

Review Articles



Research Progress on the Impacts of Social Isolation and Loneliness on the Health of the Elderly

Elisa M. Carter¹, Ryan D. Simmons¹, Megan L. Henderson², Julia A. Bennett^{1*}

¹ Department of Gerontology, University of Southern California, Los Angeles, CA, USA

² Department of Social Work and Public Health, Boston University, Boston, MA, USA

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ABSTRACT

Social isolation and loneliness have emerged as critical public health concerns affecting older adults worldwide. Despite being distinct concepts—social isolation referring to the objective lack of social connections and loneliness representing the subjective distress of feeling alone—both conditions are associated with profound adverse effects on physical and mental health. This narrative review synthesizes current research on the conceptual definitions, measurement tools, health impacts, intervention strategies, and future research directions regarding social isolation and loneliness in the elderly population. Evidence consistently demonstrates associations with increased risks of depression, cognitive decline, cardiovascular disease, and mortality. Various interventions, including cognitive behavioral therapy, social engagement programs, and technology-mediated approaches, show promise in mitigating these conditions. However, significant methodological limitations persist, necessitating more rigorous longitudinal and randomized controlled trials to establish causal relationships and optimize intervention efficacy.

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1. Introduction

The global aging population has brought increasing attention to the psychosocial determinants of health in later life. Among these, social isolation and loneliness have been identified as significant risk factors that profoundly influence the well-being of older adults [1]. In 2023, the World Health Organization (WHO) launched the Commission on Social Connection, explicitly recognizing loneliness as a pressing global health threat that affects people across all age groups and socioeconomic backgrounds [2]. The U.S. Surgeon General has similarly identified social isolation and loneliness as important public health concerns, noting that the health risks associated with loneliness are equivalent to smoking 15 cigarettes daily [3].

Contrary to common perception that these issues primarily affect older adults in high-income countries, social isolation and loneliness are universal phenomena with broadly similar prevalence rates across all regions. Approximately one in four older adults experiences social isolation, while loneliness affects individuals across the lifespan [2][4]. In the United States, a 2023 national poll reported that about 37% of older adults aged 50–80 years experienced loneliness and 34% reported feeling socially

isolated [5]. These figures likely represent underestimations, as stigma and underreporting may mask the true extent of the problem.

The consequences of social isolation and loneliness extend far beyond emotional distress. A substantial body of research has linked these conditions to a wide array of adverse health outcomes, including cardiovascular disease, cognitive decline, depression, and increased mortality risk [1][6][7]. The negative impact of loneliness on health has been reported to equate to smoking 15 cigarettes a day. Furthermore, adults with adequate or strong social relationships have demonstrated a 50% increased likelihood of survival compared with those with weaker or insufficient relationships [8].

Given the growing recognition of social isolation and loneliness as modifiable risk factors for poor health outcomes, understanding their distinct conceptualizations, accurate measurement, health impacts, and effective interventions is essential for developing targeted public health strategies. This review aims to synthesize current research progress on the impacts of social isolation and loneliness on elderly health, examining conceptual definitions, measurement tools, health consequences, intervention strategies, and directions for future research.

This narrative review was conducted by searching PubMed, Web of Science, PsycINFO, and Scopus for peer-reviewed articles published between 2000 and 2026. The search strategy employed combinations of the following terms: "social isolation", "loneliness", "older adults", "elderly

* Corresponding author: Julia A. Bennett

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health", "cognitive decline", "cardiovascular disease", "mortality", "interventions", and "mechanisms". Reference lists of identified systematic reviews and meta-analyses were hand-searched to identify additional relevant studies. Inclusion criteria were: (1) original research articles, systematic reviews, or meta-analyses published in peer-reviewed journals; (2) focus on adults aged 50 years or older; (3) published in English; and (4) examination of health outcomes or interventions related to social isolation or loneliness. Studies focusing exclusively on clinical populations with severe mental disorders or those not reporting age-stratified data were excluded.

This review adopts a narrative synthesis approach rather than a formal systematic review. A narrative review is appropriate for broad-scope topics where the heterogeneity of study designs, outcome measures, and populations precludes quantitative meta-analysis. Unlike a systematic review, this approach does not employ exhaustive literature retrieval, independent dual-screening, or formal risk-of-bias assessment tools such as the Cochrane Risk of Bias tool or ROBINS-I. Instead, priority was given to findings from large-scale longitudinal studies, meta-analyses, and randomized controlled trials where available. Readers should note that the conclusions drawn herein are subject to the limitations inherent in the primary literature, including observational designs that preclude causal inference.

2. Conceptual Definitions: Social Isolation vs. Loneliness

2.1. Social Isolation

Social isolation is defined as an objective condition in which individuals lack adequate connections to family, friends, or a community [5][9]. It is characterized by the quantifiable absence of social contacts, participation in social activities, and integration into social networks [10]. Social isolation represents a structural deficiency in an individual's social environment, measurable through indicators such as network size, frequency of social interactions, and participation in community activities. Importantly, social isolation is distinct from chosen solitude. Some individuals may voluntarily limit their social interactions without experiencing distress, whereas social isolation refers to an involuntary state of disconnection that may result from various circumstances including bereavement, retirement, relocation, physical disability, or lack of transportation. Older adults are particularly vulnerable to social isolation due to factors such as the loss of a partner or other loved ones, decreased mobility, worsening vision and hearing, chronic illness, inability to access transportation, or cessation of favorite activities.

2.2. Loneliness

Loneliness, in contrast, is a subjective emotional experience defined as the distressing feeling that arises from a perceived discrepancy between desired and actual social relationships [11][12]. It reflects the cognitive evaluation of one's social connections as insufficient in quantity or quality to meet personal needs for intimacy, belonging, and companionship [13]. As Perlman and Peplau (1981) articulated, loneliness is characterized by the disparity between one's desired social relationships and one's perception of existing relationships.

This subjective nature of loneliness means that individuals can experience profound loneliness even when surrounded by others if their relationships lack emotional depth or meaningful connection[5][12]. Conversely, some individuals may spend considerable time alone without feeling lonely if

they perceive their social needs as adequately met. Neurobiological evidence further distinguishes loneliness from solitude by linking it to heightened activation in brain regions associated with social threat processing, such as the anterior cingulate cortex, highlighting its role as an indicator of unmet social needs.

2.3. The Relationship Between Social Isolation and Loneliness

While social isolation and loneliness are conceptually distinct, they are closely interrelated. In general, the risk of loneliness increases with social isolation. However, the relationship is not deterministic—socially isolated individuals may not necessarily feel lonely, and lonely individuals may not be objectively isolated. This distinction has important implications for assessment and intervention, as addressing objective social isolation may not always resolve subjective loneliness, and vice versa [14].

Loneliness can perpetuate a self-reinforcing cycle in which withdrawal exacerbates hypervigilance to social threats, further isolating the individual. Meta-analytic data confirm that loneliness is associated with elevated cortisol levels and inflammatory markers, underscoring its bidirectional relationship with physiological stress reactivity [12]. Understanding these nuanced distinctions is crucial for developing targeted interventions that address the specific needs of individuals experiencing either or both conditions.

3. Measurement Tools

Accurate assessment of social isolation and loneliness is fundamental to both research and clinical practice. A variety of validated instruments have been developed to capture these constructs, each with distinct theoretical foundations and practical applications.

3.1. Measures of Social Isolation

3.1.1 Lubben Social Network Scale (LSNS). The Lubben Social Network Scale (LSNS) is one of the most widely used instruments for assessing social isolation in older adults [15][16]. Originally developed as a 10-item measure, it was adapted from the Berkman-Syme Social Network Index to focus specifically on the older adult population. The scale emphasizes the quality and frequency of an individual's relationships with family and friends, assessing perceived levels of support through questions about the number of relatives and friends seen or heard from at least once a month, the number with whom one feels at ease discussing private matters, and the number one feels close enough to call upon for help.

An abbreviated six-item version (LSNS-6) has been developed and widely adopted in large-scale surveys [15,16]. Scoring ranges from 0 to 30, with higher scores indicating larger social networks and lower risk of social isolation. The LSNS-6 includes three questions each about family and friends, providing a balanced assessment of both kin and non-kin relationships.

3.1.2 Duke Social Support Index (DSSI). The Duke Social Support Index is a comprehensive 35-item measure assessing various dimensions of social support, including social network (e.g., proximity of family), social interaction (e.g., frequency of interactions), subjective support (e.g., perceptions of relationships), and instrumental support (e.g., availability of help). Due to the length of the original instrument, abbreviated versions have been developed, including an 11-item scale with subscales for social interaction and subjective support, and a 23-item version that adds instrumental support [16].

3.1.3 Berkman-Syme Social Network Index (SNI). The Berkman-Syme Social Network Index assesses social integration through four domains: marital status, contact with friends and relatives, religious attendance, and participation in other groups [17]. While historically influential, this measure has been noted to have limitations in older adult populations where marital status and religious participation may vary less.

3.2. Measures of Loneliness

3.2.1 UCLA Loneliness Scale. The UCLA Loneliness Scale is among the most extensively validated instruments for assessing subjective loneliness. Version 3 consists of 20 items assessing subjective feelings of loneliness or social isolation, with all questions framed using "how often do you feel..." and response choices including never, rarely, sometimes, and often. Scores range from 20 to 80, with higher scores indicating greater loneliness. Example items include "How often do you feel a lack of companionship?", "How often do you feel left out?", and "How often do you feel isolated from others?".

A shorter three-item version (UCLA-3) has been developed for use in large surveys, asking respondents how often they feel they lack companionship, feel left out, and feel isolated from others [18]. This abbreviated version maintains strong psychometric properties while reducing respondent burden.

3.2.2 De Jong Gierveld Loneliness Scale. The De Jong Gierveld Loneliness Scale is an 11-item questionnaire designed to assess both overall loneliness and two specific types of loneliness: emotional loneliness (the absence of a close, intimate relationship) and social loneliness (the absence of a broader social network) [16][19]. The scale includes a three-item emotional loneliness subscale and a three-item social loneliness subscale, with scores ranging from 0 to 6, where higher scores indicate greater loneliness.

A shortened six-item version comprising two 3-item subscales has been widely used in large surveys. The emotional loneliness items include statements such as "I experience a general sense of emptiness" and "I miss having people around me," while the social loneliness items assess perceived availability of reliable others and feelings of closeness to others. This distinction between emotional and social loneliness provides valuable clinical information, as different intervention strategies may be needed depending on which type of loneliness predominates [20].

3.2.3 Single-Item Measures. Single-item measures, such as asking participants "Do you feel lonely?" with response options ranging from "very rarely or never" to "often or almost always," have also been employed in epidemiological research. While these measures lack the psychometric sophistication of multi-item scales, they offer practical advantages in large population surveys and have demonstrated reasonable validity in identifying individuals experiencing significant loneliness [21].

3.3. Considerations in Measurement Selection

The choice of measurement instrument should be guided by the specific research or clinical context, considering factors such as the population being studied, the available time for assessment, and whether the goal is to identify objective social isolation, subjective loneliness, or both. Recent psychometric assessments have emphasized the importance of using validated instruments that distinguish between social isolation and loneliness, as these constructs, while related, have distinct antecedents and consequences [18][22].

4. Impacts on Physical and Mental Health

4.1. Mental Health Outcomes

4.1.1 Depression and Anxiety. The relationship between social isolation, loneliness, and depression is well-established and bidirectional. Lonely individuals are twice as likely to develop depression, and socially isolated older adults consistently demonstrate worse mental health outcomes. Depression is highly prevalent among older adults, with systematic reviews indicating substantial global burden [23]. Loneliness serves as a significant psychosocial stressor that may trigger depression through stress-related pathways. Longitudinal research has confirmed that depressive states prospectively predict subsequent cognitive decline, and both depression and cognitive function in older adults exhibit temporal fluctuations with significant cross-lagged predictive effects between the two [24]. Network analysis has identified depression, particularly suicidal ideation, as a central node bridging social isolation and cognitive decline, suggesting that depression may mediate the relationship between social disconnection and cognitive deterioration.

4.1.2 Cognitive Function and Dementia Risk. Social isolation and loneliness have emerged as significant modifiable risk factors for cognitive decline and dementia. The Lancet Commission on dementia prevention identified social isolation as one of the strongest modifiable risk factors, estimating that addressing social isolation could prevent approximately 5% of dementia cases worldwide [25]. A longitudinal study of 12,030 participants aged 50 and older from the Health and Retirement Study found that loneliness was associated with a 40% increased risk of dementia after controlling for effects of social isolation and other risk factors [26].

A meta-analysis of 10 studies observing healthy adults aged 50+ years revealed that prolonged loneliness and social isolation were associated with a 49–60% higher risk of developing dementia compared to individuals who do not experience these conditions. Those who suffer a high degree of loneliness are twice as likely to develop cognitive impairment and dementia. A comprehensive cross-national study drawing on harmonized data from five major longitudinal aging studies across 24 countries (N = 101,581) found that social isolation was significantly associated with reduced cognitive ability, with consistently negative effects across memory, orientation, and executive function domains [27].

The mechanisms underlying the association between social disconnection and cognitive decline are multifaceted. Social engagement may promote cognitive reserve through mental stimulation, while social isolation may accelerate neurodegenerative processes through chronic stress and inflammation. Additionally, depression, which frequently co-occurs with loneliness, may serve as a mediating factor linking social isolation to cognitive deterioration.

4.2. Physical Health Outcomes

4.2.1 Cardiovascular Conditions. Social isolation and loneliness have been consistently associated with increased risk of cardiovascular disease. A systematic review and meta-analysis of longitudinal observational studies found that loneliness and social isolation were significant risk factors for coronary heart disease and stroke [28]. Prolonged social isolation and loneliness may increase the risk of mental health disorders and physical health problems such as cardiovascular disease, dementia, diabetes, and weight disorders [29].

The mechanisms linking social disconnection to cardiovascular disease include elevated blood pressure, increased inflammatory markers, altered

autonomic function, and disrupted sleep patterns. Chronic loneliness has been associated with immune dysfunction and increased cardiovascular events. Social isolation has been linked to a 30% increased risk of cardiovascular disease.

4.2.2 Frailty and Functional Decline. Social isolation and loneliness are associated with increased prevalence of frailty and functional decline in older adults. Chronic loneliness has been linked to frailty, sleep disturbance, and obesity. Frail older adults are at an increased risk of mortality, and this risk is even higher for those who are also lonely or socially isolated. The combination of frailty with loneliness or social isolation represents an elevated risk for mortality in later life.

4.2.3 Mortality Risk. Perhaps the most compelling evidence for the health impact of social disconnection comes from studies examining mortality. A landmark meta-analytic review by Holt-Lunstad and colleagues (2015) found that loneliness and social isolation were associated with a significantly increased risk of mortality, with effect sizes comparable to or exceeding those of other well-established risk factors such as smoking, obesity, and physical inactivity. Adults with adequate or strong social relationships had a 50% increased likelihood of survival compared with those with weaker or insufficient relationships.

A comprehensive systematic review, meta-analysis, and meta-regression found that chronic loneliness and chronic social isolation among older adults were associated with significantly increased mortality risk. Frail older adults who were also lonely or socially isolated faced particularly elevated mortality risks. These findings underscore the critical importance of social connection as a determinant of longevity.

4.3. Mechanisms Underlying Health Impacts

The adverse health effects of social isolation and loneliness are mediated through multiple interacting biological, psychological, and behavioral pathways that often reinforce one another in a self-perpetuating cycle.

Biological Mechanisms. At the neuroendocrine level, loneliness has been associated with alterations in hypothalamic-pituitary-adrenal (HPA) axis functioning. Adam and colleagues (2006) found that greater loneliness reported on one evening predicted a higher cortisol awakening response (CAR) the following morning in older adults, suggesting a time-lagged association between subjective social distress and next-day HPA activation [30]. Steptoe and colleagues (2004) similarly reported that loneliness was associated with a higher CAR in middle-aged and older adults [31]. However, the literature on loneliness and diurnal cortisol slope has yielded inconsistent results: while some studies reported a flatter diurnal cortisol slope in lonely older adults, others found no significant association [32]. These inconsistencies suggest that the relationship between loneliness and HPA axis activity may be moderated by factors such as sex, age, and chronicity of loneliness.

At the immunological level, a systematic review and meta-analysis by Smith and colleagues (2020) synthesized evidence from 14 studies on loneliness and 16 studies on social isolation. The meta-analysis found no significant association between loneliness and C-reactive protein (CRP) or fibrinogen, but a significant association between loneliness and interleukin-6 (IL-6) in most-adjusted analyses [33]. For social isolation, significant least-adjusted associations were found with CRP and fibrinogen, though the association with CRP did not remain significant in most-adjusted analyses. The authors noted substantial methodological heterogeneity across studies and concluded that while social isolation and loneliness could be linked with systemic inflammation, more robust methodology is needed to confirm these associations and unpack mechanisms. Van Bogart and colleagues

(2022) examined 222 socioeconomically diverse older adults and found that both trait and momentary loneliness were associated with higher CRP levels ($\beta = 0.16$, $p = 0.02$ and $\beta = 0.15$, $p = 0.03$, respectively), though no significant associations were found with basal or LPS-stimulated cytokines [34].

Research has also examined whether loneliness is associated with accelerated cellular aging. Cole and colleagues (2007, 2011) reported that chronically lonely older adults exhibited a pro-inflammatory gene expression profile characterized by increased activity of the NF- κ B transcription factor and decreased transcription of glucocorticoid receptor target genes [35][36]. Cole (2008) further found that loneliness was associated with smaller neutrophil: lymphocyte and neutrophil: monocyte ratios in a nationally representative sample of older Taiwanese adults, consistent with leukocyte glucocorticoid resistance [37]. Regarding epigenetic aging, Freilich and colleagues (2024) examined data from the Health and Retirement Study and found that baseline loneliness was weakly associated with greater GrimAge acceleration net of demographic and behavioral covariates ($\beta = 0.07$, $p = .003$) [38]. The association between loneliness and increasing chronic condition counts was significantly mediated by GrimAge (indirect path $\beta = 0.020$, $p = .003$), suggesting that epigenetic processes may partially contribute to loneliness-related health risk. However, the authors emphasized that the direct association between loneliness and multimorbidity remained substantial, indicating that DNA methylation explains only a modest portion of the overall relationship.

Psychological Mechanisms. Lonely individuals exhibit systematically negatively biased social cognition that perpetuates and deepens social disconnection. According to the regulatory loop model proposed by Cacioppo and Hawkley (2009), loneliness triggers hypervigilance to social threats, causing individuals to attend to, encode, and remember more negative social information. This cognitive bias manifests across multiple stages of information processing: attentional bias toward socially threatening stimuli, negative attribution bias in interpreting ambiguous social situations, and heightened rejection sensitivity characterized by exaggerated expectations of social rejection. Lonely individuals also demonstrate lower self-efficacy in social domains and a tendency toward excessive self-monitoring during social interactions, which paradoxically deteriorates social performance and confirms negative self-views [39]. Depression serves as a critical psychological mediator: lonely individuals are twice as likely to develop depression, and depressive states prospectively predict subsequent cognitive decline, creating a pathway through which social disconnection translates into neurodegenerative risk.

Behavioral Mechanisms. Socially isolated and lonely older adults demonstrate consistent patterns of health-compromising behaviors. Objectively measured physical activity data indicate that socially isolated individuals exhibit significantly lower 24-hour physical activity and greater sedentary behavior during both day and evening hours, independent of age, gender, socioeconomic status, and self-rated health [40]. Lonely older adults are more likely to experience sleep disturbances and engage in less preventive healthcare utilization. Medication adherence represents another critical behavioral pathway: systematic reviews demonstrate statistically significant negative correlations between loneliness and medication adherence among older adults with chronic diseases, with loneliness serving as both a direct predictor and a mediator in the pathway from social isolation to non-adherence [41].

Interactive Effects and Vicious Cycles. These three classes of mechanisms do not operate in isolation but rather form self-reinforcing vicious cycles. Biologically, chronic HPA activation and elevated inflammatory tone increase fatigue and pain sensitivity, reducing the capacity and motivation

for physical activity and social engagement. Psychologically, negative social cognition biases lead to avoidance of social situations, which in turn eliminates opportunities for positive social feedback that could correct maladaptive perceptions. Behaviorally, reduced physical activity and poor sleep further dysregulate the HPA axis and amplify inflammatory responses, while medication non-adherence exacerbates chronic conditions that limit mobility and social participation. This bidirectional reinforcement explains why simple increases in social contact often fail to resolve loneliness—unless the underlying cognitive and biological dysregulation is simultaneously addressed.

5. Intervention Strategies

The theoretical and empirical distinction between objective social isolation and subjective loneliness carries profound implications for intervention design. A meta-analysis by Masi and colleagues (2011), encompassing 50 studies and 50 interventions, examined the efficacy of four categories of loneliness interventions: improving social skills, enhancing social support, increasing opportunities for social contact, and addressing maladaptive social cognition. The meta-analysis found that interventions targeting maladaptive social cognition produced the largest effect size ($d = 0.51$), followed by social contact ($d = 0.28$), social support ($d = 0.21$), and social skills ($d = 0.20$). However, the authors noted that the variance in effect sizes explained by intervention type was modest, and the differences between categories did not reach conventional levels of statistical significance [42]. Nevertheless, the pattern of findings suggests that addressing the subjective perception of loneliness may be an important component of effective intervention, though it should not be interpreted as evidence that cognitive approaches are definitively superior to social contact approaches. Building on this framework, the following sections organize intervention evidence into two broad categories: social contact-oriented interventions, which aim to increase objective social integration, and cognitive mechanism-oriented interventions, which target the maladaptive thought patterns and emotional regulatory deficits that may perpetuate subjective loneliness.

5.1. Social Contact-Oriented Interventions

Social contact-oriented interventions operate on the premise that increasing the quantity or quality of social interactions will reduce both social isolation and, by extension, loneliness.

5.1.1 Group Activities and Community Programs. Group interventions with an educational focus or specific support function have been identified as key elements of successful loneliness reduction programs. These interventions may include physical exercise programs, art classes, discussion groups, and volunteer activities. The inclusion of a broad range of services and activities increases the likelihood of individuals finding a social program they enjoy, motivating continued attendance and engagement. However, meta-analytic evidence suggests that such group-based social contact interventions yield smaller effect sizes compared with cognitively focused approaches [42]. This pattern may reflect the fact that simply placing lonely individuals in social settings does not necessarily alter the negative social cognitions that drive loneliness; indeed, without cognitive restructuring, group participation may reinforce feelings of social inadequacy.

5.1.2 Befriending and Peer Support. Befriending interventions, which pair isolated older adults with trained volunteers or peers for regular social contact, have been widely implemented. While results have been mixed,

these interventions offer valuable social connection, particularly for homebound individuals who face significant barriers to community participation. Effect sizes for befriending programs generally fall within the small-to-moderate range, and their impact on subjective loneliness is often less pronounced than their impact on objective social isolation. This discrepancy underscores the distinction between isolation and loneliness: increasing social contact without addressing cognitive appraisals may resolve isolation but leave loneliness intact.

5.1.3 Technology-Mediated Social Contact. The COVID-19 pandemic accelerated the development and adoption of technology-mediated interventions to maintain social connection while physical distancing. Video calls, social media platforms, and online communities have enabled older adults to maintain contact with family and friends despite mobility limitations. Research indicates that social media communication can reduce loneliness among older adults with physical functional limitations both directly and by supporting traditional social interactions, particularly in-person meet-ups [38]. However, the efficacy of technology-mediated social contact varies considerably with digital literacy, accessibility, and the quality of interactions. Some older adults find learning to use computers too difficult and withdraw from technology-based interventions [32], highlighting the need for user-friendly designs and adequate training support.

5.2. Cognitive Mechanism-Oriented Interventions

Cognitive mechanism-oriented interventions target the maladaptive social cognitions, emotional regulatory deficits, and stress reactivity patterns that may sustain loneliness independent of objective social circumstances.

5.2.1 Cognitive Behavioral Therapy (CBT). Cognitive behavioral therapy has shown promise in addressing loneliness by helping individuals identify and challenge maladaptive thought patterns related to social interactions. Lonely individuals often harbor negatively biased perceptions of social situations and expectations of rejection, which CBT can help restructure. A review of randomized controlled trials found that two online CBT interventions for individuals with depression were successful at decreasing both depressed mood and loneliness at 12-month follow-up [31]. The potential superiority of CBT over pure social contact interventions likely stems from its direct targeting of the hypervigilance to social threat and negative attribution biases identified in the regulatory loop model [39]. By correcting these cognitive distortions, CBT may interrupt the self-fulfilling prophecy whereby negative expectations produce defensive behaviors that elicit actual social rejection.

5.2.2 Mindfulness-Based Interventions. Mindfulness training, which emphasizes awareness, acceptance, and non-judgmental attention to present experiences, has demonstrated efficacy in reducing loneliness. A randomized controlled trial using smartphone-based mindfulness training found that participants who received the intervention reported a 22% reduction in daily loneliness compared with the control group. Mindfulness may mitigate loneliness by reducing the negative emotional reactivity and rumination that often accompany perceived social disconnection [33]. Unlike CBT, which actively challenges negative thoughts, mindfulness reduces the impact of these thoughts by decreasing cognitive fusion and emotional reactivity, offering a complementary mechanistic pathway.

5.2.3 Interpersonal Psychotherapy. Interpersonal psychotherapy, which focuses specifically on maladaptive thinking related to interpersonal relationships, represents another therapeutic approach with potential for addressing loneliness. Originally developed as a treatment for depression, interpersonal psychotherapy views depression as connected to triggering

life events such as bereavement and aims to improve interpersonal functioning. While not extensively studied as a specific intervention for loneliness, its focus on interpersonal relationships makes it theoretically appropriate for older adults facing bereavement or retirement-related social disruption.

5.2.4 Reminiscence Therapy. Reminiscence therapy, which involves structured discussion of past life experiences, has shown positive effects on loneliness, depression, and psychological well-being in older adults. Both group-based and individual reminiscence therapy encourage social interaction and cooperation, thereby minimizing isolation and depressive symptoms [34]. Systematic reviews and meta-analyses have confirmed the effectiveness of reminiscence-based interventions in improving psychological well-being among cognitively intact older adults [35]. While reminiscence therapy includes social elements, its cognitive component—reconstructing positive self-narratives and reinforcing identity—may contribute to its efficacy beyond mere social contact.

5.3. Multi-Domain and Mechanism-Focused Interventions

Recent research has emphasized the importance of targeting the underlying mechanisms of loneliness rather than simply increasing social contact. A systematic review and meta-analysis of mechanistic loneliness interventions for older adults found that distress tolerance interventions, group interventions with longer and more frequent sessions, and cognitive or acceptance of aging-focused interventions had larger effect sizes. The pooled standardized mean difference for improving loneliness was significant, though heterogeneity among studies was high [40].

The US POINTER randomized clinical trial demonstrated that a structured, higher-intensity multidomain lifestyle intervention combining regular physical activity, adherence to the MIND diet, cognitive stimulation, and social engagement produced significantly greater improvements in global cognitive function over 2 years compared with a self-guided intervention in older adults at elevated risk for dementia [41]. These findings support social engagement as a key modifiable component of dementia prevention, while also highlighting that social engagement may be most effective when embedded within a broader lifestyle framework that simultaneously addresses biological and behavioral mechanisms.

5.4. Social Robots and Conversational Agents

Recent advances in artificial intelligence have led to the development of social robots, chatbots, and conversational agents designed to provide companionship and social interaction for older adults. A systematic review and meta-analysis of autonomous conversational agents found that these technologies can reduce loneliness, depression, and anxiety in older adults without cognitive impairment. However, concerns regarding accessibility, digital literacy, and the quality of human-machine interaction remain. The mechanism through which social robots reduce loneliness appears to involve both social contact simulation and cognitive engagement, though the durability of effects and their equivalence to human contact require further investigation.

5.5. Gender-Specific and Culturally Tailored Interventions

Emerging evidence suggests that intervention effectiveness may vary by gender and cultural context. Women tend to respond more positively to emotionally supportive programs, while men may benefit more from task-oriented or activity-based interventions. Culturally adapted interventions

that respect values, communication styles, and social norms of specific populations are more likely to achieve meaningful engagement and sustained participation [42].

5.6. Comparative Summary: Contact-Oriented vs. Mechanism-Oriented Approaches

The evidence suggests a tentative hierarchy of intervention efficacy. Meta-analytic data indicate that cognitive mechanism-oriented interventions (particularly CBT and mindfulness) may produce larger effect sizes than social contact-oriented approaches, though the differences between categories were not statistically significant and should be interpreted with caution. For clinical practice, this suggests a stepped-care approach in which all older adults experiencing social disconnection are assessed for both objective isolation and subjective loneliness. Those with primarily objective isolation may benefit from social contact-oriented programs, while those with persistent subjective loneliness—particularly in the presence of adequate social networks—should be considered for cognitive mechanism-oriented interventions such as CBT or mindfulness training.

6. Limitations and Future Directions of Research

6.1. Methodological Limitations

Despite the growing body of literature on social isolation and loneliness, several methodological limitations persist. First, the majority of studies are observational in nature, which limits the ability to establish causal relationships between social disconnection and health outcomes. While longitudinal designs can establish temporal precedence, confounding variables and reverse causality remain concerns [27][43]. The cross-sectional design of many studies prevents causal inferences about the relationship between functional limitations and loneliness.

Second, measurement inconsistencies across studies complicate cross-study comparisons and meta-analytic synthesis. Different instruments, cut-off points, and assessment timeframes are used to define social isolation and loneliness, leading to heterogeneous prevalence estimates and effect sizes [44]. The use of relatively brief loneliness instruments in some studies may limit measurement precision and the ability to detect subtle differences between groups.

Third, sample limitations restrict generalizability. Many studies have been conducted in high-income countries with predominantly White, educated samples. The cross-national study by Li and colleagues (2025) represents an important advance, but more research is needed from low- and middle-income countries and diverse cultural contexts [27].

6.2. Conceptual and Theoretical Gaps

The distinction between social isolation and loneliness, while conceptually clear, is not always maintained in research and practice. Future studies should explicitly distinguish these constructs and examine their independent and interactive effects on health outcomes. Additionally, the bidirectional relationship between social isolation, loneliness, and health outcomes requires further elucidation. Longitudinal studies employing cross-lagged panel models can help disentangle whether functional limitations lead to increased loneliness or whether loneliness itself accelerates functional decline.

The mechanisms underlying the health impacts of social disconnection require continued investigation. While biological pathways (inflammation,

stress response) and psychological pathways (negative cognitive biases, depression) have been identified, the relative contributions of these mechanisms and their interactions remain unclear.

6.3. Intervention Research Needs

Intervention research faces several challenges. Many interventions have small sample sizes, short follow-up periods, and methodological flaws such as inadequate control conditions and high attrition rates. The evidence base is characterized as mixed and heterogeneous, with interpretive limits shaped by review and trial quality [45]. There is an urgent need for large-scale, well-designed randomized controlled trials with long-term follow-up to establish the efficacy of specific intervention approaches.

Cost-effectiveness analyses are largely lacking, limiting the ability of policymakers to make informed decisions about resource allocation. Furthermore, few interventions have been tailored specifically to vulnerable subgroups, including cognitively impaired older adults, those with sensory impairments, and individuals from marginalized communities. Technology-mediated interventions, while promising, face barriers related to accessibility, cost, and digital literacy. Some older adults find learning to use computers too difficult and withdraw from technology-based interventions. Future research should address these barriers and develop user-friendly technologies that accommodate varying levels of technological proficiency.

6.4. Policy and Public Health Directions

The WHO Commission on Social Connection (2024–2026) has emphasized the need for cross-national interventions that strengthen social support, increase opportunities for social participation, improve welfare provisions, and foster social integration. The Commission's flagship report highlights that social isolation and loneliness are widespread, with serious but under-recognized harms to health and well-being, but also that solutions exist [46]. Future research should inform the development of age-friendly communities that facilitate social engagement and reduce barriers to participation. Interventions that fail to target the underlying causes of isolation and loneliness, such as untreated hearing loss, mobility limitations, or bereavement, are likely to be less successful. Addressing these root causes within healthcare and community settings is essential for comprehensive prevention and intervention.

6.5. Research Priorities

Based on the limitations and gaps identified above, the following research priorities are proposed to guide the field over the next decade:

1. Establish consensus on core measurement instruments. The development and adoption of standardized measurement protocols—ideally incorporating both the LSNS-6 for social isolation and the UCLA-3 or De Jong Gierveld scales for loneliness—would enable meaningful cross-study comparison and more robust meta-analytic synthesis.
2. Conduct large-scale RCTs of mechanism-focused interventions with long-term follow-up. Priority should be given to trials comparing cognitive mechanism-oriented interventions (e.g., CBT, mindfulness) against social contact-oriented interventions, with follow-up periods of at least 24 months to assess durability of effects.
3. Expand research in low- and middle-income countries and diverse cultural contexts. Current evidence is overwhelmingly derived from

high-income, Western populations. Research from Asia, Africa, and Latin America is urgently needed to assess the generalizability of findings and to develop culturally adapted interventions.

4. Investigate bidirectional relationships using cross-lagged panel designs. Longitudinal studies employing cross-lagged panel network models should examine whether functional limitations lead to increased loneliness or whether loneliness accelerates functional decline, with particular attention to the mediating roles of depression and cognitive bias.
5. Develop and test culturally tailored interventions for vulnerable subgroups. Specific attention is needed for cognitively impaired older adults, those with sensory impairments (hearing and vision loss), and individuals from marginalized communities.
6. Evaluate the cost-effectiveness of interventions to inform policy decisions. Economic evaluations comparing mechanism-oriented versus contact-oriented interventions would provide critical guidance for healthcare systems facing resource constraints.
7. Integrate biological markers into intervention trials. Future RCTs should incorporate biomarkers (e.g., diurnal cortisol slopes, IL-6, CRP, epigenetic clocks) as secondary outcomes to elucidate whether successful interventions operate through biological pathways and to identify treatment responders.

7. Conclusion

Social isolation and loneliness represent significant and growing public health concerns with profound implications for the health and well-being of older adults. While conceptually distinct—social isolation reflecting objective disconnection and loneliness representing subjective distress—both conditions are associated with increased risks of depression, cognitive decline, cardiovascular disease, and mortality. Validated measurement tools, including the LSNS, UCLA Loneliness Scale, and De Jong Gierveld Loneliness Scale, enable accurate identification of at-risk individuals.

The evidence indicates that the mechanisms linking social disconnection to adverse health outcomes operate through interacting biological (HPA axis alterations, chronic inflammation), psychological (negative social cognition biases, rejection sensitivity, depression), and behavioral (reduced physical activity, poor sleep, medication non-adherence) pathways. These mechanisms may form self-reinforcing vicious cycles that perpetuate both loneliness and poor health.

Intervention strategies show promise when they target both the cognitive mechanisms underlying loneliness and the social circumstances that produce isolation. Cognitive behavioral therapy, mindfulness-based interventions, and multi-domain lifestyle programs demonstrate encouraging effect sizes, though the evidence does not support the conclusion that cognitive approaches are definitively superior to social contact approaches. Significant methodological limitations, including the predominance of observational research, measurement inconsistencies, and limited generalizability, constrain the evidence base.

Moving forward, rigorous longitudinal and randomized controlled trials are needed to establish causal relationships and optimize intervention efficacy. The research priorities outlined above—spanning measurement standardization, mechanism-focused trials, global expansion, and economic evaluation—provide a roadmap for advancing the field. Policy initiatives, such as the WHO Commission on Social Connection, provide a framework for addressing these issues at the population level. By recognizing social connection as a fundamental human need and health determinant, healthcare systems and communities can work together to reduce the

burden of social isolation and loneliness among older adults and promote healthy aging across the lifespan.

CRedit authorship contribution statement

Elisa M. Carter: Writing – original draft, Methodology, Formal analysis, Conceptualization. **Ryan D. Simmons:** Writing – original draft, Methodology. **Megan L. Henderson:** Writing – review & editing, Methodology. **Julia A. Bennett:** Writing – review & editing, Methodology, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

The free versions of Grammarly were used for spell-checking and grammar corrections. After using these tools, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the publication.

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