Social Isolation and Loneliness: Longitudinal Impact on Cognition among Older Adults

Introduction

Two out of every three older adults in the US will experience some level of cognitive impairment during their life (Hale et al., 2020). Prevalence increases with age, with rates of mild cognitive impairment or dementia at roughly 3% in adults ages 65-69 and 35% in those over age 90 and over (Manly et al., 2022). The total burden of cost associated with cognitive impairment is comparable to heart disease or cancer (Hurd et al., 2013) and is expected to rise dramatically in future decades (Rajan et al., 2021).

Multiple risk factors for cognitive impairment have been identified, including diabetes (Zilliox et al., 2016), high blood pressure (Goldstein et al., 2013), obesity (Farr et al., 2008), physical inactivity (Aichberger et al., 2010), social isolation (Ishikawa et al., 2022), and loneliness (Wilson et al., 2007). Targeting modifiable risk factors for cognitive impairment can decrease disease burden (Livingston et al., 2020). Beyond serving as risk factors for cognitive impairment, social isolation and loneliness are risk factors for multiple health conditions and all-cause mortality (Steptoe et al., 2013). Understanding the mechanisms through which social isolation and loneliness impact cognitive impairment and their relative risks has implications for policy and intervention.

Prior work has associated both social isolation and loneliness with higher baseline levels of cognitive impairment and steeper declines in cognitive function across time (Ren et al., 2023). However, findings have not been consistent, with some work suggesting a greater influence due to social isolation (Griffin et al., 2020) and other work finding loneliness as a stronger risk factor (Freak-Poli et al., 2022). Understanding the risk conferred to cognitive health by social isolation and loneliness requires a methodological approach that captures change through time. To that

end, longitudinal approaches have played a significant role in understanding relative risk. Longitudinal approaches have particular salience because they allow for observing patterns and trends over time. Longitudinal methods allow for the observation of both intra-individual change, inter-individual change, temporal ordering, and controlling for confounders introduced through unobserved heterogeneity. Further, certain longitudinal methods allow for some degree of causal inference (Howick et al., 2019), which is not possible in cross-sectional work.

A large body of work has investigated the impact of social isolation and loneliness on cognitive function in older adults; however, a small volume of work has investigated the two constructs simultaneously. Comparing across studies, where different samples, measurement approaches, and analytic procedures were used, complicates the interpretation of findings. Given their close relationship (Newall & Menec, 2019), studies that simultaneously examine social isolation and loneliness can control for their reciprocal influence and have particular value in understanding their relative influence on cognitive health. This prelim response will detail empirical studies on the longitudinal impacts of social isolation and loneliness on cognition in older adults. Only those studies that report on outcomes of both social isolation and loneliness will be included.

Systematic Reviews

Multiple systematic reviews (Crewdson, 2016; Penninkilampi et al., 2018; Victor, 2021) have detailed the impact of social isolation or loneliness on cognition separately (i.e., examining loneliness as an outcome measure, not social isolation or vice versa). To date, only two systematic reviews have examined studies that included measures of both social isolation and loneliness (Kang & Oremus, 2023; Ren et al., 2023). These two systematic reviews also include cross-sectional data, work with younger adults and studies that operationalized cognitive impairment using brain imaging or biomarkers.

Study Selection

Three databases (PsychINFO, PubMed, and Web of Sciences) were searched using relevant search terms to identify literature for this prelim response. Studies were included if they met the following criteria: 1) the average age of participants was at least 60 years, or a large proportion of the sample was over 60 years of age, 2) the study measured both social isolation and loneliness as predictors of cognitive impairment longitudinally, and 3) the study measured cognitive impairment by either clinical diagnosis or via a psychometrically validated instrument. Additional studies were sourced from existing systematic reviews and the reference list of included articles.

Characteristics of Identified Studies

Thirteen studies, published between 2014 and 2023, met the inclusion criteria. Studies were conducted in the following countries or regions: United States ($n = 3$), Netherlands & Sweden ($n = 3$), United Kingdom ($n = 2$), England ($n = 1$), Wales ($n = 1$), Spain ($n = 1$), China ($n = 1$) and Singapore ($n = 1$). The two studies from the UK (Elovainio et al., 2022; Shen et al., 2022) used a national biobank with large sample sizes ($n = 155,070$ and $462,619$). Excluding these studies, the average sample size of other studies was 5,061. Across all studies that included a mean age, the average participant was aged 67; the age of participants was generally reported at baseline. The disciplinary affiliation of first authors spanned three academic fields: psychology ($n = 8$), epidemiology ($n = 3$), and psychiatry ($n = 2$).

Most studies used participants from the general population ($n = 8$). One study excluded participants with significant depressive symptoms (Evans et al., 2019), one study focused only on participants with depression (Kuiper et al., 2020), one study was among only African American participants (Pugh et al., 2021), and two studies used secondary data that drew from

the general population but oversampled ethnic and racial minority participants (Borghouts et al., 2021; Hülür, 2021).

Measurement

Cognitive Impairment

Cognitive impairment was measured using a variety of instruments or procedures that captured the construct with variable granularity, ranging from data sourced from healthcare registries to tests of multiple domains of cognition (e.g., episodic, working memory, semantic memory, perceptual orientation, and perceptual speed). Some studies used multiple forms of measurement (e.g., a mini-mental state exam and specific neuropsychiatric testing).

The most frequently used approach to measuring cognitive impairment in studies ($n = 7$) was creating a composite score based on adding immediate and delayed recall scores. Five studies used detailed neuropsychiatric batteries, such as the Cambridge Cognitive Evaluation (Huppert et al., 1995) to capture specific domains of cognition. Four studies used data from healthcare registries that reflected physician diagnosis (e.g., through relevant International Classification of Diseases codes). Three studies used either the Mini-Mental Status Exam (Arevalo-Rodriguez et al., 2015) or the Geriatric State Examination (Copeland et al., 2002; Freak-Poli et al., 2022; Rawtaer et al., 2017). Only one study (Shen et al., 2022) used imaging in combination with other instruments.

Loneliness

Loneliness measures were brief and completed as self-reports across all studies. Some studies used standardized and psychometrically validated measures, while others opted for single-item measures. The longest measure used was the de Jong Gierveld Short Scale for Emotional and Social Loneliness (de Jong Gierveld & Van Tilburg, 2010), which was used in three studies. Five studies used a single-item question to assess loneliness, two of which used "I

feel lonely" rated on a 4-point Likert scale. Five studies used shortened versions of the UCLA Loneliness Scale (Hughes et al., 2004). Of these, four used a 3-item version and one used a 2-item version.

Social Isolation

Social isolation was also assessed via brief self-report measures. Measurement was highly inconsistent across studies. Some studies operationalized social isolation as living alone or marital status (Holwerda et al., 2014; Rawtaer et al., 2017) while others took more detailed measures that included social activities, participation, and perceived social support (Freak-Poli et al., 2022; Shen et al., 2022). The Close Person Inventory (Stansfeld & Marmot, 1992) was used in one study, and one study used the Lubben Social Network Scale (Lubben et al., 2006). The remaining studies either created composite measures based on perceived social support from different categories of social relations (e.g., spouse, children, family, friends) or created their own measures, drawing suggestions from prior work such as the Berkman-Syme Social Network Index (Berkman & Syme, 1979).

Additional Outcomes and Predictors

All studies included social isolation and loneliness as predictors and cognitive impairment as an outcome; however, several included additional predictors or outcomes. One study used a polygenic risk score for Alzheimer's disease (Elovainio et al., 2022). In this study, the association between polygenic risk score with incident dementia was assessed alongside loneliness and social isolation. One study treated life satisfaction as a predictor (Rawtaer et al., 2017). The study by Griffin et al. (2020) included cynical hostility, measured with a modified version of the Cook-Medley Hostility Scale (Barefoot et al., 1989) as a predictor. Lastly, in the study by Shen et al. (2022), the authors used voxel-wise brain-wide

association analysis to identify gray matter volume loss associated with social isolation and loneliness.

Methodologies

While all studies included some covariates in their analysis, the selected covariates were variable and largely dependent on the information available in the given dataset. Prior research has suggested age, education, SES, race/ethnicity, health status, and functional limitations as potential covariates; at least two of these covariates were included in all studies. Some studies also included depression and self-rated health as covariates (Griffin et al., 2020). The total span of time and number of measurement points varied across studies. Total follow-up from start to finish of studies ranged from two years (Evans et al., 2019) to 14 years (Freak-Poli et al., 2022). The number of measurement instances was frequently not detailed within methods sections, or when detailed, was presented as a range (e.g., participants were re-examined every 3-6 years).

In assessing the risk of cognitive impairment due to loneliness and social isolation, the two predominant analytic methods were Cox proportional hazard ratios and multilevel modeling. The Cox proportional hazard models involved time to cognitive impairment onset, with loneliness and social isolation as separate predictors. Cox proportional hazard ratios were calculated in five studies. Three studies used multilevel modeling, which allows for examining both within-person and between-person changes over time. Authors cited their choice to use multilevel modeling as informed by its advantages in addressing missing data. Previous work has outlined options for addressing missing data in multilevel models using multiple imputation approaches, such as multilevel fully conditional specifications and passive imputation of group means (Grund et al., 2017).

The robustness of findings was examined through sensitivity analyses in seven studies. The most common sensitivity analyses involved excluding those with depressive symptoms

(completed in four of the seven studies) and censoring those who developed cognitive impairment during the early stages of a given longitudinal study (completed in three studies). Across studies, additional sensitivity analyses included alternate approaches to handling missing data, weighing analyses using inverse probability weighting to control for potential bias due to selective attrition, treating loneliness as a continuous variable (in the primary analysis, loneliness was treated as a dichotomous score given its positive skew), using binary logistic regression in place of Cox regression, and subgroup analyses.

Findings

Six studies (Evans et al., 2019; Griffin et al., 2020; Hülür, 2021; Lara et al., 2019; Pugh et al., 2021; Rafnsson et al., 2020) found both social isolation and loneliness as either related to baseline cognitive impairment or a risk factor for subsequent cognitive impairment. In the study conducted by Rafnsson et al. (2022), the authors examined how baseline information on loneliness and social isolation related to incident dementia at follow-up. Using secondary data from the English Longitudinal Study of Ageing, they followed participants over an average of 6.25 years. They analyzed social isolation and loneliness in relation to incident dementia using Cox regression. Social isolation was measured by the number of social contacts. The authors found that in comparing participants with one close friend or less, the risk of cognitive impairment decreased as social network size expanded. Participants with 2-3 close relationships had a 43% risk of developing cognitive impairment when compared to those with no or one close relation (those with 4-5 had 38% relative risk, those with 6-9 had 34% relative risk, and those with ten or more close relations had a 32% relative risk). For loneliness, they found a 44% increase in the risk of developing dementia for every point increase in a 3-item version of the UCLA Loneliness scale.

Two studies found that only loneliness was related to an increased risk of cognitive impairment over time (Freak-Poli et al., 2022; Holwerda et al., 2014). Both of these studies were conducted using a longitudinal data source based at least partially in the Netherlands. In the study by Freak et al. (2022), the authors used data from two populations, The Rotterdam Study and The Swedish National Study on Aging. For both data sources, perceived social support and a composite measure of social isolation were unassociated with baseline cognitive impairment or later development. Participants who were lonely at baseline had a higher risk of developing dementia (1.34 HR in the Rotterdam Study and 2.16 in The Swedish National Study on Aging). In linear mixed modeling, loneliness was associated with increased scores on the Mini-Mental Status Exam. Further, they controlled for depression and conducted mediation analyses in which they did not find an indirect pathway from social health through depressive symptoms to cognitive impairment. The authors suggested that the locations of the studies may have impacted their findings. The Netherlands and Sweden have low social inequality, well-developed social welfare systems, and high standards of living, which may decrease the extent to which social isolation impacts cognition.

Four studies found that social isolation and not loneliness was related to an increased risk of developing cognitive impairment (Elovainio et al., 2022; Rawtaer et al., 2017; Shen et al., 2022; Yu et al., 2021). The studies by Elovainio et al. (2022) and Shen et al. (2022) used the same sample (United Kingdom Biobank). To measure social isolation, they used an index that included if participants lived alone, their social contacts, and their involvement in social activities. The two other studies measured social isolation via a single-item question. In the study by Elovainio et al. (2022), in unadjusted models, both loneliness and social isolation were associated with increased risk in unadjusted Cox regression models; however, in adjusted models, social isolation was associated with a 34% higher risk of dementia while loneliness was

associated with a 3% increased risk for dementia. The study by Elovainino et al. (2022) was unique in that it also controlled for polygenic risk score; however, the authors commented on how their measurement of cognitive impairment (sourcing from national health records) may have under-detected incidence.

One study (Kuiper et al., 2020) found no association between social isolation (measured by network size), loneliness, (measured by de Jong Gierveld Loneliness Scale), and cognitive decline. This study focused on older adults with depression and had the shortest timeframe of all studies reviewed in this prelim response (two years). After controlling for covariates, baseline social isolation and loneliness were not significantly associated with baseline or follow-up measures of cognitive domains (processing speed, interference control, verbal memory, and working memory). The authors suggested that the lack of association may have been due to depression, which they noted "may exert its impact on cognitive decline through many different pathways that compete with loneliness and social network size. From this, they conclude that interventions to address depression may effectively reduce cognitive decline in older adults experiencing depression.

Gaps in Research and Future Directions

Many gaps exist in the current literature. While a small amount of work has been completed that addresses the risk to cognitive health conferred by social isolation and loneliness simultaneously, the number of studies is expanding rapidly. Future work has the potential to address the shortcomings of current research. Areas for future research include exploring mechanisms, considering periods not impacted by the coronavirus pandemic, improving measurement approaches, attention to historically marginalized populations, and cross-national comparisons. The studies included in this prelim response explored increased risk over time. Though many posited potential mechanisms through which social involvement and loneliness

impact cognitive decline, such as stress buffering or increasing positive health behavior (Pugh et al., 2021), with the exception of the study by Freak et al. (2021), none explored mechanisms directly. Existing available datasets include multiple relevant variables to explore potential mechanisms such as physiological risk, functional ability, self-rated health, and depressive symptoms. Some recent work (Friedler et al., 2015; Zhong et al., 2017) has explored these in either social isolation or loneliness, but none has explored them simultaneously.

A large concentration of the work that simultaneously examines social isolation and loneliness in older adults using longitudinal data has been published recently. The coronavirus pandemic increased loneliness and social isolation among older adults (Su et al., 2023). Nearly every study included in this review used at least some data conducted during the coronavirus pandemic. Some research has suggested that social isolation and loneliness rates have returned to pre-pandemic levels in older adults (Kullgren et al., 2023). Still, further longitudinal work is needed given the potential cohort effect due to the coronavirus pandemic.

The mixed findings of current literature may be partially attributable to the heterogeneity of measurement approaches for social isolation and loneliness. While many of the studies included in this prelim response used standardized and psychometrically validated measures of loneliness, such as the de Jong Gierveld Loneliness Scale or the UCLA Loneliness scale, others used single-item measures. Prior work has suggested that using a single measure has weak convergent validity compared to a 3-item version of the UCLA Loneliness scale (Reinwarth et al., 2023). Notably, the two studies that found that loneliness and not social isolation was related to increased risk of cognitive impairment used participants from the same longitudinal study (based in the Netherlands). Future studies exploring societal-level influences, such as public support, social welfare, and social norms, may help clarify mixed findings regarding the impact of social isolation and loneliness.

Among the studies reviewed in this response, only one (Pugh et al., 2021) specifically explored the impact of social isolation and loneliness on cognitive outcomes among participants from racial or ethnic minorities—additionally, a small number of studies controlled for race/ethnicity or conducted subgroup analyses. Of note, this was not due to a lack of data availability in the original dataset or because it was not relevant to a specific sample. The lack of attention to the role of race and ethnicity leaves a significant knowledge gap. Future research should also focus on working with participants from marginalized gender and sexual minorities, which will require changes to how demographic data is collected (Hanes & Clouston, 2021).

One additional area of potential future work relates to cross-national comparisons. Given that most work for this review is located in Western countries, making cross-national comparisons involving non-Western nations may highlight differential patterns and risk levels. Cross-national comparisons within Western nations may also reveal differences. Multiple longitudinal studies have been conducted internationally, many of which include harmonized measures (Beaumaster et al., 2018). Previous work has also involved cross-national comparisons and risk factors for cognitive impairment (Weir et al., 2014), but none simultaneously examined social isolation and loneliness as risk factors.

This prelim response has focused on empirical work from longitudinal surveys. These findings have a bearing on applied work, such as psychosocial interventions. In one three-year study (Lara et al., 2019), the authors found that both loneliness and social isolation were associated with decreased cognitive function over a relatively short time frame. They suggested that given that this effect can be observed even over relatively short periods, tailored interventions that enhance social participation and maintenance of emotionally supportive relationships may assist in preventing and reducing cognitive impairment.

Conclusion

This prelim response detailed the current longitudinal literature on the impact of social isolation and loneliness in older adults. Few studies examine social isolation and loneliness in connection to cognitive outcomes. Existing studies have reached contradictory conclusions regarding the relative influence of social isolation and loneliness on cognition. This may be attributable to differences in sample, use of covariates, analytic approach, and measurement approach. With one exception, existing studies have not focused on historically marginalized populations.

Of the 13 studies reviewed in this response, all were published within the last decade, and nearly all were published within the last five years ($n = 12$). The longitudinal impact of social isolation and loneliness on cognitive function among older adults is a fast-expanding area of work, and research to date has been geographically and methodologically limited. This work has been high impact, generating an average of 117 citations per paper, which is especially noteworthy given the recency of most publications.

Many gaps in research exist in the current literature. Social work researchers are not well represented in current literature but can serve an important role, particularly in drawing attention to societal-level influences and through explicit attention to marginalized populations and high-risk sub-groups of older adults. While existing studies generally indicate that social isolation and loneliness confer an increased risk for the development of cognitive impairment, less is known about specific mechanisms. Given their close relationship, future studies using longitudinal data should explore pathways through which both social isolation and loneliness impact cognitive function.

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