

The Impact of Loneliness and Social Isolation on Older Adults and the Effect of Interventions

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Abstract. Loneliness and social isolation have been a rising public health concern among older adults in recent years, especially after the COVID-19 pandemic. However, how the distinct pathways affect health and the effectiveness of existing interventions still need clearer review. By collecting and comparing data from large-scale studies and meta-analyses, the review systematically analyzes different impacts of loneliness and social isolation on cognitive function, biological health, frailty and mortality. In addition, it evaluates the effectiveness of technology-based and social interventions through systematic reviews and experiments on older adults' reflections to interventions. The results show that social isolation is a more robust predictor of dementia and mortality, while loneliness is more strongly connected to cognitive decline and frailty progression. The COVID-19 pandemic significantly intensified both conditions, which the prevalence rates remain above the pre-pandemic level. For intervention strategies, both technology-based and social intervention show positive effects on reducing loneliness and social isolation, but the evidence is limited due to the heterogeneity and methodological weaknesses. Specifically, information and communication technology (ICT) and videoconferencing demonstrate the most significant effect among technology intervention, while structured group-based intervention is more effective than other social interventions. Though most research show significant results in their studies, there are limitations in standardized measurements. The need for consistent outcome measurement across studies can improve the research validity, while with larger-scale randomized controlled trials can increase the reliability of studies. At the same time, the results of intervention effectiveness help build efficient policy interventions.

Keywords: loneliness, social isolation, COVID-19, interventions, older adults

1. Introduction

The global phenomenon of population aging, which increases the proportion of older adults who face less engagement in community and declining social networks, has brought the physical and mental health of older adults to one of the most critical public health concerns. Among the most prevalent concerns is the psychological challenge of loneliness and social isolation. A number of research has demonstrated the negative impacts of these conditions, including cognitive decline, dementia, frailty and all-cause mortality [1-3]. Furthermore, the COVID-19 pandemic has made

these pre-existing problems more severe, with a long-lasting impact on the rise in social isolation and loneliness among older adults, and the trend has not reverted to levels prior to the pandemic [4, 5].

While it is established that negative outcomes correspond to loneliness and social isolation, the literatures existed stated that though the two factors are often correlated, the mechanisms how they influence people may differ. For instance, loneliness may be strongly associated with declined cognitive function and frailty, whereas social isolation is often identified as a more solid and measurable index of risks such as dementia and mortality, although the two factors can intersect in their health effects [1, 2, 6]. To address the increasingly concerned problem, a range of intervention strategies, broadly recognized as technology-based approaches, such as digital communication platforms and virtual group activities, and human-based interventions, including community support and peer mentoring programs, has appeared and been implemented. Although the results show that most of the interventions are beneficial to reduce social isolation and loneliness, the evidence of the research remains heterogeneous and quite weak, partly because of the limitation in standardized outcome measurement and insufficient samples [7-9].

Giving these achievements and challenges, a comprehensive synthesis of the evidence is needed to clarify the distinct impacts of loneliness and social isolation and critically discuss intervention approaches. The purpose of this narrative review is to rigorously investigate how social isolation and loneliness influence older individuals' physical and mental health, specifically into cognitive, biological, and frailty and mortality aspects. It further seeks to evaluate the effectiveness of both technological and social intervention strategies. By targeting these objectives, the review intends to identify some gaps in the literature and offer an organized summary of current understanding. Also, the review offers practical recommendations for future research and policy development to better support the aging population.

2. Concept definition

The two core concepts of this article are loneliness and social isolation. Loneliness and social isolation often link together, but the two concepts are distinctly in definition. While loneliness is identified as a subjective feeling of people's insufficient social relationships, social isolation universally describes a neutral situation when social participation, social contact, or social network connections are limited. Social isolation may increase the loneliness among people, while loneliness may further strengthen the state when people are being isolated, leading people to withdraw social contact. In this way, social isolation and loneliness create a potential reciprocal relationship between two conditions, affecting people's state. However, the two conditions can occur independently, indicating that the observed correlation should not always be interpreted as causal.

2.1. Loneliness

Loneliness is described as the subjective mental state which people feel deficient for the lack of social relationship and an indicator of interpersonal relationship quality [10, 11]. Loneliness often emerges when people perceive the discrepancy between their ideal relationships and the actual social state [10]. Due to its negative consequences, loneliness has grown to be a significant issue for mental as well as physical well-being., such as depression, frailty, and other psychological mediators. To understand what contributes to loneliness, researchers, often using UCLA Loneliness Scale as the assessment, have found that personality traits, socioeconomic context, or demographic information etc., may serve as risk factors for loneliness [11].

2.2. Social isolation

Social isolation is defined as the objective situation when people are isolated by their surrounded environment and are lack of social activities [11]. Explicit measures of social connections, such as the size of a person's social network, the frequency of social interaction, and the quality of social communication, can frequently be used to quantify social isolation [12, 13]. By measuring the frequency, density or diversity of an individual's social engagement, isolation can be assessed through Social Network Index (SNI) or the 6-item Lubben Social Network Scale-6 (LSNS-6) [1, 2].

2.3. Intervention strategies

Intervention strategies have been used among older adults to reduce loneliness and increase their social interactions in recent years. For the purpose of discussion, the review broadly categorized intervention strategies into technology-based intervention and social or professionally supported interventions, while there are hybrid programs adopting both approaches. Interventions utilizing any type of information and communications technology (ICT) for social interaction are referred to as technology-based interventions, while social intervention is fundamentally based on human and the increase of social participation [7, 8].

3. Impact of loneliness and social isolation and intervention effectiveness

3.1. Impact of loneliness and social isolation on older adults

Loneliness and social isolation are prevalent among older adults, and they could significantly affect health and well-being of older adults. Both conditions are linked to a variety of serious physical and psychological health problems, such as cognitive decline, biological susceptibility, frailty, and death, even if the underlying mechanisms may differ. Social isolation and loneliness together will naturally compound and build a greater impact on human health than independently. Social isolation is likely to be a more explicit indicator than loneliness when exploring an individual's social relationship as it can be assessed through measurable aspects like social participation and network size.

3.1.1. Cognitive function

Social isolation appears to be a more robust indicator of cognitive decline, especially memory and learning, than loneliness. After controlling for all other variables including loneliness, Shen, Rolls, Cheng, discovered that social isolation was independently linked to a 1.26-fold greater risk of dementia using UK Biobank data on 462,619 adults, whereas loneliness often contributes to the dementia indirectly by the mediator depression [1]. In the study, the researchers found some specific brain regions containing low gray matter volume and related to memory retrieval and encoding are the same areas damaged by social isolation, which shows a direct link between brain structure and cognition [1]. Still, loneliness is frequently linked to poorer performance in a number of distinct cognitive domains, including processing rate, delayed retrieval, memory storage, verbal proficiency, composite cognitive scores, and global cognitive function [6]. Identified as an indicator of accelerated cognitive decline over time, loneliness still connects to the deficiency of cognitive function [6]. However, loneliness and social isolation are inconsistently associated with certain cognitive functions. The inconsistency may be attributed to several methodological weaknesses like small sample size, gender differences and measurement quality [6].

3.1.2. Biological impact

The biological effect is mainly demonstrated by social isolation and its connection to dementia. According to the research by Shen, Rolls, Cheng, social isolation contributes to the dementia risk in older adults partly by influencing the memory-related brain structures where the regional genetic activity overlaps with the observed pattern in Alzheimer's disease [1]. Using structural MRI, the researchers found socially isolated individuals had smaller gray matter volume in the hippocampus, parahippocampal gyrus, amygdala, thalamus, and temporal cortex, which are confirmed to control memory retrieval and learning [1]. The genes underlying the area directly overlap with those in Alzheimer's brain tissue [1]. This mechanism is independent of loneliness, depression, and other confounding factors. Therefore, the effect of social isolation on dementia is clearly identified and strongly involved in a well discovered pathway.

3.1.3. Frailty and mortality

Social isolation is a more consistent and stronger indicator of all-cause mortality compared to loneliness, though loneliness remains to be an independent predictor. With the result from Barnes research, both characteristics are separately linked to all-cause death; however, social isolation remained the stronger when two factors were modeled in the same regression. Severe and moderate social isolation were significantly associated with mortality with ratios 2.28 and 1.64, which was much higher comparing to the association for severe and moderate loneliness, with ratios of 1.31 and 1.22 [3]. Also, both loneliness and social isolation can be connected to depression, which is one of the most important factors that leads to suicide and vulnerability. In Singapore panel study, the research presents a partially different outcome of frailty. Though the social isolation measure is not statistically significant, the researchers found that loneliness predicted worse frailty while greater social participation, which is contradicted to social isolation, protected people from becoming frailer [2]. Together, these sources demonstrate that social isolation is a more reliable indicator of mortality, even though the frailty review reveals a somewhat different and opposite pattern. This divergence also suggests that isolation and loneliness probably function differently, which loneliness may be more psychological and personal feeling and isolation is more practical and measurable.

3.2. Trend and influence of COVID-19

After the COVID-19 pandemic, loneliness and social isolation have been increasingly recognized as factors not only with emotion distress but also with health decline in older adults and mortality. Furthermore, COVID-19 did not create the loneliness and social isolation among older adults; instead, it reinforces the pre-existing situation by limiting social contacts with people, reducing social participation opportunities, and restricting family or community support to older adults.

Before the outbreak of the pandemic, studies had already shown that older adults experienced major problems. During testing, when the two conditions—social isolation and loneliness—compound together, 9.1% of older adults had the worst mental and physical quality-of-life score and the highest medical cost [3]. Building on the pre-existing background, the pandemic further intensified loneliness and social isolation. Ernst's systematic review and meta-analysis found a statistically significant increase in loneliness during COVID-19, with increases across the young and elderly, particularly among those who live alone. Among adults aged 65 and older, the reported rates of social isolation and loneliness after three months of pandemic were higher than those recorded during the first three-month period, with social isolation increased from 15.9% to 41.5% and

loneliness increased from 25.6% to 31.3% [4]. The increase in two factors after the first three months pandemic indicates that the suppression may have prolonged effect on the psychological and social effect cumulatively [4]. They will accumulate over time as the restrictions continue, rather than fade away as soon as the restriction released. According to University of Michigan National Poll on Healthy Aging, the researchers traced the trend of loneliness for adults 50-80 and found that from 2018 to 2023, though rates have declined from the pandemic peak, the feeling of isolation rose from 27% (2018) to a peak of 56% (2020) and then declined to 34% (2023), not returning to the pre-pandemic level [5].

Overall, the evidence shows that the effect of pandemic substantially strengthened the social isolation and loneliness among older adults and other vulnerable populations. Since the level did not return to the pre-pandemic state after years, loneliness and isolation still need time to recover, and people are trying to recover their social participation through more interactions with the society and their families or friends

4. Effectiveness of interventions

4.1. Technology intervention

One of the subtypes under the technology intervention is social technology, which is explicitly described as the second type of intervention under this subject that aims to give older individuals a virtual space to cultivate new relationships and strengthen current ones [8]. Social technology intervention is mainly composed of general ICT, which encompasses internet-based networks, cell phones, laptops, and any software that facilitates online interactions—such as video chats, messaging services, virtual spaces or schools, and robotics [7].

Among all the technology categories, ICT and videoconferencing are shown to be the most effective and best-evidenced technology intervention. According to Balki, researchers found that among 119 primary studies, 72% of them, which is 86 researches, have reported positive impact on social isolation or loneliness, suggesting that technology-based interventions show a generally promised but slightly inconsistent effectiveness [7]. For the videoconferencing, there are about 79% of studies, 11 out of 14 primary studies, reported a positive impact of the loneliness, meaning that the positive correlation of the application of intervention and loneliness and social isolation is fairly consistent [7]. Both of the results are graded with moderate to high level of certainty and reliability. By contrast, for the estimation of social network sites (SNS), the report shows unclear or no impacts on older adults with a low grade of the quality of reviews, as the finding is 31 in 61 participants reporting positive to 30 reporting no effect [7]. This can be possibly attributed to the low quality of online interactions or the limitation in their familiarity with online platforms. Though the finding is ineffective, SNSs still performs better relative to other technology types.

Hoang et al. found the technology had a small effect size in community settings but a much larger effect in long-term care (LTC) (which the attrition was highest in studies in LTC, up to 44%), while the research is based on only two LTC studies and driven by videoconferencing with family [9]. As the four papers have many different ideas about the evidence to the advance of technology, each author attributes the advantage of ICT to different relationships and causes. The effectiveness of the technology intervention is not universal; instead, it much depends on the purpose of the technology and the type of social relationship it supports, whether to create new social connections or strengthening the existing friends and families. Specifically, the distinction between videoconferencing and SNS also shows the discrepancy between the social relationships, whether to

create new relationships or deepen a pre-existing relationship. This helps people understand more about what kind of relationships does technologies help to improve.

4.2. Social intervention

Social intervention refers to human-based interventions, such as peer mentoring, education-based groups, social and support groups, and interventions focused on providing social services, that aim to provide older adults direct access to environments or communities that are supportive and conducive [8]. Social and professional interventions are most effective only when the interaction is group-based and structured [8]. Within groups, people gain shared goals and clearer social identity, which help them participate in groups more frequently. However, simple unstructured social contact, such as being friend, tends to show negligible effect [8]. This finding contradicts the intuitive assumption that any kinds of social contact help to reduce loneliness. According to Paquet et al., the research directly supports this with the idea "the conducive community" (structured support/discussion groups), which eventually leads to a decrease in social isolation, a rise in participant self-confidence, and an increase in community involvement [8]. Specifically, structured discussions on relevant topic, such as coping strategies and relationship building, are more effective than one-to-one social contacts because they help older adults connect to their peers, exchange experiences with each other, and receive emotional support. In Hoang's study, the pooled social interventions (befriending, foster grandparent programs, telephone support) yielded an effect size of -0.02, which represents to no effect [9]. This shows directly that these unstructured individual social contact interventions did not significantly reduces loneliness in older adults. Combining the two researches above, the conclusion that group-based intervention is more effective than the individual ones is consistent throughout the studies. Additionally, the research of Thangavel and Balki supports the idea by stating that the structured engagement provides long-term benefit, enhancing social networks, and the provided intervention should be more active, with more engaging content and shared purpose, the effects may be better [7, 14].

4.3. Downstream influence on older adults

Beyond the direct reductions in loneliness and social isolation, the consequential effect on older adults also occurs in their psychological well-being, cognitive health and self-efficacy. As a result of reduced loneliness, one of the most related results is that the depression will be reduced, which may eventually lead to a decrease of possibilities in dementia. Self-confidence may be boosted through these interventions, increased social support, connections to the outside world, and introduction to new friends. With this self-confidence, they may take a meaningful role within a group, participating in shared activities and providing company for peers. In this way, they will get more access and be more sensitive to the outer world, which they can also feel the sense of being seen and thus contribute themselves to create a better community. As their connection to the society becomes more complete, the older adults may feel a stronger sense of belonging to the surrounding world, which is also one of the direct and central intervention purposes.

5. Discussion

This essay has analyzed the effects of loneliness and social isolation on older adults by discussing their health outcomes, the long-lasting influence of COVID-19, and the effectiveness of technology-based and social interventions. First, while the two factors may have distinct pathways, social

isolation and loneliness both can result in health problems. When they co-occur, the combined effect will appear worse than they react independently since older adults have to experience subjective pain in social deficit and the objective reality of limited access to emotional support. The evidence suggests that each factor carries their independent predictive power for different outcomes. Social isolation occurs as the more robust predictor of all-cause mortality and of the dementia, consistent with a mechanism that reduced objective social contact limits people's access to practical support [3]. For dementia, the structural brain changes in memory-relevant regions overlap with molecular signature of Alzheimer's disease [1]. By contrast, loneliness is identified as the more robust predictor of cognitive disfunctions and frailty progression in Singapore cohort [2, 6]. The frailty progression is more consistent when a person's subjective distress of feeling alone contributes to cumulative decline over time rather than a temporary mortality risk. Second, the COVID-19 still has a lasting influence on loneliness and social isolation among older adults till now. The COVID-19 amplified the problem of loneliness and social isolation among older adults, with factors like quality of life, healthcare cost, and mortality, intensifying the adversity. The recovery of people's isolation has not reverted to the pre-pandemic level (27% in 2018), but by 2023 the isolation among adults 50-80 had declined to 34%, compared to summit level in 2020, 56% [5]. Third, the technology and social intervention both can have a positive direction of effect, but the magnitude of the effectiveness cannot be quantified yet. Across the four related paper, a majority of studies show the benefit of intervention, but low study quality, inconsistent outcome measurements, and high heterogeneity mean the actual extent of the benefit remains uncertain. For technology intervention, ICT and videoconferencing are shown to be the most effective strategy to reduce loneliness on older adults, while for social intervention, group-based treatment is more efficient than simple unstructured intervention [7-9].

Based on the above summary, there are a few insights to improve the consistency and validity for following researches: first, the proxy of loneliness and social isolation can be operationally defined through the score of scales, such as the UCLA-3 Loneliness Scale and the Lubben Social Network Scale. Therefore, the standardized measurement will be more consistent across the studies and the validity will be more explicit. Second, for the Guarnera et al., 2023 and many studies in the field of the intervention, the study quality needs to be improved by expanding the sample size, minimizing the heterogeneity, or including randomized controls, etc. Only when the study quality is higher, the research result will be more effective and consistent. Third, for studies in intervention, the accuracy of the intervention for those technologies should be assessed in the future, and the effectiveness of robotics, virtual spaces, and messaging need development and exploration. For some suggestions on policy, because social isolation may indicate mortality risk, governments and care systems should pay more attention to older adults' social relationships, identify and provide community-based support for socially isolated individuals before severer consequences emerge. Apart from the mortality, as the COVID-19 impact is long-lasting and still in the recovery stage, the government should be concerned about the mental health problems among specific population like those with poor quality of life.

6. Conclusion

The essay examines how loneliness and social isolation influence older people's cognitive and physical conditions and examines how well social and technological solutions work to mitigate these two closely related but separate issues. After examining all the sources, social isolation appears as a strong predictor of Alzheimer's disease and all-cause mortality, whereas loneliness occurs as the indicator of cognitive disfunction and frailty. The COVID-19 pandemic made prolonged influence

on older individuals' social isolation and loneliness, which has not returned to pre-pandemic levels. The effectiveness of technology intervention, especially ICT and videoconferencing, and group-based human therapy are generally positive but remain inconsistent across studies, as the results are heterogenous and sampled in small size.

These findings reveal several suggestions. First, the standardized measurement of loneliness and social isolation and larger-scale randomized controlled trials should be adopted to improve the validity and consistency across studies. Second, policymakers should pay more attention to older adults that are socially isolated and provide more emotional and communal support for them to enhance their sense of belonging. The review contributes to identifying different effects of loneliness and social isolation on older adults and offering more evidence-based intervention strategies to support healthy aging.

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