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Loneliness in the Context of Long-Term Care: The Role of Social Participation and
Social Relationships

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Introduction and Theoretical Background

Loneliness, the subjective experience of feeling socially disconnected, is increasingly recognized as a major societal issue, affecting individuals across all age groups at alarming rates (Bertelsmann Stiftung, 2024; Weiss, 1975; World Health Organization [WHO], 2025a). Among individuals affected by loneliness, older adults constitute a particularly vulnerable population due to multiple predisposing factors, including living alone, the presence of chronic illnesses, cognitive and sensory impairments, and the loss of close social relationships such as spouses or friends (National Academies of Sciences, Engineering [NASEM], 2020; WHO, 2021). Living in long-term care (LTC) facilities further compound the risk by intensifying both loneliness and social isolation, the objective lack of social contacts (Freedman & Nicolle, 2020; Weiss, 1975). Residents in LTC homes often face not only declining independence and health but also the challenge of adjusting to a new social environment. This transition typically disrupts established social bonds and requires individuals to adapt to a new community structure (Burge & Street, 2010; Wenger et al., 1996). However, despite these challenges, LTC settings may also offer opportunities to mitigate loneliness and social isolation, as residents can develop new social relationships and engage in structured programs intended to promote a sense of belonging and community (Barbosa Neves et al., 2019; Fakoya et al., 2020). Despite these potential benefits, loneliness remains highly prevalent among older individuals in LTC settings, with a meta-analysis indicating that 61% of residents experience moderate loneliness and 35% experience severe loneliness (Gardiner et al., 2018). These findings are further reflected in German reports, which estimate that approximately 35% of care home residents experience loneliness (Bundesministerium für Familie, Senioren, Frauen und Jugend [BMFSFJ], 2025).

A growing body of evidence highlights the profound health implications of social connection particularly in later life. For example, good social interactions and integration were demonstrated to be a protective factor for incident dementia (Kuiper et al., 2015; Wang et al., 2023). Social connection factors have been identified as independent predictors of mental and physical health, with some of the strongest evidence concerning mortality (Holt-Lunstad, 2024). It is further linked to less cardiovascular disease risk (Valtorta et al., 2016b). People with strong social connections are further at lower risk for anxiety, depression and suicide (WHO, 2023). To foster those health benefits derived from good social connection, LTC facilities often provide structured, organized activities like group recreational activities, music-therapy, exercise programs or social events (Lapane et al., 2022).

Despite these supportive aims of LTC facilities, they often do not optimally address residents' social and emotional needs (Liougas et al., 2024; Martey et al., 2024). This is particularly concerning in light of the well-documented physical and mental health consequences associated with loneliness (NASEM, 2020; Prohaska et al., 2020).

As global populations continue to age and life expectancy increases, Austria is projected to follow a similar demographic trajectory. As of 2024, approximately 19 – 20% of the Austrian population is aged 65 years or older. This proportion is expected to rise to 26.2% by 2040 and to 29.3% by 2080. At the same time, life expectancy is projected to further increase, reaching nearly 90 years for men and 92 years for women by 2080. In contrast, birth rates are expected to remain below death rates, and the working-age population is predicted to decline by about 5%. These demographic developments are anticipated to place considerable strain on the healthcare system and to intensify challenges related to loneliness in old age (Lauren Newmyer et al., 2022; Statistik Austria, 2025). In addition to this development, the increasing likelihood of pandemics, such as COVID-19, may further exacerbate the problem of loneliness (Mukasa & Schoenmaeckers, 2021; Williams et al., 2023). Consequently, the development of effective strategies to reduce loneliness is becoming increasingly urgent at both global and national levels. This urgency is reflected in initiatives such as the WHO's establishment of a Commission on Social Connection, which underscores the recognition of loneliness as a major global health concern and calls for coordinated, evidence-based action. These efforts span a wide range of approaches, including national policies, community-based programs, public awareness campaigns, and individualized support measures (WHO, 2025a). The WHO emphasizes: "Social health is not a luxury. It is a human need." (WHO, 2025b). In order to pursue this, it is essential to develop a more comprehensive understanding of loneliness and its underlying determinants. This is particularly important in the context of population aging, as older adults are exposed to specific risk factors that may increase their vulnerability to loneliness over time. Among these factors, social isolation has been identified across different populations as one determinant.

A Preliminary Model of Social Connection

To better understand loneliness, it is essential to situate it within a broader conceptual framework of social connection. Social connection serves as an umbrella term encompassing multiple facets of human relationships, ranging from the mere presence of social networks to the emotional support and sense of connectedness they provide (Holt-Lunstad, 2018). However, research in this area is frequently complicated by inconsistent terminology and

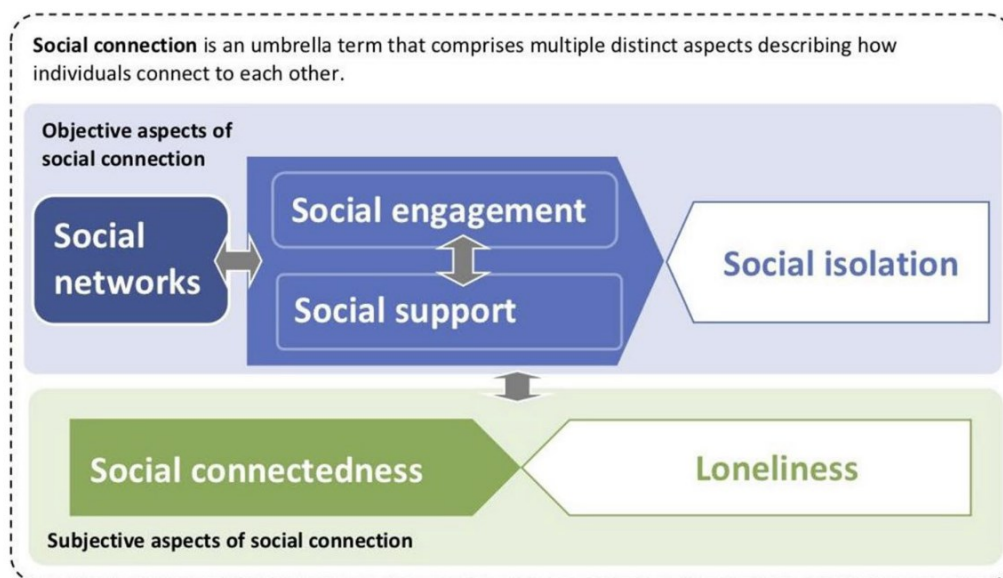
imprecise conceptualizations across disciplines, which hinder comparison of findings and clear differentiation between related constructs (Liougas et al., 2024; Valtorta, 2016a).

In response to these challenges, scholars have increasingly sought to organize social relationships along several key dimensions (Valtorta, 2016a) propose two central dimensions: subjectivity, which distinguishes between objective aspects (e.g., actual social network size) and subjective experiences (e.g. perceived support or loneliness), and Structure vs. Function, which differentiates the existence of relationships (structure) from what these relationships provide (function) (Valtorta, 2016a). Holt-Lunstad et al. (2017), further introduce quality as third dimension, capturing the distinction between positive and negative social experiences.

Building on this foundation, Liougas et al. (2024) developed a preliminary model of social connection tailored to the LTC context (Figure 1), which will serve as a guiding framework for the present thesis, with only elements most relevant to the current investigation discussed in detail.

Figure 1

A preliminary conceptual Model of Social Connection in LTC settings



Note. Adopted from *Social connection measures for older adults living in long-term care homes: A systematic review protocol*, by M. P. Liougas, A. Sommerlad, H. M. O'Rourke, K. S. McGilton, & J. Bethell, 2024, *Systematic Reviews*, 13, Article 67 (<https://doi.org/10.1186/s13643-024-02468-6>). Copyright 2024 by the authors.

Loneliness

Loneliness lies within the subjective realm of social connection and is defined as “the perception of social isolation or the subjective feeling of being lonely” (NASEM, 2020, p. 4). It constitutes an “unpleasant, subjective experience resulting from perceived inadequate social relationships” and reflects a discrepancy between desired and actual social interactions (Drageset et al., 2011, p. 612; NASEM, 2020). In the LTC context, Liougas et al. (2024) conceptualize loneliness as the absence of felt social connectedness. Loneliness encompasses both quantitative and qualitative dimensions (Perlman & Peplau, 1982; Russell et al., 1984) and is commonly conceptualized as comprising two primary forms: emotional and social loneliness. Emotional loneliness arises from the absence of close, intimate attachments, such as a spouse or best friend. In contrast, social loneliness results from a lack of a broader network such as being part of a group with shared activities or interests (Russell et al., 1984; Weiss, 1975). The former is often associated with the loss of close, intimate relationships, while the latter pertains to deficiencies in broader social networks and support systems. Further, Autschbach et al. (2024) and Mansfield et al. (2021) establish a third dimension. This so-called existential loneliness refers to a profound sense of fundamental separateness from others, extending beyond temporary social disconnection. Despite this definition, the specific expectations people hold toward their relationships and thus the potential different sources of loneliness may shift across the lifespan. These are categorized into six categories. Of these, two appear especially important in later life: generativity, defined as the opportunity to contribute meaningfully and care for future generations and respect, experiencing oneself as valued and socially included. The other four categories are viewed as important throughout all stages of life: fun, referring to shared enjoyment and mutual interests; intimacy, characterized by emotional closeness and feeling understood; support, involving the experience of care and dependable assistance; and proximity, denoting the availability of social contacts (Akhter-Khan et al., 2023; WHO, 2025a).

Social Isolation

Unlike loneliness, social isolation is an objective state. Although definitions and measurement methods vary (Holt-Lunstad et al., 2010; Valtorta, 2016a; Victor et al., 2020), it generally refers to the absence or minimal frequency of social contact (National Academies of Sciences, Engineering, 2020; WHO, 2025a). According to Liougas et al. (2024) social isolation encompasses more than just the number of relationships. Broadening narrower definitions (Gierveld & Tilburg, 2006; O'Reilly, 1988), it can be understood as the objective deficit in

social networks, social engagement and social support – components that, taken together, are also referred to as social integration (R. X. Hu, 2021; Leedahl et al., 2018). Hence, social isolation can be described as the absence of social integration.

The Relationship Between Loneliness and Social Isolation

Despite being closely interrelated loneliness and social isolation are distinct constructs (Grenade & Boldy, 2008; Liougas et al., 2024; WHO, 2025a). According to Perlman & Peplau (1982), both experiences can occur independently: one may feel lonely even in the company of others, or may be objectively isolated without feeling lonely (Coyle & Dugan, 2012; Donovan & Blazer, 2020; Liougas et al., 2024; Riesman et al., 2020; Sedlackova et al., 2024).

That said, these two constructs are, nonetheless, closely related, with social isolation frequently identified as a strong predictor of loneliness. For instance, Sun et al. (2022) found that social isolation positively predicted loneliness in Chinese LTC residents. And during the COVID-19 pandemic, reduced contact with family members was strongly associated with heightened loneliness (Li & Tang, 2022). Similarly, longitudinal analyses by Petersen et al. (2016) demonstrated that social isolation increased the likelihood of experiencing loneliness over a five-year time span. This relationship is further supported by a biological and evolutionary perspective, which conceptualize loneliness as an adaptive mechanism that, akin to hunger or thirst, motivates individuals to seek social connections necessary for survival and well-being (Holt-Lunstad, 2018). In line with that, Tomova et al., (2020) found that social cues following periods of isolation activated brain regions similar to those stimulated by food after fasting, further validating this understanding of loneliness as a fundamental “need signal” and highlighting its innate significance for human well-being.

Consequently, as emphasized by Sun et al. (2022, p. 2), it is important to further understand “[...] how social isolation affects loneliness and whether there are ways to mitigate this impact [...]”. Their findings suggest that this link between social isolation and loneliness is not merely direct but may be influenced by other psychological factors. One such factor that has emerged as particularly relevant in shaping this relationship is individuals’ attitudes toward aging, which may influence how social circumstances are perceived and experienced in later life (Sun et al., 2022).

The Role of Aging Attitudes

Aging attitudes (AA) are defined as individuals’ beliefs, opinions, and expectations about their own aging and that of others. They are typically categorized as either positive aging attitudes (PAA) (e.g. as people get older they are better able to cope with life) or negative aging attitudes

(NAA) (e.g. old age is a time of loss) (Laidlaw et al., 2007; Sun et al., 2022). Aging attitudes have been shown to significantly impact health, well-being, and quality of life (Brown et al., 2016; Chen et al., 2021; Cheng et al., 2021; Levy & Myers, 2004; Ugwu & Idemudia, 2025). Specifically, a systematic review of longitudinal work showed a robust link of more positive self-perceptions of aging and better self-rated health, reduced obesity, greater longevity, better performance of the activities of daily living, less depression, and enhanced cognitive functioning, including reduced cognitive decline and occurrence of dementia (Tully-Wilson et al., 2021). On the contrary, holding negative beliefs about aging was strongly linked to worse memory performance (Levy, 1996) or increased the likelihood amongst younger adults of suffering from cardiovascular events during their later life (Ferrucci, 2009).

Beyond those associations, aging attitudes have been directly linked to loneliness (Chen et al., 2021; Hu & Li, 2022). For example, Sun et al. (2022) found that PAAs buffered the effect of social isolation on loneliness, whereas NAAs amplified this association. Hu & Li, (2022) reported similar patterns in their study on subjective perceptions of aging and social isolation.

Described findings are consistent with Stereotype Embodiment Theory, which posits that culturally shaped beliefs and stereotypes about aging – such as viewing age as a period of inevitable decline or, conversely, as a stage of continued growth and resilience – are internalized over the lifespan and gain salience when they acquire self-relevance. Such internalized attitudes may operate both consciously and unconsciously, thereby influencing individuals' functioning, health outcomes, and psychological well-being (Ferrucci, 2009; Levy, 2009; Wurm et al., 2017). Also, amongst older individuals, specifically, negative aging attitudes are associated with reduced memory performance, according to meta-analysis by Horton et al. (2008). Additionally, a recent meta-analysis by Ugwu & Idemudia (2025) identified that in older adults' positive self-perception of aging were linked with better health-outcomes (e.g. hedonic well-being), whereas negative ones were associated with poorer health-outcomes (e.g. depression, anxiety, and perceived stress).

Individual Components of Social Isolation and Loneliness

For the LTC setting Liougas et al. (2024) identify three key components of social isolation: social networks, social support, and social engagement. Together, these components capture structural and functional aspects of social integration and provide a useful framework for examining how objective social conditions relate to experiences of loneliness in long-term care settings. The following sections discuss each of these components in the order presented.

Social Networks and Loneliness

Social networks are defined as the structural web of social relationships. Berkman et al. (2000) conceptualize social networks as the foundation upon which other aspects of social connection, such as social support and social engagement, are built. Research has demonstrated that social networks are closely linked to the experience of loneliness across different populations (Berkman et al., 2000; Cacioppo et al., 2010; Cohen-Mansfield et al., 2009; Victor & Bowling, 2012). In particular, social network size has been identified as a key predictor of loneliness (Perlman & Peplau, 1982), with smaller networks being especially associated with social loneliness (Dykstra & Fokkema, 2007; Hawkley et al., 2008).

Although the moderating role of aging attitudes has not been explicitly examined in this context, insights from Socioemotional Selectivity Theory (Carstensen, 1992, 2021) provide a plausible explanatory framework. According to this theory, as individuals perceive their remaining lifetime as more limited, they increasingly prioritize emotionally meaningful and close relationships over the expansion of large social networks (Akhter-Khan et al., 2023; Carstensen, 1992; WHO, 2021). In later life, the quality of social ties becomes more central than their quantity. Aging attitudes may shape how these age-related shifts in social preferences are interpreted and experienced. For example, individuals who view aging as a period of emotional growth, wisdom, or relational depth may perceive a smaller but emotionally close network as sufficient and meaningful, thereby experiencing less loneliness despite reduced social breadth. Conversely, individuals who associate aging with decline, loss, and social marginalization may interpret the same reduction in network size as evidence of abandonment or diminished social value, thereby intensifying loneliness. In this way, aging attitudes could influence whether normative age-related changes in social networks are experienced as adaptive selectivity or as social loss.

Social Support and Loneliness

Social support refers to the actual or perceived availability of support from others. It represents a functional component of social relationships (NASEM, 2020). A substantial body of research has demonstrated that social support is negatively associated with loneliness (Gabarrell-Pascuet et al., 2022; Zhao et al., 2018) and is widely regarded as a protective factor against loneliness (C. Hu et al., 2025). Both receiving and providing support have been shown to reduce loneliness and to enhance well-being (Antonucci et al., 2014; Bethell et al., 2019). These findings align with Social Support Theory, which posits that social relationships function as a key resource that promote psychological health and buffer the effects of stress through multiple

pathways, particularly in older adulthood (Chen et al., 2021; Lakey & Cohen, 2000; Vaux, 1988).

While research directly examining the moderating role of aging attitudes in this context remains scarce, related evidence on subjective age provides important insight. Subjective age is defined as the age individuals feel relative to their chronological age (Spitzer et al., 2022). It reflects individuals' internalized perceptions of aging and their age identity. In their study, subjective age moderated the association between close social relationships and loneliness: Although close relationships were generally linked to lower loneliness, this association was significantly weaker among individuals who felt older than their chronological age. In other words, those with an older subjective age derived fewer protective benefits from their close social ties. Conceptually, subjective age overlaps with aging attitudes, as both constructs capture internalized perceptions of aging and the self in relation to aging (Wurm et al., 2017). Whereas subjective age reflects how old individuals feel, aging attitudes encompass broader evaluative beliefs and expectations about aging. Both constructs, however, relate to age identity and internalized age stereotypes, and both may shape how social experiences are interpreted and emotionally processed. It is therefore plausible that aging attitudes similarly influence how social support is experienced and utilized. For example, individuals holding more negative aging attitudes may perceive themselves as burdensome, dependent, or socially less valuable, potentially reducing their ability to benefit from available social support. Conversely, more positive aging attitudes may enhance receptivity to support and strengthen its protective effect against loneliness.

Social Engagement and Loneliness

Social engagement is defined as the “enactment of potential ties in real life activities within the communities in which people live” (Leedahl et al., 2018, p. 5), including productive, as well as social and leisure activities (Glass et al., 2006). In community research, low social engagement was for example found to be a strong risk factor for loneliness among older adults (Meehan et al., 2025) and was found to be significantly negatively associated with loneliness (Ohta et al., 2024). In the LTC context, participation in nursing home activities is considered as the best indicator of social engagement (Leedahl et al., 2018). Specifically, LTC residents can benefit from both structured programs and informal social interactions (Forsman et al., 2013; Roberts & Bowers, 2015). As an example, engagement in organized activities has been linked to reductions in loneliness among LTC residents (Dahlberg et al., 2018).

While there is a paucity of research directly examining the role of aging attitudes in this, findings from community-based research by Xu et al. (2024) suggest that an increased participation in community life is associated with lower levels of loneliness, particularly among individuals who hold negative views of societal change. These are operationalized as older adults' subjective perceptions of rapid societal transformation and its consequences, particularly whether they experience these changes as difficult, unfavorable, or hard to adapt to. Hence, these subjective evaluations reflect for example perceived loss of norms, difficulty adapting, feeling marginalized by change, and reduced fit between older adults and contemporary society (W. Xu & Hu, 2024). Like aging attitudes, which represent appraisals of (one's own) aging, views of social change describe the individual's attitude towards society and one's own role within. Given the conceptual parallels between perceptions of societal change and aging attitudes, it is reasonable to assume that aging attitudes could similarly moderate the effect of social engagement on loneliness in LTC settings. For example, an older adult who perceives society as changing too rapidly and becoming less favorable toward older people may experience feelings of exclusion. In such a context, structured community engagement may compensate for this perceived marginalization and reduce loneliness. In parallel, negative attitudes toward one's own aging may similarly shape expectations of social value and belonging, thereby influencing how social engagement relates to loneliness.

Aims and Research Questions

While the association between social isolation and loneliness is well established, the moderating role of aging attitudes – particularly in relation to specific components of social isolation including social networks, social support, and social engagement – remains underexplored (Holt-Lunstad, 2018; Li & Tang, 2022; Petersen et al., 2016; Sun et al., 2022; Tomova et al., 2020). This gap is especially pronounced within Austrian long-term care (LTC) settings.

In light of demographic aging, increasing demand for LTC services, and the substantial physical and psychological consequences associated with loneliness, a deeper understanding of the mechanisms underlying loneliness is essential (Lauren Newmyer et al., 2022; Statistik Austria, 2025; WHO, 2025a). If aging attitudes shape how older adults perceive and are affected by their social environments, they may represent a modifiable protective factor. Integrating assessments of aging attitudes into intervention strategies could help amplify beneficial effects of social connection while mitigating harmful impacts of social isolation. Ultimately, fostering more positive aging attitudes within LTC facilities may contribute to

improved emotional well-being, reduced loneliness, and enhanced quality of life among residents (Wurm et al., 2017).

Building on this rationale, the present study aims to examine the relationship between social isolation and loneliness in LTC residents, with particular attention to the moderating role of aging attitudes and the hitherto underexplored differential contributions of social networks, social support, and social engagement. Examining these dimensions separately is especially valuable, as it moves beyond treating social isolation as a global construct and instead identifies which specific aspects of social connection are most strongly linked to loneliness. Such differentiation has important practical implications: while “social isolation” as a broad concept offers limited guidance for intervention, understanding whether loneliness is more closely related to infrequent contact, insufficient perceived support, or limited network size allows for more targeted and potentially effective strategies. For example, if frequency of contact emerges as particularly relevant, interventions could prioritize structured opportunities for regular contact with close family members or meaningful one-to-one interactions with staff. If perceived social support proves central, programs might focus on strengthening emotionally supportive relationships rather than simply increasing the number of social activities. By disentangling these components, the study contributes to a more nuanced understanding of loneliness in LTC settings and provides a clearer basis for the development of tailored, evidence-informed interventions. Accordingly, the study addresses the following research questions:

RQ1: How are social isolation and its specific components (social networks, social support, and social engagement) associated with loneliness among LTC residents?

RQ2: Do aging attitudes moderate the relationship between social isolation and loneliness, as well as the relationships between its individual components and loneliness?

Hypotheses

Based on the theoretical framework and prior empirical findings, the following hypotheses are proposed. Figure 2 provides an overview of all study hypotheses.

Main Hypotheses

H1: Social isolation is positively associated with loneliness.

H2: Social network size is negatively associated with loneliness.

H3: Social support is negatively associated with loneliness.

H4: Social engagement is negatively associated with loneliness.

Exploratory Moderation Hypotheses

Given the limited empirical evidence regarding the moderating role of aging attitudes, particularly within LTC settings, the following moderation hypotheses are examined on an exploratory basis:

H1a: Positive aging attitudes are associated with the relationship between social isolation and loneliness.

H1b: Negative aging attitudes are associated with the relationship between social isolation and loneliness.

H2a: Positive aging attitudes are associated with the relationship between social network size and loneliness.

H2b: Negative aging attitudes are associated with the relationship between social network size and loneliness.

H3a: Positive aging attitudes are associated with the relationship between social support and loneliness.

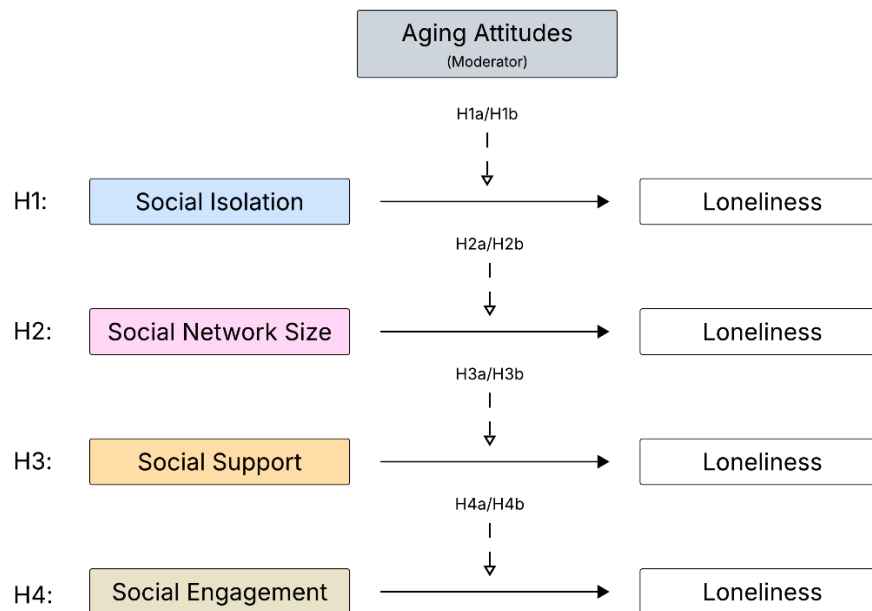
H3b: Negative aging attitudes are associated with the relationship between social support and loneliness.

H4a: Positive aging attitudes are associated with the relationship between social engagement and loneliness.

H4b: Negative aging attitudes are associated with the relationship between social engagement and loneliness.

Figure 2

Conceptual Model of the Hypothesized Relationships Between Social Isolation, its Components, and Loneliness with Aging Attitudes as a Moderator.



Note. Social isolation and its components (social networks, social support, and social engagement) are hypothesized to predict loneliness (H1 – H4; main analysis). Aging attitudes (positive and negative) are expected to moderate each of these associations (H1a–H4b; exploratory moderation hypotheses), such that positive aging attitudes weaken and negative aging attitudes strengthen the respective relationships.

Materials and Methods

Procedure

The present investigation was conducted in collaboration with two-sites of a well-established long-term care institution in Vienna, Austria. Both sites provide long-term, multidisciplinary care for older adults and individuals with special needs, offering comprehensive in-house medical, nursing, and therapeutic services aimed at holistic well-being. They actively promote social interaction by engaging volunteers and visitors, providing attractive indoor and outdoor spaces, and organizing regular events. While sharing a common care philosophy, the two sites differ slightly. Research site 1 represents the larger facility, with a broader range of long-term care units and a higher number of residents, which may result in greater opportunities for peer interaction but also in more complex social dynamics. In contrast, research site 2 is smaller,

with a comparatively more compact residential structure and fewer residents per unit. These differences in size, spatial layout, and resident composition may influence the frequency of contact, opportunities for social participation, and perceived social connectedness among residents.

The study was approved by the Ethics Committee of the University of Vienna (reference number 01364). Data were collected using a mixed-methods approach with a convenience sample, drawing on both primary and secondary sources. Primary data describes data collected specifically for this study, whereas secondary data refers to pre-existing data that were originally collected for purposes other than the present study. Primary data was gathered through on-site interviews with residents, conducted by three researchers trained in psychology, all of whom hold a B.Sc. in Psychology and are currently pursuing an M.Sc. degree in Psychology. Initially, eligible potential participants were approached and informed about the study background and procedures. Those who expressed interest were invited to provide written informed consent. Following consent, interviews were either conducted immediately or scheduled for a later appointment. Upon beginning, participants were informed about the interview procedure, including the voluntary nature of participation, the option to discontinue or take a break, and an explanation of the response format. The interviews were conducted in a structured manner using the specified predetermined set of questionnaires (Appendix). They were held in locations within the respective facilities based on participant preference and lasted between approximately 15 to 120 minutes, depending on the participants' health status and willingness to engage. At the end, the participants were debriefed and advised on how to get in touch if they had any further questions or concerns. Secondary data was obtained from existing care documentation. The overall data collection period extended from 01.08.2025 to 15.12.2025.

Participants

To be eligible for participation, individuals were required to be of legal age and able to provide written informed consent; accordingly, participants under legal guardianship were excluded. Potential participants were identified by the respective ward managers or nursing administration. A list was passed on to the interviewers. Based on this list, potentially suitable residents were approached.

Measures

Loneliness

Loneliness was assessed using the German adaptation of the 20-item UCLA Loneliness Scale (Döring & Bortz, 1993). Responses were recorded on a 5-point Likert scale (1 = not true at all to 5 = completely true). Scores were computed for the overall scale and its three subscales: ‘feeling of loneliness’ (Factor 1), ‘perceived emotional isolation’ (Factor 2), and ‘perceived social isolation’ (Factor 3) (Döring & Bortz, 1993). Sum scores were divided by the number of items to yield a final score ranging from 1 to 5, with higher scores indicating greater loneliness. The German adaptation demonstrated good psychometric properties, with an internal consistency of $\alpha = .89$ (Döring & Bortz, 1993). In the present study, the scale showed similarly high internal consistency (Cronbach’s $\alpha = .90$).

Social Isolation

Social isolation was assessed using the 23-item Revised Lubben Social Network Scale for Long-Term Care (LSNS-LTC; Munn et al., (2018). The items are organized into three conceptual categories: active and intimate social network size (item 1; 7; 13; 19), frequency of contact (item 2; 8; 14; 20) and reciprocal social support (item 3 – 6; 9 – 12; 15 – 18; 21 – 23) (Bincy et al., 2022; Burnette & Myagmarjav, 2013; Eslami et al., 2023; Munn et al., 2018; Myagmarjav et al., 2019). Responses were provided on a 5-point Likert scale with quantitative items assessing the number of social contacts, and frequency-based items assessing how often contact occurred, ranging from none to daily. The LSNS-LTC includes subscales reflecting different target groups (i.e., family, residents, friends, and staff). The LSNS-LTC total score ranges from 0 to 115 for total social isolation. Subscale scores range from 0 – 20 for the social network size subscale and frequency of contact subscale, and from 0 – 75 for the social support subscale. Higher scores indicate lower social isolation, smaller social network size, lower social support and frequency of contact. Previous studies have reported good internal consistency for the overall scale (Cronbach’s $\alpha = .85$), with all subscales surpassing the cutoff limited of $\alpha = 0.3$ (Munn et al., 2018). According to (Munn et al., 2018) this supports the notion that each subscale represents an unidimensional scale. In the present study, the LSNS-LTC showed similar internal consistency (Cronbach’s $\alpha = .89$). However psychometric properties for the subscales ranged from low to good: social network size (Cronbach’s $\alpha = .43$), frequency of contact (Cronbach’s $\alpha = .52$), and social support (Cronbach’s $\alpha = .86$).

Social Engagement

Based on the framework suggested by Leedahl et al. (2018) social engagement was operationalized by resident participation in long-term care home activities, obtained from existing care documentation. Activities were classified into therapeutic interventions and social/leisure activities. Therapeutic activities included groups such as the gardening group, snoezelen group, opera group, fall prevention, cognitive group, and boccia. All groups aim to promote cognitive and motor activation as well as perception and functional skills. The social and leisure activities primarily consisted of activities organized by the respective ward, such as craft afternoons, events and gatherings. For each, participation frequencies were recorded on a monthly (i.e., July 2025) and annual (01.07.2024 – 01.07.2025) basis. This enabled both an analysis based on activity types per period, and of the combined social engagement score.

Aging Attitudes

Based on (Sun et al., 2022), aging attitudes were assessed using the Attitudes to Aging Questionnaire (AAQ; Laidlaw et al., 2007). It includes two subscales, namely positive (PAA) and negative aging attitudes (NAA). Responses are given on a 5-point-likert scale (1 = strongly disagree to 5 = strongly agree) (Laidlaw et al., 2007; Sun et al., 2022). Total scores range from 3 to 15 for the PAA subscale, and from 4 to 20 for the NAA subscale. Higher scores indicate a stronger endorsement of the respective attitude. Both scales have been reported to demonstrate sufficient internal consistency (PAA: Cronbach's $\alpha = .60$; NAA: Cronbach's $\alpha = 0.70$) (Sun et al., 2022). In the present investigation, both scales demonstrated lower internal consistency (PAA: Cronbach's $\alpha = .51$; NAA: $\alpha = .60$).

Covariates

Due to expected sample size, only depression was initially included as covariates in the models, since it shows a robust link with both the dependent and independent variables (Chamberlain et al., 2020; Lapane et al., 2022; Mulla et al., 2025; Sedlackova et al., 2024; Smith & Theeke, 2024; Theurer et al., 2021; Yen et al., 2024). Information on diagnosis involving depression was obtained from existing care documentation. It was dummy coded as either no diagnosis (0) and past/present diagnosis (1).

Demographics

Demographic data including age, gender, marital status, and residential ward was extracted from existing care documentation.

Data Analysis

All statistical analyses were conducted using RStudio (Version 2025.09.2+418 (2025.09.2+418)). For each hypothesis, single or multiple linear regression analyses were performed. Statistical tests were conducted using a two-tailed significance level of $\alpha = .05$.

Data Preparation and Screening

Positively worded items of the UCLA-Loneliness Scale were reverse coded so that higher values consistently indicated greater loneliness. Missing data were examined at both item and sample levels using diagnostics and visuals. Participants with 20% or more missing values on the UCLA-LS, LSNS-LTC, or AAQ scales were excluded from the analyses. For remaining cases, missing values were imputed using within-person mean substitution.

Mean and sum scores were subsequently calculated as specified for each instrument. Additionally, LSNS-LTC total scores were reverse-coded so that higher scores would indicate greater social isolation, whereas subscale scores for social network size, social support and frequency of contact were not reversed coded (i.e., original direction retained), with higher scores reflecting greater social network size, greater social support, and higher frequency of contact.

For analyses involving social engagement, missingness was examined separately. As these variables were not suitable for mean imputation, cases with missing data in either variable (monthly social engagement and yearly social engagement) were excluded listwise for these analyses.

Assumption Testing Prior to regression analyses, assumptions of linear regression were evaluated. Normality of residuals was examined using Q – Q plots. Homoscedasticity was inspected through visual inspection of residuals plotted against fitted values and formally tested using the Breusch–Pagan test. When violations of homoscedasticity were detected, robust standard errors were applied. However, assumption tests are reported only in cases where violations of the respective assumptions were observed.

Influential observations were examined using Cook's distance, applying the sample-size-adjusted cutoff criterion ($D > 4/(N - p - 1)$). For models in which influential cases were identified, regression analyses were re-estimated after excluding these observations, and model coefficients and fit indices (R^2 , adjusted R^2 , and F-statistics) were compared to assess robustness.

For each hypothesis, a series of single or multiple linear regression analyses was conducted. Loneliness (UCLA total score) served as the dependent variable in all primary analyses. Independent variables varied by hypothesis:

- H1: Social Isolation
- H2: Social Network Size
- H3: Social Support
- H4: Social Engagement

For the respective exploratory sub-hypotheses (H1a – H4b) positive and negative aging attitudes were included to the analyses as moderators. All independent variables were z-standardized prior to model estimation. Interaction terms were computed as the product of the standardized independent and moderator variables. Additionally, to afore mentioned assumptions multicollinearity (VIF) was checked. Significant interactions were probed using simple slope analyses at -1 SD, mean, and +1 SD levels of the moderator. Additionally, Johnson-Neyman-analyses was performed.

Exploratory Analyses

Exploratory analyses were conducted by stratifying participants into two age groups: old-old (85–94 years) and oldest-old (95 years and older). For each group, descriptive statistics and correlations were calculated, and all primary hypotheses were re-tested. Additionally, the association between frequency of contact to loneliness was examined, including potential moderation by positive and negative aging attitudes using the same analytic approach as in the primary analyses. Finally, a multiple regression model including all variables that significantly correlated with loneliness (ref. Table 7) was estimated (i.e. social network sizes, social support, positive aging attitudes, negative aging attitudes). Interaction terms were not included in this combined model.

Power Analysis

An a priori power analysis was conducted using GPower (Version 3.1.9.6) to determine the required sample size for detecting effects in multiple regression analyses. Previous research has reported associations between social isolation and loneliness ranging from small to moderate ($\beta = 0.11$ to $\beta = 0.31$) (Hong et al., 2023, 2024; Shankar et al., 2011; Sun et al., 2022).

Assuming a medium effect size ($f^2 = 0.25$), an alpha level of .05, and a desired power of .80, the required sample size was estimated at $N = 53$. To account for potential attrition and incomplete data, a 10% buffer was added, resulting in a final target sample size of $N = 58$.

Results

Missing data Analysis

Item-Level Missingness

First, the extent of missing values at the item level was examined. Regarding items of UCLA Loneliness Scale, LSNS-LTC and AAQ, visual inspection did not indicate any missing data pattern. Across all items, the proportion of missing values was low and amounted to approximately 2% of all item-level data points ($n = 50$). Highest proportions of missing values were found in individual items of the UCLA Loneliness Scale and the LSNS-LTC (i.e. UCLA item 8 (16.18 %); item 18 (8.82 %), LSNS-LTC item 12 (10.29 %), LSNS-LTC item 17 (8.82 %). The Aging Attitudes Questionnaire was answered completely, only item 6 showed missingness of 1.47%. Missing analysis of both social engagement variables (i.e. yearly and monthly) was conducted separately. Monthly social engagement displayed 2.94% ($n = 2$) missingness and yearly social engagement 4.41% ($n = 3$). Visual inspection did not indicate systematic patterns of missing values. For demographics including age, gender and marital status only marital status displayed 2% ($n = 2$) missingness.

Sample-Level Missingness.

On sample level missing values were analyzed for Attitudes to Aging Questionnaire, LSNS-LTC Scale and UCLA Loneliness Scale, separately. Considering the Attitudes to Aging Questionnaire, only one participant displayed missing data of 14.3%, the rest showed complete data on this scale. Regarding the LSNS-LTC approximately 71% of the participants showed complete data. The rest displayed missingness varying from 4.35% to 17.4% on the scale. On the UCLA Loneliness Scale, approximately 63% of individuals had complete data; the remaining participants predominantly showed little missing data of 5% up to a maximum of 15%. Across all scales, no individual exceeded the pre-specified threshold of 20% missing values per scale.

Descriptive results

Regarding the mean age was 81.91 years ($SD = 11.63$, $range = 50 - 103$). 7.4% of participant ($n = 5$) identified as the oldest-old (95+ years), 39.7% ($n = 27$) as old-old (85 – 94 years), 32.4% ($n = 22$) as old (76 – 84 years), 13.2.% ($n = 9$) as elderly (61 – 75 years), and 7.4.% ($n = 5$) as middle old (44 – 60 years). 75% ($n = 51$) presented as female, and 25% ($n = 17$) as male. Marital status was represented as follows: 45.6% ($n = 31$) widowed, 27.9% ($n = 19$) married/partnered, 13.2% ($n = 9$) divorced/separated, 10.3% ($n = 7$) single, and 2.9% ($n = 2$)

NA. Descriptive statistics according research sites are displayed in Table 1 and Table 2.

Table 1

Descriptive characteristics of metric variables for the total sample split by research site.

Variable										
	Research site	N	M	SD	SE	Min	Max	Range	Skew	Kurtosis
Age	1	53	81.66	12.45	1.71	50	99	49	-1.08	0.19
	2	15	82.8	8.43	2.18	69	103	34	0.38	0.31
Loneliness	1	53	2.1	0.8	0.11	1.1	4.32	3.22	1.09	0.45
	2	15	1.92	0.75	0.19	1.3	3.8	2.5	1.36	0.59
PAA	1	53	3.4	1.07	0.15	1	5	4	-0.23	-0.87
	2	15	2.84	1.05	0.27	1	5	4	0.2	-0.68
NAA	1	53	2.32	1.08	0.15	1	4.75	3.75	0.53	-0.74
	2	15	2.22	1.07	0.28	1	4.5	3.5	0.7	-0.87

Table 2

Descriptive characteristics of categoric variables.

Variable	Research site	N	%
Gender			
Female	1	38	71.7
Female	2	13	86.7
Male	1	15	28.3
Male	2	2	13.3
Marital status			
Married/partnered	1	12	23.1
Married/partnered	2	7	50
Widowed	1	27	51.9
Widowed	2	4	28.6
Divorced/separated	1	7	13.5
Divorced/separated	2	2	14.3

Single	1	6	11.5
Single	2	1	7.1

Loneliness

In the total sample, the mean score of loneliness was 2.06 ($SD = 0.79$, $SE = 0.1$, $range = 1.1 - 14.32$). For parameters for both research site is referred to Table 1 How loneliness was manifested across the different age groups is presented in Table 3.

Table 3

Descriptive statistics of loneliness according to age groups.

Age group									
	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>SE</i>	<i>Min</i>	<i>Max</i>	<i>Range</i>	<i>Skew</i>	<i>Kurtosis</i>
Middle (44-60 years)	5	1.85	0.77	0.34	1.1	2.84	1.74	0.18	-2.06
Elderly (61-75 years)	9	2.03	0.74	0.25	1.15	3.42	2.27	0.57	-1.08
Old (76-84 years)	22	1.98	0.65	0.14	1.3	3.65	2.35	1.25	0.3
Old-old (85- 94 years)	27	2.09	0.88	0.17	1.2	4.32	3.12	1.36	0.85
Oldest-old (95+ years)	5	2.57	1.05	0.47	1.3	3.8	2.5	-0.06	-2.06

Accounting for gender, females ($n = 51$) showed a mean loneliness score of $M_{Loneliness} = 2.02$ ($SD = 0.83$, $SE = 0.12$, $range = 1.10 - 4.32$), while males ($n = 17$) had a slightly higher mean score ($M_{Loneliness} = 2.18$, $SD = 0.67$, $SE = 0.16$, $range = 1.39 - 3.80$). Loneliness characteristics categorized by marital status can be found in Table 4.

Table 4

Descriptive statistics of loneliness across marital status categories.

Marital status									
	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>SE</i>	<i>Min</i>	<i>Max</i>	<i>Range</i>	<i>Skew</i>	<i>Kurtosis</i>
Married/partnered	19	2.04	0.68	0.16	1.25	3.42	2.17	0.84	-0.59
Widowed	31	2.03	0.87	0.16	1.15	4.32	3.17	1.31	0.82
Divorced/separated	9	2.12	0.73	0.24	1.35	3.65	2.3	0.95	-0.47
Single	7	1.96	0.75	0.28	1.1	3.33	2.23	0.6	-1

Aging Attitudes

In the total sample, the mean score for positive aging attitudes was $M_{PAA} = 3.28$ ($SD = 1.08$, $SE = 0.13$, $range = 1 - 5$). The mean score for negative aging attitudes was $M_{NAA} = 2.30$ ($SD = 1.07$, $SE = 0.13$, $range = 1 - 4.75$). For values regarding both research sites refer to Table 1. The expression of aging attitudes across all age groups can be seen in following Table 5

Table 5

Descriptive statistics for both aging attitudes scales across all age groups.

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>SE</i>	<i>Min</i>	<i>Max</i>	<i>Range</i>	<i>Skew</i>	<i>Kurtosis</i>
Positive aging attitudes									
Middle (44-60 years)	5	4.4	0.83	0.37	3.33	5	1.67	-0.34	-2.17
Elderly (61-75 years)	9	2.74	1	0.33	1	4	3	-0.12	-1.28
Old (76-84 years)	22	3.06	1.07	0.23	1	5	4	0.07	-0.86
Old-old (85- 94 years)	27	3.47	1.02	0.2	1.33	5	3.67	-0.23	-0.88
Oldest-old (95+ years)	5	3.07	1.14	0.51	1.67	4	2.33	-0.29	-2.2
Negative aging attitudes									
Middle (44-60 years)	5	1.7	0.93	0.41	1	3.25	2.25	0.76	-1.29
Elderly (61-75 years)	9	2.19	1.07	0.36	1	4	3	0.43	-1.47
Old (76-84 years)	22	2.35	0.96	0.2	1	4.25	3.25	0.34	-1.08
Old-old (85- 94 years)	27	2.3	1.06	0.2	1	4.75	3.75	0.56	-0.72
Oldest-old (95+ years)	5	2.85	1.71	0.76	1	4.75	3.75	0.1	-2.17

Overall, females ($n = 51$) reported slightly higher positive aging attitudes ($M_{PAA} = 3.34$, $SD = 1.12$, $SE = 0.16$, $range = 1 - 5$) compared to males ($n = 17$) ($M_{PAA} = 3.10$, $SD = 0.95$, $SE = 0.23$, $range = 1.33 - 5$). Negative aging attitudes were slightly lower among females ($M_{NAA} = 2.24$, $SD = 1.11$, $SE = 0.16$, $range = 1 - 4.75$) than among males ($M_{NAA} = 2.49$, $SD = 0.94$, $SE = 0.23$, $range = 1.5 - 4$). The manifestation of aging attitudes across different marital status can be seen in Table 6. Results of Spearman correlations between all study variables can be obtained from Table 7.

Table 6

Descriptive statistics of aging attitudes across different marital status groups.

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>SE</i>	<i>Min</i>	<i>Max</i>	<i>Range</i>	<i>Skew</i>	<i>Kurtosis</i>
Positive aging attitudes									
Married/partnered	19	3.32	1.02	0.23	1.33	5	3.67	-0.18	-0.8
Widowed	31	3.35	1.09	0.2	1	5	4	-0.46	-0.59
Divorced/separated	9	2.89	0.96	0.32	1.67	5	3.33	0.86	0.02
Single	7	3.71	1.31	0.5	2	5	3	-0.32	-1.86
Negative aging attitudes									
Married/partnered	19	2.53	1.02	0.23	1	4.75	3.75	0.47	-0.85
Widowed	31	2.15	1.05	0.19	1	4.75	3.75	0.72	-0.37
Divorced/separated	9	2.39	1.13	0.38	1	4	3	0.27	-1.63
Single	7	1.71	0.77	0.29	1	3.25	2.25	0.91	-0.52

Table 7

Correlation of key study variables for total sample.

Variables	Age	Gender	Marital Status	Social Engagement (monthly)	Social Engagement (yearly)	Loneliness	Social Isolation	Social Network Size	Social Support	PAA	NAA
Age	1***	-0.15	-0.15	-0.03	-0.03	0.11	0.23	-0.11	-0.23	0.09	0.02
Gender	-0.15	1***	-0.16	0.15	0.14	0.18	-0.09	-0.01	0.13	-0.1	0.14
Marital Status	-0.15	-0.16	1***	0.01	0.08	-0.01	0.07	-0.02	-0.1	-0.01	-0.19
Social Engagement (monthly)	-0.03	0.15	0.01	1***	0.62***	-0.12	-0.12	0.08	0.15	0.29	-0.12
Social Engagement (yearly)	-0.03	0.14	0.08	0.62***	1***	-0.09	0.02	-0.08	0.04	0.18	-0.18
Loneliness	0.11	0.18	-0.01	-0.12	-0.09	1***	0.49**	-0.42*	-0.43*	-0.24	0.47**
Social Isolation	0.23	-0.09	0.07	-0.12	0.02	0.49***	1***	-0.81***	-0.96***	-0.06	0.1
Social Network Size	-0.11	-0.01	-0.02	0.08	-0.08	-0.42***	-0.81***	1***	0.69***	-0.05	-0.14
Social Support	-0.23	0.13	-0.1	0.15	0.04	-0.43***	-0.96***	0.69***	1***	0.07	-0.07
PAA	0.09	-0.1	-0.01	0.29*	0.18	-0.24*	-0.06	-0.05	0.07	1***	-0.19
NAA	0.02	0.14	-0.19	-0.12	-0.18	0.47***	0.1	-0.14	-0.07	-0.19	1***

Note. * $p < 0,05$; ** $p < 0,01$; *** $p < 0,001$.

Main Hypothesis

Hypothesis 1

(“Social isolation is positively associated with loneliness.”)

Visual inspection of the residuals versus fitted values did not clearly support homoscedasticity; this was confirmed by a significant Breusch–Pagan test, $BP = 6.04$, $df = 1$, $p = .014$, indicating heteroskedasticity. Cases 15, 17, 18, 30, and 43 as were identified as potentially influential. The model demonstrated significance, $F(1, 66) = 27.24$, $p < .001$, explaining approximately 29% of the variance in loneliness ($R^2 = .29$). Social isolation was positively linked with loneliness ($\beta = 0.48$, $SE = 0.09$, $t(66) = 5.22$, $p < .001$). Controlling for heteroskedasticity using robust SE s, the overall model fit remained similar ($F(1, 66) = 27.24$, $p < .001$, $R^2 = .29$) and the link between social isolation and loneliness stayed significant ($\beta = 0.48$, $SE = 0.11$, $t(66) = 4.48$, $p < .001$). Excluding potential influential cases, the model remained statistically significant, $F(1, 61) = 34.13$, $p < .001$, with greater explained variance in loneliness ($R^2 = .36$, adjusted $R^2 = .35$). Compared to the initial model the regression coefficient presented highly similar ($\beta = 0.47$, $SE = 0.08$, $t(61) = 5.84$, $p < .001$).

Hypothesis 2

(“Social network size is negatively associated with loneliness.”)

Inspection of residuals versus fitted values did not clearly support the assumption of homoscedasticity, which was further confirmed by a significant Breusch-Pagan test ($BP = 4.03$, $df = 1$, $p = .045$). As potential influential cases IDs: 15, 30, 43, and 44 were identified. Linear regression model showed that the relationship of social network size and loneliness is significant ($\beta = -0.36$, $SE = 0.09$, $t(66) = -4.01$, $p < .00$). The model explained approximately 20% of the variance in loneliness ($R^2 = .20$, $adj. R^2 = .18$; $F(1, 66) = 16.08$, $p < .001$). Applying robust standard errors, results remained unchanged ($\beta = -0.36$, $SE = 0.09$, $t(66) = -4.10$, $p < .001$). After excluding potential influential cases, the negative association between social network size and loneliness remained statistically significant ($\beta = -0.28$, $SE = 0.09$, $t(66) = -3.17$, $p = .002$). However, explained variance reduced compared to the initial model ($R^2 = .14$, $adj. R^2 = .13$; $F(1, 62) = 10.02$, $p = .002$).

Hypothesis 3

(“Social support is negatively associated with loneliness.”)

Homoskedasticity could not be confirmed based on visual inspection and the Breusch-Pagan Test ($BP = 6.36$, $df = 1$, $p = .012$). Cook’s distance identified following IDs as potential

influential cases: 10, 15, 17, 18, 30, 43. Social support demonstrated a significant link with loneliness ($\beta = -0.41$, $SE = 0.09$, $t = -4.53$, $p < .001$). The overall model was significant ($F(1, 66) = 20.49$, $p < .001$) and explained approximately 24% of the variance in loneliness ($R^2 = .24$, $adj. R^2 = .23$). Using heteroskedasticity-robust standard errors (HC3), the results remained unchanged ($\beta = -0.41$, $robust SE = 0.11$, $t(66) = -3.83$, $p < .001$). After excluding influential cases, the relation stayed significant ($\beta = -0.40$, $SE = 0.08$, $t(66) = -5.08$, $p < .001$). The explained variance increased compared to the full sample ($R^2 = .30$, $adj. R^2 = .29$).

Hypothesis 4

(“Social engagement is negatively associated with loneliness.”)

Upon analysis, IDs with missing in the variable yearly social engagement were excluded (IDs: 57, 61, 62). Hence $n = 65$ participants remained for this analysis. Inspection of the residuals-versus-fitted plot did not clearly support homoskedasticity; however, the Breusch–Pagan test was not significant ($BP = 3.09$, $df = 1$, $p = .079$), suggesting no strong evidence for heteroskedasticity. As potential influential cases IDs: 15, 41, 43, 44, and 61 were identified. Social engagement over a one-year period was not significantly associated with loneliness ($\beta = 0.00013$, $SE = 0.00120$, $t(63) = 0.11$, $p = .91$). The model was not significant ($F(1, 63) = 0.01$, $p = .91$) and did not explain any variance loneliness, $R^2 = .0002$ ($adj. R^2 = -.016$),

Exploratory Analysis

Hypothesis H1a

(“Positive aging attitudes are associated with the relationship between social isolation and loneliness.”)

Visual inspection of residuals versus fitted values did not clearly support homoscedasticity; this was further confirmed by a significant Breusch–Pagan test ($BP = 12.82$, $df = 2$, $p = .002$), indicating heteroskedasticity. Following IDs were identified as potential influential cases: 15, 17, 18, 30, 43, and 68. The overall model was significant, $F(3, 64) = 12.42$, $p < .001$, with 37% explained variance in loneliness ($R^2 = .37$, $adj. R^2 = .34$). Both social isolation ($\beta = 0.54$, $p < .001$) and positive aging attitudes ($\beta = -0.29$, $p = .007$) were significantly associated with loneliness. However, the interaction term between social isolation and positive attitudes toward aging did not present as significant ($\beta = 0.09$, $p = .426$). Using heteroskedasticity-robust standard errors. The pattern of results remained unchanged for social isolation ($\beta = 0.54$, $robust SE = 0.12$, $t = -4.59$, $p < .001$), as well as for positive aging attitudes ($\beta = -0.29$, $robust SE = 0.11$, $t = -2.66$, $p = .010$). The interaction term remained non-significant ($\beta = 0.09$, $robust SE = 0.13$, $t = 0.70$, $p = .485$). Excluding potential influential cases, the reduced model was

statistically significant, $F(3, 59) = 15.61, p < .001$, demonstrating a greater explained variance ($R^2 = .44, \text{adj. } R^2 = .41$). Social isolation remained significantly related to loneliness, ($\beta = 0.55, SE = 0.09, t(59) = 6.22, p < .001$, as did positive attitudes toward aging, ($\beta = -0.22, SE = 0.09, t(59) = -2.51, p = .015$). In contrast to the initial model, the interaction between social isolation and positive attitudes toward aging was statistically significant in the reduced sample, ($\beta = -0.22, SE = 0.11, t(59) = -2.07, p = .043$). Compared to the original moderation model ($R^2 = .37$), model fit improved ($R^2 = .44, \text{adj. } R^2 = .42$). To further examine the significant interaction, a simple slopes analysis was conducted (Figure 3). Here the association between social isolation and loneliness demonstrated significant at lower levels of positive aging attitudes ($-1 SD$) ($\beta = 0.63, SE = 0.15, t = 4.16, p < .001$). At the mean level of positive aging attitudes, the slope remained significant ($\beta = 0.54, SE = 0.10, t = 5.38, p < .001$). At higher levels of positive aging attitudes ($+1 SD$), the association was weaker but still statistically significant ($\beta = 0.44, SE = 0.15, t = 2.90, p = .010$). Additionally, a Johnson-Neyman analysis was conducted. Here the association between social isolation and loneliness was statistically significant for values of positive aging attitudes within the interval $z = -3.75$ to $z = 1.49$ ($p < .05$). Within the observed range of positive aging attitudes in the sample ($z = -2.11$ to $z = 1.59$), this indicates that the link of social isolation on loneliness was significant across most observed values, becoming non-significant only at the upper end of positive aging attitudes (Figure 4).

Figure 3

Simple Slopes analysis of moderating link of positive aging attitudes.

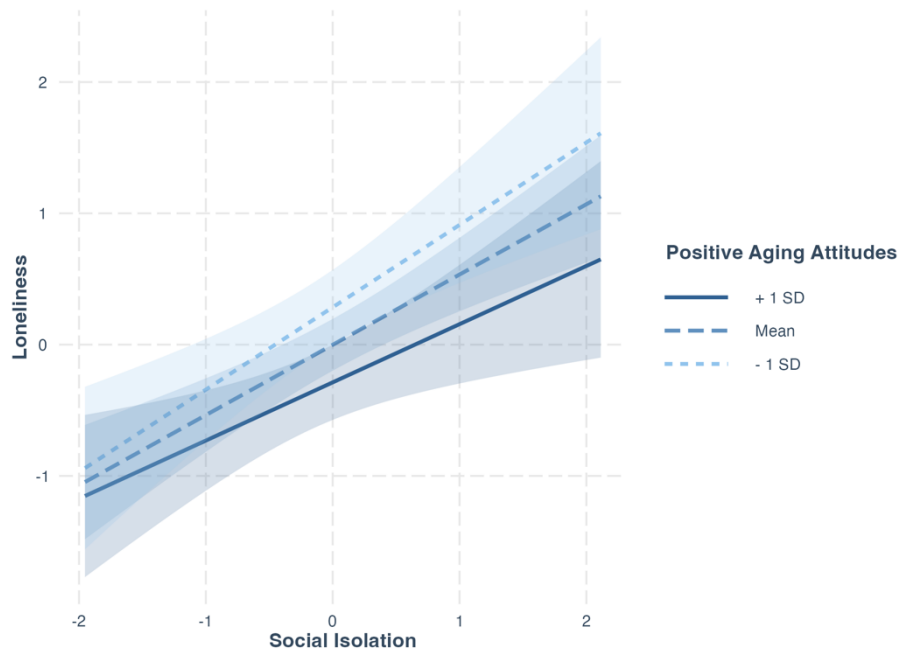
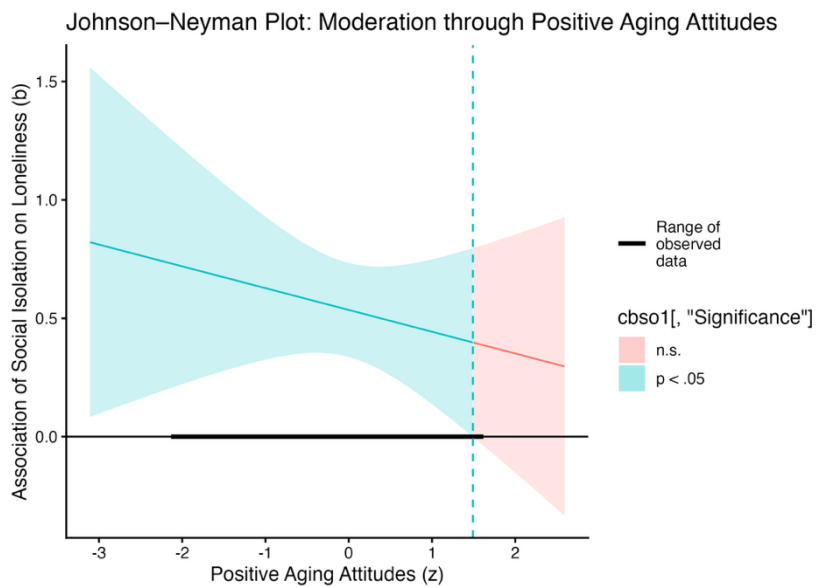


Figure 4

Johnson-Neyman analysis moderating link of positive aging attitudes.



Hypothesis H1b

(“Negative aging attitudes are associated with the relationship between social isolation and loneliness.”)

Visual inspection of residuals versus fitted values did not clearly support homoscedasticity; however, the Breusch–Pagan test was just below the threshold for statistical significance, $BP = 5.74$, $df = 2$, $p = .057$. IDs 15, 17, 18, 23, 43, 54, 68 were identified as potentially influential. The overall model was significant, $F(3, 64) = 17.79$, $p < .001$, explaining 46% of the variance in loneliness ($R^2 = .46$, $adj. R^2 = .43$). Social isolation was significantly related to loneliness ($\beta = 0.49$, $SE = 0.09$, $t(64) = 5.24$, $p < .001$), and negative aging attitudes were also significantly associated with higher loneliness ($\beta = 0.39$, $SE = 0.09$, $t(64) = 4.1$, $p < .001$). However, the interaction term was not statistically significant ($\beta = 0.08$, $SE = 0.09$, $t(64) = 0.86$, $p = .399$). After excluding potential influential cases, the reduced model displayed significant, $F(3, 57) = 25.33$, $p < .001$, with an increased explained variance in loneliness ($R^2 = .57$, $adj. R^2 = .55$). Social isolation remained a significantly linked with loneliness ($\beta = 0.45$, $SE = 0.08$, $t(57) = 5.41$, $p < .001$), and negative aging attitudes were positively associated with loneliness ($\beta = 0.37$, $SE = 0.09$, $t(57) = 4.37$, $p < .001$). Contrary to the initial model, the interaction term reached statistical significance ($\beta = 0.29$, $SE = 0.10$, $t(57) = 2.96$, $p < .001$). Simple slopes analyses showed following pattern at lower levels ($\beta = 0.41$, $SE = 0.13$, $t = 3.30$, $p = .001$), at the mean level ($\beta = 0.49$, $SE = 0.09$, $t = 5.24$, $p < .001$), and at higher levels ($\beta = 0.57$, $SE = 0.14$, $t = 4.11$, $p < .001$). A Johnson–Neyman analysis further revealed statistically significant for values of negative aging attitudes between $z = -1.73$ and $z = 4.23$. Given that the observed range of negative aging attitudes in the sample was $z = -1.22$ to $z = 2.30$, the association was significant for nearly the entire observed range, becoming stronger as negative aging attitudes increase (Figure 6).

Figure 5

Simple Slopes analysis for moderating link of negative aging attitudes.

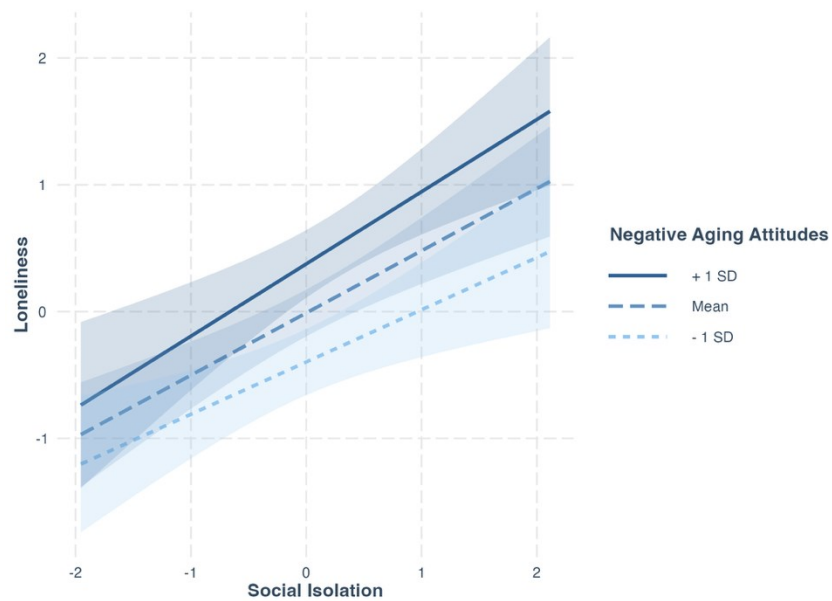
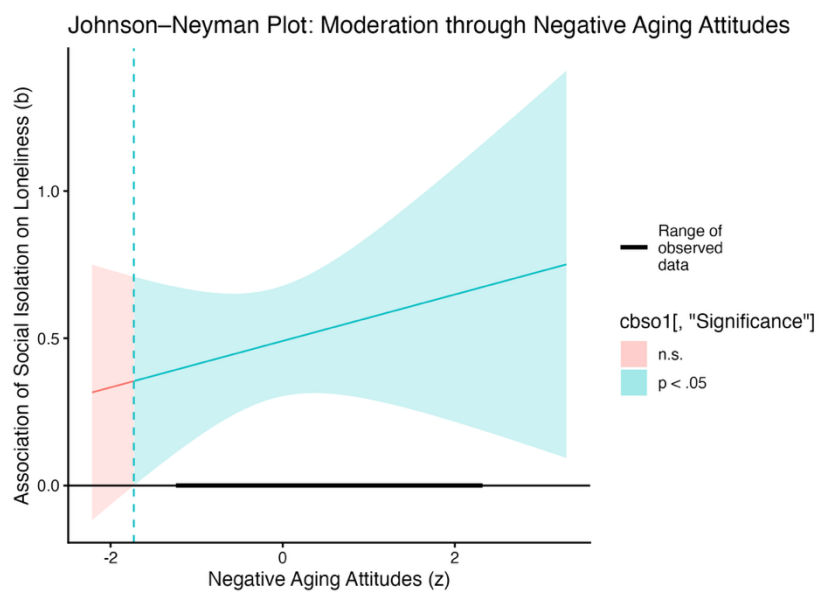


Figure 6

Johnson-Neyman analysis moderating link of negative aging attitudes.



Regression 2a

("Positive aging attitudes are associated with the relationship between social network size and loneliness.").

Homoskedasticity was not supported by visual inspection and a by a significant Breusch–Pagan test ($BP = 7.18$, $df = 2$, $p = .028$). Following potential influential cases were identified: IDs: 15, 43, 68. Social network size was significantly negatively associated with loneliness ($\beta = -0.45$, $SE = 0.11$, $t(64) = -4.28$, $p < .001$). Positive aging attitudes also showed a significant negative link ($\beta = -0.30$, $SE = 0.11$, $t(64) = -2.81$, $p = .007$). However, the interaction term did not prove significant ($\beta = 0.10$, $SE = 0.11$, $t(64) = 0.89$, $p = .375$). The overall model was significant and explained approximately 29% of the variance in loneliness ($R^2 = .29$, $adj. R^2 = .25$). Using robust standard errors (HC3), the association of social network size and loneliness remained similar ($\beta = -0.45$, $SE = 0.10$, $t(64) = -4.42$, $p < .001$), as well as the link of positive aging attitudes and loneliness ($\beta = -0.30$, $SE = 0.11$, $t(64) = -2.69$, $p = .009$). However, the interaction did not reach significance, again. After excluding influential cases, these links remained significant but weaker (social network size: $\beta = -0.36$, $SE = 0.10$, $t(60) = -3.43$, $p = .001$; positive aging attitudes: $\beta = -0.25$, $SE = 0.10$, $t(60) = -2.57$, $p = .013$). The interaction term, again, did not attain significance ($\beta = 0.12$, $SE = 0.11$, $t(60) = 1.11$, $p = .27$). The overall model fit decreased to $R^2 = .24$ ($adj. R^2 = .20$).

Hypothesis 2b

(“Negative aging attitudes are associated with the relationship between social network size and loneliness.”)

Following potentially influential cases were identified: IDs 15, 22, 30, 40, 43, 44. Social network size scores were significantly negative related to loneliness ($\beta = -0.38$, $SE = 0.10$, $t = -3.81$, $p < .001$). Also, the relation between negative aging attitudes and loneliness presented significant ($\beta = 0.41$, $SE = 0.10$, $t = 4.08$, $p < .001$). The interaction between social network size and negative aging attitudes, however, did not reach significance ($\beta = -0.12$, $SE = 0.10$, $t = -1.21$, $p = .231$). Overall, the model explained 37% in loneliness ($R^2 = .37$, $adj. R^2 = .35$, $F(3, 64) = 12.80$, $p < .001$). Applying robust standard errors (HC3), the results did not change. Social network size ($\beta = -0.38$, $SE = 0.11$, $t(64) = -3.41$, $p = .001$) as well as negative aging attitudes ($\beta = 0.41$, $SE = 0.13$, $t(64) = 3.13$, $p = .003$) were significantly related with loneliness. The interaction between both variables did not reach significance ($\beta = -0.12$, $SE = 0.12$, $t(64) = -0.96$, $p = .342$). After excluding potential influential cases, a stronger overall model fit ($R^2 = .49$, $adj. R^2 = .47$; $F(3, 58) = 18.73$, $p < .001$) was shown. Social network size remained significantly linked with loneliness, albeit less strong ($\beta = -0.29$, $SE = 0.09$, $t(58) = -3.30$, $p = .002$), while negative aging attitudes showed an increased positive association with loneliness ($\beta = 0.50$, $SE = 0.08$, $t(58) = 6.00$, $p < .001$). Unlike in the initial model, the interaction between

both variables became significant ($\beta = -0.29$, $SE = 0.10$, $t(58) = -3.00$, $p = .004$). Simple slopes analysis indicates that at low levels of negative aging attitudes ($-1\ SD$), the relationship is weakly negative and only marginally significant ($\beta = -0.26$, $p = .06$). At average levels of negative aging attitudes, the association is moderately negative and statistically significant ($\beta = -0.38$, $p < .001$). At high levels of negative aging attitudes ($+1\ SD$), the negative association is strongest and significant ($\beta = -0.50$, $p < .001$) (Figure 7). Johnson–Neyman analysis revealed that the link between social network size and loneliness is significantly negative for moderate to high levels of negative aging attitudes, specifically for z-standardized values of negative aging attitudes between -0.95 and 4.67 (Figure 8).

Figure 7

Simple Slopes analysis for moderating link of negative aging attitudes.

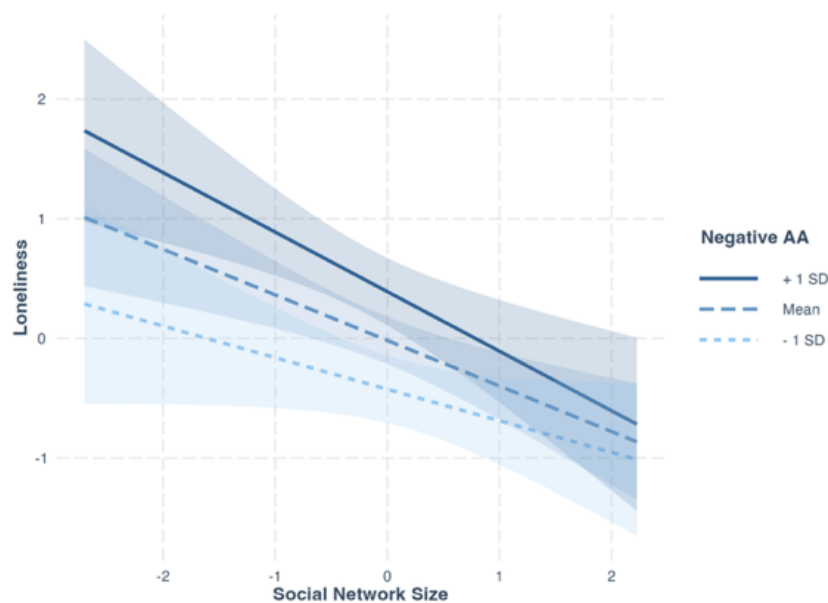
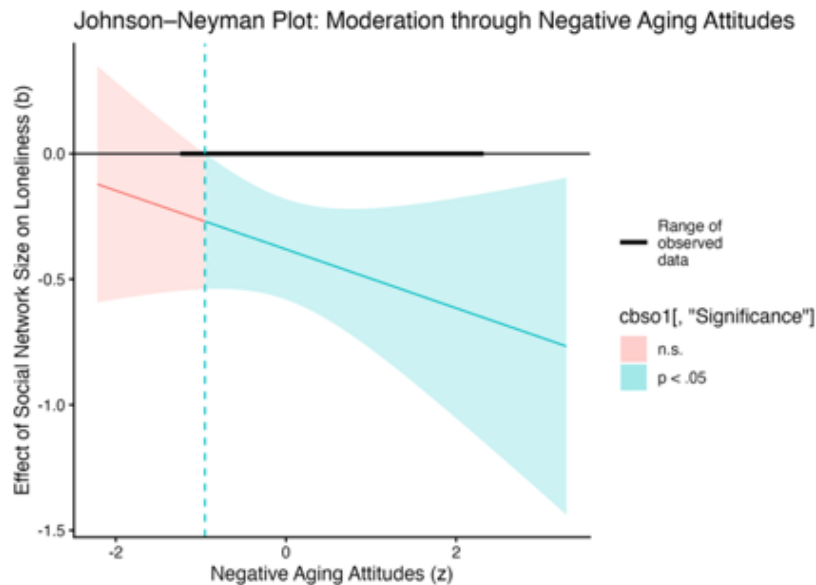


Figure 8

Johnson-Neyman analysis moderating link of negative aging attitudes.



Hypothesis 3a

("Is there a moderating influence of positive Aging Attitudes on the association described in H3")

Violation of homoscedasticity was indicated by visual inspection of residuals-versus-fitted plot indicated and confirmed by the Breusch–Pagan test ($BP = 11.34$, $df = 3$, $p = .010$). As potential influential cases were identified IDs: 15, 17, 18, 30, 43, 68. Social support significantly related with loneliness ($\beta = -0.48$, $SE = 0.10$, $t(64) = -4.63$, $p < .001$), as well as positive aging attitudes also significantly linked with loneliness ($\beta = -0.28$, $SE = 0.11$, $t(64) = -2.58$, $p = .012$). The interaction term, however, was not significant ($\beta = 0.10$, $SE = 0.12$, $t(64) = 0.82$, $p = .415$). The overall model was, yet, significant, $F(3, 64) = 9.54$, $p < .001$, explaining approximately 31% of the variance in loneliness ($R^2 = .31$, $adj. R^2 = .28$). Using robust standard errors (HC3), the results remained largely unchanged. Social support showed a significant negative association with loneliness ($\beta = -0.48$, $SE = 0.13$, $t(64) = -3.77$, $p < .001$), and positive aging attitudes were also significantly negatively related to loneliness ($\beta = -0.28$, $SE = 0.11$, $t(64) = -2.49$, $p = .015$). The interaction was not significant ($\beta = 0.10$, $SE = 0.14$, $t(64) = 0.71$, $p = .483$). After excluding potential influential cases, social support was still associated with loneliness ($\beta = -0.50$, $SE = 0.09$, $t(58) = -5.59$, $p < .001$), and positive aging attitudes were also negatively linked to loneliness ($\beta = -0.20$, $SE = 0.09$, $t(58) = -2.32$, $p = .024$). The interaction term reached

significance ($\beta = 0.25$, $SE = 0.10$, $t(58) = 2.38$, $p = .02$). The overall model was significant, $F(3, 58) = 12.81$, $p < .001$, explaining 39.9% of the variance ($R^2 = .40$, $adj. R^2 = .37$). Simple slopes analysis indicated that at low positive aging attitudes the association of social support and loneliness was strongest ($\beta = -0.58$, $SE = 0.16$, $p < .001$). At average levels of positive aging attitudes, the relationship remained robust ($\beta = -0.48$, $SE = 0.10$, $p < .001$). At high positive aging attitudes (+1 SD), the association was weaker but still significant ($\beta = -0.38$, $SE = 0.15$, $p = .02$) (Figure 9). The link of social support and loneliness is significantly negative for values of positive aging attitudes between approximately $z = -3.16$ and $z = 1.27$, which largely overlaps with the observed data range. Within this interval, higher social support is associated with lower loneliness. For higher levels of positive aging attitudes (above ~ 1.27 SD), the association of social support and loneliness is no longer statistically significant (Figure 10).

Figure 9

Simple Slopes analysis for moderating link of positive aging attitudes.

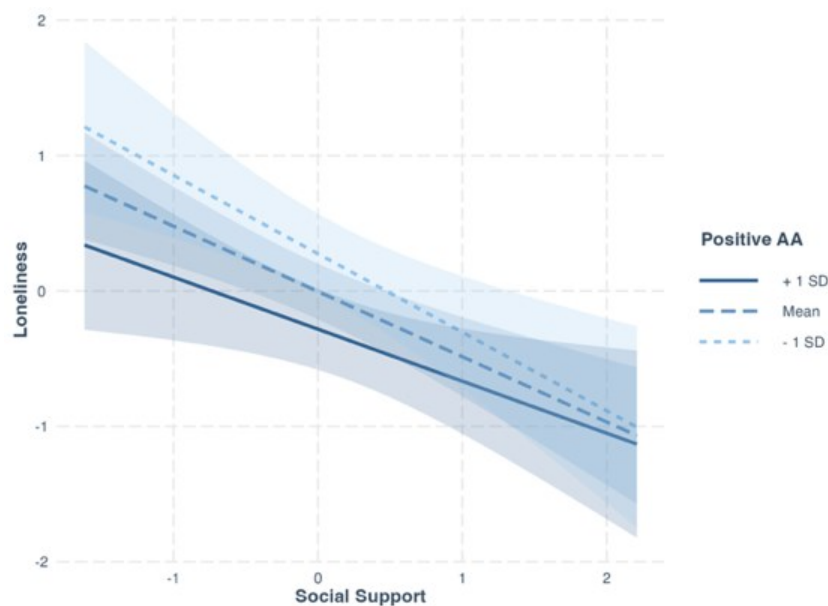
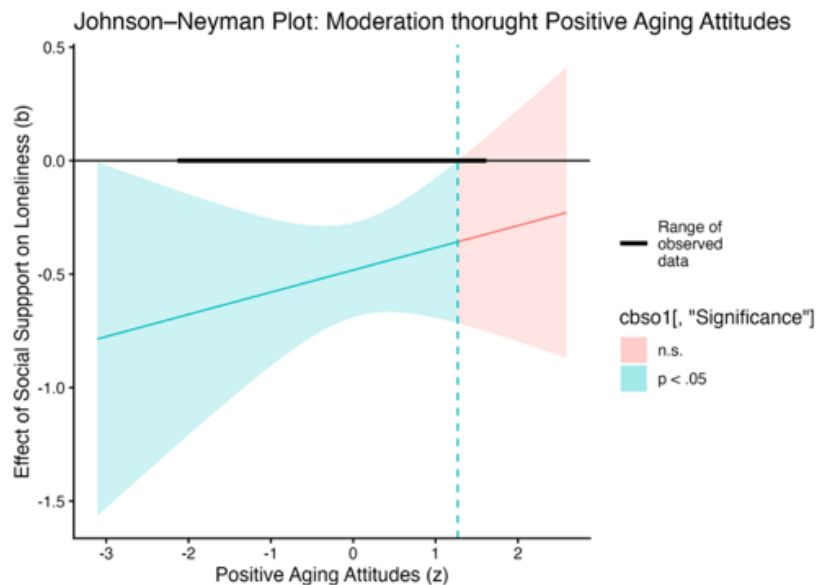


Figure 10

Johnson-Neyman analysis moderating link of negative aging attitudes.



Hypothesis 3b

(“Negative aging attitudes are associated with the relationship between social support and loneliness.”).

The Residuals vs. Fitted plot indicated heteroskedasticity, which was supported by a significant Breusch-Pagan test ($BP = 10.996$, $df = 3$, $p = .0117$). Following potential influential cases were identified: IDs 15, 17, 18, 23, 30, 43. Social support was negatively associated with loneliness ($\beta = -0.45$, $SE = 0.10$, $t(64) = -4.61$, $p < .001$). Negative aging attitudes were significantly positively related to loneliness ($\beta = 0.40$, $SE = 0.10$, $t(64) = 4.12$, $p < .001$). The interaction term, however, was not significant ($\beta = -0.08$, $SE = 0.10$, $t(64) = -0.77$, $p = .45$). The overall model explained 42% variance in loneliness ($R^2 = .42$, $adj. R^2 = .39$), and the model fit was significant ($F(3, 64) = 15.14$, $p < .001$). Using robust standard errors (HC3), the results remained largely unchanged (Social support: $\beta = -0.45$, $SE = 0.13$, $t(64) = -3.42$, $p = .001$; negative aging attitudes: $\beta = 0.40$, $SE = 0.13$, $t(64) = 3.06$, $p = .003$). The interaction remained non-significant ($\beta = -0.08$, $SE = 0.15$, $t(64) = -0.50$, $p = .62$). After, excluding influential cases, social support was still negatively associated with loneliness ($\beta = -0.48$, $SE = 0.09$, $t(58) = -5.67$, $p < .001$). Negative aging attitudes remained positively associated with loneliness ($\beta = 0.34$, $SE = 0.09$, $t(58) = 3.77$, $p < .001$). The interaction term reached statistical significance ($\beta = -0.26$, $SE = 0.10$, $t(58) = -2.58$, $p = .012$). Overall model fit increased ($R^2 = .53$, $adj. R^2 = .51$; $F(3, 58) = 22.21$, $p < .001$) compared to the initial model. Simple slope analysis showed

that when negative aging attitudes are low ($-1\ SD$), social support is moderately and significantly associated with lower loneliness ($\beta = -0.37, p = .01$). At average levels of negative aging attitudes, this association is stronger and highly significant ($\beta = -0.45, p < .001$). When negative aging attitudes are high ($+1\ SD$), the association is strongest, with higher social support being associated with substantially lower loneliness ($\beta = -0.52, p < .001$) (Figure 11). The Johnson–Neyman analysis indicates that social support is significantly associated with lower loneliness for values of negative aging attitudes above approximately $z \approx -1.4$ and up to about $z \approx +3.1$ ($p < .05$). Within this region, the conditional relationship of social support and loneliness becomes increasingly negative as negative aging attitudes increase (β ranging approximately from -0.35 to -0.75). For very low levels of negative aging attitudes (below $z \approx -1.4$), the association between social support and loneliness is not statistically significant (Figure 12).

Figure 11

Simple Slopes analysis for moderating link of positive aging attitudes.

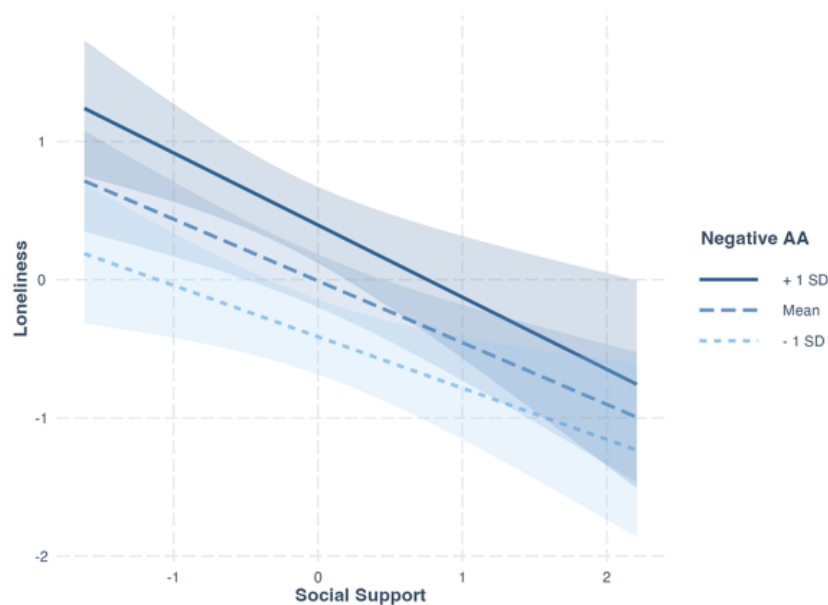
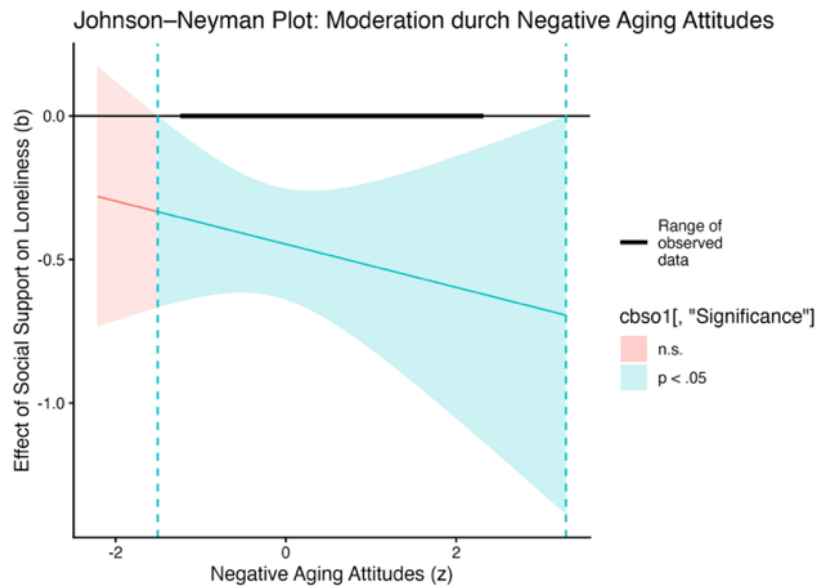


Figure 12

Johnson-Neyman analysis moderating link of negative aging attitudes.



Hypothesis 4a

(“Positive aging attitudes are associated with the relationship between social engagement and loneliness.”)

Visual inspection suggested heteroskedasticity, which was confirmed by the Breusch-Pagan test ($BP(3) = 10.23, p = .0167$). IDs 15, 41, and 65 were identified as potential influential cases. The overall model was not significant ($F(3, 61) = 1.37, p = .262$). Social engagement was not significantly associated with loneliness ($\beta = 0.06, SE = 0.13, t(61) = 0.48, p = .636$). Positive aging attitudes, however, showed significant negative association with loneliness ($\beta = -0.26, SE = 0.13, t(61) = -2.02, p = .048$). The interaction was not significant ($\beta = -0.06, SE = 0.15, t(61) = -0.38, p = .706$). Using robust standard errors (HC3), neither the main links nor the interaction became significant, as well as after excluding influential cases.

Hypothesis 4b

(“Negative aging attitudes strengthen the association between social engagement and loneliness.”)

As potential influential cases IDs: 15, 23, 43, 61 were identified. Negative aging attitudes were positively associated with loneliness ($\beta = 0.47, SE = 0.11, t(61) = 4.17, p < .001$). Contrary, social engagement showed no significant association with loneliness ($\beta = 0.12, SE = 0.12, t(61) = 1.07, p = .289$). The interaction was not significant ($\beta = 0.15, SE = 0.12, t(61) = 1.29, p =$

.203) either. The overall model, however, was significant ($F(3, 61) = 6.29, p < .001$), explaining 23.6% of the variance in loneliness ($R^2 = .24, \text{adj. } R^2 = .20$). Using robust (HC3) negative aging attitudes were still positively associated with loneliness ($\beta = 0.47, SE = 0.14, t(61) = 3.36, p = .001$). Social engagement was, again, not significantly associated with loneliness ($\beta = 0.12, SE = 0.12, t(61) = 1.03, p = .306$) as well as the interaction between social engagement and negative aging attitudes was also not significant ($\beta = 0.15, SE = 0.15, t(61) = 1.02, p = .314$). After excluding influential cases negative aging attitudes remained positively associated with loneliness ($\beta = 0.52, SE = 0.11, t(57) = 4.63, p < .001$). Yet, social engagement was again not significantly associated with loneliness ($\beta = 0.02, SE = 0.11, t(57) = 0.16, p = .874$), and the interaction between social engagement and negative aging attitudes remained non-significant, too ($\beta = 0.07, SE = 0.13, t(57) = 0.52, p = .603$). The model explained 29% variance in loneliness ($R^2 = .29, \text{adj. } R^2 = .25$).

Old-old.

The age group old-old contained 27 participants. Approximately 88% ($n = 21$) were female, and 22% ($n = 6$) male. Approximately 26% ($n = 7$) were married, 59% ($n = 16$) widowed, 7% ($n = 2$) divorced/separated and 4% ($n = 1$). One participant showed NA (4%). Correlations of key variables for the age group old-old (85-94) can be obtained from Table 8. Descriptive parameters are shown in Table 9.

Table 8

Spearman rank correlation of key study variables for the age group old-old.

Variables	Loneliness	Social Isolation	PAA	NAA	Social Network Size	Social Support	Frequency of Contact	Social Engagement	Gender	Marital Status	Age
Loneliness	1***	-0.603***	-163	0.506**	-0.514**	-0.546**	-0.628***	61	98	-18	147
Social Isolation	-0.603***	1***	157	-272	0.852***	0.97***	0.871***	-153	138	6	-287
PAA	-163	157	1***	-0.42*	161	169	0.07	133	-0.398*	85	0.414*
NAA	0.506**	-272	-0.42*	1***	-0.471*	-214	-0.18	-321	253	-96	-279
Social Network Size	-0.514**	0.852***	161	-0.471*	1***	0.742***	0.744***	-65	34	72	-178
Social Support	-0.546**	0.97***	169	-214	0.742***	1***	0.753***	-157	173	-11	-299
Frequency of Contact	-0.628***	0.871***	0.07	-0.18	0.744***	0.753***	1***	-162	85	-4	-249
Social Engagement	61	-153	133	-321	-65	-157	-162	1***	-152	297	295
Gender	98	138	-0.398*	253	34	173	85	-152	1***	-59	-62
Marital Status	-18	6	85	-96	72	-11	-4	297	-59	1***	43
Age	147	-287	0.414*	-279	-178	-299	-249	295	-62	43	1***

Note. * $p < 0,05$; ** $p < 0,01$; *** $p < 0,001$.

Table 9

Descriptive statistics of loneliness, positive and negative aging attitudes for the age group 85-94 years.

Variables								
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>Median</i>	<i>Min</i>	<i>Max</i>	<i>Range</i>	<i>SE</i>
Loneliness	27	2.09	0.88	2	1.2	4.32	3.12	0.17
PAA	27	3.47	1.03	3.67	1.33	5	3.67	0.2
NAA	27	2.3	1.06	2	1	4.75	3.75	0.2

Regarding H1 homoskedasticity could not be confirmed. Hence, robust standard errors were considered. Higher social isolation was linked to higher loneliness for the initial model ($\beta = 0.57$, $SE = 0.15$, $t(25) = 3.78$, $p < .001$), as well as when considering robust standard errors ($\beta = 0.60$, $SE = 0.19$, $t(25) = 3.16$, $p = .004$). The model explained 36% of the variance in loneliness ($R^2 = .36$, $adj. R^2 = .34$; $F(1, 25) = 14.30$, $p < .001$). For H2 social network size was significantly linked to loneliness ($\beta = -0.44$, $SE = 0.15$, $t(25) = -3.00$, $p = .006$), with a significant model ($F(1, 25) = 8.97$, $p = .006$) explaining about 23% variance in loneliness. Analyzing H3 heteroscedasticity was indicated. The analysis revealed a statistically significant model, $F(1, 25) = 10.63$, $p = .003$, explaining approximately 27% of the variance in loneliness ($R^2 = .30$, $adj. R^2 = .27$; $F(1, 25) = 10.63$, $p = .003$). Social support was significantly negatively associated with loneliness in the standard model ($\beta = -0.53$, $t(25) = -3.26$, $p = .003$) and remained significant when using robust standard errors ($\beta = -0.55$, $t(25) = -2.69$, $p = .013$). For H4, the overall model was not statistically significant, $F(1, 25) = 0.09$, $p = .761$, explaining no variance in loneliness ($R^2 = .004$, $adj. R^2 = -.04$; $F(1, 25) = 0.09$, $p = .761$). Social engagement over one year was not significantly associated with loneliness ($\beta = 0.00$, $t = 0.31$, $p = .761$).

Exploring Hypothesis 1a, social isolation was significantly positively associated with loneliness ($\beta = .59$, $SE = 0.20$, $t(23) = 3.02$, $p = .006$). The overall model explained 43% of the variance in loneliness ($R^2 = .43$, $adj. R^2 = .36$, $F(3, 23) = 5.77$, $p = .004$). For Hypothesis 1b, social isolation was again significantly positively related to loneliness in both the standard ($\beta = .54$, $SE = 0.16$, $t(23) = 3.49$, $p = .002$) and robust models ($\beta = .54$, $SE = 0.24$, $t(23) = 2.26$, $p = .033$). The overall model was statistically significant ($F(3, 23) = 8.13$, $p < .001$), explaining approximately 45% of the variance in loneliness. Regarding Hypothesis 2a, social network size was significantly negatively associated with loneliness in both the standard ($\beta = -.50$, $SE =$

0.17, $t(23) = -2.90$, $p = .008$) and robust models ($\beta = -.50$, $SE = 0.16$, $t(23) = -3.06$, $p = .006$). For Hypothesis 2b, social network size remained significantly negatively linked with loneliness ($\beta = -.42$, $SE = 0.20$, $t(23) = -2.10$, $p = .047$), with the overall model explaining approximately 30% of the variance ($R^2 = .38$, $adj. R^2 = .30$, $F(3, 23) = 4.65$, $p = .011$). Examining Hypothesis 3a, social support was significantly negatively associated with loneliness in both the standard ($\beta = -.55$, $SE = 0.17$, $t(23) = -3.28$, $p = .003$) and robust models ($\beta = -.55$, $SE = 0.22$, $t(23) = -2.50$, $p = .020$). The model accounted for approximately 29% of the variance in loneliness ($R^2 = .37$, $adj. R^2 = .29$). Similarly, for Hypothesis 3b, social support showed a robust negative association with loneliness in both the standard ($\beta = -.52$, $SE = 0.16$, $t(23) = -3.31$, $p = .003$) and robust models ($\beta = -.52$, $SE = 0.23$, $t(23) = -2.27$, $p = .033$), with the model explaining 50% of the variance ($R^2 = .50$, $adj. R^2 = .44$, $F(3, 23) = 7.72$, $p < .001$). For Hypothesis 4b, negative aging attitudes were significantly positively associated with loneliness in the standard model ($\beta = .59$, $SE = 0.20$, $t(23) = 2.99$, $p = .007$).

Oldest (90+).

The age group comprised 18 participants. Approximately 83% ($n = 15$) were female and 17% ($n = 3$) male. Regarding marital status, about 22% ($n = 4$) were married or partnered, 61% ($n = 11$) widowed, 6% ($n = 1$) divorced/separated, and 6% ($n = 1$) single. For one participant, marital status information was missing (6%, $n = 1$). An overview of correlations of key study variables can be obtained in Table 10, as well as descriptives of in Table 11.

Table 10

Spearman rank correlation of key study variables for the age group oldest (90+).

Variables	Loneliness	Social Isolation	PAA	NAA	Social Network Size	Social Support	Frequency of Contact	Social Engagement	Gender	Marital Status	Age
Loneliness	1***	-0.641**	-0.571*	338	-0.475*	-0.614**	-0.59*	23	171	331	421
Social Isolation	-0.641**	1***	459	-98	0.862***	0.963***	0.803***	-19	73	-0.543*	-171
PAA	-0.571*	459	1***	-179	331	428	465	-248	-0.21	-0.606**	-0.533*
NAA	338	-98	-179	1***	-169	-122	75	-0.49*	104	-332	0.471*
Social Network Size	-0.475*	0.862***	331	-169	1***	0.74***	0.726***	97	9	-434	-39
Social Support	-0.614**	0.963***	428	-122	0.74***	1***	0.641**	-24	116	-0.497*	-167
Frequency of Contact	-0.59*	0.803***	465	75	0.726***	0.641**	1***	-98	-24	-0.542*	-226
Social Engagement	23	-19	-248	-0.49*	97	-24	-98	1***	-75	102	75
Gender	171	73	-0.21	104	9	116	-24	-75	1***	38	-314
Marital Status	331	-0.543*	-0.606**	-332	-434	-0.497*	-0.542*	102	38	1***	313

Age	421	-171	-0.533*	0.471*	-39	-167	-226	75	-314	313	1***
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Notes. * $p < 0,05$; ** $p < 0,01$; *** $p < 0,001$.

Table 11

Descriptive statistic of loneliness, positive and negative aging attitudes across the oldest age group.

Variables								
	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>Median</i>	<i>Min</i>	<i>Max</i>	<i>Range</i>	<i>SE</i>
Loneliness	18	2.24	0.97	2	1.2	4.32	3.12	0.23
PAA	18	3.65	0.93	3.67	1.67	5	3.34	0.22
NAA	18	2.23	1.22	1.9	1	4.75	3.75	0.29

Higher social isolation (H1) was significantly associated with higher loneliness ($\beta = 0.64$, $SE = 0.19$, $t(16) = 3.34$, $p = .004$). The model explained 41% of the variance in loneliness ($R^2 = .41$, $adj. R^2 = .37$). Further, social network size (H2) was significantly negatively associated with loneliness ($\beta = -0.48$, $SE = 0.22$, $t(16) = -2.16$, $p = .046$). The model accounted for approximately 23% of the variance in loneliness ($R^2 = .23$, $adj. R^2 = .18$; $F(1, 16) = 4.67$, $p = .046$). Similarly, social support (H3) was significantly negatively associated with loneliness ($\beta = -0.61$, $SE = 0.20$, $t(16) = -3.11$, $p = .007$), with this link remaining robust when applying robust standard errors ($\beta = -0.61$, $SE = 0.18$, $t(16) = -3.48$, $p = .003$). The model explained approximately 38% of the variance in loneliness ($R^2 = .38$, $adj. R^2 = .34$; $F(1, 16) = 9.69$, $p = .007$). Contrary for social engagement (H4), no statistically significant associations with loneliness were observed.

Exploring Hypothesis 1a, social isolation was significantly positively associated with loneliness (H1a: $\beta = 0.56$, $SE = 0.22$, $t(14) = 2.53$, $p = .024$) and the overall model explained 54% of the variance in loneliness ($R^2 = .54$, $adj. R^2 = .44$, $F(3, 14) = 5.40$, $p = .011$). Also analyzing 1b revealed a significant link of social isolation and loneliness ($\beta = 0.65$, $SE = 0.24$, $t(14) = 2.76$, $p = .015$), with a significant overall model ($F(3, 14) = 4.49$, $p = .021$), explaining approximately 49% of the variance in loneliness ($R^2 = .49$, $adj. R^2 = .38$). For Hypothesis 2a, only positive aging attitudes were significantly negatively associated with loneliness when robust standard errors were applied ($\beta = -0.41$, $SE = 0.19$, $t(14) = -2.16$, $p = .049$). Contrary no significant findings appeared regarding H2b. Social support in H3a, however, was significantly related with loneliness ($\beta = -0.55$, $SE = 0.22$, $t(14) = -2.49$, $p = .026$). The model accounted for approximately 53% of the variance in loneliness ($R^2 = .53$, $adj. R^2 = .43$). Similar,

H3b testing showed a significant negative association of social support and loneliness ($\beta = 0.60$, $SE = 0.22$, $t(14) = -2.68$, $p = .018$). The model explained approximately 45% of the variance in loneliness ($R^2 = .45$, $adj. R^2 = .33$, $F(3, 14) = 3.81$, $p = .035$). Finally, for Hypothesis 4a and H4b no significant results were seen.

Frequency of Contact.

Homoskedasticity could not be confirmed and four potentially influential cases (IDs 15, 43, 54, and 62) were observed. Linear regression analysis indicated that frequency of contact was significantly associated with loneliness. Higher frequency of contact was associated with lower loneliness scores, ($\beta = -0.38$, $SE = 0.07$, $t(66) = -5.57$, $p < .001$). The model explained 32% of variance in loneliness ($R^2 = .32$; $adj. R^2 = .31$), and was statistically significant ($F(1, 66) = 31.04$, $p < .001$). Using heteroskedasticity-robust standard errors, this link remained significant ($\beta = -0.38$, $SE = 0.08$, $t(66) = -4.98$, $p < .001$). Similar, after excluding influential cases ($\beta = -0.34$, $SE = 0.07$, $t(62) = -4.98$, $p < .001$). However, the overall model fit was reduced ($R^2 = .29$, $adj. R^2 = .27$; $F(1, 62) = 24.80$, $p < .001$).

In addition to this model moderating associations were explored first with positive aging attitudes, then with negative aging attitudes. Homoscedasticity was not fully supported and IDs: 15, 22, 43, 62, 68 were identified as potential influential cases. The overall model was significant ($F(3, 64) = 14.23$, $p < .001$), explaining 40.0% of the variance in loneliness ($R^2 = .40$, $adj. R^2 = .37$). Frequency of contact was a significantly negatively related with loneliness ($\beta = -0.56$, $SE = 0.10$, $t(64) = -5.75$, $p < .001$). Positive aging attitudes also showed a significant negative link ($\beta = -0.30$, $SE = 0.10$, $t(64) = -2.91$, $p = .005$). However, interaction between frequency of contact and positive aging attitudes was not significant ($\beta = 0.07$, $SE = 0.12$, $t(64) = 0.57$, $p = .574$). Using heteroskedasticity-robust standard errors (HC3), frequency of contact ($\beta = -0.56$, $SE = 0.11$, $t(64) = -4.88$, $p < .001$) and positive aging attitudes ($\beta = -0.30$, $SE = 0.10$, $t(64) = -2.84$, $p = .006$) both remained significantly negatively related with loneliness. The interaction was again not significant ($\beta = 0.07$, $SE = 0.14$, $t(64) = 0.52$, $p = .604$). Excluding influential cases yielded comparable results. Frequency of contact ($\beta = -0.51$, $SE = 0.10$, $t(60) = -5.27$, $p < .001$) and positive aging attitudes ($\beta = -0.30$, $SE = 0.09$, $t(60) = -3.14$, $p = .003$) remained significantly associated with loneliness, whereas the interaction term remained non-significant ($\beta = 0.12$, $SE = 0.12$, $t(60) = 1.00$, $p = .322$). The reduced model explained 38.7% of the variance in loneliness ($R^2 = .39$, $adj. R^2 = .36$; $F(3, 60) = 12.62$, $p < .001$).

Regarding the moderating association of negative aging attitudes, homoskedasticity again was not confirmed and following potential influential cases were identified: IDs 10, 15,

22, 23, 43, 54. Using robust standard errors a significant association of frequency of contact and loneliness ($\beta = -0.51$, $SE = 0.13$, $t(64) = -3.83$, $p < .001$) was found. Negative aging attitudes revealed a significant positive association with loneliness ($\beta = 0.38$, $SE = 0.13$, $t(64) = 3.04$, $p = .003$). The interaction term was non-significant ($\beta = -0.04$, $SE = 0.14$, $t(64) = -0.32$, $p = .753$). The overall model, however, was significant, $F(3, 64) = 18.77$, $p < .001$, explaining 46.8% of the variance in loneliness ($R^2 = .468$, $adj. R^2 = .443$). After excluding influential cases, the regression model remained significant ($F(3, 58) = 24.64$, $p < .001$), with increased model fit. Frequency of contact remained negatively related ($\beta = -0.46$, $SE = 0.08$, $t(58) = -5.74$, $p < .001$), whereas negative aging attitudes were positively associated with loneliness ($\beta = 0.48$, $SE = 0.08$, $t(58) = 5.73$, $p < .001$). The interaction stayed non-significant ($\beta = -0.14$, $SE = 0.09$, $t(58) = -1.53$, $p = .132$).

Combined Model

Homoskedasticity was not supported, and several potentially influential cases were identified (IDs: 15, 17, 23, 43, and 44).

The multiple linear regression model including all five variables was overall significant ($F(5, 62) = 13.26$, $p < .001$) and explained 51.7% of the variance in loneliness ($R^2 = .51$; $adj. R^2 = .48$). Frequency of contact emerged negatively associated with loneliness ($\beta = -0.41$, $SE = 0.14$, $t(62) = -3.01$, $p = .004$) and positive aging attitudes were also significantly negatively associated with loneliness ($\beta = -0.18$, $SE = 0.09$, $t(62) = -2.01$, $p = .049$), whereas negative aging attitudes showed a significant positive association ($\beta = 0.34$, $SE = 0.09$, $t(62) = 3.67$, $p < .001$). Social support ($\beta = -0.18$, $SE = 0.14$, $t(62) = -1.34$, $p = .187$) and social network size ($\beta = 0.03$, $SE = 0.14$, $t(62) = 0.21$, $p = .831$) were not significant related to loneliness in this model. Robust regression analyses using HC3 standard errors yielded a comparable pattern of results. After excluding influential cases, the multiple regression model remained significant ($F(5, 57) = 11.57$, $p < .001$), explaining 50.4% of the variance in loneliness ($R^2 = .50$; $adj. R^2 = .46$). In this reduced-sample analysis, social support emerged significantly negatively related with the outcome variable ($\beta = -0.25$, $SE = 0.12$, $t(57) = -2.04$, $p = .046$), while negative aging attitudes remained linked with loneliness ($\beta = 0.41$, $SE = 0.09$, $t(57) = 4.73$, $p < .001$). Frequency of contact ($\beta = -0.18$, $SE = 0.12$, $t(57) = -1.45$, $p = .153$), social network size ($\beta = 0.04$, $SE = 0.13$, $t(57) = 0.32$, $p = .751$), and positive aging attitudes ($\beta = -0.13$, $SE = 0.08$, $t(57) = -1.63$, $p = .109$) were not statistically significant. Model fit was comparable to the full-sample analyses.

Discussion

The present study examined associations between social isolation and social integration with loneliness, particularly focusing on the association of social network size, social support, and social engagement with loneliness in older adults. Additionally, the role of aging attitudes in this context was explored. Overall, the findings provide strong and consistent evidence that greater social isolation is associated with higher loneliness. In line, larger social networks and higher perceived social support were reliably linked to lower loneliness. Social engagement over a one-year period, however, was not significantly related to loneliness. Beyond these main findings, exploratory moderation analyses indicated that aging attitudes play an important contextual role, especially negative aging attitudes.

Main findings

Results showed a strong positive relationship between social isolation and loneliness, indicating that greater social isolation may be associated with higher levels of loneliness. This finding aligns with preexisting literature (Li & Tang, 2022; Petersen et al., 2016; Sun et al., 2022) and is further supported by the biological viewpoint on loneliness, which regards loneliness as an evolutionary essential adaptive mechanism driven by the absence of social connection, which proves necessary for our survival and well-being. It is perceived as a deficit signal, which indicates the need for social connection and hence drives us to seek contact with others (Holt-Lunstad, 2018; Tomova et al., 2020). In line with this perspective, the results further revealed medium and strong negative associations between both social network size and social support with loneliness. Findings show a smaller social network and lower social support are linked to elevated loneliness. This pattern is consistent with a substantial body of previous research demonstrating that social support plays a protective role in the experience of loneliness, particularly in older age, and therefore aligns with social support theory (Antonucci et al., 2014; Bethell et al., 2019; Carstensen, 2021; Cheng et al., 2021; Gabarrell-Pascuet et al., 2022; C. Hu et al., 2025; Lakey & Cohen, 2000; Zhao et al., 2018). Notably, compared to social support, social network size showed weaker associations with loneliness. This could indicate that social support represents the primary pathway through which social networks influence physical and mental health outcomes and thus also loneliness (Berkman et al., 2000). Nonetheless, these results should be interpreted with caution, as the internal consistency of the social isolation subscales, namely social network size and social support, in the present study ranged from low to acceptable.

In contrast to the findings reported above, social engagement did not show a direct association with loneliness in the present study. This finding contradicts previous studies suggesting that social engagement can ameliorate loneliness (Dahlberg et al., 2018; Lapane et al., 2022), as well as the activity theory. This theory conceptualizes successful aging and well-being as the maintenance of an active lifestyle adapted to individual capacities and preferences (Rupprecht, 2008). For example, participation in interventions such as gardening, music, laughter yoga, and peer mentor programs has been found to successfully reduce loneliness (Smith & Theeke, 2024). At the same time, the evidence regarding the effectiveness of interventions targeting loneliness remains mixed. As noted by Lapane et al. (2022), a recent systematic review reported heterogeneous effects, including for interventions implemented in nursing homes, such as group activities and animal-assisted therapy. Furthermore, Matsuzaki et al. (2025) reported that some older adults experience high levels of loneliness despite active social participation. According to their findings, characteristics not considered in the present study – such as a preference for solitude, reduced engagement in personally meaningful social and solitary activities, and elevated depressive symptoms – may help explain this discrepancy. In particular, individuals with a strong preference for solitude may engage less in socially valuable activities, which in turn reduces engagement in meaningful solitary activities, contributing to increased depression and sustained loneliness (Matsuzaki et al., 2025). Their findings suggest that some older adults may derive limited benefit from increased social activity alone and that interventions tailored to individuals' values regarding solitude may be more effective. This interpretative approach is supported by socioemotional selectivity theory (Carstensen, 2021), more specifically, the disengagement theory (Rupprecht, 2008). It posits that across lifespan, the quality of relationships becomes more important than the quantity of social ties. Given that social engagement was primarily operationalized through the quantity of group activities, this measurement approach may have biased the results by emphasizing quantity over subjective quality. It is possible that some activities or interventions lacked personal meaning for residents and therefore were not related to the experience of loneliness. Moreover, the absence of a direct association between social engagement and loneliness may indicate that social engagement is rather indirectly linked with loneliness, such as via social network size or perceived social support (Autschbach et al., 2024; Lapane et al., 2022). Moreover, despite findings by Leedahl et al. (2018) suggesting that participation in activities in nursing homes represents a key indicator of social engagement, the absence of a significant association with loneliness in the present study may be explained by the institutional setting. Here, social engagement may reflect organizational structures rather than residents'

autonomous social motivation, which may weaken its association with subjective loneliness. In particular, activities such as physical therapy are often prescribed by insurance or care plans and are therefore obligatory rather than self-selected. Consequently, participation in such activities may be largely independent of residents' personal characteristics, preferences, or social needs, limiting their relevance for the subjective experience of loneliness.

Taken together, the findings support a robust association between social isolation and loneliness. Among the individual components of the broader construct of social integration, social network size and social support showed significant associations with loneliness, whereas social engagement did not demonstrate a direct link with loneliness in the present study.

Aging Attitudes

Findings of the present study underscore the complex nature of loneliness, demonstrating robust associations of aging attitudes with loneliness, and highlighting their relevance in later-life. The following section therefore first addresses the main links of positive and negative aging attitudes on loneliness, before turning to their potential moderating role.

Across all hypotheses, positive aging attitudes consistently demonstrated a moderate negative association with loneliness. This pattern suggests that more positive attitudes toward one's own aging are associated with lower levels of loneliness. Negative aging attitudes, however, were consistently positively linked to loneliness, indicating that more negative perceptions of aging are linked to a heightened experience of loneliness.

These findings are well aligned with stereotype embodiment theory proposed by Levy (2009). According to this framework, age-related stereotypes are internalized across the lifespan and can operate unconsciously once they become self-relevant. Common societal stereotypes of aging, such as being forgetful, incompetent, or dependent, may gradually be assimilated into individuals' self-concepts and transform into self-stereotypes in later life. When activated, these internalized beliefs can influence psychological, behavioral, and physiological processes, thereby shaping health-related outcomes. In the context of loneliness, negative aging attitudes may foster expectations of social withdrawal, dependency, or reduced social value, which in turn may intensify feelings of loneliness. In contrast, more positive self-perceptions of aging may support adaptive coping strategies, greater emotional resilience, and continued engagement in meaningful relationships, thereby buffering against loneliness. This theoretical account appears supported by empirical evidence. Negative self-perceptions of aging have been linked to cognitive and psychological costs in later life, including higher loneliness and depressive symptoms (Barber, 2017; Bergman & Segel-Karpas, 2021; Hu & Li,

2022). Contrary, positive attitudes toward one's own aging have been associated with better mental and physical health outcomes, lower loneliness, and even increased longevity (Hu & Li, 2022; Levy et al., 2002). Further, attitudes toward one's own aging appear to be relatively stable over time, with longitudinal research indicating largely stable mean levels from midlife into older adulthood, followed by only gradual changes thereafter (Diehl et al., 2022). This relative stability suggests that aging attitudes may function as enduring vulnerability or protective factors, providing a plausible mechanism through which both positive and negative aging attitudes are consistently associated with loneliness in later life.

Notably, negative aging attitudes showed stronger associations with loneliness than positive aging attitudes, a pattern that is consistent with findings reported by Sun et al. (2022). In their study examining both mediating and moderating roles of aging attitudes in the relationship between social isolation and loneliness, negative aging attitudes exerted larger influence on loneliness compared to positive aging attitudes when controlling for social isolation. A similar asymmetry has been observed in related research on mental health outcomes, indicating that negative beliefs often demonstrate stronger effects than positive beliefs regarding health outcomes and mood (Ownby et al., 2014). Also Meisner, (2012) examined the differential impact of positive and negative age stereotypes on various behavioral outcomes in later life and found that the effects of negative stereotype priming were nearly three times stronger than those of positive stereotypes when compared to a neutral baseline.

Moderating links of aging attitudes

Across the primary analyses, no moderating associations of aging attitudes could be observed in any context. Although the inclusion of interaction terms was in some cases accompanied by slight improvements in model fit indices, the interaction terms themselves did not reach statistical significance in the full-sample analyses.

Moderating links of negative aging attitudes with the relationships between social isolation, social network size, and social support with loneliness emerged only after the exclusion of potentially influential cases. Across these findings, positive aging attitudes were associated with weaker associations between social factors and loneliness, whereas negative aging attitudes were associated with stronger associations. Given that these relationships were not present in the full sample, they must be interpreted with caution and should be regarded as exploratory trends rather than robust findings. For positive aging attitudes a similar pattern was observed. The interactions only became significant in analyses with a reduced sample size for

the correlations between social isolation and loneliness and between social support and loneliness.

Overall, the present findings suggest that aging attitudes may be primarily directly related to loneliness, rather than through moderating ties. The emergence of significant interaction terms after case exclusion could only indicate potential moderating relations, against the by Hu and Li (2022) and Sun et al. (2022), demonstrating a mediating and moderating influence of aging attitudes and subjective perceptions of aging on social isolation and loneliness. Notably, these studies were based on substantially larger sample sizes, which may have provided greater statistical power to detect interaction effects. This underscores the need for replication in larger and more heterogeneous samples before firm conclusions regarding moderating associations can be drawn.

Exploratory Analysis

Beyond the pre-registered hypotheses, several exploratory analyses were conducted to further contextualize the observed patterns and to examine additional aspects of social connection that may be relevant for loneliness in long-term care settings.

Here, frequency of contact demonstrated a strong negative association with loneliness. More frequent contact could reduce the experience of loneliness, which also corresponds to the results from (Drageset et al., 2011), for example, which have shown that low frequency of social contact with family, friends, neighbors is associated with loneliness. However these contradict studies where no such link was found (Dugan & Kivett, 1994; Routasalo et al., 2006 cited in Drageset et al., 2011)

Positive, as well as negative aging attitudes proved to be significantly linked to loneliness, with negative aging attitudes displaying a stronger association. However, in contrast to the main analysis since the interaction was not supported in any analysis, a moderating link of aging attitudes on the relation between frequency of contact and loneliness cannot be assumed at all.

Since frequency of contact showed the strongest association with loneliness among all examined independent variables, an exploratory model was estimated including all variables that were significantly correlated with loneliness (i.e. social network size, social support, frequency of contact, positive and negative aging attitudes) (Table 7). In this combined model, only frequency of contact remained a significantly related with loneliness, whereas social network size and social support no longer showed independent main links. This suggests that the frequency with which social ties are enacted may be more relevant for the experience of

loneliness than the mere existence of social relationships or perceived support. This would align with the framework proposed by Berkman et al. (2000) which conceptualizes social networks as the structural foundation that enables the actual enactment of social ties. Frequency of contact therefore may reflect the extent to which this in enactment is realized in everyday life. Consequently, infrequent contact may foster feelings of social neglect or diminished social value, potentially intensify loneliness. Hence, frequency of contact could take on a mediating role in this context. At first glance, this pattern appears to contrast with socioemotional selectivity theory, which posits that with increasing age the quality of relationships becomes more important than the quantity of social ties (Carstensen, 2021). However, this apparent contradiction may be partly explained by the operationalization of frequency of contact in the LSNS-LTC. The scale assesses contact frequency with emotionally close family members and friends but also includes more general contact with other residents and staff. Thus, frequency of contact may capture not only quantitative aspects of social interaction but also the regular activation of emotionally meaningful relationships. Because having a small, emotionally close network may be important, yet how often contact with this network is actually enacted, could foster the feeling of being lonely or contrary promote the feeling of being a valuable part of the social environment. Concerning aging attitudes, this exploratory analysis again demonstrated robust associations between both positive and negative aging attitudes and loneliness, confirming a more prominent role of negative views.

As additional exploratory analyses, age-specific patterns were examined to assess whether the observed associations differed across later-life subgroups. For the old-old group (85–94 years), several associations with loneliness did not reach statistical significance, likely due to limited statistical power. To address this limitation, analyses were therefore adapted for the oldest age group by focusing on participants aged 90 years and older. Within this oldest-old subgroup, social isolation showed a strong positive association with loneliness ($\beta \approx .60 - .64$), mirroring the direction of links observed in the full sample but with noticeably larger effect sizes. Similar patterns were observed for social network size and social support, which were negatively associated with loneliness, although these findings should be interpreted cautiously due to reduced power. Social engagement again showed no direct association with loneliness, consistent with the main analyses, whereas frequency of contact emerged as a particularly relevant factor, showing a strong negative association with loneliness. Aging attitudes also followed a pattern comparable to the main analyses. Both positive and negative aging attitudes were associated with loneliness, with negative aging attitudes again showing the stronger association. This suggests that subjective perceptions of aging may become

increasingly salient for loneliness in very late life, potentially outweighing structural aspects of social integration. However, given the small subgroup sizes and exploratory nature of these analyses, these findings should be viewed as preliminary. Nevertheless, the consistency in direction and the amplification of effect sizes point toward the possibility that psychosocial factors such as social isolation and aging attitudes may be more strongly associated with loneliness in older age, warranting further investigation in larger, age-stratified samples.

Limitations

While the present findings provide valuable insights into the associations between social isolation, loneliness, and the role of aging attitudes, several additional limitations need to be considered. Firstly, due to the cross-sectional design, no causal inferences can be drawn, and the possibility of bidirectional associations remains. Also, despite reaching the desired sample size, compared to other studies like (Sun et al., 2022) the sample size presented relatively small, which may have limited statistical power, especially for detecting moderating associations.

Additionally, study participation was restricted to residents not having a legal guardian. As a result, severely impaired residents (e.g. with progressed dementia) were most likely underrepresented. As well as, during recruitment process it appeared that some individuals who perceived themselves as especially lonely were reluctant to participate, expressing that they had nothing to contribute – despite emphasizing that all experiences were valuable. Both this reluctance and the participation criteria likely led to a selection bias, potentially resulting in an underrepresentation of individuals experiencing the highest levels of loneliness and limiting generalizability of findings to a broader population.

Furthermore, response biases commonly associated with Likert-scale measures were observed during interviewing. Those predominantly included tendencies towards midpoint responding as well as tendencies to extreme responding. Some item-specific difficulties could have influenced the assessment as well. For example, UCLA Loneliness Scale item 8 was frequently skipped because participants reported being unable to judge the statement. Similarly, response options for some LSNS-LTC items assessing contact frequency (e.g., “how often...”) were criticized by participants, with suggestions that more concrete options such as “always” to “never” would have been more suitable.

An additional limiting factor may have been that several additional variables could play an important role in the context of social isolation and loneliness in the LTC context. Here, depression represents a well-established correlate of both social isolation and loneliness among long-term care residents and is frequently discussed as both a consequence and a predictor of

loneliness (Chamberlain et al., 2020; Lapane et al., 2022; Mulla et al., 2025; Sedlackova et al., 2024; Smith & Theeke, 2024; Theurer et al., 2021; Yen et al., 2024). Although depression was initially planned to be included as a covariate and assessed, the available data proved unreliable since the assigned diagnosis did not consistently correspond with documented treatment or medication. Consequently, depression was excluded from the analyses, limiting the ability to disentangle its role in the observed associations. Also, cognitive impairment e.g. has been linked to higher loneliness (Lee et al., 2022) and is also related to social isolation on an individual, systemic or structural level (Boamah et al., 2021). But in order to avoid complicating the model and due to sampling resources, only one covariate was collected, initially. Beyond that, other contextual factors relevant to loneliness in long-term care were not assessed. As such, e.g. the length of stay may influence both social integration and loneliness, as adaptation processes and social network restructuring evolve over time. Likewise, baseline social connectedness prior to institutionalization could shape residents' vulnerability to loneliness after entering long-term care. The omission of these factors further limits the interpretability of the findings. Due to the given simple study design no mediating influence could be examined of any variable.

Ultimately, a more comprehensive assessment of the individual dimensions of social integration using clearly defined and validated questionnaires might have yielded more reliable psychometric properties (Cronbach's α) for social network size and social support. This consideration is further underscored by the very high correlations observed between the LSNS subdimensions and the overall construct of social isolation. Specifically, social isolation was highly negatively correlated with social support ($r = -.96, p < .001$) and strongly negatively correlated with social network size ($r = -.81, p < .001$). These substantial associations suggest considerable overlap between the constructs and point to potential limitations in discriminant validity, indicating the need for a more precise and comprehensive assessment of social isolation and its components. However, implementing more differentiated measures would likely have increased the overall length and burden of the interviews.

Implications

Despite these limitations, the present study highlights several implications for clinical practice, intervention development, and social policy. First, loneliness often carries social stigma, and some older adults may hesitate to explicitly label themselves as lonely. Assessing attitudes toward one's own aging may therefore represent a less threatening and complementary approach to identifying individuals at risk. Self-perceptions of aging (SPA), for example, have

been linked to new friendship development (Menkin et al., 2017), social engagement (Schwartz et al., 2021), perceived social support (Cheng, 2017), and loneliness (Losada-Baltar et al., 2022). Incorporating such measures into psychosocial assessments may facilitate earlier identification of vulnerable individuals and enable more targeted interventions.

Second, the consistent and comparatively stronger links of negative aging attitudes suggest that reducing negative views of aging may be particularly important. Interventions should therefore not only foster positive self-perceptions but also actively challenge internalized negative age stereotypes. Cognitive and psychoeducational programs aimed at reframing maladaptive age-related beliefs could be integrated into active aging strategies, particularly for socially isolated older adults. At a broader societal level, promoting age-friendly environments and publicly acknowledging the social value and contributions of older adults may help counteract negative stereotypes. Encouraging meaningful social participation and strengthening intergenerational relationships have been shown to improve positive aging attitudes (Liu et al., 2022) and may thereby indirectly reduce loneliness.

Third, the prominent role of frequency of contact in the exploratory analyses suggests that not only the existence of social ties but also their regular enactment is crucial. Future interventions should therefore consider how to maintain consistent and meaningful contact for older adults. At the same time, further research should examine whether specific types of contact (e.g., family, friends, fellow residents, or staff members) differ in their protective potential. In this context, it is essential to assess not only the quantity but also the perceived meaning and quality of social interactions. Furthermore, a promising direction for future research concerns the development and systematic evaluation of interventions targeting aging attitudes. Experimental designs could investigate whether modifying negative age stereotypes through cognitive reframing, structured intergenerational programs, or stereotype-challenging training can effectively reduce loneliness. Embedding such interventions within active aging strategies or routine institutional care practices may offer scalable and sustainable solutions.

Future research should also consider contextual moderators that may shape the relationship between social connection, aging attitudes, and loneliness. Factors such as length of stay in long-term care, baseline social connectedness prior to institutionalization, cultural norms regarding aging, and the organizational climate within care facilities may meaningfully influence these associations. By integrating longitudinal designs, innovative measurement strategies, and experimental intervention approaches, future studies can contribute to a more nuanced and practically applicable understanding of loneliness in later life.

Conclusion

Research on loneliness in later life is characterized by substantial methodological and conceptual challenges. Variations in definitions, operationalizations, and measurement approaches make comparisons across studies difficult and highlight the complexity of disentangling structural, functional, and subjective components of social connection. Despite these challenges, the present findings underscore the relevance of aging attitudes as an important psychological correlate of loneliness in later life. Both positive and negative perceptions of aging demonstrated consistent associations with loneliness, emphasizing that subjective views of aging represent meaningful vulnerability and protective factors. These results contribute to a growing body of literature highlighting that loneliness is not solely a structural problem of social disconnectedness but also a cognitive and attitudinal phenomenon. Finally, addressing loneliness in older adults is not only a matter of individual well-being but also a broader societal responsibility. As demographic aging continues and demands on health and long-term care systems increase, early identification and prevention of loneliness may help mitigate downstream consequences for mental and physical health. Promoting age-inclusive environments, reducing internalized age stereotypes, and strengthening meaningful social connections represent important steps toward supporting this growing segment of the population and responding proactively to the increasing demands placed on care systems.

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Abstracts

English Abstract

Loneliness is highly prevalent among older adults in long-term care (LTC) settings and represents a significant public health concern. An effect of social isolation on loneliness is already established, as well as that aging attitudes can amplify or attenuate these effects. Less known is about whether these mechanisms also account for the individual components of social isolation, namely social network size, social support and social engagement. The present study examines these component's relationship with loneliness and whether positive and negative aging attitudes are associated with differences in these relationships. Data were collected from 68 residents of two LTC facilities in Vienna, Austria, using structured interviews and care documentation. Loneliness was assessed using the German UCLA Loneliness Scale, social isolation via the Lubben Social Network Scale, social engagement through documented activity participation, and aging attitudes using the Attitudes to Aging Questionnaire. Simple and multiple linear regression analyses were conducted. Results showed greater social isolation was significantly associated with higher loneliness. Among the individual components, smaller social network size, lower perceived social support, and lower frequency of contact were linked to higher loneliness, whereas social engagement showed no direct association. In combined models, frequency of contact emerged showing the strongest link with loneliness. Positive aging attitudes were consistently associated with lower loneliness, whereas negative aging attitudes showed stronger positive associations. Moderating links of aging attitudes were not observed in full-sample analyses and emerged only after exclusion of influential cases, indicating exploratory trends rather than robust interaction effects. Overall, negative aging attitudes showed stronger relations compared to positive aging attitudes.

Keywords: loneliness, social isolation, attitudes toward aging, social engagement, social support, social network size

German Abstract

Einsamkeit ist unter älteren Menschen im Kontext der Langzeitpflege weit verbreitet und stellt sowohl ein relevantes gesellschaftliches als auch individuelles gesundheitliches Problem dar. Ein Zusammenhang zwischen sozialer Isolation und Einsamkeit wurde in zahlreichen Studien nachgewiesen. Zudem gibt es Hinweise darauf, dass Einstellungen zum (eigenen) Altern diese Zusammenhänge moderieren können. Weniger bekannt ist allerdings, ob diese Mechanismen auch für die einzelnen Aspekte sozialer Isolation gelten, insbesondere für soziale Netzwerke, soziale Unterstützung und soziale Teilnahme. Die vorliegende Studie untersucht daher die Zusammenhänge dieser Komponenten mit Einsamkeit sowie die Frage, ob positive und negative Einstellungen zum Altern mit Unterschieden in diesen Beziehungen verbunden sind. Die Datenerhebung erfolgte mithilfe von 68 Bewohner:innen zweier Wiener Langzeitpflegeeinrichtungen anhand strukturierter Interviews sowie ergänzender Informationen aus der bestehenden Pflegedokumentation. Einsamkeit wurde mithilfe der deutschen Version der UCLA Loneliness Scale erfasst, soziale Isolation über die für den Langzeitpflegekontext adaptierte Lubben Social Network Scale. Soziale Teilnahme wurde anhand dokumentierter Teilnahme an Aktivitäten und therapeutischen Angeboten erhoben, und Einstellungen zum Altern wurden mit dem Attitudes to Aging Questionnaire gemessen. Zur Analyse der Zusammenhänge wurden jeweils einfache und multiple lineare Regressionsanalysen durchgeführt. Die Ergebnisse zeigen, dass in der vorliegenden Stichprobe stärkere soziale Isolation signifikant mit höherem Einsamkeitserleben assoziiert war. Auch eine kleinere Netzwerkgröße, geringere soziale Unterstützung sowie eine niedrigere Kontakthäufigkeit standen mit höherer Einsamkeit in Zusammenhang. Für soziale Teilnahme zeigte sich hingegen kein direkter Zusammenhang mit Einsamkeit. In einem Modell, das alle signifikanten Faktoren berücksichtigte, erwies sich die Kontakthäufigkeit als Aspekt mit der stärksten Verbindung mit Einsamkeit. Positive Einstellungen zum Altern waren konsistent mit geringerem Einsamkeitserleben assoziiert, während negative Einstellungen stärkere positive Zusammenhänge aufwiesen. Moderierende Zusammenhänge der Einstellungen zum Altern zeigten sich in den Analysen der Gesamtstichprobe nicht und traten erst nach Ausschluss einflussreicher Fälle auf, sodass diese lediglich als explorative Hinweise und nicht als robuste Interaktionseffekte interpretiert werden können.

Stichwörter: Einsamkeit, soziale Isolation, Einstellungen zum Altern, soziale Teilnahme, soziale Unterstützung, Größe sozialer Netzwerke

Appendix A

Additional Questionnaire Items

The following additional items were administered as part of the structured interview.

Subjective Health

Measured using a single-item Likert scale (1–5):

„Wie gesund fühlen Sie sich?“

Knowledge of offered Activities

Assessed using a dichotomous response format (Yes/No):

„Haben Sie das Gefühl, ausreichend über Therapie und Beschäftigungsmöglichkeiten informiert zu sein?“

Importance of Social Participation

Assessed using a 5-point Likert scale (1–5):

„Wie wichtig ist es Ihnen, an Angeboten für Aktivitäten und Interventionen teilzunehmen?“

„Wie wichtig ist es Ihnen, an Therapieangeboten teilzunehmen?“

„Wie wichtig ist es Ihnen, an Beschäftigungsangeboten von der Station teilzunehmen?“

Non-Participation

Open-ended question:

„Falls Sie ungerne, selten oder gar nicht, an Aktivitäten/Interventionen teilnehmen, aus welchem Grund?“

Satisfaction with offered Activities

Assessed using a 7-point Likert scale (1–7):

„Wie zufrieden sind Sie mit dem Angebot für Beschäftigungen/Aktivitäten/Interventionen?“

Open-Ended Feedback

„Was gefällt Ihnen besonders gut/nicht so gut?“

„Gibt es etwas, dass Sie sich wünschen?“

List of Abbreviations

LTC = Long-Term Care

AA = Aging Attitudes

PAA = Positive Aging Attitudes

NAA = Negative Aging Attitudes

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