55–65 who were invited to join the study for the first time, forming the 2022 'refresh' cohort. Māori were oversampled for this study using the Māori descent indicator on the general electoral roll to maximise participant recruitment and ensure adequate representation of Māori perspectives. This oversampling strategy was designed to account

for the unique health and ageing experiences of indigenous populations and to enable culturally meaningful analysis of health and well-being outcomes (Phillips, 2022).

The survey distribution process followed a systematic multi-contact protocol. Initial contact involved sending each participant a comprehensive survey package, including an introductory letter, information sheet, pen, survey booklet, consent form, and a reply-paid return envelope. To maximise response rates, a follow-up procedure was implemented. Three weeks after the initial mailing, a first reminder was sent. It comprised a postcard thanking the individuals who had returned the survey and asking those who had not to do so. For those who still had not responded, a second reminder was sent 12 weeks after the initial contact, including a final reminder letter, information sheet, survey booklet, consent form and a reply-paid return envelope. Response rates varied across cohorts and demographic groups. Among the existing longitudinal participants, the overall response rate was 78.7%. Māori descent showed a lower response rate (72.0%) than non-Māori participants (83.0%). For the newly recruited 2022 refresh cohort, the overall response rate was 23.5%. Consistent with the existing cohort, the refresh cohort also showed differential response rates by ethnicity, with Māori descent having a lower response rate (19.3%) compared to the general sample (29.8%).

Measures

The measures selected in the present study were designed to measure individual factors related to loneliness, PiL, and sleep. For the detailed overview of the selected measurement from the NZHWR 2022 cohort in this thesis, see Appendix.

Loneliness (Dependent Variable)

The six-item short-form version of the De Jong Gierveld Loneliness Scale was used to assess participants' overall, emotional, and social loneliness (De Jong Gierveld & Van Tilburg, 2006). The instrument was developed based on Weiss's (1973) conceptual distinction between these two forms of loneliness. Emotional loneliness refers to the absence of an intimate relationship, or a close emotional attachment, whereas social loneliness reflects the lack of a broader social network and meaningful social engagement. This theoretical framework underlies the scale's two-factor structure, capturing the multidimensional nature of loneliness in older adults.

Scale Administration and Scoring. The scale comprises six items, three measuring each dimension of loneliness. Participants respond to each item using a 3-point scale: 1 = *yes*, 2 = *more or less*, and 3 = *no*. There are three negatively framed items (Items 1, 5, 6) assess emotional loneliness: "I experience a general sense of emptiness," "I miss having people around," and "Often, I feel rejected." The other three positively framed items (Items 2, 3, 4) measure social loneliness: "There are plenty of people that I can rely on when I have problems," "There are many people that I can trust completely," and "There are enough people I feel close to." The following instructions were used to administer the scale: "Please indicate for each of the statements below, the extent to which they apply to the way you feel now."

A composite loneliness score was determined using an item-response model in which items are scored dichotomously. For emotional loneliness items, responses of *more or less* or *yes* are coded as 1 (indicating loneliness), and *no* is coded as 0. For social loneliness items, responses of *more or less* or *no* are coded as 1 (indicating loneliness) and *yes* is coded as 0. Two subscale scores are computed by averaging the scores of their respective three items, then multiplying by 3, yielding subscale scores from 0 to 3. Higher scores reflect greater loneliness in that domain. Finally, the total loneliness score is the sum of the emotional and social subscales, ranging from 0 to 6 (De Jong Gierveld & Van Tilburg, 2010). For analysis, loneliness was also dichotomised into high (scores ≥ 2.0) and low (scores < 2.0) categories (Neville et al., 2018). Both continuous and categorical forms were used in the analyses.

Psychometric Properties. De Jong Gierveld and Van Tilburg (2006) validated the short-form version with over 10,000 participants across two surveys in the Netherlands (participants age range 18 to 99). The six-item scale demonstrated strong psychometric properties, showing high correlation with the original 11-item scale. Correlation coefficients for convergent validity were between .93 and .95, indicating that the short form captures the same construct as the full version (Tavakol & Dennick, 2011). Importantly, the convergent validity correlation coefficient did not differentiate between age groups (under 45, 45–64 years, and 65 and over) and demonstrated the scale's applicability across the adult lifespan. Construct validity was confirmed through confirmatory factor analysis, which verified the existence of two factors for the loneliness dimensions. Internal consistency reliability was excellent for both subscales, with the

emotional loneliness scale yielding a Cronbach's α of .88, and the social loneliness scale had an α coefficient of .93 (De Jong Gierveld & Van Tilburg, 2006).

Further psychometric evaluation has confirmed the reliability of the six-item version across diverse populations. In general population studies, Cronbach's α coefficients for the total scale have consistently ranged from .70 to .76, indicating acceptable to good internal consistency (De Jong Gierveld & Van Tilburg, 2010; Lai et al., 2025). When examined separately, the three-item emotional loneliness scale showed slightly lower but still acceptable reliability ($\alpha = .67$ to $.74$), whereas the social loneliness score demonstrated consistently good reliability ($\alpha = .70$ to $.73$). Moreover, the six-item measure is widely used in gerontology research worldwide. For instance, among New Zealanders aged 55 or over, both subscales yielded acceptable reliability, with emotional reliability ranging from $\alpha = .61$ to $.66$ and social reliability ranging from $\alpha = .75$ to $.79$ across multiple studies (Stephens & Gatchel, 2018; Szabó et al., 2024). Similarly, among the Chinese population, the loneliness scale has demonstrated good reliability (Cronbach's $\alpha = .82$; Zhang et al., 2023), further supporting its cross-cultural applicability. The total loneliness scale has shown strong reliability, ranging from $\alpha = .80$ to $.90$ in studies of older adults (Wright-St Clair et al., 2017).

Sense of Purpose in Life (PiL)

PiL was measured using the Life Engagement Test (LET; Scheier et al., 2006). LET is a six-item instrument that assesses the extent to which individuals' purposeful engagement in life and the extent to which they find their activities meaningful and worthwhile (Scheier et al., 2006). While AshaRani et al. (2022) noted that some may question whether the LET adequately captures PiL, they argued that engagement in valued activities does not necessarily equate to having PiL. This concern reflects a theoretical discrepancy about the nature of purpose itself. In contrast with Ryff's (1989) Psychological Well-Being scale, which is based on abstract philosophical principles, the LET conceptualises purpose as an action-oriented construct manifested through engagement with personally meaningful goals and activities (Scheier et al., 2006). From this perspective, PiL is expressed through behaviour. For instance, individuals with higher levels of purpose actively invest time and effort in activities they find valuable, whereas those who lack purpose are more likely to disengage from activities, even when they are beneficial to health and well-being. Older adults' PiL might alter because they are more likely to experience significant life

transitions, such as retirement, bereavement, and health decline. Consequently, assessing whether a person is presently experiencing purpose in their life is crucial, as current purpose may influence their current health status, psychosocial well-being (e.g., loneliness), and health-related behaviours (e.g., sleep).

Scale Administration and Scoring. The LET comprises six items: three items are positive framed (Items 2, 4, 6), such as “To me, the things I do are all worthwhile”, and three negative formulated (Items 1, 3, 5), such as “There is not enough purpose in my life”. Participants respond using a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Items 1, 3, and 5 were reverse coded. Item scores were summed (range: 6–30) and then averaged (range: 1–5). For analysis, PiL was also dichotomised into high (scores ≥ 4) and low (scores 1–3) categories (Musich et al., 2020). Both continuous and categorical forms were used in the analyses.

Psychometric Properties. There is evidence supporting the validity and reliability of the LET. The LET has demonstrated robust construct validity through extensive factor analytic work (Pearson et al., 2013). Exploratory factor analyses conducted across eight diverse samples consistently revealed a one-dimensional structure, with all six items loading onto a single factor representing life engagement. Factor loadings were uniformly high across all items, averaging .71 (Scheier et al., 2006). In addition, the LET has shown satisfactory convergent validity through moderate correlations with other psychosocial measures: emotional health ($r = .19$ to $.42$), depression ($r = -.33$ to $-.49$), and mental health ($r = .32$ to $.49$). Notably, the LET correlated strongly with Ryff’s Purpose in Life subscale ($r = .73$), confirming that both instruments assess aspects of life purpose (AshaRani et al., 2022; Scheier et al., 2006). Moreover, the LET demonstrated significant associations with all seven psychological well-being indicators: life satisfaction, self-esteem, self-mastery, positive and negative affect experienced during the past year, depressive symptomatology, and perceived stress (Ryff, 1989). These correlations ranged from moderate to strong, supporting the scale’s ability to capture a dimension of purpose that is meaningfully related to, yet distinct from, general well-being (Neville et al., 2018; Scheier et al., 2006).

The LET has demonstrated superior discriminant validity through its ability to distinguish between groups with different health and psychosocial statuses, including individuals with different levels of chronic illness, functional limitations, and psychosocial resources. Internal consistency was relatively high across diverse populations (Cronbach’s

$\alpha = .72$ to $.87$), and test-retest reliability was moderately stable ($r = .61$ to $.76$; Scheier et al., 2006). Therefore, given the robust psychometric profile, the LET is particularly well-suited for health psychology studies examining the relationships between PiL and health-related outcomes among older adults.

Sleep Measures

Sleep was captured in several ways in the NZHWR and therefore the following variables were explored for the present thesis.

Sleep Duration. Sleep duration was assessed by asking participants to report the total number of hours of sleep they usually obtain in a 24-hour period, including all naps and periods of sleep (Paine & Gander, 2016). Responses were rounded to the nearest whole hour (Gibson et al., 2023). The National Sleep Foundation recommends that adults aged 65 and older sleep 7 to 8 hours per day (Hirshkowitz et al., 2015). Several studies demonstrated that older adults who sleep 6 to 9 hours showed better physical, cognitive, and mental functioning and improved quality of life compared with those who sleep shorter or longer durations (Caputo, 2025; Hirshkowitz et al., 2015; Lauderdale et al., 2016; Shen et al., 2016). Therefore, based on the Sleep Foundation Guidelines and empirical studies, sleep duration was categorised into three groups for analysis: short (< 6 hours), regular (6–9 hours), and long (> 9 hours) per 24-hour period (Caputo, 2025). Both continuous and categorical forms were used in the analyses.

Sleep Quality. Sleep quality was assessed with a single-item measure that asked participants, “How satisfied are you with your sleep?” on a 5-point Likert scale, where 1 = *very dissatisfied*, 2 = *dissatisfied*, 3 = *neither satisfied nor dissatisfied*, 4 = *satisfied*, and 5 = *very satisfied*. For group categorisation, participants who answered 1 or 2 were classified as the dissatisfied sleep group, and those who answered 3, 4, or 5 were classified as the not dissatisfied sleep group (WHOQOL Group, 1998). Single-item sleep quality measure has shown strong concurrent validity and significant correlations with multi-item measures, including the PSQI sleep quality item, ranging from $r = -.87$ to $r = -.92$ (Snyder et al., 2018).

Daytime Sleepiness. Daytime sleepiness was measured using a single-item indicator by asking participants, “How often have you had trouble staying awake while

driving, eating meals, or engaging in social activity?” Responses were recorded on a 4-point Likert scale (1 = *not during the last month*, 2 = *less than once a week*, 3 = *once or twice a week*, 4 = *three or more times a week*). Participants who answered, *not during the last month* (scores = 1) were categorised as not experiencing daytime sleepiness, while those who scored 2, 3, or 4 were classified as experiencing daytime sleepiness (Mollayeva et al., 2016).

Sleep Disorders. The presence of diagnosed sleep disorders was assessed as part of the chronic condition question (see below Chronic Condition). Participants were asked whether they had been diagnosed with a sleep disorder by a health professional. Participants who answered 1 = *No* were categorised as not having a sleep disorder. Those who answered 2 = *Yes, in the last 12 months* or 3 = *Yes, prior to the last 12 months* were categorised as having a sleep disorder.

Covariates (Exposure Variables)

Throughout the data analyses, a set of covariates previously shown to influence older adults’ sleep, perception of loneliness, and PiL was explored and potentially controlled for in models (Hong et al., 2023; Kim et al., 2022; McLay et al., 2021; Musich et al., 2018; Pinquart & Sorensen, 2001; Shankar, 2020; Zhang et al., 2022). These variables represent sociodemographic characteristics (i.e., age, gender, marital status, living arrangement, and SES), as well as indicators of physical, mental, and psychosocial well-being. These variables included in the 2022 NZHWR Survey are listed below.

Sociodemographic Characteristics

The sociodemographic covariates are summarised in Table 1, including age, gender, ethnicity, marital status, living arrangement, and SES. They are possible predictive variables in logistic regression models (Paine et al., 2005).

Table 1*Sociodemographic Variables and Measurement*

Demographic Variables	Description	Categorising and Coding for Regression Analysis
Age (in years)	Date of Birth	Calculated as the difference between the participants' date of birth and the date the survey was completed
Gender	Tāne/Male, Wāhine/Female, Gender Diverse	Male = 1, Female = 2, Gender diverse = 3
Ethnicity	Māori, NZ European, Samoan, Cook Island Māori, Niuean, Chinese, Indian, Tongan, Other specified	Māori = 1, Non-Māori = 2
Marital status	Married, Civil Union/De Facto/Partnered, Divorced/Separated, Widow/er, Single	Partnered (married or de facto) = 1, Single (widowed, never married, divorced or separated) = 2
Living arrangement	Live alone, living spouse/partner, parent/parent-in-law, son/daughter, sister/brother, mokopuna/grandchild, other relative	Live with others = 1, Live alone = 2
Socioeconomic measurement	Economic Living Standard Indicator Short Form (ELSI-SF)	Used as continuous variables

Economic Living Standard Indicator Short Form (ELSI-SF). SES was assessed using the NZ Economic Living Standard Indicator Short Form (ELSI-SF; Jensen et al., 2005), a multidimensional tool developed by the Ministry of Social Development. ELSI-SF evaluates individuals' material well-being based on self-assessment of income adequacy, spending behaviour, and material ownership. The short-form version included a 25-item scale that examines four domains: asset ownership, restrictions in social participation due to income, economising behaviour, and perception of one's own standard of living.

ELSI-SF has shown good internal consistency (Cronbach's $\alpha = .88$) as well as solid discriminant and convergent validity (Jensen et al., 2005). The 25 items are grouped into four subscales with different response ranges: (1) Asset Ownership (seven items, each rated on a 4-point nominal scale); (2) Social Participation Restriction (seven items, 4-point nominal scale); (3) Economising Behaviour (eight items, 3-point ordinal scale); and (4) Self-Assessment of Living Standards (three items, scale range between 4 to 5 points).

Analyses in this thesis explored three forms of the ELSI-SF variable:

- ELSI total score – interval variable with possible values between 0–31, with higher scores indicating better SES.
- ELSI-SF Long Category – nominal variable with seven total categories. Categories include severe hardship (score range 0 to 8), significant hardship (9 to 12), some hardship (13 to 16), fairly comfortable (17 to 20), comfortable (21 to 24), good (25 to 28), and very good (29 to 31).
- ELSI-SF Short Category – nominal variable with three groups: hardship, comfortable, and good. The cutoff points were hardship (0–16), comfortable (17–24), and good (25–31).

Health and Lifestyle Variables

Nakamura et al. (2022) found that physical activities, physical health conditions, and depression were associated with subsequent purpose four years later. Therefore, we include self-reported physical and mental health, depression, Quality of Life (QOL), chronic conditions, and physical activities as covariates to control.

Short-Form Health Survey Version Two (SF-12v2). The self-reported health status was measured using the 12-item SF-12v2. The questionnaire covers eight domains to measure physical, mental, emotional and social health and well-being-related QOL (Ware et al., 2005). Participants respond to items using either 3-point or 5-point ordinal Likert scales. All 12 items contributed to the calculation of two factor scores: PCS and MCS, and both are scored on a scale from 0 to 100, with a population mean of 50 and a standard deviation (SD) of 10. A higher score indicates better health or well-being in that specific domain. Scores above 50 indicate better-than-average health-related QOL, and scores below 50 suggest below-average health (Frieling et al., 2013). The SF-12v2 scores were normed to the NZ population (Frieling et al., 2013). Psychometric evaluation of the SF-12v2 has indicated satisfactory construct validity and discriminant, concurrent, and

convergent validity. Montazer et al. (2011) demonstrated that confirmatory factor analysis has consistently supported the two-factor structure of the physical health component (PCS) and the mental health component (MCS) across diverse populations. Additionally, SF-12v2 showed significant correlations with related health measures, such as functional status measures and QOL ($r = .50$ to $.70$) (Al Omari et al., 2019). The SF-12v2 has been used with diverse age groups and ethnicities with acceptable internal consistency and reliability (Cronbach's α range from $.60$ to $.87$; Al Omari et al., 2019; Lay-Yee et al., 2022; Neville et al., 2018).

CES-D Depression. Symptoms of depression were assessed using the Centre for Epidemiological Studies Depression Scale (CES-D10; Andresen et al., 1994), a measure designed for older adults in epidemiological studies. The CES-D10 comprises 10 questions assessing frequency of symptoms of depression in the past seven days on a 4-point scale of 0 (*Rarely or none of the time*) to 3 (*All of the time*), with two questions reverse scored, with higher scores indicating more frequent symptoms of depression (score range 0 to 30). An example: "I was bothered by things that usually don't bother me". A score of 10 or higher suggests significant depressive symptoms and is categorised as depressed. A score less than 10 is categorised as not depressed.

The CES-D10 has strong psychometric properties across diverse older adult samples. Mohebbi et al. (2018) conducted a large validation study of 19,114 community-based individuals from Australia and the CES-D10 showed good internal consistency (Cronbach's $\alpha = .70$, composite reliability = $.72$). Similarly, studies with Hispanic/Latino older adults have shown good internal consistency (Cronbach's $\alpha = .80 - .88$) and test-retest reliability (r values = $.41 - .70$) across different ethnicities, cultures, and language groups (González et al., 2017; Zhang et al., 2012).

CASP-12 Quality of Life (QOL). QOL was assessed using the CASP-12 index, an age-specific instrument designed for older adults aged 50 and over (Towers et al., 2015). The scale is grounded in the Needs Satisfaction Theory drawn from Maslow's hierarchy of human needs, and Doyal and Gough's theory of human needs (Fria-Goytia et al., 2024). CASP-12 emphasises that successful ageing depends on satisfying four psychological needs: control, autonomy, pleasure, and self-realisation (Hyde et al., 2015). In this study, participants responded to 12 items using a 4-point Likert-type scale (*often, sometimes,*

rarely, and *never*). Scores range from 12 to 48, with higher scores reflecting better QOL. Only the total score was used in the analysis.

The instrument has demonstrated robust psychometric properties across multiple international ageing studies, including the English Longitudinal Study of Ageing and the Survey of Health, Ageing and Retirement in Europe (Beridze et al., 2020). Moreover, a recent systematic review included 51 studies found that the three-factor model, by combining control and autonomy into a single dimension, along with pleasure and self-realisation, provided the best fit (α above .70) compared to the original four-factor structure (Pérez-Rojo et al., 2017). In terms of discriminant validity, studies demonstrated that CASP-12 scores differentiate healthy older adults from those with chronic conditions, depression, ADL limitations, and adverse psychosocial contexts (Frias-Goytia et al., 2024). Concurrent validity is supported by significant correlations with current health outcomes, functional status, and psychosocial factors, including social support ($r = .39$ to $.50$), financial resources, and social network features (Frias-Goytia et al., 2024). Convergent validity is established through correlations with related psychological measures, with CASP-12 showing significant associations with life satisfaction ($r = .52$), self-perceived health ($r = .43$), and depression ($r = -.61$; Rodríguez-Blázquez et al., 2020). CASP-12 has shown good internal consistency across diverse groups (Cronbach's $\alpha = .76 - .86$; Beridze et al., 2020; Pérez-Rojo et al., 2017; Towers et al., 2015).

Chronic Conditions. Participants were asked whether they had been diagnosed with certain health conditions. The survey question states, “Please indicate whether a health professional has ever told you that you have any of the following conditions,” followed by a list of thirteen conditions, such as diabetes, stroke, and cancer. Chronic conditions were counted and categorised as 0 = *absence of a diagnosis*, 1 = *presence of one diagnosis*, 2 = *diagnosed with two chronic conditions*, and 3 or more = *diagnosed with three or more chronic conditions*. Note, sleep disorder was excluded from the count as it was used separately for sleep status (as described above).

Physical Activity. Participants were asked about the frequencies with which they participated in vigorous (e.g., running or jogging, swimming, aerobics), moderately energetic (e.g., gardening, brisk walking), and mildly energetic (e.g., vacuuming, laundry/washing) activities. Response options are: 1 = *more than once a week*, 2 = *once a week*, 3 = *once to three times a month*, and 4 = *hardly ever or never*. Physical activity level

was dichotomised as follows: high = *moderate or vigorous intensity activity* $\geq$ *once per week*, low = *< once per week* (Lindsay et al., 2018).

Missing Values

Missing data analysis was conducted to assess the randomness of missing values in the dataset. The study key variables (i.e., PiL, overall loneliness, sleep duration, and sleep quality) had missing data percentages ranging from 0.4% to 2.6%. Little's Missing Completely at Random test was undertaken for the key variables. The results indicated that the missing data were not completely at random ($X^2 = 48.749$, $df = 21$, $p = .001$), suggesting a systematic rather than random pattern (Little, 1988). Multiple imputation was employed to handle the missing values, as this method appropriately accounts for the uncertainty associated with imputed values and produces unbiased parameter estimates when data is Missing at Random or Missing Not At Random (Tabachnick & Fidell, 2019). Multiple imputation with 20 imputations was conducted to generate complete datasets for subsequent statistical analyses. Analyses were undertaken using both imputed and unimputed data, and there were no substantive differences in the direction or magnitude of the findings between the two datasets. Given that all variables had less than 5% missing data and the consistency between imputed and unimputed results, the findings are reported using the unimputed dataset, in accordance with Tabachnick and Fidell's (2019) recommendations.

Data Analysis

All statistical analyses were conducted using IBM Statistical Package for the Social Sciences software (SPSS Version 29.0) and the PROCESS macro (Version 5.0) for SPSS (Hayes, 2022; IBM Corp, 2015). A two-tailed significance level of $\alpha = .05$ was applied for all statistical tests.

Descriptive Statistics

Summary statistics were calculated to characterise the study sample and examine data distributions. For continuous variables, descriptive analyses included measures of central tendency (mean and median), dispersion (SD and range), and distribution characteristics (skewness and kurtosis) to assess normality assumptions. For categorical variables, frequencies and percentages were computed. To evaluate the psychometric quality of the

instruments, internal consistency reliability for each multi-item scale was assessed using Cronbach's alpha coefficient (Tavakol & Dennick, 2011).

Bivariate Analyses

Following the descriptive analysis, bivariate analyses were conducted to examine relationships between variables before proceeding to multivariate models.

Continuous Variables. Pearson correlation coefficients (r) were computed to examine bivariate associations among continuous variables, specifically focusing on the relationships between PiL, loneliness, and other continuous covariates. Correlation strength was interpreted using Cohen's (1988) guidelines: small ($r = .10$ to $.29$), medium ($r = .30$ to $.49$), and large ($r \geq .50$).

Categorical Variables. Independent samples t-tests and one-way analysis of variance (ANOVA) were conducted to examine differences in loneliness scores across categorical demographic and health variables when data met normality assumptions. For non-normally distributed data, the Mann-Whitney U test (for two groups) and the Kruskal-Wallis test (for three or more groups) was employed as non-parametric alternatives. Effect sizes were calculated using Cohen's d for t-tests (small = $.20$, medium = $.50$, large = $.80$) and eta-squared (η^2) for ANOVA.

Multivariable Analysis – Hierarchical Multiple Regression

Hierarchical multiple regression was conducted to examine the independent predictors of loneliness (dependent variable), while controlling for established confounders, including sociodemographic characteristics, health and lifestyle factors, and PiL (independent variables). While sleep has been associated with loneliness, its role as a confounder is less well established theoretically. Sleep was intentionally reserved for the mediation analysis, where its role in the PiL-loneliness relationship could be examined in greater theoretical depth. Therefore, sleep duration and quality were not included as covariates in the hierarchical regression model. The confounders were entered in five sequential blocks. This analytical approach enables the assessment of how much additional variance each set of predictors explains beyond those entered in the previous steps. Therefore, it reveals the unique contribution of each predictor block while controlling for potential confounders.

Covariate Selection Strategy. Variable selection was guided by both theoretical considerations and empirical evidence from prior research examining loneliness in older adults (Gibson et al., 2023; Hawkey et al., 2022; Kim et al., 2022; Lay-Yee et al., 2022; McLay et al., 2021; Neville et al., 2018; Yuan et al., 2020). Essential confounders were identified a priori based on the consistent findings in the literature. Additional covariates were tested for inclusion using F-change statistics with a liberal criterion ($p < .10$) to minimise Type II error while building preliminary models. This tiered approach ensured that theoretically important variables were retained across all models, while allowing for increasingly comprehensive analyses as the sample size permitted, thereby balancing statistical rigour with practical constraints.

Model Specification. Variables were entered in five sequential blocks:

- Block 1: Purpose in life (LET) was entered first as the key predictor of interest
- Block 2: Demographic characteristics (age, gender, ethnicity, marital status, living arrangement) were introduced as fundamental covariates known to influence loneliness
- Block 3: Socioeconomic measurement (ELSI-SF scores) was added next to account for material resources and financial security
- Block 4: Health status indicators (SF-12v2 PCS and MCS) were subsequently included to control for health-related influences
- Block 5: Health behaviours and conditions (physical activity level, number of chronic diseases) were entered to capture lifestyle and disease burden effects.

Model Evaluation. For each regression model, both unstandardised (B) and standardised (β) regression coefficients were reported to facilitate interpretation of effect magnitudes and comparisons across predictors. Model fit was assessed using the coefficient of determination (R^2), which indicates the proportion of variance in loneliness scores explained by the independent variables. The R^2 statistic ranges from 0 to 1, with values closer to 1 indicating greater explanatory power. Change in R^2 (ΔR^2) was evaluated at each step using F-change statistics to determine whether each successive block of variables significantly improved model fit. To ensure the validity of regression estimates, assumptions of multiple regression were examined. This included linearity, independence

of errors, homoscedasticity, normality of residuals, and absence of multicollinearity, which were assessed using appropriate diagnostics, such as residual plots, Durbin-Watson statistics, and variance inflation factors (VIF <10).

Mediation Analysis

Mediation analysis was conducted using Model 5 of the PROCESS macro (Version 5.0) for SPSS (Hayes, 2022) to test whether sleep satisfaction or duration (as continuous variables) mediate the relationship between PiL (independent variable) and loneliness (dependent variable). The analysis decomposed the total effect of PiL on loneliness into direct and indirect effects. The indirect effect (mediated pathway through the sleep satisfaction and duration variables) was estimated using bias-corrected bootstrap confidence intervals based on 5,000 bootstrap samples (Igartua & Hayes, 2021). Mediation was considered statistically significant if the 95% bias-corrected confidence interval for the indirect effect did not include zero. The proportion of the total effect mediated was calculated as the ratio of the indirect effect to the total effect.

Results

A total of 5,514 older NZ adults participated in the 2022 data collection wave of the NZHWR cohort study. Two participants under 55 were excluded, as the study focuses on adults aged 55 and above. For key variables (e.g., loneliness, PiL, sleep measurements), missing data ranged from 0.4% to 2.6%, which represented less than 5% of responses for all variables. Therefore, participants with missing data were retained in the analysis to maximise statistical power and reduce potential selection bias (Field, 2018).

Descriptive Statistics

Descriptive statistics for categorical variables are presented in Table 2, and for continuous variables in Table 3. The final sample comprised 5,512 participants, with a mean age of 66.2 years (SD = 7.20; range: 55–93 years), and 85.2% were under 75 years old. The sample included more females than males. Four participants who identified as gender-diverse were excluded from further analysis, as this was determined to be an insufficient number for meaningful analysis. Most participants identified as NZ European or Pākehā (N = 4,234, 76.8%), while 35.6% identified as Māori, 2.7% as Pasifika (N = 149), 1.8% as Asian (N = 100), and 6.9% as Other (N = 381). Most participants were

married or in a partnered relationship and lived with others. Participants also reported relatively high SES, with 88.6% rating their living standards as fairly comfortable to very good and 11.4% reporting some level of hardship. In addition, close to one quarter of the sample reported depressive symptoms. Over three-quarters of participants engage in moderate to vigorous intensity physical activity at least once a week. However, the sample revealed notable health challenges, with only 13.0% of participants having no diagnosed chronic conditions, 43.4% with one to two diagnosed chronic diseases, and 43.4% with three or more chronic conditions.

Table 2

Categorical Variables Descriptive Data (N = 5,512)

Variable	n	%	Variables	n	%
Age			Loneliness (binary)		
55-64	2,708	49.1%	Lonely	2,247	41.1%
65-74	1,992	36.1%	Not lonely	3,214	58.9%
75+	812	14.7%	Purpose (binary)		
Gender			Low	1,513	27.4%
Female	3,119 ^a	56.6%	High	3,999	72.6%
Male	2,386	43.3%	Sleep satisfaction		
Gender-diverse	4	0.1%	Not dissatisfied	4,039	73.8%
Ethnicity			Dissatisfied	1,437	26.2%
Māori	1,962	35.6%	Sleep duration		
Non-Māori	3,550	64.4%	<6h	379	7.1%
Marital status			6-9h	4,139	77.1%
Married/partnered	3,932	71.3%	>9h	853	15.9%
Single/divorced/widowed	1,487	27.0%	Daytime sleepiness		
Living arrangement			Not (within last month)	4,780	88.1%
Alone	1,069	19.4%	Yes (within last month)	732	11.9%
With others	4,443	80.6%	Sleep disorder		
ELSI-SF			No	4,600	83.5%
1 very good	1,337	24.3%	Yes	912	16.5%
2 good	1,849	33.5%	Physical activity		
3 comfortable	984	17.9%	≥once per week moderate or vigorous intensity	4,245	77.0%
4 fairly comfortable	558	10.1%	< once per week	1,267	23.0%
5 some hardship	285	5.2%	Diagnosed chronic disease		
6 significant hardship	171	3.1%	0	716	13.0%
7 severe hardship	172	3.1%	1	1,184	21.5%
Depression			2	1,205	21.9%
Yes	1,278	23.4%	3 and more	2,393	43.4%
No	4,185	76.6%			

Note. ^aSample sizes may vary due to missing data.

Building on these demographic and health characteristics, participants reported relatively low levels of loneliness across all dimensions. The mean overall loneliness score was 1.57 (SD = 1.68), with social loneliness averaging 0.97 (SD = 1.17) and emotional loneliness 0.60 (SD = 0.87). Despite these low mean scores, 41.4% of participants scored above the established cutoff for loneliness, indicating considerable variability within the sample. Figure 1 provides a graphical representation of the total loneliness scale for this population. The majority of participants (72.6%) scored in the high range for PiL. Sleep-related outcomes were evident in a notable proportion of the sample. Approximately one quarter (26.2%) reported dissatisfaction with their sleep quality, while 23.0% reported abnormal sleep duration (outside the recommended 6–9 hours range per 24-hour period). Additionally, 13.3% experienced daytime sleepiness in the past month, and 16.5% had received a clinical diagnosis of a sleep disorder.

Internal consistency was assessed using Cronbach's alpha (see Table 3). PiL and social loneliness measures demonstrated excellent reliability, while overall loneliness showed acceptable reliability due to lower internal consistency in the emotional loneliness subscale. Most variables exhibited moderate departures from normality, with sleep duration displaying the most extreme positive kurtosis, indicating potential outliers. Both sleep duration and social loneliness were positively skewed. The ELSI socioeconomic measurement and SF-12 PCS and MCS were negatively skewed. Considering these distributional characteristics, Pearson correlations, independent t-tests, and one-way ANOVAs were conducted to explore bivariate relationships and group differences.

The prevalence of daytime sleepiness (13.3%) and sleep disorder (16.5%) was relatively low compared to the proportions reporting dissatisfied sleep quality (26.2%) and abnormal sleep duration (23.0%). As a result, daytime sleepiness and sleep disorders were excluded from the regression analysis. This decision was further justified by the limited diagnostic and intervention resources for sleep disorders and daytime dysfunction in NZ (Gibson et al., 2023), making a comprehensive examination of these variables beyond the scope of this thesis. Moreover, sleep duration was initially examined as a continuous variable in the descriptive analysis. However, the results revealed high skewness (1.42) and kurtosis (8.09), suggesting the presence of extreme values and a non-normal distribution. Additionally, evidence from the literature indicated that the relationship between sleep duration and health outcomes follows a non-linear, U-shaped pattern. For

older adults, sleep duration of 6–9 hours are associated with lower loneliness and better physical function and well-being, while less than 6 hours or more than 9 hours are linked to higher levels of loneliness and poorer health outcomes (Caputo, 2025). Therefore, given these distributional concerns and the established non-linear relationship in the literature, sleep duration was categorised into three groups for subsequent analysis: short sleepers (<6 hours), optimal sleepers (6–9 hours), and long sleepers (>9 hours).

Figure 1

Distribution of Total Loneliness Score

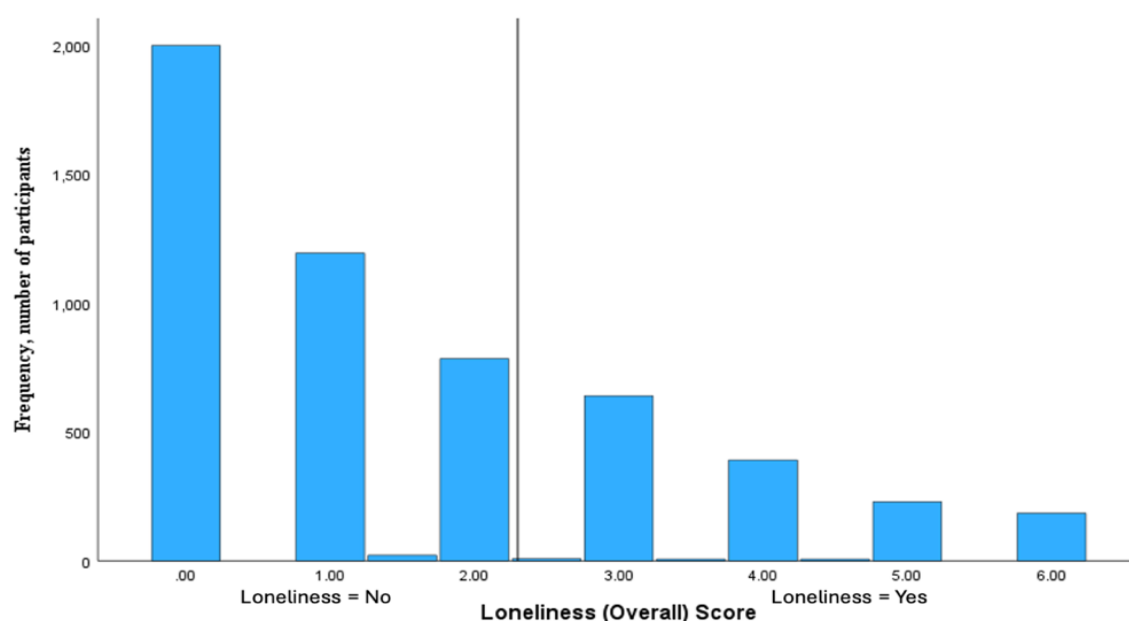


Table 3

Continuous Variable Descriptive Statistics

Measure	Range	Median	Cronbach's alpha	Skew	Kurtosis
Age	55-93 ^a	65		0.80	0.02
ELSI SES	0-31	26.00	0.82	-1.42	2.03
Loneliness (emotion)	0-3	0.00	0.61	0.72	-1.07
Loneliness (social)	0-3	0.00	0.82	1.39	1.01
Loneliness (overall)	0-6	1.00	0.75	0.96	0.00
PiL	1-5	4.33	0.83	-0.81	0.43
Sleep duration	1-21	7.00		1.42	8.09
Depression	0-30	5.00	0.85	1.09	1.16
SF-12 physical	0-100	48.74	0.60	-0.91	0.18
SF-12 mental	0-100	52.43	0.87	-1.13	1.18
CASP12 QOL	3-36	30.00	0.87	-1.01	0.74

Note. ^a Rounded to the nearest year

Table 4*Pearson's r Correlations of Main Study Variables with Total Loneliness*

Variables	Total Loneliness
Age	-0.080***
ELSI SES	-0.393***
PiL	-0.514***
SF-12 Physical Health	-0.174***
SF-12 Mental Health	-0.458***
Depression	0.549***
CASP QOL	-0.560***

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Bivariate Analysis

Loneliness Outcomes

Table 4 presents the Pearson's r bivariate correlation coefficients for the main continuous study variables with the dependent variable total loneliness. Correlation analysis revealed a strong negative relationship between loneliness and PiL, indicating that higher PiL is associated with lower loneliness. Additional significant relationships included a medium negative correlation between loneliness and both mental health and SES. Loneliness and depression were strongly positively correlated, while loneliness and QOL demonstrated a strong negative correlation.

The independent-samples t -test was used to examine the relationship between loneliness and key categorical variables with two groups (see Table 5). Results indicated a significant association between loneliness and sleep satisfaction. Participants who were dissatisfied with their sleep quality had significantly higher loneliness scores than those who were not dissatisfied with their sleep. The mean difference was 0.68 points and the effect size was medium. These findings suggested that poor sleep quality is associated with increased loneliness. In addition, participants without daytime sleepiness or sleep disorders reported significantly lower loneliness compared to those who experienced daytime sleepiness in the last month or were diagnosed with sleep disorders. Therefore, experiencing daytime sleepiness and being diagnosed with a sleep disorder were associated with increased loneliness.

Table 5*Independent-samples t-test Summary: Loneliness by Group Variables*

Variable	Group	M (SD)	t	df	Cohen's d	Effect Size
Gender	Male	1.61 (1.63)	1.222	5,453	0.033	Trivial
	Female	1.55 (1.73)				
Ethnicity	Māori	1.64 (1.67)	2.297*	5,459	0.065	Small
	Non-Māori	1.53 (1.69)				
Marital Status	Partnered	1.41 (1.60)	-11.194***	5,381	0.341	Small-Medium
	Not partnered	1.98 (1.83)				
Living Arrangement	Living alone	2.02 (1.87)	9.598***	5,459	0.329	Small-Medium
	Living with others	1.47 (1.62)				
Sleep Satisfaction	Dissatisfied	2.07 (1.86)	13.335***	5,435	0.411	Small-Medium
	Not dissatisfied	1.39 (1.58)				
Daytime Sleepiness	No sleepiness	1.49 (1.65)	-9.405***	5,459	0.379	Small-Medium
	Has sleepiness	2.12 (1.80)				
Sleep Disorder	No disorder	1.46 (1.62)	-10.990***	5,459	0.403	Small-Medium
	With disorder	2.14 (1.86)				
Physical Activity	High activity	1.42 (1.60)	-12.722***	5,459	0.410	Small-Medium
	Low activity	2.10 (1.85)				

Note. M = mean, SD = standard deviation. *p < .05. **p < .01. *** p < .001.

There was no significant difference in loneliness observed between males and females, although males reported slightly higher scores. A statistically significant difference in loneliness was found between Māori and non-Māori participants, with Māori reporting higher loneliness scores. However, the effect size was small, indicating a modest practical difference. A highly significant difference in loneliness was observed between partnered and non-partnered individuals, with non-partnered participants reporting substantially higher loneliness. Additionally, participants living alone reported significantly higher loneliness compared to those living with others. Participants who

engaged in higher levels of physical activity reported significantly lower levels of loneliness than those who engaged in less physical activity.

A one-way ANOVA test was used to examine the relationship between loneliness and key categorical variables with three or more categories (see Table 6). The results showed that loneliness was significantly related to age, with the highest levels observed in the youngest senior group (55–64 years). The two older groups (65–74 and 75+ years) did not differ significantly, suggesting that individuals aged 65 and older reported lower loneliness levels than those aged 55–64, with similar levels across the older age groups. Additionally, loneliness progressively higher among participants with more chronic disease diagnoses, with a significant increase observed among those with three or more diagnoses. Moreover, the results revealed a statistically significant difference in loneliness scores across the three sleep duration groups. Participants who slept less than 6 hours had the highest loneliness scores, while those who slept 6–9 hours had the lowest. Those sleeping more than 9 hours had a slightly elevated loneliness score compared to the 6–9 hours group. However, the effect sizes were small for all three variables according to Cohen's (1988) conventions. Sleep duration accounted for 1.1% of the variance in loneliness scores, while age and chronic disease diagnosis explained 0.1% and 1.5%, respectively.

Table 6

One-Way ANOVA Summary: Loneliness by Multiple Independent Variables

Variable	Groups	M (SD)	F	df	η^2	Effect size
Age Range	55-64	1.68 (1.72)	12.337***	2, 5458	.005	small
	65-74	1.50 (1.67)				
	75+	1.40 (1.53)				
Sleep Duration	<6 hours	2.20 (1.91)	29.269***	2, 5328	.011	small
	6-9 hours	1.51 (1.65)				
	>9 hours	1.56 (1.68)				
Health Condition	0	1.31 (1.56)	27.144***	3, 5452	.015	small
	1	1.37 (1.55)				
	2	1.48 (1.65)				
	3+	1.80 (1.77)				

Note. M = mean, SD = standard deviation, η^2 = eta-squared. * $p < .05$. ** $p < .01$. *** $p < .001$.

PiL and Sleep Outcomes

The independent t-test (Table 7) revealed a significant difference in PiL score between sleep satisfaction groups. Participants who were dissatisfied with their sleep quality had significantly lower PiL scores than those who were not dissatisfied with their sleep, representing a small-to-medium effect size. A one-way ANOVA (Table 8) indicated significant differences in PiL scores across sleep duration groups. Participants who slept 6–9 hours per 24-hour period reported the highest PiL scores, followed by those who slept more than 9 hours, while those who slept less than 6 hours had the lowest scores. However, the effect size is very small according to Cohen's (1988) conventions, with sleep duration accounting for only 1.8% of the variance in PiL scores. Overall, both sleep quality and sleep quantity were significantly associated with PiL among older adults, with sleep satisfaction showing a stronger effect than sleep duration. Higher PiL was associated with adequate sleep satisfaction and optimal sleep duration (6–9 hours).

Table 7

Independent-samples t-test Summary: PiL and Sleep Satisfaction

Variable	Group	M (SD)	t	df	Cohen's d	Effect Size
Sleep Satisfaction	Dissatisfied	4.04 (0.69)	14.144** *	5,460	0.435	Small-Medium
	Not dissatisfied	4.32 (0.61)				

Note. M = mean, SD = standard deviation. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 8

One-Way ANOVA: PiL and Sleep Duration

Variable	Groups	M (SD)	F	df	η^2	Effect size
Sleep Duration	<6 hours	3.95 (0.73)	49.69***	2, 5355	.018	small
	6-9 hours	4.29 (0.63)				
	>9 hours	4.20 (0.66)				

Note. M = mean, SD = standard deviation, η^2 = eta-squared. * $p < .05$. ** $p < .01$. *** $p < .001$.

Multivariate Analysis – Hierarchical Multiple Regression

Depression and QOL were excluded from the regression analysis despite strong correlations with loneliness ($r = .55$ and $r = .56$, respectively) and PiL ($r = -.63$ and $r = -.67$, respectively). First, including these variables would introduce problematic multicollinearity, making it difficult to distinguish the unique contributions of each predictor and potentially resulting in unstable regression coefficients (Field, 2018). Second, there was substantial conceptual and measurement overlap among SF-12 physical and mental health, depression, QOL, and loneliness, as the measurement scales shared similar features (Cacioppo et al., 2010). Third, the directionality of relationships between depression, QOL, and loneliness is unclear and likely bidirectional, complicating the establishment of these variables as predictors versus outcomes (Cacioppo et al., 2010; Pinquart & Sörensen, 2001).

A five-step hierarchical multiple regression analysis was conducted to identify predictors of loneliness ($N = 4,754$). The final model accounted for 34.1% of the variance in loneliness (see Table 9). Model 1, which included only PiL, explained 25.9% of the variance. The addition of demographic variables (age, gender, ethnicity, marital status, and living arrangement) in Model 2 significantly increased the explained variance to 27.2%. Model 3 incorporated the socioeconomic measurement (ELSI score), further improving the model to explain 31.3% of the variance. Model 4 added physical and mental health components, accounting for an additional 2.8% of the explained variance. Model 5 included physical activity and chronic disease diagnosis, but this did not significantly enhance the model.

In summary, the final model identified PiL, mental health, SES, age, living arrangement, ethnicity, and gender as significant predictors of loneliness (see Table 10). Marital status, physical health, physical activity, and number of chronic conditions were not significantly related to loneliness score in the final model. Although marital status was significant in Model 2 ($B = .132$, $\beta = .036$, $p = .043$, 95% CI [.004, .259]), its effect was not observed in Model 5. PiL was the strongest predictor of loneliness. Individuals with a lower sense of purpose reported significantly higher levels of loneliness, and this association remained robust after adjusting for all other variables. Specifically, each one-unit decrease in PiL score corresponded to a 0.85-point increase in loneliness. Additionally, poor mental health was the second strongest predictor, with lower SF-12

MCS scores strongly associated with increased loneliness. Lower SES, as indicated by lower ELSI scores and greater economic hardship, was also substantially related to loneliness. Furthermore, younger age, male gender, non-Māori ethnicity, and living alone were associated with increased loneliness.

Table 9

Hierarchical Regression Model Summary and Overall Fit Statistics

Model	R	R ²	R ² Change	F Change	df1	df2
1	.508	.259	.259	1656.771***	1	4752
2	.521	.272	.013	17.134***	5	4747
3	.559	.313	.041	282.563***	1	4746
4	.584	.341	.028	99.427***	2	4744
5	.584	.341	.000	.077	2	4742

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 10

Hierarchical Regression Final Model (Model 5) Summary Predictors of Total Loneliness Score

Predictors	B	SE B	β	t	95% CI for B
(constant)	9.230	.368	---	25.098***	[8.509, 9.951]
PiL	-.854	.038	-.326	-22.516***	[-.928, -.780]
Age (55-93)	-.013	.003	-.053	-4.184***	[-.018, -.007]
Gender (ref. Male)	-.122	.040	.037	3.033**	[.043, .201]
Ethnicity (ref. Māori)	.133	.043	-.038	-3.134**	[-.217, -.050]
Marital Status (ref. Married/Partnered)	.026	.062	.007	.410	[-.097, .148]
Living Arrangement (ref. With Others)	.209	.072	.049	2.924**	[.350, .069]
ELSI	-.048	.004	-.175	-12.274***	[-.056, -.040]
SF-12 Physical Component	.000	.002	-.002	-.108	[-.005, .004]
SF-12 Mental Component	-.034	.002	-.209	-13.957***	[-.038, -.029]
Physical Activity	-.021	.054	-.005	-.385	[-.126, .085]
Chronic Disease Diagnosis	-.002	.020	-.001	-.076	[-.041, .038]

Note. B = unstandardised coefficient, SE B = standard error, β = standardised coefficient.

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

Mediator Effect – Sleep Satisfaction and Duration, Purpose and Loneliness

Two separate mediation analyses were conducted using PROCESS Model 5.0 (Hayes, 2022) with 5,000 bootstrap samples to examine whether sleep satisfaction and sleep duration mediate the relationship between PiL and loneliness.

Sleep Satisfaction as Mediator (N = 5,423)

The second mediation analysis examined sleep satisfaction as a potential mediator using the same analytical approach (see Table 11 and Figure 2). This analysis examined whether individuals with a higher PiL experienced greater satisfaction with their sleep, which in turn contributes to lower feelings of loneliness. *Path a* showed that PiL was a significant and substantial positive predictor of sleep satisfaction. The coefficient indicated that for each one-unit increase in PiL, sleep satisfaction increased by 0.434 points (on the 1-5 scale). In other words, individuals who reported a stronger sense of PiL also reported significantly greater satisfaction with their sleep quality. PiL explained 6.4% of the variance in sleep satisfaction, representing a small to medium effect size. *Path b* results revealed that sleep satisfaction was a significant negative predictor of loneliness. The negative coefficient indicated that higher sleep satisfaction was associated with lower loneliness scores, even after accounting for the direct effect of PiL.

The direct effect (*Path c'*) of PiL on loneliness remained highly significant and substantial. The large negative coefficient demonstrated that PiL strongly predicts lower loneliness even when controlling for sleep satisfaction. Each one-unit increase in PiL was associated with a 1.266-point decrease in loneliness, representing a robust and meaningful relationship that persisted independent of sleep satisfaction. The indirect effect of PiL on loneliness mediated by sleep satisfaction was statistically significant. Because the 95% bootstrap confidence interval did not include zero, this confirmed that sleep satisfaction significantly mediates the relationship between PiL and loneliness. The negative indirect effect suggested that higher PiL is associated with better sleep satisfaction, which in turn is associated with lower loneliness. This indirect effect accounted for approximately 5.1% of the total effect of PiL on loneliness. The pattern of results demonstrated partial mediation rather than complete mediation, as both the indirect pathway (through sleep satisfaction) and the direct pathway (from PiL to loneliness) were significant.

Sleep Duration as Mediator (N = 5,318)

The first mediation analysis investigated sleep duration as a potential mediator of the PiL and loneliness relationship (see Table 12 and Figure 3). This analysis examined whether individuals with higher PiL achieve optimal sleep duration and whether sleep duration in turn influences loneliness. *Path a* showed that PiL was a statistically significant but very weak predictor of sleep duration. The small positive coefficient indicated that individuals with higher PiL reported slightly longer sleep duration. However, PiL explained only 0.2% of the variance in sleep duration, representing a negligible effect size. *Path b* examined whether sleep duration predicted loneliness while controlling for PiL. Sleep duration showed a significant negative relationship with loneliness. The negative coefficient indicated that longer sleep duration was associated with lower loneliness scores, even after accounting for the direct effect of PiL. While this relationship was statistically significant, the effect size was relatively small.

The direct effect (Path c') of PiL on loneliness remained very strong and highly significant. The large negative coefficient indicated that PiL is a powerful predictor of loneliness even when controlling for sleep duration. Each one-unit increase in PiL was associated with a 1.327-point decrease in loneliness, representing a robust and substantial relationship. The magnitude of this direct effect was nearly identical to the total effect, indicating that sleep duration had virtually no impact on the strength of the purpose-loneliness relationship. The indirect effect of PiL on loneliness through sleep duration was statistically significant, as the 95% bootstrap confidence interval did not include zero. The negative indirect effect suggested that a higher PiL is associated with slightly longer sleep duration, which in turn is associated with slightly lower loneliness. However, this indirect effect accounted for less than 0.3% of the total effect of PiL on loneliness, making it practically negligible.

Table 11

Summary of Mediation Analysis: Sleep Satisfaction Mediating the Effect of PiL on Loneliness

Predictor	Path	Sleep Satisfaction			Loneliness (Overall)		
		<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
PiL	<i>a / c'</i>	0.434	0.023	<.001	-1.266	0.031	<.001
Sleep Satisfaction	<i>b</i>	-	-	-	-0.156	0.018	<.001
Constant		1.451	0.097	<.001	7.463	0.133	<.001
Model Summary							
<i>R</i> ²		.064			.272		
<i>F</i> (df)		372.35 (1, 5421)			1010.06 (2, 5420)		
				<.001			<.001

Note. *b* = unstandardised regression coefficient, *SE b* = standard error.

Table 12

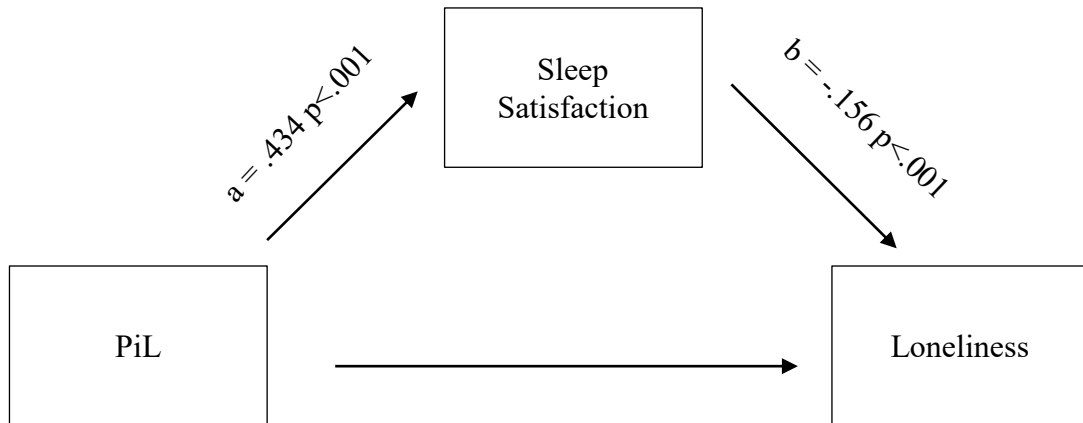
Summary of Mediation Analysis: Sleep Duration Mediating the Effect of PiL on Loneliness

Predictor	Path	Sleep Duration			Loneliness (Overall)		
		<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
PiL	<i>a / c'</i>	0.029	0.010	.004	-1.327	0.031	<.001
Sleep Duration	<i>b</i>	-	-	-	-0.130	0.042	.002
Constant	<i>i_t</i>	1.964	0.043	<.001	7.481	0.156	<.001
Model summary							
<i>R</i> ²		.002			.262		
<i>F</i> (df)		8.44 (1, 5316)			945.48(2, 5315)		
				.004			< .001

Note. *b* = unstandardised regression coefficient, *SE b* = standard error.

Figure 2

Mediation Model for Sleep Satisfaction Mediating the Effect of PiL on Loneliness

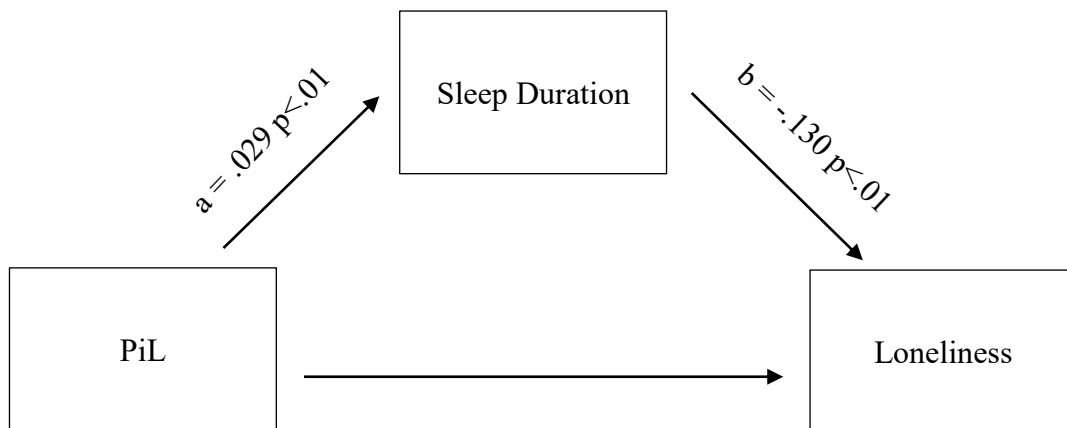


Direct Effect (c'): $b = -1.266, p < .001, 95\% \text{ CI } [-1.327, -1.205]$

Indirect Effect (axb): $b = -.068 p < .001, 95\% \text{ CI } [-.085, -.050]$

Figure 3

Mediation Model for Sleep Duration Mediating the Effect of PiL on Loneliness



Direct Effect (c'): $b = -1.327, p < .001, 95\% \text{ CI } [-1.388, -1.267]$

Indirect Effect (axb): $b = -.004 p < .01, 95\% \text{ CI } [-.008, -.001]$

Discussion

The primary aim of this thesis was to investigate the relationship between PiL, sleep quality and duration, and loneliness among older NZ adults. A further aim was to explore the mediating effect of sleep duration and quality on the relationship between PiL and loneliness. This discussion chapter first provides a summary of results and then reviews and interprets the major findings, strengths, limitations, and recommendations for future research, and how the current study contributes to the literature on health and well-being among older adults.

Overview of Main Findings

The first objective of this thesis was to investigate the distribution and patterns of loneliness, PiL, and sleep status in older NZ adults. Data were drawn from the 2022 wave of the NZHWR study. Results indicated that 41.4% of participants scored above the established cutoff for loneliness, consistent with Cacioppo et al.'s (2015) findings that over 40% of older adults experience loneliness. This finding also aligns with the NZ General Social Survey, which reported that 42% of New Zealanders experience loneliness in their daily lives (Stats NZ, 2021). Regarding PiL, 72.6% of participants scored in the high range, consistent with previous research showing that participants assessed with the LET typically report high levels of PiL. The high PiL levels observed in this study population may be explained by several protective factors that were observed in the previous research: a higher percentage of participants were married or partnered (71.3%), a lower percentage lived alone (19.4%), and participants demonstrated higher SES, with only 11.4% identified as experiencing economic hardship (Chen et al., 2020; Irving et al., 2017; Pinquart, 2002; Wood et al., 2016). For sleep quality, 26.2% of participants reported dissatisfaction with their sleep quality. Consistent with the NZ Health Survey data, which indicates that approximately 27.8% of adults aged 65 or older report poor sleep quality (Jones, 2022). Regarding sleep duration, 23.0% reported abnormal sleep duration in this thesis. While previous research indicated that approximately over 10% of NZ adults have short or long sleep duration (Gibson et al., 2023), this difference may be attributed to differing definitions of normal sleep duration. Gibson et al. (2023) defined normal sleep duration for older adults as 5–9 hours, whereas this thesis used a narrower range of 6–9 hours.

The results revealed significant associations between loneliness, sleep satisfaction, and sleep duration. Participants who were dissatisfied with their sleep quality exhibited significantly higher loneliness scores than those who were not. Moreover, individuals who slept less than 6 hours had the highest loneliness scores, while those with optimal sleep duration (6–9 hours) had the lowest. The findings supported the primary hypothesis that poor sleep outcomes (characterised by poor sleep quality and inadequate sleep duration) were associated with higher levels of loneliness. The result is consistent with Jia and Yuan (2020), who found that Chinese older adults with poor sleep quality and shorter sleep duration reported higher loneliness scores. However, Hawkley et al.'s (2010) study only found that sleep duration was not associated with loneliness, but sleep quality was. Correlational analyses also demonstrated a strong negative relationship between PiL and loneliness, and regression analyses indicated that PiL was independently associated with loneliness. The results confirmed the second hypothesis that higher levels of PiL are associated with lower levels of loneliness and are consistent with Sutin et al.'s (2022) meta-analysis, which found that having a sense of purpose was significantly associated with lower loneliness and psychological distress in cross-sectional and longitudinal data (Pynnönen et al., 2024). The findings also align with the US population longitudinal study (Kim et al., 2022), which found that higher PiL is associated with better psychosocial well-being and lower loneliness, and with Neville et al.'s (2018) study among NZ men over 60 years old, which identified low PiL as a key indicator of loneliness.

Meditation analysis revealed that a higher PiL was associated with slightly longer sleep duration, which in turn was associated with slightly lower loneliness scores. Sleep duration significantly mediated the relationship between PiL and loneliness, but the indirect effect of PiL on loneliness through sleep duration was too small to be practically meaningful. Additionally, sleep satisfaction mediated the relationship between PiL and loneliness, such that individuals with higher PiL reported greater sleep satisfaction, which in turn contributed to lower feelings of loneliness. However, the direct effect of PiL on loneliness remained highly significant. Therefore, as both the indirect pathway (via sleep satisfaction) and the direct pathway (from PiL to loneliness) were significant, the pattern of results indicated partial rather than complete mediation. Mediation analysis results also supported the third hypothesis that sleep outcomes (duration and quality) mediate the relationship between PiL and loneliness. No existing research has examined this precise mediating relationship between PiL and loneliness through sleep quality or sleep duration. The findings align with self-

determination theory in the context of healthy ageing (Ng & Ho, 2020). Ryan and Deci (2017) indicated that when individuals' psychological needs (i.e., PiL) are supported and satisfied, they are more likely to engage in healthy lifestyles (e.g., maintain a healthy sleep routine, engage in physical activity), which in turn improve both physical and psychological well-being (i.e., reduce loneliness). The novelty of this study lies in its exploration of the mediating relationship. These findings contribute to the growing body of literature examining the interconnections between psychosocial well-being (e.g., purpose and loneliness) and sleep health in later life.

Sociodemographic and Health Factors Associated with Loneliness

Sociodemographic factors demonstrated complex and nuanced relationships with loneliness. In bivariate analyses, marital status, physical activity, and the number of chronic conditions were significantly associated with loneliness. Married or partnered individuals, those engaging more frequently in physical activities, and those with fewer chronic diseases reported significantly lower loneliness levels. However, these relationships became non-significant in the multivariate hierarchical regression models when other sociodemographic and health-related factors were controlled. This pattern suggests that the protective effects of partnership, physical activity, and fewer diagnosed diseases may operate indirectly through other mechanisms, such as living arrangements, SES, and mental health status, rather than exerting direct, independent effects on loneliness. The present study supports Hawkley et al.'s (2022) findings that loneliness was higher among individuals who lived alone, had lower SES, and had poorer health. Additionally, the current study found that Māori older adults had higher levels of loneliness than non-Māori, which is inconsistent with Neville et al. (2018), who found no significant differences in loneliness levels between Māori and non-Māori older males. This discrepancy warrants further investigation and may reflect differences in sample composition.

Interestingly, while gender was not significantly related to loneliness in bivariate analysis, it emerged as a significant predictor in the regression model after controlling for other sociodemographic and health factors. This finding differs from Mittelman et al. (2023) and Hawkley et al. (2022), who found that gender was not significantly associated with loneliness after such adjustments. This pattern suggests a suppression effect, where confounding variables initially obscured the relationship between gender and loneliness. This aligns with Kim and Lee's (2022) findings among older Korean adults, who demonstrated that

men were more likely to be lonely than women after controlling for demographic, health-related, and social variables. Importantly, Kim and Lee (2022) found that the protective factors against loneliness differed by gender. Marital status and family networks were correlated with loneliness in males but not in females, while social participation and friendship networks were protective for both genders. This suggests that when factors such as living arrangement, SES, and mental health are statistically controlled in the present study, gender-specific vulnerabilities to loneliness become apparent among older NZ adults. For instance, men may rely more heavily on specific protective factors (such as marriage) compared to women due to their smaller social networks, fewer intimate friends, or less emotional support. When these factors are held constant in regression analyses, an underlying vulnerability to loneliness emerges that is masked in simple bivariate comparisons (Barnes et al., 2022; Sulandari et al., 2024).

These gender differences highlight the need for a deeper understanding of how loneliness operates differently for men and women in later life. Given that men appear to rely more heavily on specific protective factors such as marriage and family networks, while women may benefit from broader friendship and community ties. Future research could add relationship quality, social determinants, social integration, and loneliness across genders among older New Zealand adults. Additionally, studies could examine how life transitions such as widowhood, retirement, or health decline differentially affect men's and women's risk of loneliness, and what social or psychological resources might buffer against these vulnerabilities. Understanding these gender-specific pathways could provide important insights into how social determinants of health intersect with gender to shape loneliness risk among older New Zealand adults.

PiL and Loneliness

The strongest finding from this study was the robust negative relationship between PiL and loneliness. PiL remained the most powerful predictor in the final regression model. The final model explained 34.1% of the variance in loneliness, while PiL alone accounted for over one quarter (25.9%), indicating substantial explanatory power. The results supported the hypothesis and aligned with extensive research demonstrating PiL's protective role against loneliness and psychological distress in older populations. Sutin et al.'s (2022) meta-analysis revealed that higher PiL was consistently associated with lower concurrent loneliness across diverse countries, ethnicities, and cultural contexts. For instance, these results were consistent

with findings from studies among US older adults (Kim et al., 2022) and NZ men aged 60 or older (Neville et al., 2018). Both identified low PiL as a key indicator of loneliness. This pattern mirrors findings from Mittelman et al. (2023), who also found PiL the strongest predictor of loneliness among partnered older adults than relationship satisfaction or various forms of social support (emotional, informational, and instrumental). Moreover, Kang et al. (2021) demonstrated that during the recent COVID-19 pandemic, individuals with higher levels of PiL reported feeling less lonely during the period of social isolation. Furthermore, align with Neville et al.'s (2018) study, which found that a significant bivariate association between sociodemographic variables and loneliness became non-significant in multivariate analyses. In their study, only PiL and mental health remained significantly associated with loneliness, with lower PiL and poorer mental health predicting higher levels of loneliness. This suggests that the protective effect of purpose may operate independently of social relationship factors. PiL may be more fundamental to emotional well-being than social relationships alone. This interpretation is further supported by Sutin et al.'s (2022) meta-analysis of 36 cohorts (aged 18-109), which demonstrated that higher PiL was significantly associated with less loneliness across all samples, even after controlling for sociodemographic factors, suggesting that having PiL is an ongoing need that extends through the life course. Their longitudinal analyses revealed that PiL also protected against the development of new incident loneliness, underscoring its prospective protective value.

The mechanisms underlying this protective effect likely operate through multiple pathways. According to Life Engagement Theory and Viktor Frankl's Theory of Meaning, purpose provides direction, leads to goal pursuit, and guides action. Individuals with higher PiL tend to demonstrate greater affective, cognitive, and behavioural engagement than those with less purpose (McKnight & Kashdan, 2009; Scheier et al., 2006). Importantly, many types of purpose-driven engagement are inherently social in nature, such as volunteering (Warner et al., 2024), learning activities (Fu & Ji), positive daily social interactions with family and friends (Pfund et al., 2022; Weston et al., 2021), and caregiving activities (Kim et al., 2014; Mittelman et al., 2023). PiL may also reduce loneliness through non-social pathways. Engaging in purposeful activities such as physical exercise (Yemiscigil & Vlaev, 2021), creative work and meditation (Kim et al., 2014), and health-protective behaviours, such as frequent handwashing during COVID-19 (Kang et al., 2021), can be intrinsically satisfying and contribute to psychological and emotional well-being regardless of their social components.

Another mechanism by which PiL may reduce loneliness operates indirectly by protecting against psychological distress and maintaining physical health and functioning (Kim et al., 2022; Kim et al., 2021; Chen et al., 2020). According to Ryff's (1989) model of psychological well-being, PiL as a component of psychological well-being helps individuals adapt and find value in past, present, and future experiences (Burrow & Hill, 2020). Older adults use their sense of purpose to navigate and overcome adverse life events, such as bereavement and physical and cognitive decline. Consequently, older adults with a greater sense of PiL tend to have better psychological, emotional, and mental health, as well as better physical health over time, and these health advantages may facilitate social interactions that further protect against loneliness (Chen et al., 2020; Weston et al., 2021). Notably, meta-analytic evidence suggests that the association between PiL and loneliness appears to be even stronger among individuals experiencing concurrent psychological distress (i.e., depression), suggesting that PiL may be particularly protective during periods of mental health vulnerability. Higher PiL may serve as a psychosocial resource, helping older adults build resilience and cope with unique stressors in later life, such as retirement and caregiving (Hill et al., 2018; Fogelman & Canli, 2015). By providing a framework for making sense of life challenges and maintaining momentum, PiL may buffer against psychological distress and thereby lower loneliness levels. However, the present study did not directly examine depression as a predictor or potential mediator in the relationship between PiL and loneliness. Depression was excluded from regression analyses due to concerns about multicollinearity (given its strong correlations with loneliness), substantial conceptual overlap with mental health measures already included in the model, and the unclear directionality of relationships among depression, purpose, and loneliness (Cacioppo et al., 2010; Pinquart & Sörensen, 2001). It is recommended that future research employs longitudinal or experimental designs to clarify whether depression serves as a mediating mechanism through which purpose influences loneliness, or whether purpose and loneliness independently contribute to depressive symptoms, or whether these relationships operate bidirectionally in a dynamic system of psychological well-being.

The findings of this study reveal that nearly three-quarters of participants scored in the high range for PiL, yet 41.4% still scored being lonely. This suggests that while PiL is protective, it may not eliminate loneliness entirely, and other external factors, such as SES, living arrangement, and mental health, also play important roles (Neville et al., 2018). For instance, SES accounted for 4.1% of the variance in loneliness scores within the regression

model, highlighting its measurable impact on loneliness. The results of the present study indicated that PiL appears to be a necessary but not sufficient condition for preventing loneliness in older adults. Nevertheless, the consistent evidence across studies, including the present findings, indicated that establishing and maintaining PiL represents an ongoing developmental need that extends into old age and serves as a critical protective factor against the experience of loneliness in later life.

Sleep Outcomes and Loneliness

The findings supported the hypothesis that poor sleep outcomes, characterised by lower sleep satisfaction and inadequate sleep duration, are negatively associated with loneliness. Participants who were dissatisfied with their sleep quality had significantly higher loneliness scores than those who were not dissatisfied with their sleep. Additionally, both insufficient sleep (<6 hours) and excessive sleep (>9 hours) were associated with higher loneliness scores compared to the recommended 6–9 hours range for older adults. These results demonstrated a U-shaped relationship between sleep duration and loneliness. Although the effect sizes were small, suggesting that sleep accounts for a modest proportion of variance in loneliness.

The present findings are consistent with Hawkley et al. (2010) and Simon and Walker (2018), who demonstrated significant associations between poor sleep and increased loneliness in older adults. Hawkley et al.'s (2010) systematic review and meta-analysis, which included 27 articles examining the relationship between loneliness and sleep. The meta-analysis results showed that sleep quality has a greater impact on loneliness levels than sleep duration. Individuals experiencing daytime dysfunction, characterised by fatigue, low energy, and sleepiness, showed higher levels of loneliness, suggesting that the functional consequences of poor sleep may matter more than the quantity of sleep obtained. Sleep duration and quality may have different effects on psychosocial well-being. Experimental research by Simon and Walker (2018) demonstrated that even a single night of poor sleep can have immediate negative impacts on psychosocial well-being. In their study, sleep-deprived participants were judged by independent observers as lonelier and less socially desirable, with observers subsequently choosing not to engage socially or collaboratively with sleep-deprived individuals. More remarkably, these observers themselves reported feeling significantly lonelier after viewing videos of sleep-deprived participants than of sleep-rested participants.

The mechanism linking poor sleep to increased loneliness appears to operate through multiple pathways. From the cognition and behaviours pathway, poor sleep might increase the risk of loneliness by promoting social withdrawal behaviours and social isolation. Chang et al. (2023) demonstrated that older Chinese adults (aged 60 and over) sleeping either less than 6 hours or more than 8 hours per night not only felt lonelier but were also more likely to have insufficient participation in leisure activities, be more physically inactive, and engage in unhealthy dietary behaviours, all of which can potentially increase feelings of loneliness. Social Cognitive and Motivation Theory (Simon et al., 2022) explains that this "social contagion" effect may occur because sleep-deprived individuals send signals through facial expressions, emotional displays, and behavioural cues that they have low social motivation. Consequently, sleep-deprived individuals are more likely to withdraw from social interaction and to desire greater social distance from others (Palmer et al., 2024). These social withdrawal signals could negatively impact those they encounter, leaving others feeling unwelcome and rejected. Over time, lonely individuals may generate feelings of psychological distress in those around them (Simon & Walker, 2018). Furthermore, poor sleep outcomes create a vicious cycle: individuals with poor sleep outcomes not only experience heightened subjective loneliness themselves, but their altered social presentation also reduces others' desire to interact with them, further limiting their social relationships and reinforcing their sense of loneliness (Simon et al., 2022; Simon & Walker, 2018). Therefore, poor sleep may compound loneliness through both internal psychological mechanisms and external social rejection processes.

From the physiology pathway, both loneliness and sleep loss create unsafe feelings and hypervigilance for social threat and distance themselves from social interaction. Both also diminish capacity for self-regulation, increase stress level, depressed mood and engagement in unhealthy behaviours (i.e., abuse alcohol), and decreased emotional regulation (Hawkley & Cacioppo, 2010; Palmer et al., 2024). Poor sleep further impairs emotion regulation, resulting in increased anxiety, stress, and negative mood. These emotional difficulties make social interactions more challenging and less rewarding. Gradually, individuals experience reduced social engagement, which reinforces feelings of loneliness (Palmer et al., 2024). Conversely, sleep may also serve as a protective factor, helping individuals against the adverse effects of loneliness. Individuals who sleep well tend to experience better physical functioning, more stable mood, and stronger self-regulation. As a result, they are more adaptive to challenging situations, respond positively to social cues, and maintain effective cognitive control over

their social behaviours (Finley & Schaefer, 2022). For instance, Hawkley et al. (2010) found that older adults with the same number of sleep hours, only more socially isolated individuals felt more fatigue (e.g., showed reduced daytime functioning) than those who were not socially isolated. Together with the findings from this thesis, it suggests that poor sleep quality may directly amplify feelings of loneliness, even when duration is adequate among older adults.

Another potential mechanism is that socially isolated people tend to have limited social support and resources. They are more vulnerable, have low emotional regulation and more psychological distress. Consequently, abnormal/short sleep duration could lead to loneliness and negatively impact their health and well-being (Miner & Kryger, 2020). Furthermore, older people with poorer sleep quality and more sleep problems are more likely to experience restlessness than those with better sleep quality (Stephens & Gatchel, 2018), and unsatisfactory sleep quality is harmful to physical, mental, psychological, and social health, which, in turn, increases levels of social isolation and loneliness. For instance, nonrestorative sleep (i.e., feels non-refreshing in the morning) results in daytime impairments, such as physical and intellectual fatigue, role impairments, and cognitive and memory problems. Sleepiness during the day might lead older people to nap and miss social opportunities. Napping during the day further negatively impacts nighttime sleep. Older adults may experience prolonged wakefulness, reduced nighttime sleep duration, and poor sleep quality, creating a recursive cycle (Palmer et al., 2024).

Despite these supportive findings, the current findings diverge from Hawkley et al. (2010), who found that only sleep quality, not sleep duration, was correlated with loneliness. This discrepancy between current and previous findings may be due to methodology. Specifically, the current study used the De Jong Gierveld Scale of loneliness, whereas Hawkley et al. (2010) employed the UCLA Scale of loneliness, which may capture different dimensions of loneliness. Beyond measurement differences, confounding variables may also explain these inconsistent findings. Yu et al. (2018) demonstrated that the association between sleep quality and loneliness was no longer significant after controlling for demographic, health, cognitive factors, and depressive symptoms among Taiwanese older adults. The present study did not control for cognitive factors or depressive symptoms in the regression models, which may have acted as confounders. In particular, depression has been shown to play a significant role in loneliness and sleep. Griffin et al. (2020) showed that depression

attenuated the association between loneliness and sleep disturbances. Future research could benefit from including a more comprehensive set of covariates.

The literature also shows considerable inconsistency about which specific sleep dimensions are most strongly associated with loneliness. Some studies have found that only certain sleep components, rather than all aspects of sleep, are significantly associated with loneliness. For instance, Jia and Yuan (2020) demonstrated that Chinese older adults with worse sleep quality and shorter sleep duration reported higher degrees of loneliness. However, they found that higher scores for habitual sleep efficiency and sleep disturbances were not statistically significantly related to loneliness in their Chinese sample (Jia & Yuan, 2020). The relationship between sleep and loneliness is complex and multifaceted, which cannot be robustly assessed with subjective measures of sleep quality and sleep duration. As Yu et al. (2018) suggested, incorporating additional sleep parameters, such as the timing and regularity of sleep or sleep architecture (using objective sleep measures such as polysomnography or actigraphy), may provide a more nuanced understanding of how sleep health relates to loneliness.

Bidirectional Relationships and Dimensional Complexity

Although this thesis and other research suggest that sleep health informs loneliness, this study found only a small effect size for sleep quality and duration on loneliness. The findings can be explained by emerging evidence suggesting that the relationship between loneliness and sleep may be bidirectional. Griffin et al. (2020) found reciprocal effects between loneliness and sleep disturbance, with loneliness predicting subsequent sleep problems and sleep problems predicting subsequent loneliness. This reciprocal pattern suggests a self-perpetuating cycle wherein loneliness disrupts sleep, which in turn exacerbates feelings of loneliness.

Adding to this complexity, the specific sleep dimensions implicated in this bidirectional relationship also appear to vary across studies. Shankar (2020) demonstrated that individuals with higher loneliness reported more sleep problems than those with lower loneliness, but, interestingly, high loneliness was only associated with increased odds of short sleep duration, not long sleep duration. This asymmetric pattern differs from the U-shaped relationship observed in the present study, suggesting that the direction and nature of the loneliness and sleep association may depend on which sleep dimension is being measured.

Conversely, Hawkey et al. (2010) found that loneliness was positively associated with time in bed and time spent in bed awake (indicating poorer sleep efficiency), suggesting that lonely individuals may spend more time attempting to sleep but achieve less actual sleep.

Furthermore, Benson et al. (2021) found that loneliness was associated with wake after sleep onset and sleep efficiency, but not with total sleep time. Importantly, Benson et al. (2021) also distinguished between types of loneliness, finding that social loneliness was associated with spending more time in bed (possibly due to depressive symptoms), while emotional loneliness was associated with more insomnia symptoms and shorter sleep duration. Together, these findings highlight that both sleep and loneliness are multidimensional constructs and that different dimensions may relate to one another in distinct ways.

This dimensional complexity likely contributes to the small effect observed in the present study, which focused narrowly on sleep quality and duration. Other potentially relevant sleep dimensions, such as sleep efficiency (percentage of time in bed actually asleep), sleep latency (time to fall asleep), sleep fragmentation (number and duration of awakenings), daytime sleepiness, and clinically diagnosed sleep disorders such as insomnia and sleep apnea (Jia & Yuan, 2020), were not examined in this study. Furthermore, the current study did not differentiate between social and emotional loneliness, which, as Benson et al. (2021) demonstrated, may relate to sleep in meaningfully different ways. These findings underscore the importance of considering not only multiple dimensions of sleep but also different types or dimensions of loneliness when examining their interrelationships. Future research would therefore benefit from adopting a more comprehensive approach that captures multiple dimensions of both sleep and loneliness, thereby providing a more complete understanding of their interrelationship.

Theoretical Explanations for Directional Emphasis

Despite growing recognition of bidirectional relationships, the majority of current sleep and health studies among ageing populations focus on loneliness as a predictor of poor sleep rather than the reverse (Zhang et al., 2022). This directional emphasis is grounded in several theoretical frameworks that position loneliness as a primary stressor with downstream effects on physiological processes, including sleep. John Cacioppo's Evolutionary Theory of Loneliness (2018) suggest that feeling socially isolated triggers hypervigilance and enhanced threat detection. This adaptive survival mechanism may have protected vulnerable, isolated individuals from predation in ancestral environments (Cacioppo & Cacioppo, 2018).

However, in modern contexts, this heightened vigilance state directly disrupts sleep by maintaining physiological and psychological arousal that is incompatible with the relaxation needs for sleep onset and maintenance (Finley & Schaefer, 2022). Moreover, stress and coping models conceptualise loneliness as a chronic psychosocial stressor that activates the hypothalamic-pituitary-adrenal axis and increases cortisol secretion, leading to disrupted circadian rhythms and poor sleep quality. Taken together, current theory and framework consistently position loneliness as a predictor that causes physiological and psychological reactions. Sleep is often conceptualised as an outcome or consequence of psychological distress rather than a cause of it (Hawkley & Cacioppo, 2010).

From a measurement and temporal stability perspective, loneliness may be viewed as a more stable psychological condition or trait-like characteristic that persists over time (Gao et al., 2017; Hammond et al., 2022), whereas sleep is a physiological process that can fluctuate substantially from night to night based on numerous factors such as stress, physical activity, diet, environmental conditions, and daily routines (Smagula et al., 2016). This differential stability makes it more intuitive to conceptualise the relatively stable condition (loneliness) as the driving antecedent, with sleep as the physiological consequence rather than the reverse. Nevertheless, experimental evidence and Social Cognitive and Motivation Theory challenge this unidirectional view. Simon and Walker (2018) demonstrated that acute sleep deprivation can rapidly alter social-emotional functioning and heighten feelings of loneliness, suggesting that sleep may have more immediate causal effects on loneliness. From this perspective, sleep may not merely be a consequence of loneliness but also a contributing factor to loneliness. Taken together with the bidirectional evidence discussed above, these findings suggest that the relationship between sleep and loneliness is likely reciprocal and mutually reinforcing, with each capable of influencing the other across different timescales and contexts.

While existing research has established connections between loneliness and sleep, and emerging evidence suggests these relationships may be bidirectional, the present thesis focused specifically on examining how sleep influences loneliness among older adults. This directional focus was deliberate and practically motivated. Given the high prevalence of both sleep disturbances and loneliness in ageing populations and considering that loneliness is a complex psychological state that has proven notoriously difficult to modify through direct intervention, sleep represents a more tangible and modifiable target for intervention. Sleep

behaviours and sleep health can be improved through various evidence-based interventions, including sleep hygiene adaptations (e.g., consistent sleep schedule, limit napping, and manage nighttime wakefulness), cognitive behavioural therapy for insomnia, and medication. It is a promising approach for indirectly addressing loneliness and improving overall health and well-being in older adults (Manber & Carney, 2015). By understanding how sleep affects loneliness, rather than solely focusing on the reverse relationship, this research may identify actionable strategies that could yield meaningful improvements in the psychosocial and emotional health of ageing populations.

Sleep Mediation Effect

The novelty of the present study comes from testing sleep quality or sleep duration as potential mediator between PiL and loneliness among older people. The current study supported the hypothesis that both sleep duration and quality variables mediated the relationship between PiL and loneliness. Specifically, individuals with better sleep outcomes showed a weaker association between PiL and loneliness, indicating that sleep may interrupt or weaken this link. Sleep satisfaction accounted for about 5.1% of the total effect of PiL on loneliness, while sleep duration accounted for only 0.3%. This suggests that sleep satisfaction is a more important mechanism than duration in the relationship between purpose and loneliness.

While no existing research has examined this precise mediating relationship between PiL and loneliness through sleep quality, the findings align with numerous studies on the purpose-health association. For example, Hill et al. (2017) demonstrated that sleep quality mediated the relationship between purposeful lifestyle behaviours (e.g., engaging in meaningful activities and experiences, maintaining a healthy diet) and self-rated health among ethnically diverse older adults, including Japanese Americans, European Americans, and Hawaiian or Pacific Islander populations. Similarly, Fu and Ji (2020) found that sleep-wake disturbances mediated the relationship between engagement in purposeful activities and depression among community-dwelling Chinese older adults. These findings align with broader research on how psychosocial well-being and sleep health interact. Furthermore, both Fu and Ji (2020) and Liu et al. (2025) demonstrated that sleep quality mediated the relationship between depressive symptoms and loneliness among Chinese older adults, while Liu et al. (2017) showed that sleep quality mediated the association between perceived stress and depression among older adults aged 60 and over. Sleep plays a significant role in

maintaining psychological and emotional health among older adults. Taken together, these studies position sleep as a key pathway through which various psychological factors influence health and well-being outcomes. The present study adds to this body of literature by suggesting that a lower sense of purpose (e.g., reduced engagement in goal pursuit) may be associated with poorer health behaviours (e.g., sleep), which, in turn, may be associated with a greater likelihood of experiencing loneliness and adverse ageing outcomes.

Self-determination theory provides a theoretical framework for understanding these relationships in the context of healthy ageing. According to this framework, when individuals' basic psychological needs for autonomy, competence, and relatedness are met through purposeful living, they are more likely to engage in healthy lifestyles and behaviours, such as maintaining regular sleep routines, exercising consistently, and having nutritious diets (Ng & Ho, 2020). These healthy lifestyle behaviours, in turn, contribute to better sleep quality and adequate sleep duration, which positively impact physical health, physiological regulation, and psychosocial well-being. Consequently, this cascade of effects is thought to reduce psychological distress, including feelings of loneliness (Hill et al., 2017; Kim et al., 2015).

However, the finding that sleep quality partially rather than completely mediates the relationship between PiL and loneliness, combined with the negligible mediation by sleep duration, suggests that PiL operates through multiple pathways; sleep satisfaction is one piece of a larger puzzle, and direct effects remain dominant. Additionally, sleep quality matters more than sleep quantity, suggesting that among NZ older adults, how well people sleep matters more than how long they sleep. This may reflect individual variations in sleep needs, but it may also point to the importance of sleep timing and social synchronisation. For instance, daytime napping, being awake or asleep at antisocial hours and having irregular sleep-wake patterns may reduce opportunities for social engagement. These factors are more relevant than total sleep hours (Hom et al., 2017; 2020). It is therefore recommended that future research examines how sleep timing and circadian dysregulation influence the relationship between PiL and loneliness.

The ecology of purposeful living framework further illuminates why PiL serves as such a powerful protective factor against loneliness. According to Burrow and Hill (2020), PiL is associated with wide-ranging benefits throughout the ageing process, protecting individuals from physical and cognitive decline while facilitating faster recovery from disease and psychological distress. This ecological perspective suggests that purpose is a resource that

builds across the lifespan. Older adults with higher PiL are more resilient toward negative life events (e.g., loss of social roles and relationships, decline in physical and psychological health). Consequently, they may be less likely to experience changes in sleep patterns and duration or disrupted sleep, and more likely to report satisfaction with their sleep quality and achieve adequate sleep duration (Phelan et al., 2010). Given that sleep is well established as crucial for emotional, cognitive, and behavioural regulation (Hawkley & Cacioppo, 2010), it would be valuable to consider sleep health more seriously in health promotion activities for mental health issues such as loneliness. Taken together, this study indicates that a sense of engagement and PiL provide a foundation for good sleep health, which, in turn, informs feelings of loneliness among older adults.

Ethnic Differences

One interesting finding from this thesis was the inconsistent relationship between ethnicity and loneliness across different tests. In the bivariate analysis, Māori participants showed a significantly higher loneliness score than non-Māori participants. However, this relationship became more nuanced when examined within the hierarchical regression analysis. In model 2, after controlling for PiL, age, gender, marital status, and living condition, the difference in loneliness scores between Māori and non-Māori participants was no longer statistically significant. This suggests that the group difference observed in the t-test may be partly attributable to differences in these covariates between ethnic groups, rather than reflecting an independent effect of ethnicity on loneliness. In particular, given that PiL emerged as a strong predictor of loneliness in this model, it is possible that group differences in PiL scores between Māori and non-Māori may contributed to the loneliness score differences observed at the bivariate level. Once PiL and other demographic factors were controlled, the raw ethnicity difference in loneliness became nonsignificant. Furthermore, when SES was introduced into the regression model, the ethnicity differences in loneliness reversed direction in Model 3. Māori participants actually demonstrated significantly lower loneliness scores than non-Māori participants when controlling for SES. This finding suggests that SES may act as a suppressor variable, masking the true relationship between ethnicity and loneliness. Szabó et al. (2024) indicated that Māori are disproportionately represented in lower-SES groups in NZ due to intergenerational effects (e.g., historical and structural inequities). Additionally, lower SES is also a well-established risk factor for loneliness

(Pinquart & Sörensen, 2001). As a result, when statistically removing the SES disadvantage in regression analysis, it reveals that Māori actually experience lower loneliness than non-Māori.

These findings carry important theoretical and practical meaning. It suggests that Māori may benefit from cultural protective factors that buffer against loneliness, such as the collective values embedded in Māori culture (Szabó et al., 2024). For instance, a strong sense of cultural identity, community belonging, whānau and spiritual connection may foster better health behaviours, social connection, and finding PiL in ways that reduce loneliness, independent of socioeconomic circumstances (Crestani et al., 2022). Critically, however, the initial t-test finding illustrated that these protective cultural assets are being offset at the population level by the structural socioeconomic disadvantage disproportionately experienced by Māori. Taken together, these findings underscore the importance of accounting for structural determinants, such as SES, when examining ethnicity differences in health and well-being outcomes (Lay-Yee et al., 2022). Failure to do so may result in misinterpreting the complex interplay between cultural resilience and systemic inequity in shaping loneliness among Māori older adults (Pitama et al., 2017).

Implications

The study results offer several contributions to the current literature and have meaningful implications for both research and practice. The present study demonstrated that PiL was the strongest predictor of loneliness. Individuals with a higher sense of purpose reported significantly lower levels of loneliness, and this association remained robust after adjusting for all other sociodemographic and health variables. Specifically, each one-unit increase in PiL score corresponded to a 0.854-point decrease in loneliness. The findings align with considerable research and support models of psychological well-being that emphasise the centrality of purpose in protecting against negative psychological states, including loneliness (Hill & Turiano, 2014). The complex relationship observed between sleep, PiL, and loneliness highlights the interconnected nature of physical and psychological well-being in later life. The findings suggest that addressing loneliness in older adults requires a multifaceted approach that considers not only social connections but also physical health, healthy behaviours (e.g., sleep) and psychological resources (e.g., purpose). Clinicians and practitioners should be aware that improvement in one domain (e.g., sleep quality) may have cascading positive effects on other domains (e.g., reduced loneliness and improved emotional

and psychological well-being). Conversely, that deterioration in one area (e.g., reduced PiL due to retirement) may trigger a downward spiral affecting multiple aspects of well-being.

The study findings also provide empirical support for the NZ Healthy Ageing Strategy (2016) and Better Late Life - He Oranga Kaumātua 2019 to 2034 Strategy, which emphasise enhancing social connections, developing a sense of purpose, and promoting psychological well-being among older New Zealanders (Associate Minister of Health, 2016; Office for Seniors, 2019). Given the ageing population and the documented prevalence of loneliness among older adults, the study findings underscore the urgency of implementing and adequately funding programs that support older adults in purposeful living.

Sleep played only a partial mediating role in the relationship between PiL and loneliness, suggesting other factors to be considered when addressing loneliness among older adults. The study results demonstrated the important roles of sociodemographic factors, SES, and mental health in influencing loneliness. The strength of the association between PiL and loneliness, combined with the significant contributions of these other factors, aligns with research that suggests interventions targeting PiL may be particularly effective in addressing loneliness among older adults, especially when integrated with approaches that address broader determinants of well-being. From a practical standpoint, these findings suggest that healthcare providers, social service agencies, and community organisations working with older adults should adopt a comprehensive, multifaceted approach to combating loneliness. Programmes could incorporate culturally sensitive purpose-building activities that simultaneously address emotional well-being as well as sleep health promotion. Such activities might include volunteering opportunities, mentoring programmes, or engagement in meaningful creative, educational, or community projects that help older adults maintain or rediscover their sense of purpose during life transitions such as retirement or bereavement (Warner et al., 2024). The development of integrated intervention approaches that simultaneously target multiple interconnected risk factors rather than addressing each in isolation is essential for promoting holistic well-being in older adults.

Strengths and Limitations

Strengths

A major strength of the current study is its basis in a nationally representative sample of NZ's older adult population. The NZHWR study was determined to be nationally representative with respect to age, gender, and ethnicity, providing an accurate reflection of NZ's general older adult population characteristics (Health and Ageing Research Team, 2018). This representativeness enhances the generalisability of findings. The inclusion of Māori participants (35.6% of the sample) represents a significant strength, as Māori are often underrepresented in health research despite experiencing disproportionate health inequities. This meaningful representation allows for the examination of ethnic differences in loneliness experiences and provides evidence to inform culturally responsive interventions.

The study addresses important health concerns in an ageing population. Loneliness and sleep issues are highly prevalent among older adults, and with global ageing and extended life expectancy, both the number and proportion of older adults experiencing these issues continue to increase (Grandner, 2017; Stephens & Gatchel, 2018). Extended research indicates that both factors significantly impact older adults' quality of life (Beridze et al., 2020; Lan et al., 2024). By examining these pressing public health issues together with PiL, this study addresses a gap in the literature and provides evidence to inform public policy and interventions targeting multiple interconnected aspects of healthy ageing.

The substantial sample size of 5,512 participants represents another important strength, providing excellent statistical power to detect even small but meaningful effects. This robust sample size enabled this study to conduct comprehensive hierarchical regression and mediation analyses with multiple predictors while maintaining adequate statistical power. The large sample size also enabled subgroup comparisons across demographic categories (e.g., gender, ethnicity, marital status, living arrangements, SES levels). Just as we need to identify the important factors that impact loneliness, it is equally important to identify the less important ones. For instance, the study results indicated that the SES level has a greater impact on loneliness than gender or marital status. Align with the recent report from the NZ Ministry of Health, which found that adults living in the most deprived areas are less likely to meet the recommended sleep duration guidelines (Ministry of Health, 2026). Taken together, a larger sample size and the control for a robust array of potential confounders enhance our

understanding of how relationships among purpose, sleep, and loneliness may vary across populations and provide directions for future research.

A key theoretical and empirical strength is that this study is among the first to examine the relationships among PiL, sleep, and loneliness together. While previous research has examined these variables in pairs – purpose and loneliness, sleep and loneliness, or purpose and sleep – few studies have investigated how all three are interrelated and whether sleep serves as a mechanism through which purpose influences loneliness. This integrated approach recognises that older adults' health and well-being are complex, with psychological health critically influencing physical health and healthy behaviours. Studying the relationships among loneliness, PiL, and sleep behaviours can enhance our understanding of these intertwined dynamics and provide a more holistic picture of the factors contributing to psychological well-being in later life.

Limitations

While this study offers unique findings, several limitations must be acknowledged at both the design and methodological levels.

Cross-sectional Design. This thesis used only cross-sectional data from the 2022 wave of the NZHWR. Cross-sectional mediation analysis examined the relationships between PiL, sleep, and loneliness, all measured at the same point in time. While significant relationships were found, the fundamental issue is that causation unfolds over time, but cross-sectional data captures everything simultaneously. In reality, it might take weeks or months for PiL to influence sleep outcomes, and longer still for sleep changes to affect psychological and emotional well-being, such as loneliness. Additionally, for mediation to work causally, there must be a temporal sequence: the independent variable must first affect the mediating variable, which then affects the dependent variable. In this case, PiL must first affect sleep outcomes, which, in turn, affect loneliness. Therefore, cross-sectional data have limited power to determine the sequence of events. Since the NZHWR study started in 2006 and is an ongoing longitudinal study, future research could use longitudinal data to examine temporal relationships. For example, using data from the 2020 and 2024 waves could determine whether participants with high PiL in 2020 showed better sleep quality, adequate sleep duration, and lower levels of loneliness in 2024.

Measurement Reliability and Validity. The emotional loneliness subscale had a much lower internal consistency (Cronbach's $\alpha = .61$) than the overall loneliness scale ($\alpha = .75$) and the social loneliness subscale ($\alpha = .82$), thereby compromising the reliability of the overall De Jong Gierveld loneliness score. This low reliability is concerning, as it suggests considerable measurement error in the emotional loneliness construct. Similar patterns have been observed in studies by Szabó et al. (2020; 2024) and Lai et al. (2025), where the emotional loneliness subscale yielded a much lower Cronbach's α than the social loneliness subscale. Deng et al. (2023) suggested that emotional loneliness may be more multifaceted than social loneliness, resulting in greater individual variability. Emotional loneliness encompasses various dimensions, such as romantic relationships, close friendships, intimacy, and attachment. Items might be tapping into different aspects of emotional connection rather than a single unified concept. For instance, the item "I miss having people around" is highly subjective, and older people may or may not miss their family members depending on circumstances, relationship quality, and personal preferences. People may experience and interpret emotional loneliness more heterogeneously than social loneliness. Given these reliability concerns, the present study used the total loneliness scale score, with adequate reliability. Pinquart and Sörensen's (2001) meta-analysis of 149 loneliness studies found different results across the De Jong Gierveld Scale, the UCLA Loneliness Scale, and single-item indicators. Future studies might consider using the UCLA Loneliness Scale, which has shown stronger reliability ($\alpha = 0.81$; Shankar et al., 2020)

Sleep duration and sleep quality were self-reported in this study, which presents notable limitations. Stephens and Gatchel (2018) found that self-reported sleep is often inaccurate, with older adults potentially overestimating their sleep duration. When comparing original self-reported sleep duration to objective actigraphy (wrist-worn monitors that track physiological sleep-related activity), participants reported nearly one hour more sleep than the objective measurement indicated. Average sleep duration per night was 6 hours with the actigraphy monitor and 6.8 hours with self-reported data, both of which are below the National Sleep Foundation's recommended sleep duration guidelines for older adults (Stephens & Gatchel, 2018). These findings underscore the importance of incorporating objective sleep measurements to improve data accuracy in future research. An additional limitation concerns the measurement of sleep duration over a 24-hour period without distinguishing between nighttime sleep and daytime napping. This distinction is particularly important among older adults, for whom napping is more common due to shorter sleep

duration and poor sleep quality at night. Cross et al. (2015) demonstrated that prolonged napping in older people is associated with increased risk of dementia and decreased psychological well-being. They found that participants who napped most frequently or for the longest durations exhibited the poorest quality and duration of nighttime sleep, the worst physical health, and more morbidities, poorer cognitive performance, and the greatest number of depressive symptoms, compared to those who napped less. Without separating nighttime sleep from total 24-hour sleep duration, the current study cannot determine whether the observed associations with loneliness are driven by nighttime sleep patterns, daytime napping behaviours, or both. A distinction that warrants attention in future research.

Conceptualising and Measurement Consideration. An important consideration when interpreting these findings is that the PiL can be conceptualised in various ways. The present study used the LET to measure purpose, emphasising individuals' engagement in activities they perceive as worthwhile and significant (Scheier et al., 2006). A review of 44 studies indicated that PiL can be conceptualised in diverse ways, including dimensions such as health and well-being, meaningful goals and purpose, inner strength, social relationships, mattering to others, and spirituality and religiousness (AshRani et al., 2022). Consequently, the use of different measurement scales might yield varying results. For instance, Ryff's (1989) Psychological Well-being Scale, which is commonly used in ageing research, included the PiL subscale. In Ryff's PiL subscale, purpose is assessed within the broader context of psychological well-being and measures having long-term goals, a sense of direction in life, and perceiving one's past, present, and future life as purposeful. In contrast, LET focuses on the present moment. Both instruments demonstrate strong psychometric properties and high internal consistency, yet they capture distinct aspects of the PiL construct. The choice of the LET in the current study aligns with the study's theoretical framework, which examines how active, purposeful living is related to health behaviours such as sleep and influences psychological well-being through behavioural pathways. Future research could use different measurement scales to explore how potential cognitive and psychosocial appraisals of life's meaning operate through different mechanisms.

Sample Representativeness. The representativeness of the study sample presents limitations that may affect the generalisability of findings. In the 2022 survey wave, the response rate is decent, but there are significant differences among ethnicities. For instance, the response rate was found to be lower for Māori than for non-Māori (72.0% vs. 83.0% in the

existing cohort and 19.3% vs. 29.8% in the new 2022 refresh cohort; Phillips, 2022), suggesting potential underrepresentation of Māori ethnicity. This disparity is particularly significant because Māori communities face systemic health inequities and may experience different patterns of PiL, sleep, and loneliness compared to the general population (Lay-Yee et al., 2022).

Previous reports also indicated that the NZHWR cohort is, in general, healthier and more socioeconomically advantaged compared to the broader NZ population (Health and Ageing Research Team, 2018). This selection bias is problematic because these socioeconomically disadvantaged groups are considered more likely to have fewer opportunities for positive life engagement and PiL, as well as an increased likelihood of experiencing sleep problems and social isolation (Neville et al., 2018; Paine & Gander, 2016). It is plausible that the broader NZ older population may be even more lonely than the study cohort. Therefore, the lower response rate among Māori participants and the overall healthier profile of the study cohort may introduce systematic bias into the results, potentially leading to an underestimation of the prevalence and severity of sleep problems and loneliness, particularly among vulnerable populations. Future studies could prioritise strategies to improve recruitment and retention of underrepresented populations, including Māori and Pacific people, individuals from lower socioeconomic backgrounds, and those with poor health status. This could include culturally tailored recruitment approaches, community partnerships, and oversampling strategies to ensure adequate representation across all demographic groups.

Confounding Variables. A further point of reflection concerns the potential effects of unmeasured confounders. For instance, this thesis did not control for social support and social participation, which represents a notable limitation, given the well-established interconnections between these constructs and the study variables. Social isolation is closely related to loneliness (Shankar et al., 2013), whereas social participation has been shown to increase PiL (Irving et al., 2017). Moreover, recent studies have demonstrated that low sleep quality and irregular sleep patterns were positively correlated with insufficient social participation and perception of social isolation (Azizi-Zeinalhajlou et al., 2022; Chang et al., 2023). Given that social relationships and participation may play a significant role in PiL, sleep outcomes and loneliness, future studies could include these variables as potential confounders to strengthen causal inference.

The NZHWR dataset does not include questions on several acute and chronic risk factors for loneliness, such as bereavement, major life transitions, cognitive functioning, and health behaviours, such as fruit and vegetable intake. All of these factors have been linked to loneliness among older adults in the literature (Kim et al., 2022). Recent bereavement, in particular, represents an acute precipitant of loneliness that may reduce PiL level and disrupt sleep patterns (Dahlberg et al., 2018). Despite the limitations, the current findings provide a valuable foundation for future study. The robust associations identified between PiL, sleep, and loneliness using available NZHWR variables establish preliminary evidence for these pathways in older NZ adults.

Future Directions

Future research may pursue several important directions to build upon the findings of the present study. While the present findings support significant associations between poor sleep outcomes and increased loneliness in older NZ adults, the broader literature reveals considerable complexity in these relationships. The associations vary depending on which sleep dimensions are measured (duration, quality, efficiency, or fragmentation), which types of loneliness are examined (social vs. emotional), the methodology employed (cross-sectional vs. longitudinal vs. experimental), and the population studied (cultural and age differences). Future research employing longitudinal designs with comprehensive assessment (including objective and subjective measures) of multiple sleep dimensions, different types of loneliness, and potential mediating mechanisms would help clarify causal pathways and temporal dynamics. Such studies could examine whether changes in purpose predict subsequent changes in loneliness and sleep over time, or whether the relationships operate primarily in the opposite direction, or bidirectionally. Understanding these temporal sequences is crucial for designing effective interventions and identifying optimal timing for intervention delivery.

Second, future research could investigate how different conceptualisations and measurements of PiL may influence findings and the mechanisms through which purpose protects against loneliness. The present study measured PiL using LET, which focused on valued activities and behavioural engagement in meaningful pursuits. Future research could use Ryff's (1989) PiL Scale, derived from her model of psychological well-being. Ryff (1989) emphasises the importance of having goals and a sense of direction in life, and of holding beliefs that give life purpose. Moreover, not all purposes may be equally protective. For example, purpose derived from social roles and relationships (e.g., being a grandparent,

community volunteer, or mentor) has different effects on loneliness than purpose derived from individual pursuits (e.g., learning new things) or spiritual beliefs (Hupkens et al., 2018). Therefore, understanding which sources of purpose are most strongly associated with reduced loneliness could inform the development of more targeted interventions. Additionally, research could examine how older adults maintain or rebuild purpose following major life transitions that may threaten their sense of purpose.

Conclusion

The present study examined the relationship between PiL and loneliness, as well as the potential mediating effects of sleep quality or duration among older NZ adults. PiL emerged as a strong predictor of loneliness. This finding underscores the importance of psychological factors, particularly the building and maintenance of a sense of meaning and purpose, in protecting against loneliness among older adults. Sleep quality and duration were significantly correlated with loneliness. Participants reporting dissatisfied sleep and shorter sleep (<6 hours) had the highest loneliness scores. Mediation analyses revealed that sleep satisfaction partially mediated the relation between PiL and loneliness, with sleep duration showing negligible mediation effects. The results indicated that sleep accounts for a small proportion of the variance, with other factors, such as PiL, socioeconomic status, and mental health, playing larger roles. Nevertheless, the consistency of significant associations across diverse studies and populations suggests that sleep represents a meaningful and potentially modifiable factor in the experience of loneliness among older adults.

As NZ's population continues to age, understanding and supporting the factors that protect older adults from loneliness becomes increasingly critical. By helping older adults discover and maintain their sense of purpose, we may be able to substantially reduce the burden of loneliness and its associated negative health outcomes. Ultimately, this thesis points toward a more holistic understanding of loneliness in later life. The interplay among psychological resources like purpose, health behaviours like sleep, and social experiences and emotional well-being, such as loneliness, is complex. Addressing loneliness effectively will require integrated approaches that support older adults in maintaining not just their social connections and physical health, but also their sense that life continues to hold meaning, purpose, and possibilities for growth and contribution, regardless of age.

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Appendix

Question Inventory Requires List of the New Zealand Health, Work and Retirement Study (NZHWR) 2022 Cohort

Question #	Content	# of Items	Origin & Reference (where applicable)
Question 1-7	SF-12 health status	12 (plus calculated global and physical and mental health score)	Australia/New Zealand adaptation SF-12v2: Ware, J., Kosinski, M., Turner-Bowker, D., & Gandek, B. (2002). <i>How to Score Version 2 of the SF-12® Health Survey (With a Supplement Documenting Version 1)</i> . Lincoln, RI: Quality Metric Incorporated. Recommended scoring: Frieeling, M. A., Davis, W. R., & Chiang, G. (2013). The SF-36v2 and SF-12v2 health surveys in New Zealand: Norms, scoring coefficients and cross-country comparisons. <i>Australian and New Zealand Journal of Public Health</i> , 37(1), 24-31.
Question 8	Life satisfaction	1	The WHOQoL Group. Development of the World Health Organization WHOQOL-BREF quality of life assessment. The WHOQOL Group. (1998). <i>Psychological Medicine</i> , 28(3), 551-558.
Question 9	WHO Quality of life	1	WHOQoL-8: kept single item "...rate your quality of life"
Question 16	Purpose in life	6 (and global score)	Scheier, M. F., Wrosch, C., Baum, A., Cohen, S., Martire, L. M., Matthews, K. A., Schulz, R., & Zdzienicka, B. (2006). The life engagement test: Assessing purpose in life. <i>Journal of Behavioral Medicine</i> , 29(3), 291–298. https://doi.org/10.1007/s10865-005-9044-1

Question 17	CES-D depression	10 (and global score)	Andresen, E. M., Malmgren, J. A., Carter, W. B., & Patrick, D. L. (1994). Screening for depression in well older adults: Evaluation of a short form of the CES-D. <i>American Journal of Preventive Medicine</i> , 10(2), 77–84. https://doi.org/https://doi.org/10.1016/S0749-3797(18)30622-6
Question 19	Physical activity	3	Items from ELSA
Question 24	CASP-12 quality of life	12 (and global score)	Wiggins, R. D., Netuveli, G., Hyde, M., Higgs, P., & Blane, D. (2008). The evaluation of a self-enumerated scale of Quality of Life (CASP-19) in the context of research on ageing: A combination of exploratory and confirmatory approaches. <i>Social Indicators Research</i> , 89(1), 61-77.
Question 25	Chronic conditions (included sleep disorder)	15	Health and Ageing Research Team
Question 31	Sleep duration	1	Paine, S. J., & Gander, P. H. (2016). Explaining ethnic inequities in sleep duration: A cross-sectional survey of Māori and non-Māori adults in New Zealand. <i>Sleep Health</i> , 2(2), 109-115. https://doi.org/10.1016/j.sleh.2016.01.005
Question 32	Sleep satisfaction	1	WHOQOL
Question 33	Daytime sleepiness	1	Buysee, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). <i>Pittsburgh Sleep Quality Index (PSQI)</i> . APA PsycTests. https://doi.org/10.1037/t05178-000

Question 46	Loneliness	6 (plus the global and sub-scale scores if available)	De Jong Gierveld, J., & Van Tilburg, T. (2006). A 6-Item Scale for Overall, Emotional, and Social Loneliness: Confirmatory Tests on Survey Data. <i>Research on Aging</i> , 28(5), 582–598. https://doi.org/10.1177/0164027506289723
Question 88-93	Economic Living Standards Index Short Form (ELSI-SF)	25 (plus global score)	Economic Living Standards Index Short Form (ELSI Short Form): Jensen, J., Spittal, M., & Vasantha Krishnan. (2005). <i>ELSI Short Form: User manual for a direct measure of living standards</i> . Centre for Social Research and Evaluation Te Pokapū Rangahau Arotaki Hapori. Retrieved from http://www.msd.govt.nz/about-msd-and-our-work/publications-resources/monitoring/living-standards/elsi-short-form.html
Question 95-99	Gender, sexuality, DOB, marital status, education	5	NZ Census
Question 100	Household composition	1	NZ Census
Question 101	Ethnicity	2	NZ Census