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## Review Article

# Facing the Next “Geriatric Giant”—A Systematic Literature Review and Meta-Analysis of Interventions Tackling Loneliness and Social Isolation Among Older Adults



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## A B S T R A C T

**Keywords:**  
 Interventions  
 loneliness  
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 systematic review

**Objectives:** Loneliness and social isolation are associated with adverse health outcomes, especially within the older adult population, underlining the need for effective interventions. This systematic review and meta-analysis aims to summarize all available evidence regarding the effectiveness of interventions for loneliness and social isolation, to map out their working mechanisms, and to give implications for policy and practice.

**Design:** Systematic literature review and meta-analysis.

**Setting and Participants:** Older adults ( $\geq 65$  years).

**Methods:** A systematic search was conducted in MEDLINE, PsycINFO, and CINAHL for studies quantitatively or qualitatively assessing effects of interventions for loneliness and social isolation in older adults, following predefined selection criteria. Risk of bias as well as small study effects were assessed and, wherever appropriate, information about effect sizes of individual studies pooled using random-effects meta-analyses. Sources for between-study heterogeneity were explored using meta-regression.

**Results:** Of  $n = 2223$  identified articles,  $n = 67$  were eventually included for narrative synthesis. Significant intervention effects were reported for a proportion of studies (55.9% and 50.0% for loneliness and social isolation, respectively) and 57.6% of studies including a follow-up measure ( $n = 29$ ) reported sustained intervention effects. Meta-analysis of  $n = 27$  studies, representing  $n = 1756$  participants, suggested a medium overall effect of loneliness interventions ( $d = -0.47$ ; 95% CI,  $-0.62$  to  $-0.32$ ). Between-study heterogeneity was substantial and could not be explained by differences in study design, year of publication, outcome measures, intervention length, participant demographics, setting, baseline level of loneliness, or geographic location. However, non-technology-based interventions reported larger effect sizes on average ( $\Delta d = -0.35$ ; 95% CI,  $-0.66$  to  $-0.04$ ;  $P = .029$ ) and were more often significant. Qualitative assessment of potential intervention mechanisms resulted in 3 clusters of effective components: “promoting social contact,” “transferring knowledge and skills,” and “addressing social cognition”.

**Conclusions and Implications:** Interventions for loneliness and social isolation can generally be effective, although some unexplained between-study heterogeneity remains. Further research is needed regarding the applicability of interventions across different settings and countries, also considering their cost-effectiveness.

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Loneliness and social isolation are major public health concerns, which have become especially prominent during the Coronavirus Disease 2019 (COVID-19) pandemic.<sup>1</sup> Loneliness is frequently defined as a subjective mismatch between desired and actual quality and quantity of social contacts, while more refined constructs further differentiate between types of loneliness (eg, “emotional,” “social,” or “existential” loneliness).<sup>2–4</sup> Social isolation, on the other hand, may be defined more objectively as the absence of social contacts and relationships.<sup>2,5</sup> Levels of loneliness and social isolation are found to change nonlinearly throughout life, with the highest levels frequently being reported in young adulthood and old age.<sup>6</sup>

Older adults may experience a wide range of risk factors for loneliness and social isolation, including demographic, health and socio-environmental factors.<sup>7–9</sup> Among this population, both loneliness and social isolation have been associated with lower quality of life, higher risk for cardiovascular disease, depression and suicidal ideation, stroke, and cognitive decline and dementia.<sup>10–15</sup> This, in turn, is associated with major health care costs.<sup>16</sup> These potentially detrimental consequences highlight the importance of directed and effective actions for the reduction and prevention of loneliness and social isolation.

Several systematic reviews have assessed the ability of interventions to tackle loneliness and social isolation.<sup>17–19</sup> Although they generally support the effectiveness of such interventions, heterogeneity of effect magnitude and clinical relevance have been reported. One subgroup meta-analysis of loneliness interventions showed that effect magnitude differed as a function of study design, with randomized controlled trials generally reporting somewhat smaller effect sizes as compared with nonrandomized studies.<sup>17</sup> This study did not impose any restrictions with regard to participant age range. In light of the age-specificity of risk factors,<sup>6</sup> there is a need to conduct an in-depth exploration of intervention effectiveness in the context of older age.

In their updated conceptual framework, Lim et al propose that life events (eg, death of a spouse) and risk factors (eg, age) may interact to induce loneliness.<sup>7</sup> They furthermore suggest that, in light of the multifaceted nature of loneliness and its risk factors, possible interventions should be delivered at various levels. To develop such multilevel interventions, knowledge about underlying intervention mechanisms, in addition to potential levels of delivery, is invaluable. Furthermore, considering the fast pace in which new interventions are developed, especially during the COVID-19 pandemic, there is a need to update existing literature concerning intervention effectiveness.<sup>17–19</sup>

The current systematic literature review and meta-analysis therefore aims to (1) summarize all available evidence regarding the effectiveness of interventions targeting loneliness and social isolation in older adults living in the general population or in long-term care facilities and (2) to identify mechanisms (effective components) underlying these interventions.

## Method

This systematic literature review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.<sup>20</sup> No registration protocol is available for the current review.

### Data Sources and Search Strategy

A keyword profile was created based on items relating to the constructs of (1) “loneliness” or “social isolation,” (2) “older adults,” and (3) “intervention.” Individual keywords were identified based on a primary search in the MEDLINE database. The search was conducted in MEDLINE, PsycINFO, and CINAHL, using the EBSCOhost search

interface. Peer-reviewed articles published in English, Dutch, German, or French from inception until date of abstract extraction on March 23, 2023, were included. [Supplementary Table 1](#) contains further details regarding the specifiers used in the literature search.

### Study Selection

Abstracts were screened by 2 independent raters (L.A.D. and N.J.) and selections compared. In case of discrepancies regarding inclusion, a third reviewer (M.Y.V.) was consulted. Full texts of selected studies were then examined individually by 2 investigators (L.A.D. and N.J.). Their reference lists were additionally scrutinized for eligible manuscripts.

### Inclusion Criteria and Study Eligibility

#### Types of participants

Studies including cognitively healthy older adults aged 65 years and older, were eligible. This age represents a commonly used cutoff for “older age” (eg, by the National Institutes of Health<sup>21</sup> or Eurostat<sup>22</sup>).

#### Types of interventions

All nonpharmacological interventions, programs, initiatives, or projects targeting loneliness and/or social isolation as primary outcome were included. This included interventions addressing the reduction or prevention of loneliness and/or social isolation.

#### Types of outcomes

Measures of loneliness or social isolation as collected before and after the intervention were eligible. This included both quantitative (eg, scores of loneliness questionnaires) ratings and qualitative assessments.

#### Study design

Randomized controlled trials (RCTs) or nonrandomized (quasi-experimental) interventions published in peer-reviewed journals were eligible. Reference lists of identified systematic and scoping reviews were scrutinized for additional eligible studies.

#### Data Extraction

Information of individual studies were extracted using a standardized data-extraction protocol ([Supplementary Table 2](#)). Retrieved data were descriptive information, participant characteristics, details about the intervention, and outcome measures. In this study, we use the term “effective” to refer to a statistically significant difference between pre- and immediate post-intervention loneliness or social isolation scores. This was a parsimonious choice and does not automatically imply clinical meaningfulness. An intervention effect was furthermore termed “sustained” if a statistically significant difference as compared with baseline measures was still observed at follow-up. For qualitative outcomes, experiences of change in loneliness or social isolation in response to the specific intervention had to be reported.

Wherever baseline levels of loneliness were available, they were used to cluster study participants into “lonely at baseline” or “not lonely at baseline.” This could only be done for studies using tools for which information about validated cutoff values was available. This included the 3-, 10-, and 20-item versions of the University of California Los Angeles (UCLA) loneliness scale and the 6- and 11-item versions of the De Jong Gierveld Loneliness Scale.<sup>23–26</sup> The exact cutoff values used for this classification are presented in [Supplementary Table 3](#). Given the lack of reference cutoff values, no classification of baseline levels of social isolation was made.

## Study Quality Assessment

Study quality was assessed using the Mixed-Methods Appraisal Tool (MMAT).<sup>27</sup> The MMAT was chosen as it allows assessment of study quality of quantitative, qualitative, and mixed-method designs using a single tool. In the MMAT, risk of bias of individual studies is quantified in terms of representativeness of the sample to the wider population of interest, the appropriateness of measures, and the risk of confounding. The tool is intended as a starting point for making decisions about inclusion on a study-to-study basis and does thus not include prespecified cutoff values. Individual studies were assessed by 2 independent raters (L.A.D. and N.J.) and their decisions compared. In case of discrepancy, a third assessor (M.Y.V.) was consulted, who then made the final decision.

## Data Synthesis

To compare effect sizes between interventions, standardized mean differences (Cohen's *d*) were calculated based on the information provided, wherever appropriate.<sup>28</sup> Standardized mean difference was chosen as an alternative to simple mean differences, in light of the diversity in scales used by individual studies. Cohen's *d* was calculated separately for RCTs, single-group pre-posttest, and pre-posttest studies with nonequivalent groups (ie, interventions studies with more than one group, but without random assignment) using formulas presented by Campbell et al.<sup>29</sup> Assuming successful randomization in RCTs (ie, no group differences at baseline), mean differences of the posttest measure only were used for assessing effect sizes. For pre-posttest studies with nonequivalent groups without baseline differences, the same procedure was followed. As for single-group pre-posttest designs, formulas for inferring effect sizes based on repeated measures analysis of variance were used, while considering repeated measurements. Based on estimations by Cacioppo et al.,<sup>30</sup> we assumed a correlation of 0.7 between pre- and posttest loneliness or social isolation. Qualitative information about potential intervention mechanisms were extracted from all studies reporting an intervention effect.

## Statistical Analysis

Wherever appropriate, effect sizes were pooled based on random-effects meta-analyses. Heterogeneity was assessed using  $I^2$  and Cochran's *Q* at an alpha level of 0.05 in 2-sided tests.<sup>31,32</sup> The risk of small-study bias was assessed visually and quantitatively using Funnel plots and Egger's tests.<sup>33</sup> In order to assess differences in Cohen's *d* by study design, number of participants, baseline levels of loneliness, participant age and sex, setting (community-dwelling vs institutionalized), as well as intervention type and duration, meta-regression was conducted using the respective variables as main predictors. For this, the crude (univariable) analyses were used as the main model for interpretation (model 1), in light of missing information about potential covariates in one-third of included studies. However, we incrementally controlled for age and sex (model 2) and study design (model 3) as sensitivity analyses, in addition to a subgroup meta-analysis (model 1) by study design.

## Results

### Study Characteristics

A total of *n* = 2223 unique articles were identified through literature search, of which *n* = 67 were eventually retained for narrative synthesis. [Supplementary Figure 1](#) depicts a PRISMA-style flow diagram of the study selection process. Based on scores of the MMAT, all but one study were of sufficient quality to be included in the review

([Supplementary Tables 4–7](#)).<sup>34</sup> Most studies reported intervention effects as measured immediately after the intervention, and some studies (*n* = 29) also included follow-up measures. For 2 interventions, results at follow-up were published separately.<sup>35,36</sup> Overall, sample sizes ranged from *n* = 5 to *n* = 858 (total *n* = 7938; median *n* = 60; [Table 1](#)). Across individual studies, mean ages of participants ranged from 65.0 to 85.8 (overall mean age was 73.5) and 70.2% were women (range 18.6%–100%; [Table 1](#)). Most studies included community-dwelling participants (*n* = 49) and some included people living in care facilities (*n* = 16). One study included participants of both populations, and for one study, information about setting could not be inferred.<sup>81,95</sup>

Most studies (*n* = 27) were RCTs, with intervention lengths ranging from 4 weeks to 2 years (maximum follow-up after intervention completion = 243 days) and 39 studies were quasi-experimental. Of those, 13 were pre-posttest studies with nonequivalent groups (intervention length ranging from 1 week to 3 years; maximum follow-up after intervention completion = 350 days), 20 were of single-group pre-posttest design (intervention length between 3 weeks and 2 years; maximum follow-up after intervention completion = 625 days), and 7 were single-group posttest-only studies ([Table 1](#)). Control conditions in RCTs mainly entailed no intervention for community-dwelling participants or treatment as usual for people living in care facilities ([Table 2](#)).

Loneliness was mainly assessed through standardized scales, such as the UCLA Loneliness Scale or the De Jong Gierveld Loneliness Scale ([Table 2](#)).<sup>106,109</sup> Twelve studies additionally included a measure of social isolation, as assessed by validated scales such as the Lubben Social Network Scale or study-specific questionnaires.<sup>105</sup> One study specifically assessed social isolation, but not loneliness.<sup>53</sup> Level of baseline loneliness could be inferred for 41 studies. Most of those studies (*n* = 32) included people who were classified as lonely at baseline. All studies reporting qualitative outcomes (all single-group posttest-only designs) made use of inductive thematic content analysis. One study included a quantitative assessment of change in loneliness scores in addition to a qualitative post-intervention assessment.<sup>50</sup>

Interventions were clustered based on their main components into community-based (*n* = 14; eg, education health promotion programs), intergenerational (*n* = 4; eg, intergenerational reading programs), information communication technology (ICT) (*n* = 9; eg, social media courses), high-tech (*n* = 4; eg, virtual reality group therapy), spiritual/religious (*n* = 2; eg, meditation programs), psychological (*n* = 14; eg, group reminiscence therapy), physical activity (*n* = 5; eg, walking programs), leisure activity (*n* = 5; eg, horticultural activities), pet-based (*n* = 1), or a combination of these (*n* = 9; [Table 1](#)). Interventions were additionally categorized into 2 overarching clusters ("Technology-based," *n* = 16 and "Non-technology-based," *n* = 51) depending on the degree of technology being involved, either in terms of administration (eg, virtual reality-based psychotherapy) or intervention content (eg, ICT competence training).

### Are Interventions for Loneliness or Social Isolation Effective?

Of the included studies quantitatively measuring change in loneliness (*n* = 59), 55.9% (*n* = 33) found a significant difference between study baseline and immediate post-intervention scores. Effect sizes of significant studies ranged from *d* = -0.40 to *d* = -1.27. Meta-analysis of 27 studies suggested a significant overall effect size of *d* = -0.47 for loneliness interventions (95% CI = -0.62 to -0.32), corresponding to a medium effect.<sup>121</sup> There was substantial interstudy heterogeneity ( $Q = 84.4$ ,  $P < .001$ ;  $I^2 = 72.3\%$ ), but no signs of small-study bias based on visual inspection of the Funnel plot ([Supplementary Figure 2](#)) and the Egger's test ( $P = .550$ ). [Figure 1](#) contains a forest plot of the studies included in the meta-analysis.

**Table 1**  
Baseline Characteristics of Included Studies

Author, year	Country	Study Design	Community Dwelling?	N*	Mean Age (SD)* <sup>†</sup>	% Female*	Intervention Type
Barbosa et al, 2021 <sup>37</sup>	Portugal	Quasi-experimental <sup>‡</sup>	No	12	Median = 80.5 (not reported)	83.3	Intergenerational
Borji & Tarjoman, 2020 <sup>38</sup>	Iran	RCT <sup>§</sup>	Yes	88	74.3 (8.0)	54.3	Spiritual
Bruce et al, 2021 <sup>36</sup>	United States	RCT <sup>§</sup>	Yes	64	73.9 (not reported)	61.8	Psychological
Cattan et al, 2011 <sup>39</sup>	United Kingdom	Quasi-experimental <sup>  </sup>	Yes	40	Not reported**	Not reported	Community-based
Chan et al, 2017 <sup>40</sup>	Hong Kong	RCT <sup>§</sup>	Yes	46	75.4 (5.9)	75.0	Physical activity
Chen & Ji, 2015 <sup>41</sup>	Taiwan	Quasi-experimental <sup>††</sup>	No	10	75.3 (9.6)	40.0	Leisure
Chen et al, 2020 <sup>42</sup>	Taiwan	Quasi-experimental <sup>††</sup>	No	20	81.1 (8.2)	65.0	High-tech
Choi et al, 2020 <sup>43</sup>	United States	RCT <sup>§</sup>	Yes	89	74.4 (8.2)	67.4	Psychological
Chu et al, 2019 <sup>44</sup>	Taiwan	RCT <sup>§</sup>	No	150	Not reported**	66.7	Leisure
Cohen-Mansfield et al, 2018 <sup>45</sup>	Israel	RCT <sup>§</sup>	Yes	74	76.6 (6.8)	79.5	Psychological
Coll-Planas et al, 2017 <sup>46</sup>	Spain	Quasi-experimental <sup>††</sup>	Yes	38	77.2 (5.8)	95.0	Community-based
Coll-Planas et al, 2021 <sup>47</sup>	Spain	Quasi-experimental <sup>  </sup>	Yes	26	Not reported**	97.4	Community-based
Collins & Benedict, 2006 <sup>48</sup>	United States	Quasi-experimental <sup>††</sup>	Yes	339	73.2 (8.6)	80.0	Community-based
Creswell et al, 2012 <sup>49</sup>	United States	RCT <sup>§</sup>	Yes	40	65.0 (7.0)	85.0	Psychological
Damnée et al, 2019 <sup>50</sup>	France	Quasi-experimental <sup>††</sup>	Yes	13	75.9 (12.7)	69.0	ICT <sup>‡‡</sup>
Ehsan et al, 2021 <sup>51</sup>	Switzerland	Quasi-experimental <sup>††</sup>	Yes	235	69.4 (not reported)	56.0	Community-based
Ekwonye & Gerdes, 2022 <sup>52</sup>	United States	Quasi-experimental <sup>  </sup>	No	22	Not reported**	68.2	Intergenerational
Elshebiny & Al Maamari, 2018 <sup>53</sup>	Egypt	Quasi-experimental <sup>‡</sup>	No	43	67.9 (not reported)	36.4	Psychological
Esmailzadeh & Oz, 2020 <sup>54</sup>	Turkey	Quasi-experimental <sup>††</sup>	Yes	39	Not reported**	87.2	Psychological
Fields et al, 2021a <sup>55</sup>	United States	RCT <sup>§</sup>	Yes	57	75.0 (7.9)	48.0	ICT <sup>‡‡</sup>
Fields et al, 2021b <sup>56</sup>	United States	Quasi-experimental <sup>††</sup>	No	15	85.8 (4.5)	73.3	High-tech
Fokkema & Knipscheer, 2007 <sup>57</sup>	Netherlands	Quasi-experimental <sup>‡</sup>	Yes	26	66.0 (not reported)	91.7	ICT <sup>‡‡</sup>
Follmann et al, 2021 <sup>58</sup>	Germany	Quasi-experimental <sup>‡</sup>	No	70	83.0 (not reported)	72.3	High-tech
Franke et al, 2021 <sup>59</sup>	Canada	Quasi-experimental <sup>††</sup>	Yes	452	Not reported**	23.0	Physical activity
Gaggioli et al, 2014 <sup>60</sup>	Italy	Quasi-experimental <sup>††</sup>	Yes	32	67.5 (6.0)	Not reported	Intergenerational
Galinha et al, 2022 <sup>61</sup>	Portugal	RCT <sup>§</sup>	Yes	149	76.8 (8.9)	86.5	Leisure
Gonyea & Burnes, 2013 <sup>62</sup>	United States	Quasi-experimental <sup>††</sup>	Yes	33	81.0 (not reported)	85.0	Community-based
Gustafsson et al, 2017 <sup>63</sup>	Sweden	RCT <sup>§</sup>	Yes	416	82.0 (not reported)	62.0	Community-based
Heller et al, 1991 <sup>64</sup>	United States	Quasi-experimental <sup>††</sup>	Yes	265	Not reported**	100	Community-based
Hernández-Ascanio et al, 2023 <sup>65</sup>	Spain	RCT <sup>§</sup>	Yes	119	80.8 (5.4)	76.5	Psychological
Honigh-De Vlamming et al, 2013 <sup>66</sup>	The Netherlands	Quasi-experimental <sup>‡</sup>	Yes	858	73.6 (5.9)	56.0	Community-based
Hudson et al, 2020 <sup>67</sup>	United States	Quasi-experimental <sup>  </sup>	Yes	20	76.0 (not reported)	50.0	Combined
Hwang et al, 2019 <sup>68</sup>	Canada	Quasi-experimental <sup>  </sup>	Yes	16	76.6 (not reported)	93.8	Combined
Jeste et al, 2023 <sup>69</sup>	United States	Quasi-experimental <sup>††</sup>	Yes	20	78.3 (7.8)	80.0	Psychological
Jones et al, 2019 <sup>70</sup>	Canada	RCT <sup>§</sup>	Yes	66	74.3 (6.3)	40.0	Physical activity
Kahlon et al, 2021 <sup>71</sup>	United States	RCT <sup>§</sup>	Yes	240	69.4 (11.5)	79.0	Community-based
Knowles et al, 2017 <sup>72</sup>	United States	Quasi-experimental <sup>‡</sup>	Yes	28	67.0 (11.0)	88.0	Combined
Lai et al, 2020 <sup>73</sup>	Canada	RCT <sup>§</sup>	Yes	60	Not reported**	33.3	Community-based
Larsson et al, 2016 <sup>74</sup>	Sweden	RCT <sup>§</sup>	Yes	30	73.4 (not reported)	80.0	ICT <sup>‡‡</sup>
Lee & Kim, 2019 <sup>75</sup>	United States	Quasi-experimental <sup>††</sup>	Yes	55	73.8 (12.3)	63.6	Intergenerational
Lin et al, 2020 <sup>76</sup>	Taiwan	Quasi-experimental <sup>‡</sup>	No	106	77.4 (7.5)	18.6	Combined
Lorente-Martínez et al, 2022 <sup>77</sup>	Spain	Quasi-experimental <sup>‡</sup>	Yes	48	77.6 (7.9)	100	Psychological
Mays et al, 2021 <sup>78</sup>	United States	Quasi-experimental <sup>††</sup>	Yes	382	76.8 (9.1)	83.1	Physical activity
Ollonqvist et al, 2008 <sup>79</sup>	Finland	RCT <sup>§</sup>	Yes	708	78.1 (6.6)	84.6	Physical activity
Pandya, 2021 <sup>80</sup>	India, Nepal, Myanmar, Sri Lanka	RCT <sup>§</sup>	Yes	378	65.7 (3.6)	20.1	Spiritual
Quinn, 2021 <sup>81</sup>	United States	RCT <sup>§</sup>	Combined	36	76.8 (6.0)	76.5	ICT <sup>‡‡</sup>
Roberts & Windle, 2020 <sup>82</sup>	United Kingdom	Quasi-experimental <sup>††</sup>	Yes	120	76.7 (not reported)	81.7	Psychological
Robinson et al, 2013 <sup>83</sup>	New Zealand	RCT <sup>§</sup>	No	40	Not reported**	67.5	High-tech
Rodríguez-Romero et al, 2021 <sup>84</sup>	Spain	RCT <sup>§</sup>	Yes	55	80.2 (6.6)	78.0	Community-based
Routasalo et al, 2009 <sup>85</sup>	Finland	RCT <sup>§</sup>	Yes	235	80.0 (not reported)	74.4	Psychological
Saito et al, 2012 <sup>86</sup>	Japan	RCT <sup>§</sup>	Yes	60	72.6 (4.4)	60.0	Community-based
Sen & Prybutok, 2021 <sup>87</sup>	United States	Quasi-experimental <sup>  </sup>	Yes	15	79 (not reported)	66.6	Combined
Shapira et al, 2021 <sup>88</sup>	Israel	RCT <sup>§</sup>	Yes	82	72.1 (5.3)	81.0	Psychological
Slegers et al, 2008 <sup>89</sup>	The Netherlands	RCT <sup>§</sup>	Yes	194	Not reported	Not reported	ICT <sup>‡‡</sup>
Stewart et al, 2001 <sup>90</sup>	Canada	Quasi-experimental <sup>††</sup>	Yes	22	66.0 (not reported)	100	Psychological
Taube et al, 2018 <sup>91</sup>	Sweden	RCT <sup>§</sup>	Yes	153	81.4 (5.9)	65.0	Community-based

(continued on next page)

Table 1 (continued)

Author, year	Country	Study Design	Community Dwelling?	N*	Mean Age (SD) <sup>†</sup>	% Female*	Intervention Type
Teater & Baldwin, 2014 <sup>92</sup>	United Kingdom	Quasi-experimental <sup>  </sup>	Yes	5	Not reported**	80.0	Combined
Tkatch et al, 2021 <sup>93</sup>	United States	Quasi-experimental <sup>††</sup>	Yes	216	Not reported**	52.8	Combined
Travers & Bartlett, 2011 <sup>94</sup>	Australia	Quasi-experimental <sup>††</sup>	Yes	113	79.9 (8.9)	70.8	Leisure
Tsai & Tsai, 2011 <sup>95</sup>	Taiwan	Quasi-experimental <sup>‡</sup>	No	90	73.8 (11.2)	55.0	ICT <sup>‡‡</sup>
Tsai et al, 2020 <sup>96</sup>	Taiwan	Quasi-experimental <sup>‡</sup>	No	62	81.1 (8.5)	75	ICT <sup>‡‡</sup>
Tse, 2010 <sup>97</sup>	Hong Kong	Quasi-experimental <sup>‡</sup>	No	53	85.2 (5.2)	96.2	Leisure
Vrbanac et al, 2013 <sup>98</sup>	Croatia	Quasi-experimental <sup>††</sup>	No	21	80.5 (6.6)	80.1	Pet
White et al, 2002 <sup>99</sup>	United States	RCT <sup>§</sup>	No	93	71.0 (12.0)	71	ICT <sup>‡‡</sup>
Winningham & Pike, 2007 <sup>100</sup>	United States	Quasi-experimental <sup>‡</sup>	No	58	82.1 (7.2)		Psychological
Xu et al, 2016 <sup>101</sup>	Singapore	Quasi-experimental <sup>‡</sup>	Yes	89	75.9 (not reported) & 76.0 (not reported) <sup>§§</sup>	79.9	Combined
Yang et al, 2023 <sup>102</sup>	Taiwan	RCT <sup>§</sup>	No	89	68.1 (6.7)	65.9	Combined

\*For RCTs and pre-posttest studies with nonequivalent groups, descriptive information is provided for the experimental group only.

<sup>†</sup>Standard deviation.

<sup>‡</sup>Pre-posttest design with nonequivalent groups.

<sup>§</sup>Randomized controlled trial.

<sup>||</sup>Single-group posttest-only design.

\*\*Authors provided information about percentage of people per age category instead of mean age. Choice of categories differed per study.

<sup>††</sup>Single-group pre-posttest design.

<sup>‡‡</sup>Information communication technology.

<sup>§§</sup>For the 2 experimental groups, respectively.

Of the 12 included studies quantitatively assessing change in social isolation, 50.0% found a significant difference between baseline and immediate post-intervention measures. Given the lack of comparable outcome measures, only 2 studies assessing social isolation could be pooled. Meta-analysis of those studies did not reveal a significant pooled effect size ( $d = 0.18$ ; 95% CI,  $-0.21$  to  $0.58$ ;  $Q = 0.11$ ,  $P = .74$ ;  $I^2 = 0.00\%$ ; [Supplementary Figure 3](#)).

There were generally large between-study differences in measurement instruments used, both for loneliness and social isolation (see [Table 2](#)). In terms of sustainability of intervention effect, of those studies including a follow-up measure for loneliness ( $n = 27$ ), 17 (63.0%) still found a significant difference as compared with immediate post-intervention measure. For social isolation, 2 of 6 (33.3%) studies reported a sustained intervention effect.

Qualitative outcomes generally suggested experiences of reductions in loneliness and social isolation. More specifically, the 7 studies reporting on qualitative outcomes identified the following common relevant themes: a reduction of loneliness and social isolation, fostering of new social connections and establishment of friendships, and the creation of a sense of belonging.

#### Does Effectiveness Differ Based on Intervention or Sample Characteristics?

Results of the uni- and multivariable meta-regression analyses for loneliness are presented in [Table 3](#). Between-study heterogeneity was not explained by differences in baseline age, sex, study design, year of publication, intervention length, baseline level of loneliness, or setting. However, there was a significant association with intervention cluster (technology-based vs non-technology-based;  $\Delta d = -0.35$ ; 95% CI,  $-0.66$  to  $-0.04$ ;  $P = .029$ ), meaning that nontechnological interventions were associated with 0.35 points lower Cohen's  $d$  scores (ie, a larger reduction in loneliness scores) compared with technology-based interventions. However, this association did not survive additional adjustment for age and sex ( $\Delta d = -0.35$ ; 95% CI,  $-0.75$  to  $0.04$ ;  $P = .074$ ), and study design ( $\Delta d = -0.33$ ; 95% CI,  $-0.74$  to  $0.09$ ;  $P = .114$ ; sensitivity analyses), while effect estimates remained virtually unchanged. Furthermore, in the latter model, there was a significant association between study tool (UCLA Loneliness Scale vs other tools)

and Cohen's  $d$  scores ( $\Delta d = 0.44$ ; 95% CI,  $0.00$  to  $0.89$ ;  $P = .049$ ). Given the small number of eligible studies, no meta-regression was performed for social isolation.

A subgroup meta-analysis of loneliness interventions based on intervention clusters showed somewhat lower group-specific between-study heterogeneity ([Figure 2](#)) as compared with the global meta-analysis. In an additional subgroup meta-analysis by study design (sensitivity analysis), effect sizes for single-group pre/post designs ( $n = 10$ ) and RCTs ( $n = 12$ ) were roughly comparable ( $d = -0.52$  and  $-0.49$ , respectively), whereas results for non-randomized group comparable studies ( $n = 4$ ) were smaller and nonsignificant ( $d = -0.22$ ; [Supplementary Figure 4](#)). In a further subgroup meta-analysis (sensitivity analysis; [Supplementary Figure 5](#)) based on study tools, effect sizes remained similar ( $d = -0.44$  and  $-0.54$ , respectively).

#### Intervention Mechanisms

Interventions were categorized into 3 overarching strategies or mechanisms: (1) promoting social contact—with the focus of directly creating opportunities for social interaction; (2) transferring knowledge and skills—providing people with the necessary tools for engaging in social interaction; and (3) addressing social cognition—addressing psychological barriers evolving around social contact.

These are not mutually exclusive and interventions may comprise more than 1 mechanism. [Supplementary Figure 6](#) contains a visual presentation of all mentioned effective components (described by the authors in the discussion section), clustered by their overarching mechanism category.

#### Discussion

This systematic literature review and meta-analysis aimed to summarize the available evidence regarding the effectiveness of interventions tackling loneliness and social isolation, as well as intervention mechanisms. Some studies reported significant reductions in loneliness or social isolation scores following interventions. Meta-analysis of 27 studies assessing loneliness revealed a pooled Cohen's

**Table 2**  
Description of Included Interventions Tackling Loneliness and Social Isolation

Author, year	Description	Instrument*	Measurement Time	Lonely at Baseline? <sup>†</sup>	Effective? <sup>§</sup>	Sustained? <sup>  </sup>
Barbosa et al, 2021 <sup>37</sup>	Intergenerational program; monthly 2-hour meetings for 1 year vs no intervention	<b>Lon:</b> 20-item UCLA <sup>103</sup>	T0; T1 (365 d)	No	No	n.a.
Borji & Tarjoman, 2020 <sup>38</sup>	Religious intervention; 20 30- to 45-minute sessions vs no intervention	<b>Lon:</b> 20-item UCLA <sup>24</sup>	T0; T1 (30 d); T2 (61 d); T3 (91 d)	Yes	Yes	Yes
Bruce et al, 2021 <sup>36,**</sup>	Lay coach tele-behavioral activation program; 5 weekly 1-hour sessions vs tele-delivered friendly visits	<b>Lon:</b> 8-item Patient Reported Outcomes Measurement Information System ( <i>PROMIS</i> ); <b>SI:</b> 4-item Duke Social Support Index ( <i>DSSI</i> )	T3 (365 d)	Yes	Yes	Yes
Cattan et al, 2011 <sup>39</sup>	Community-based telephone support program; varying frequency and duration	Semistructured interviews	T1 (91 d)	n.a.	Yes	n.a.
Chan et al, 2017 <sup>40</sup>	Tai chi qigong intervention; 2 weekly 1-hour sessions for 3 months vs care as usual	<b>Lon:</b> 6-item De Jong Gierveld Loneliness Scale <sup>104</sup> ; <b>SI:</b> 6-item Lubben Social Network Scale <sup>105</sup>	T0; T1 (91 d); T2 (183 d)	Yes	Yes	Yes
Chen & Ji, 2015 <sup>41</sup>	Horticultural intervention; weekly 1.5-hour sessions for 10 weeks	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (35 d); T2 (70 d)	Yes	Yes	Yes
Chen et al, 2020 <sup>42</sup>	Eight-week personal assistive robot (Paro) intervention after 8-week observation period	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup>	T0.1; T0.2 (56 d) <sup>††</sup> ; T1 (84 d); T2 (112 d)	No	Yes	Yes
Choi et al, 2020 <sup>43</sup>	Lay coach tele-behavioral activation program; 5 weekly 1-h sessions vs tele-delivered friendly visits	<b>Lon:</b> 8-item Patient Reported Outcomes Measurement Information System ( <i>PROMIS</i> ); <b>SI:</b> 4-item Duke Social Support Index ( <i>DSSI</i> )	T0; T1 (42 d); T2 (84 d)	Yes	Yes	No
Chu et al. 2019 <sup>44</sup>	Horticultural intervention; 8 weekly 1.5- to 2-hour sessions vs care as usual	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (56 d)	Yes	Yes	n.a.
Cohen-Mansfield et al, 2018 <sup>45</sup>	Individual counseling sessions and/or group sessions (10 and 7 sessions, respectively) over a period of 6 months vs no intervention	<b>Lon:</b> 8-item UCLA Loneliness Scale <sup>107</sup> & study-specific questionnaire <sup>‡‡</sup>	T0; T1 (183 d); T2 (274 d)	Not known <sup>§§</sup>	Yes	Yes
Coll-Planas et al, 2017 <sup>46</sup>	Complex intervention/group-based program; 15 weekly 1.5-hour sessions	<b>Lon:</b> 11-item De Jong Gierveld Loneliness Scale <sup>25</sup>	T0; T1 (105 d); T2 (730 d)	Yes	Yes	Yes
Coll-Planas et al, 2021 <sup>47</sup>	Peer support through group meetings and community assets; 15 weekly 1.5-hour sessions	Semistructured interviews	T1 (105 d)	n.a.	Yes	n.a.
Collins & Benedict, 2006 <sup>48</sup>	Educational health promotion program; 15 sessions across 4 months	<b>Lon:</b> 4-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (122 d)	Not known <sup>§§</sup>	Yes	n.a.
Creswell et al, 2012 <sup>49</sup>	Mindfulness-based stress reduction program; 8 weekly 2-hour sessions + 30-minute individual daily practice and 1 day-long retreat vs no intervention (wait list)	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (56 d)	Yes	Yes	n.a.
Damnée et al, 2019 <sup>50</sup>	Introductory course about tablet use and communication via social media; 10 biweekly 2-hour sessions	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>106</sup> + semistructured interviews	T0; T1 (140 d)	Yes	No	n.a.
Ehsan et al, 2021 <sup>51</sup>	Various community-based participatory interventions	<b>Lon:</b> 6-item De Jong Gierveld Loneliness Scale <sup>25</sup>	T0; T1 (365 d)	No	No	n.a.
Ekwoyie & Gerdes, 2022 <sup>52</sup>	Virtual intergenerational compassionate presence intervention; 10-week period (variable frequency)	Semistructured interviews	n.a.	n.a.	Yes	n.a.
Elsherbiny & Al Maamari, 2018 <sup>53</sup>	Logotherapy; Twenty 30-minute group sessions across 12 weeks vs care as usual	<b>SI:</b> 9-item social isolation scale <sup>108</sup>	T0; T1 (84 d); T2 (98 d)	n.a.	Yes	Yes
Esmailzadeh & Oz, 2020 <sup>54</sup>	Group meetings and discussions; 9 weekly 2-hour meetings	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (63 d)	Yes	Yes	n.a.
Fields et al, 2021a <sup>55</sup>	Digital training on using a tablet; 8 weekly sessions vs no intervention (wait list)	<b>Lon:</b> 3-item UCLA Loneliness Scale <sup>23</sup>	T0; T1 (56 d)	Yes	No	n.a.
Fields et al, 2021b <sup>56</sup>	Social robot intervention (pilot); three 10-minute sessions	<b>Lon:</b> 3-item UCLA Loneliness Scale <sup>23</sup>	Not known	No	No	n.a.
Fokkema & Knipscheer, 2007 <sup>57</sup>	Internet-based intervention; five 2-hour lessons on using the internet	<b>Lon:</b> 11-item De Jong Gierveld Loneliness Scale <sup>109</sup>	T0; T1 (730 d); T2 (1080 d)	Yes	Yes	Yes
Follmann et al, 2021 <sup>58</sup>	Video calls via humanoid robot; variable frequency for 2 months	<b>Lon:</b> 3-item UCLA Loneliness scale <sup>23</sup>	Not known	Not known	Yes	n.a.
Franke et al, 2021 <sup>59</sup>	Choice-based health promotion program; variable frequency for 6 months	<b>Lon:</b> 3-item UCLA Loneliness Scale <sup>23</sup>	T0; T1 (91 d); T2 (183 d)	Yes	Yes	Yes
Gaggioli et al, 2014 <sup>60</sup>	Intergenerational group reminiscence intervention; 3 weekly meetings	<b>Lon:</b> Italian Loneliness Scale <sup>110</sup>	T0; T1 (21 d)	Not known <sup>§§</sup>	Yes	n.a.
Galinha et al, 2022 <sup>61</sup>	Group singing program; 2 weekly 2-hour sessions for 17 weeks vs leisure activities <sup>  </sup>	<b>Lon:</b> 4-item UCLA Loneliness Scale <sup>111</sup>	T0; T1 (122 d); T2 (183 d)	Not known <sup>§§</sup>	No	n.a.

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Table 2 (continued)

Author, year	Description	Instrument*	Measurement Time Points <sup>†</sup>	Lonely at Baseline? <sup>‡</sup>	Effective? <sup>§</sup>	Sustained? <sup>  </sup>
Gonyea & Burnes, 2013 <sup>62</sup>	Neighborhood-based program to support aging in place; variable frequency and duration	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup>	T0; T1 (274 d)	No	No	n.a.
Gustafsson et al, 2017 <sup>63</sup>	Group discussions; 4 weekly 2-hour group meetings vs normal community service	<b>Lon:</b> study-specific questionnaire; <b>SI:</b> study-specific questionnaire***	T0; T1 (365 d)	Not known <sup>§§</sup>	No	n.a.
Heller et al, 1991 <sup>64</sup>	Three-phase telephone intervention; variable frequency for 10 weeks per phase	<b>Lon:</b> 7-item study-specific questionnaire <sup>112</sup> ; <b>SI:</b> study-specific questionnaire <sup>111</sup>	T0; T1 (35 d); T2 (70 d); T3 (140 d); T4 (210 d)	Not known <sup>§§</sup>	No	No
Hernández-Ascanio et al, 2023 <sup>65</sup>	Multicomponent intervention; six 30-minute in-person sessions and five 20-minute phone calls across 16 weeks vs no intervention	<b>Lon:</b> 6-item De Jong Gierveld Loneliness Scale <sup>113</sup> ; <b>SI:</b> Duke-University of North Carolina Functional Support Scale <sup>114</sup> (DUFSS)	T0; T1 (122 d); T2 (183 d)	Not known <sup>§§</sup>	Yes	No
Honigh-De Vlaming et al, 2013 <sup>66</sup>	Multicomponent intervention; variable frequency over 2 years vs no intervention	<b>Lon:</b> 11-item De Jong Gierveld Loneliness Scale <sup>109</sup>	T0; T1 (730 d)	Yes	No	n.a.
Hudson et al, 2020 <sup>67</sup>	Interaction with robotic pet; variable frequency for 60 days	Semistructured interviews	T0; T1 (30 d); T2 (60 d)	n.a.	Yes	n.a.
Hwang et al, 2019 <sup>68</sup>	Community-based program; 2 weekly 2.5-hour group sessions for 12 weeks	Semistructured interviews	T1 (84 d)	n.a.	Yes	n.a.
Jeste et al, 2023 <sup>69</sup>	Individual psychotherapy intervention; 6 weekly 1-hour sessions for 6 weeks	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>103</sup>	T0; T1 (42 d)	Yes	No	n.a.
Jones et al, 2019 <sup>70</sup>	Auditory group intervention, physical exercise and health education vs auditory group intervention only; weekly 2-hour sessions for 10 weeks	<b>Lon:</b> 11-item De Jong Gierveld Loneliness Scale <sup>109</sup>	T0; T1 (77 d)	Yes	No	n.a.
Kahlon et al, 2021 <sup>71</sup>	Phone calls by trained volunteers; 2 to 5 calls per week for 4 weeks vs no intervention	<b>Lon:</b> 3-item UCLA Loneliness Scale <sup>115</sup> & 6-item De Jong Gierveld Loneliness Scale <sup>25</sup>	T0; T1 (28 d)	Yes	Yes	n.a.
Knowles et al, 2017 <sup>72</sup>	Virtual reality grief counseling sessions vs active control; 2 weekly 1-hour sessions for 8 weeks	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (56 d); T2 (112 d)	Yes	No	No
Lai et al, 2020 <sup>73</sup>	Peer-based support intervention; variable frequency for 8 weeks vs telephone calls only	<b>Lon:</b> 6-item De Jong Gierveld Loneliness Scale <sup>104</sup> ; <b>SI:</b> 10-item Lubben Social Network Scale <sup>116</sup>	T0; T1 (70 d)	Yes	Yes	n.a.
Larsson et al, 2016 <sup>74</sup>	Social internet-based intervention; weekly 1.5-hour individual and group meetings for 3 months vs no intervention (crossover design)	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup>	T0; T1 (91 d); T2 (238 d)	Yes	Yes	Yes
Lee & Kim, 2019 <sup>75</sup>	Intergenerational mentor-up program; 6 sessions (unknown duration)	<b>Lon + SI</b> <sup>111</sup> ; 9-item social isolation scale <sup>108</sup>	T0; T1 (not reported)	Not known <sup>§§</sup>	Yes <sup>§§§</sup>	n.a.
Lin et al, 2020 <sup>76</sup>	3D virtual reality and horticultural therapy intervention; 2 weekly 1-hour sessions for 9 weeks vs no intervention	<b>Lon:</b> 6-item UCLA Loneliness Scale <sup>117</sup>	T0; T1 (63 d); T2 (124 d)	Not known <sup>§§</sup>	Yes	Yes
Lorente-Martínez et al, 2022 <sup>77</sup>	Social support intervention focusing on conversation, attribution retraining and behavioral activation; 25 hours across 2 months vs no intervention	<b>Lon:</b> 10-item UCLA Loneliness Scale <sup>24</sup>	T0; T1 (61 d); T2 (183 d; EG only)	Yes	No	n.a.
Mays et al, 2021 <sup>78</sup>	Three physical activity programs and health support (multiple could be chosen); unknown frequencies for 8 weeks	<b>Lon:</b> 3-item UCLA Loneliness scale <sup>23</sup>	T0; T1 (42 d); T2 (183 d)	No	Yes	Yes
Ollonqvist et al, 2008 <sup>79</sup>	In-patient geriatric rehabilitation vs no intervention; 3 periods (20 to 56 hours) across 8 months	<b>Lon:</b> Single question <sup>1111</sup>	T0; T1 (243 d); T2 (365 d)	Not known <sup>§§</sup>	No	No
Pandya, 2021 <sup>80</sup>	Meditation program; weekly 45-minute sessions across 2 years vs no intervention	<b>Lon:</b> 6-item De Jong Gierveld Loneliness Scale <sup>25</sup>	T0; T1 (730 d)	Yes	Yes	n.a.
Quinn, 2021 <sup>81</sup>	Social media workshop; four 2-hour sessions across 4 weeks vs no intervention (waitlist)	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup>	T0; T1 (28 d); T2 (122 d)	Yes	No	No
Roberts & Windle, 2020 <sup>82</sup>	One to one mentoring and psychosocial support from volunteers; weekly meetings for 10-15 weeks	<b>Lon:</b> 6-item De Jong Gierveld Loneliness Scale <sup>25</sup>	T0; T1 (70-105 d)	Yes	Yes	n.a.
Robinson et al, 2013 <sup>83</sup>	Companion robot (Paro) intervention; 2 weekly 1-hour sessions across 12 weeks vs leisure activities	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup>	T0; T1 (84 d)	Yes	Yes	n.a.
Rodríguez-Romero et al, 2021 <sup>84</sup>	Community intervention; 18 sessions across 6 months vs no intervention	<b>Lon:</b> 10-item UCLA Loneliness Scale <sup>118</sup>	T0; T1 (183 d)	Yes	Yes	n.a.
Routasalo et al, 2009 <sup>85</sup>	Psychosocial group rehabilitation program; 12 weekly sessions (duration unknown) vs no intervention	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup> ; <b>SI:</b> 10-item Lubben Social Network Scale <sup>105</sup>	T0; T1 (91 d); T2 (183 d)	Yes	No	No
Saito et al, 2012 <sup>86</sup>	Community-based intervention; 4 biweekly 2-hour sessions vs no intervention (waitlist)	<b>Lon:</b> 10-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (72 d); T2 (225 d)	No	Yes	Yes

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Table 2 (continued)

Author, year	Description	Instrument*	Measurement Time Points <sup>1</sup>	Lonely at Baseline? <sup>2</sup>	Effective? <sup>3</sup>	Sustained? <sup>4</sup>
Sen & Prybutok, 2021 <sup>87</sup>	Community-based exercise center; variable number of visits	Semistructured interviews	T1 (unknown)	n.a.	Yes	n.a.
Shapira et al, 2021 <sup>88</sup>	Internet-based cognitive behavioral therapy/mindfulness group intervention; seven 1- to 1.5-hour sessions for 3.5 weeks vs no intervention (wait list)	<b>Lon:</b> 3-item UCLA Loneliness Scale <sup>23</sup>	T0; T1 (28 d); T2 (56 d)	No	Yes	No
Slegers et al, 2008 <sup>89</sup>	Introductory computer course; three 4-hour training sessions; subsequently personal computer use vs course only vs no intervention	<b>Lon:</b> 11-item De Jong Gierveld Loneliness Scale <sup>109</sup>	T0; T1 (122 d); T2 (365 d)	Not known****	No	No
Stewart et al, 2001 <sup>90</sup>	Support group intervention for widowed seniors; weekly 1- to 1.5-hour meetings for 20 weeks	<b>Lon + SI:</b> Emotional/Social Loneliness Inventory <sup>119,†††</sup>	T0; T1 (140 d); T2 (231 d)	Not known <sup>§§</sup>	No	No
Taube et al, 2018 <sup>91</sup>	Case-management intervention by nurses and physiotherapists; variable frequency (at least monthly) and duration for 1 year vs no intervention	<b>Lon:</b> Single question <sup>††††</sup>	T0; T1 (183 d); T2 (365 d)	Not known <sup>§§</sup>	No	No
Teater & Baldwin, 2014 <sup>92</sup>	Group singing; weekly 1-hour sessions for variable duration (at least 3 months)	Semistructured interviews	T1 (variable)	n.a.	Yes	n.a.
Tkatch et al, 2021 <sup>93</sup>	Animatronic pet intervention; variable frequency for 60 days	<b>Lon:</b> 10-item UCLA Loneliness Scale <sup>24</sup>	T0; T1 (30 d); T2 (60 d)	Yes	Yes	Yes
Travers & Bartlett, 2011 <sup>94</sup>	Radio program; participants instructed to listen to the program for 1 hour daily for 3 months	<b>Lon:</b> Single question <sup>§§§§</sup>	T0; T1 (91 d)	No	No	n.a.
Tsai & Tsai, 2011 <sup>95</sup>	Videoconference/interaction program; 5 minutes once per week for 3 months vs care as usual	<b>Lon:</b> 10-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (7 d); T2 (91 d)	Yes	Yes	Yes
Tsai et al, 2020 <sup>96</sup>	Smartphone-based videoconferencing program; weekly sessions (minimum 5 minutes) for 6 months vs care as usual	<b>Lon:</b> 10-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (30 d); T2 (91 d); T3 (183 d)	Yes	Yes	Yes
Tse, 2010 <sup>97</sup>	Horticultural intervention; variable frequency across 8 weeks vs care as usual	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup> ; <b>SI:</b> 10-item Lubben Social Network Scale <sup>105</sup>	T0; T1 (56 d)	Yes	Yes	n.a.
Vrbanac et al, 2013 <sup>98</sup>	Animal assisted therapy program using dogs; 3 weekly 1.5-hour sessions	<b>Lon:</b> 7-item UCLA Loneliness Scale <sup>120</sup>	T0; T1 (183 d)	Not known <sup>§§</sup>	Yes	n.a.
White et al, 2002 <sup>99</sup>	Internet group training intervention; 9 hours of training across 2 weeks vs no intervention (wait list)	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup>	T0; T1 (140 d)	Yes	No	n.a.
Winningham & Pike, 2007 <sup>100</sup>	Cognitive enhancement program; 3 sessions per week for 3 months vs care as usual	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup>	T0; T1 (91 d)	No	No	n.a.
Xu et al, 2016 <sup>101</sup>	Exergaming with other elderly vs with adolescent vs alone; variable number of 10- to 15-minute sessions across 1 week	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>106</sup>	T0; T1 (7 d)	Not known <sup>     </sup>	Yes	n.a.
Yang et al, 2023 <sup>102</sup>	Online interactive course; daily 8-hour program - 5 days per week for 8 weeks vs online content only	<b>Lon:</b> 20-item UCLA Loneliness Scale <sup>24</sup>	T0; T1 (56 d)	Yes	Yes	n.a.

Lon, loneliness; n.a., not applicable; SI, social isolation; T0, study baseline; T1, first post-intervention measure; T2, first follow-up measure; T3, second follow-up measure.

\*References as reported by individual studies.

<sup>1</sup>For comparability, follow-up times are expressed as the number of days from T0. If follow-up times were reported in terms of months, these were multiplied by 30.4 (365.25/12).

<sup>2</sup>For RCTs and pre-posttest studies with nonequivalent groups, information about baseline loneliness is provided for the experimental group only.

<sup>3</sup>Significant difference between T0 and T1.

<sup>4</sup>Significant difference between T0 and last follow-up measure.

\*\*Follow-up of Choi et al, 2020.<sup>43</sup>

††End of 8-week observation period.

‡Cohen-Mansfield et al<sup>45</sup> used a combination of an adapted version of the 8-item UCLA Loneliness Scale, and study-specific questionnaires for the frequency and severity of loneliness as outcome.

§§No validated cutoff values available.

||||For Galinha et al,<sup>61</sup> active control participants had access to other leisure activities offered.

\*\*\*Gustafsson et al<sup>63</sup> assessed loneliness using a single question. Social isolation was inferred from contact frequency with children, other relatives and friends.

†††Heller et al<sup>64</sup> assessed social isolation was inferred from the frequency of contact, using a combination of weekly and global contact.

‡‡‡Combined measure of the 3-item UCLA Loneliness Scale<sup>23</sup> and items examining perceived social support.

§§§Significant differences between pre- and post-intervention measures only reported for loneliness items.

|||||Ollonqvist et al<sup>79</sup> assessed loneliness using a single item ("Do you feel yourself lonely") on a Likert scale with 5 response options ranging from "never" to "always."

\*\*\*\*Slegers et al<sup>89</sup> summed item scores of the De Jong Gierveld Loneliness Scale<sup>109</sup> on a 1 to 5 Likert Scale, yielding a maximum score of 55. Given the absence of cutoff values for this method, no assessment of baseline loneliness could be done.

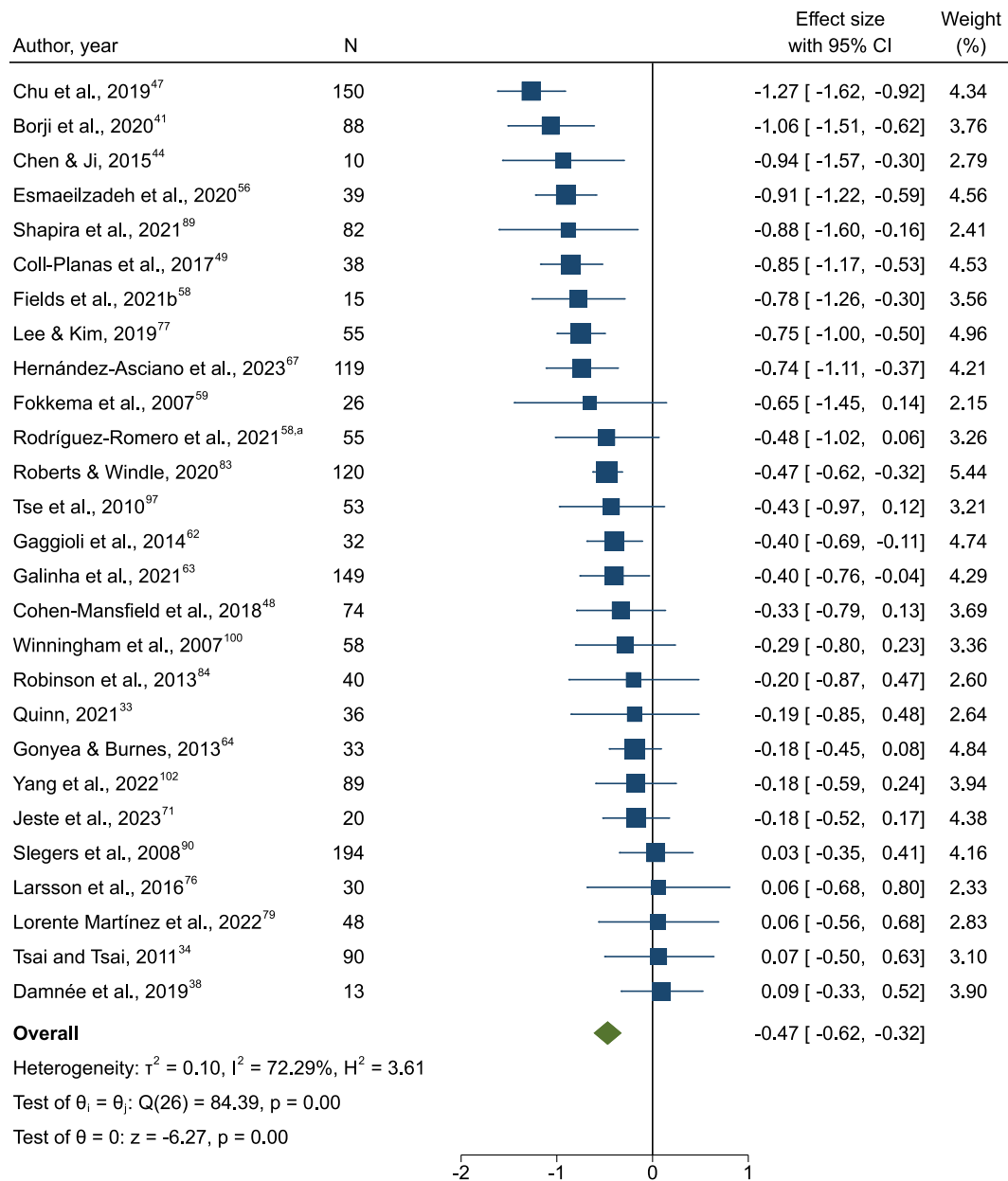
††††The Emotional/Social Loneliness Inventory<sup>119</sup> is a 15-item scale assessing both structural (ie, countable) and functional (ie, feelings) social network characteristics.

‡‡‡‡Taube et al<sup>91</sup> assessed loneliness using a single item ("Do you feel lonely nowadays") on a 3-point Likert scale.

§§§§Travers & Bartlett<sup>94</sup> assessed loneliness using a single question ("How often do you feel lonely") on a 4-point Likert scale.

|||||||Xu et al<sup>101</sup> report average scores on an item basis (as opposed to the average sum of items), for which there are no validated cutoff values.





**Fig. 1.** Forest plot of included quantitative studies assessing the effectiveness of loneliness interventions in older people. <sup>a</sup>Rodríguez-Romero et al. (2021) used reversed coding (ie, higher scores corresponding to lower levels of loneliness)—these were switched for analysis.

$d$  of  $-0.47$ , corresponding to a medium effect size, which was sustained in a majority of studies including a follow-up measure. Similar results for social isolation were not available. Between-study heterogeneity in loneliness studies was substantial overall and was only modestly explained by differences in participant characteristics and methodology. Information about intervention mechanisms was divided into “promoting social contact,” “transferring knowledge and skills,” and “addressing social cognition.”

#### Effectiveness of Interventions for Loneliness and Social Isolation

The findings of this systematic review and meta-analysis suggest that interventions for loneliness and social isolation are generally effective, with effect sizes comparable to those of (non-)pharmacological interventions for various psychiatric disorders.<sup>122</sup> However, determining whether this intervention effect actually translates to a

clinically meaningful reduction in loneliness is less straightforward. Such clinical significance has been defined as a return to normal levels of functioning,<sup>123</sup> the meaning of which has not been well established for loneliness. In terms of scoring below a certain cutoff on a validated scale (such as the UCLA Loneliness Scale), a reduction of 0.47 standard deviations (corresponding to a Cohen’s  $d$  of  $-0.47$ ) may thus not translate to a return to “healthy levels.” An early umbrella meta-analysis of 301 meta-analyses of social and behavioral interventions reported a pooled effect size of  $d = 0.50$ .<sup>124</sup> Our findings show that effectiveness of loneliness interventions may not be far off the expected effect magnitude in the field. Unfortunately, the relative absence of studies investigating intervention effectiveness for social isolation prohibits an in-depth comparison between the 2 constructs.

One previous meta-analysis by Masi et al reported significant differences of effect sizes for loneliness by study design, with RCTs showing smaller effects as compared with single-group and pre-

**Table 3**  
Results of the Meta-Regression

Variable	Model 1 (Main Model)			Model 2 (Sensitivity Analysis)			Model 3 (Sensitivity Analysis)		
	Coefficient	95% CI	P Value	Coefficient	95% CI	P Value	Coefficient	95% CI	P Value
Age (n = 24)	−0.01	−0.04 to 0.03	.691	−0.02*	−0.06 to 0.02	.339	−0.02 <sup>†</sup>	−0.06 to 0.03	.389
Sex (n = 23)	0.00	−0.01 to 0.02	.489	0.01 <sup>‡</sup>	−0.01 to 0.02	.228	0.01 <sup>§</sup>	−0.01 to 0.02	.407
Study design (n = 27)									
Randomized controlled trials	−0.05	−0.36 to 0.27	.762	−0.13	−0.51 to 0.24	.468	N/A	N/A	N/A
Single-group pre/post	−0.10	−0.41 to 0.22	.536	−0.00	−0.40 to 0.40	.992	N/A	N/A	N/A
Nonrandomized group comparison studies	0.28	−0.15 to 0.71	.191	0.28	−0.25 to 0.81	.283	N/A	N/A	N/A
Year of publication	−0.02	−0.05 to 0.01	.177	0.00	−0.05 to 0.05	.908	.04	−0.03 to 0.11	.215
Measurement instrument (n = 27)									
UCLA Loneliness Scale	0.11	−0.23 to 0.45	.523	0.35	−0.05 to 0.75	.080	<b>0.44</b>	<b>0.00 to 0.89</b>	<b>.049<sup>  </sup></b>
DJG Loneliness Scale	−0.07	−0.46 to 0.32	.700	−0.36	−0.83 to 0.10	.116	−0.39	−0.90 to 0.11	.119
Other tool	−0.12	−0.66 to 0.41	.642	−0.23	−1.02 to 0.55	.540	−0.29	−1.15 to 0.58	.491
Geographical region (n = 26)									
Asia	−0.22	−0.57 to 0.12	.199	−0.16	−0.59 to 0.27	.444	−0.31	−0.83 to 0.22	.238
Europe	0.11	−0.21 to 0.43	.482	0.08	−0.36 to 0.53	.698	0.13	−0.35 to 0.60	.575
United States	0.09	−0.28 to 0.47	.607	0.10	−0.38-0.58	.672	0.14	−0.42 to 0.69	.606
Intervention cluster (n = 27)									
Non-technology-based interventions	<b>−0.35</b>	<b>−0.66 to −0.04</b>	<b>.029<sup>  </sup></b>	−0.35	−0.75 to 0.04	.074	−0.33	−0.74 to 0.09	.114
Intervention components (n = 27)									
Promoting social contact	−0.13	−0.44 to 0.18	.405	−0.12	−0.50 to 0.25	.501	−0.13	−0.51 to 0.26	.503
Increasing knowledge and skills	−0.27	−0.87 to 0.33	.362	−0.38	−1.06 to 0.30	.253	−0.55	−1.27 to 0.18	.130
Addressing maladaptive social cognitions	−0.11	−0.47 to 0.25	.526	−0.11	−0.52 to 0.30	.578	−0.13	−0.60 to 0.33	.553
Intervention length (n = 24)	−0.00	−0.00 to 0.00	.972	−0.00	−0.00 to 0.00	.356	−0.00	−0.00 to 0.00	.284
Baseline level of loneliness (n = 20)									
Lonely at baseline (n = 20)	0.12	−0.42 to 0.66	.642	−0.06	−1.02 to 0.10.11	.920	−0.13	−1.04 to 0.18	.833
Setting (n = 26)									
Community-dwelling	−0.05	−0.36 to 0.25	.737	0.03	−0.33 to 0.40	.856	0.05	−0.36 to 0.47	.787

DJG Loneliness Scale, De Jong Gierveld Loneliness Scale; N/A, not applicable.

\*Controlling for sex.

<sup>†</sup>Controlling for sex and study design.

<sup>‡</sup>Controlling for age.

<sup>§</sup>Controlling for age and study design.

<sup>||</sup>Statistically significant ( $P \leq .05$ ); Model 1 (main model) = crude estimate; Model 2 = model 1 + age + sex; Model 3 = model 2 + study design.

posttest studies with nonequivalent groups.<sup>17</sup> Conversely, although in our meta-regression, study design did not significantly explain differences in effect size by itself, in a subgroup meta-analysis, pre-posttest studies with nonequivalent groups showed a smaller and nonsignificant effect size than RCTs and single-group pre/post designs. Notably, however, pre-posttest studies with nonequivalent groups included in the meta-analysis were not only fewer in number, but also included somewhat smaller sample sizes than RCTs, which may have affected statistical power.

Masi et al also report significant effect moderation in terms of study tool used.<sup>17</sup> More specifically, studies using the UCLA Loneliness Scale reported somewhat stronger effect sizes as opposed to other studies. This moderation was, however, specific to single-group pre-post designs. In the current study, information about the study tool used significantly predicted differences in effect sizes between studies only when all other study characteristics were adjusted for (model 3; sensitivity analyses). However, in a subsequent subgroup meta-analysis by measurement instrument, effect sizes of studies using the UCLA Loneliness Scale, as compared with those using other instruments, were largely comparable. This was also the case when additionally stratifying by study design (results not shown).

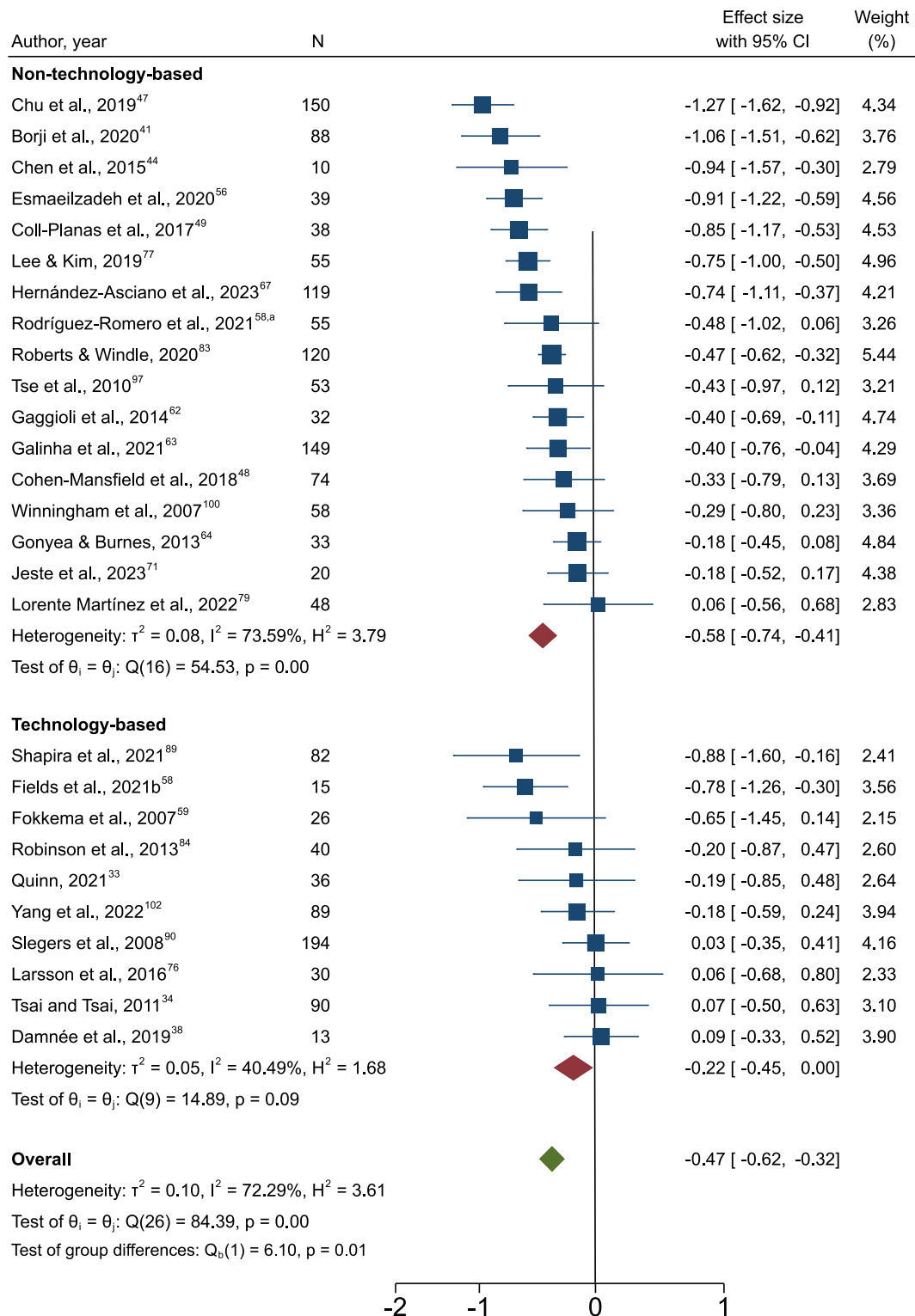
Next, Masi et al reported significantly higher effect sizes for non-randomized group comparison studies using technology for delivering interventions, as compared to non-technology-based interventions.<sup>17</sup> Conversely, in the current study the opposite was found. These differential findings may, in part, stem from differences in sample characteristics—in particular the focus on older adults in the current review—as opposed to no age restriction in Masi et al.<sup>17</sup> This population may be less technology-affine and may thus benefit less from technology-driven interventions as compared with younger adults. However, when barriers to in-person contact are high, such

interventions may still be valuable “indirect” sources for contact. Qualitative information from technology-based studies included in this review for instance suggests that technology may serve as a starting point for conversations and may thus more indirectly lead to real human connections.<sup>55</sup> However, to harvest the full benefit of technology-based interventions, existing barriers to technology use among older adults (eg, technophobia) may be tackled first.<sup>125</sup>

Given that most studies, by necessity, included participants who were lonely at baseline, conclusions about the potential of identified interventions to prevent (as opposed to tackle) loneliness and social isolation are difficult to draw. As noted previously, there also was a relative absence of studies assessing intervention effectiveness for social isolation. This prohibits strong assertions regarding the ability of interventions to objectively increase the frequency of social contact and warrants further in-depth assessment thereof in future intervention studies.

#### Methodological Considerations

There was substantial between-study heterogeneity with regard to study design, participant and intervention characteristics, and measurement instruments. With the exception of intervention type, including quantifiable variables as predictors in the meta-regression for loneliness did not yield any significant results. Interventions may be highly dependent on the context in which they are being carried out. Such contextual variables, which could not be considered in the analysis, may (in part) account for some of the remaining heterogeneity. This may include intervention intensity, participant motivation and adherence rates, socioeconomic position, clinical/cognitive characteristics, or skills of intervention facilitators—information about which was not commonly reported in studies included in this review.



**Fig. 2.** Forest plot of the subgroup meta-analysis by intervention type (technology-based vs non-technology-based); <sup>a</sup>Rodríguez-Romero et al. (2021) used reversed coding (ie, higher scores corresponding to lower levels of loneliness)—these were switched for analysis.

Observed heterogeneity also may be explained by cultural diversity between and within samples. Even though we aimed to control for such differences to some degree by using geographic location as proxy, this may not capture cultural diversity in its entirety. A further source for heterogeneity may be the diversity in outcome measures used. As for loneliness, this was measured using both unidimensional (UCLA

Loneliness Scale) and multidimensional (De Jong Gierveld Loneliness Scale) tools. However, instruments may differ in the specific underlying conceptualizations of loneliness.<sup>126</sup> In addition, single-item questions were used, assuming that participants have a general understanding of the loneliness concept.<sup>3</sup> Although type of instrument did not add to explaining heterogeneity of effect sizes, there may

potentially also be diversity between different versions of the same tool, for instance with regard to sensitivity for change.

### Strengths, Limitations, and Future Directions

This study has various strengths, including a carefully selected keyword profile, no restriction concerning publication dates, and the integration of both quantitative and qualitative evidence. It also has some limitations. First, the clustering of interventions was done based on face validity regarding the overarching intervention cluster. It was not always possible to categorize interventions in a mutually exclusive manner. Second, meta-analysis was based on only 38.9% of quantitative studies included in the review, given that information necessary for pooling could not be obtained for all studies.

Third, loneliness was treated as a unidimensional construct, given the lack of information about intervention effects on different subtypes of loneliness (ie, subscale specific results). Future intervention studies should furthermore consider potential fluctuations throughout the course of time, for instance by the use of experience sampling.<sup>127</sup> In a similar vein, efforts should be made to establish proper “cutoff values” for loneliness, especially in light of their predictive power for physical and mental health outcomes. Loneliness may to some degree be regarded a normal part of life and there are no clear definitions on what constitutes “excess loneliness.” More “distant” health outcomes (such as dementia) associated with loneliness should be considered when establishing such cutoffs, in addition to long-term changes in loneliness in its own regard.

As interventions also differ in terms of (financial) resources needed to be implemented, future studies should also examine their cost-effectiveness, including their potential social return of investment. Incorporating this health economic perspective will support policy-makers in selecting the most appropriate interventions considering the budget available.

### Conclusions and Implications

This systematic review and meta-analysis identified several interventions for loneliness and social isolation in older adults. It showed that some interventions may be effective with medium effect sizes. Effective interventions may address loneliness and social isolation by promoting social contact, transferring knowledge and skills, and changing social cognitions. As interventions may differ with regard to those underlying mechanisms, a person-centered (ie, considering the specific needs of the individual) instead of a “one-size-fits-all” approach should be pursued. More research is necessary to further examine the clinical relevance of interventions and examine their cost-effectiveness. Future conceptual studies should furthermore assess the multidimensionality of the loneliness construct as well as normal fluctuations in loneliness.

### Disclosure

The authors declare no conflicts of interest.

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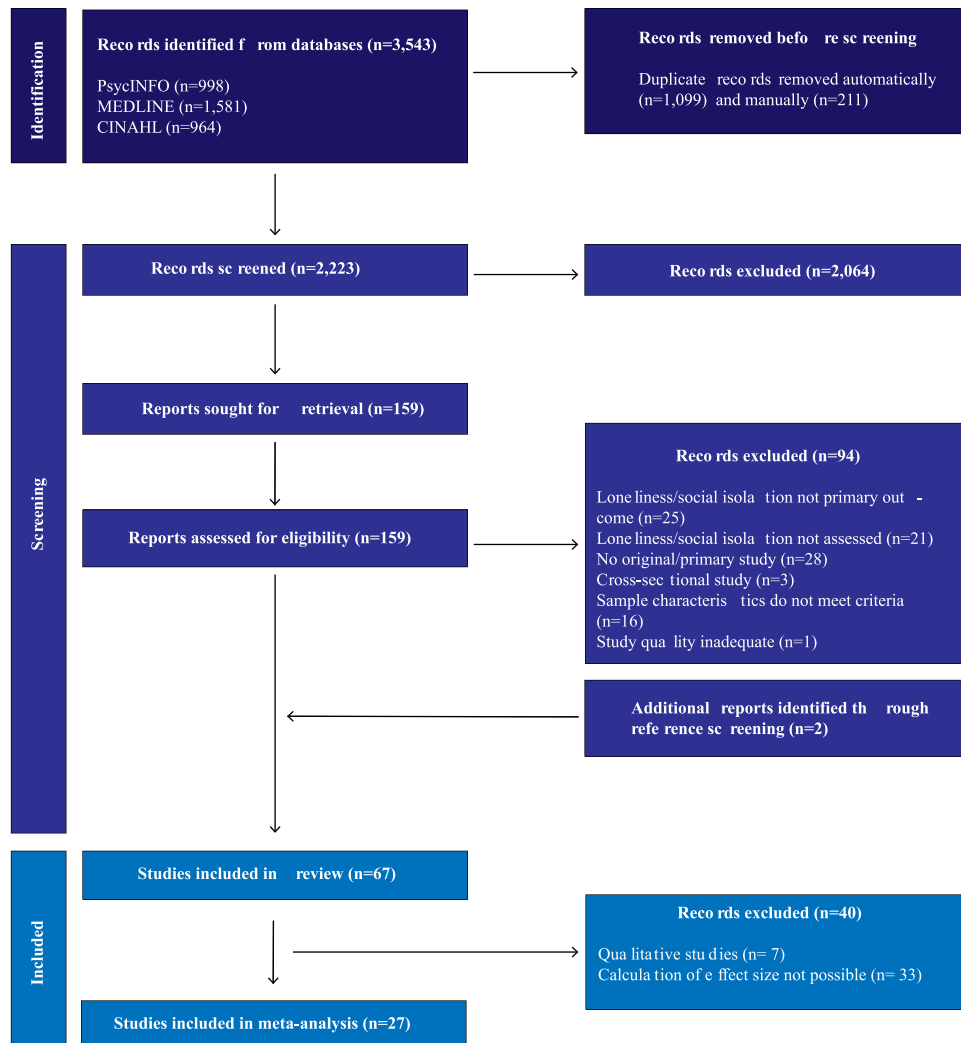
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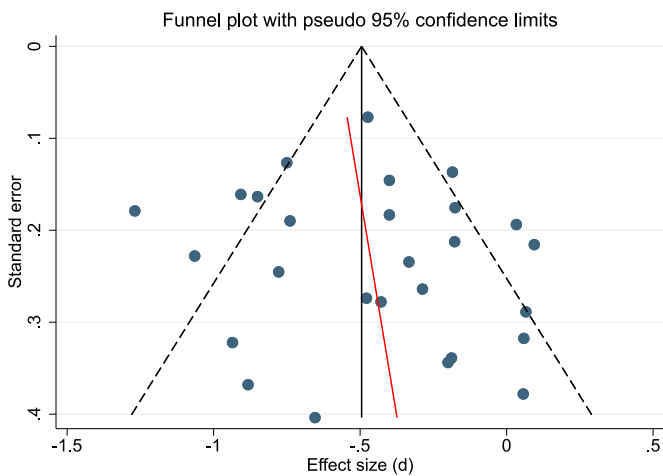
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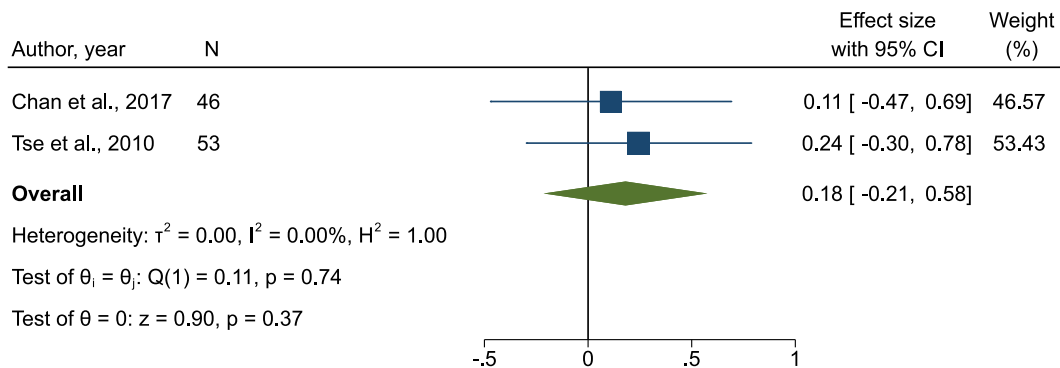
Supplementary Material



Supplementary Figure 1. Flow diagram of the study selection process.

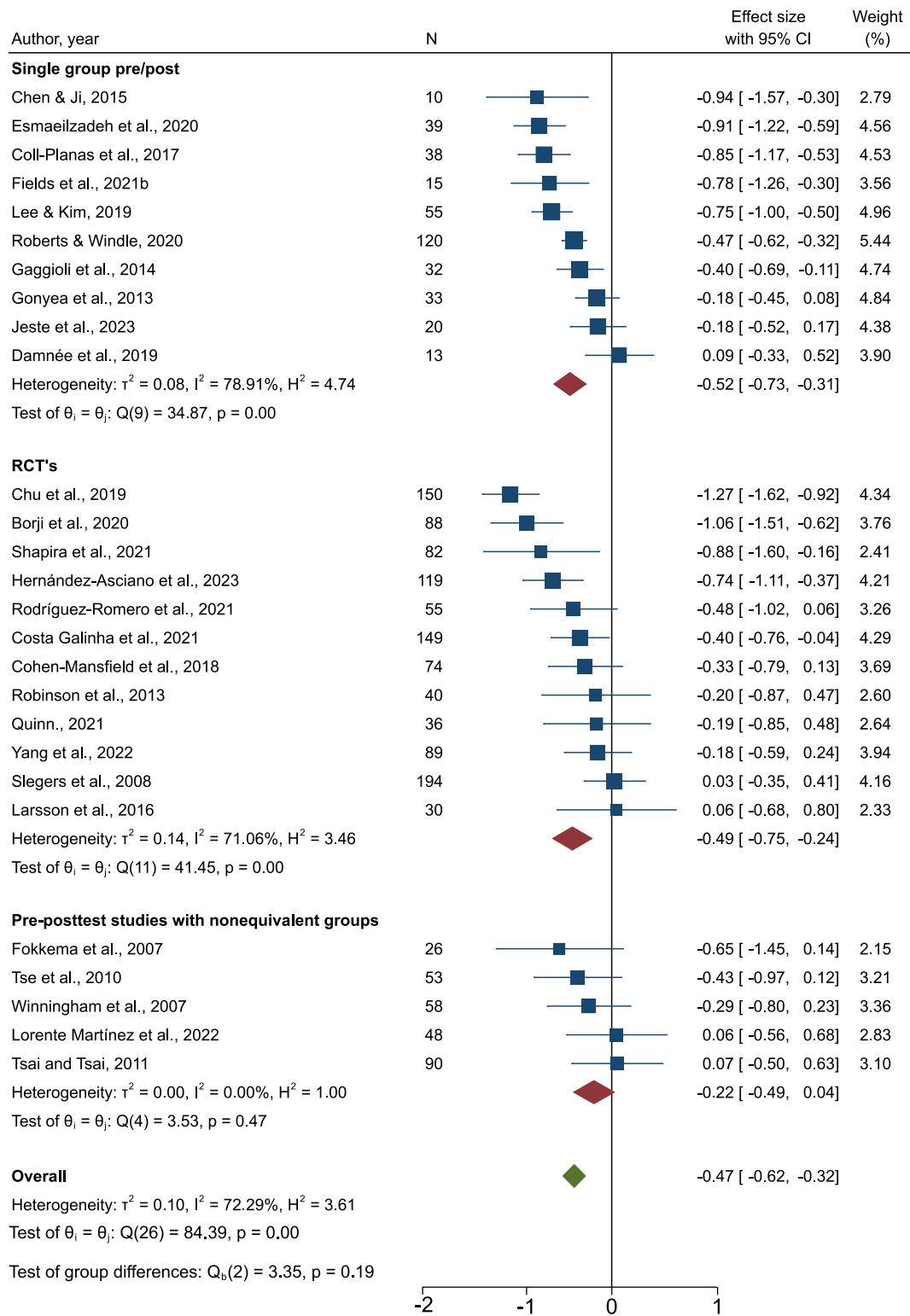


Supplementary Figure 2. Funnel plot of studies included in the meta-analysis of loneliness interventions, showing the effect sizes (Cohen's d) by their standard errors.

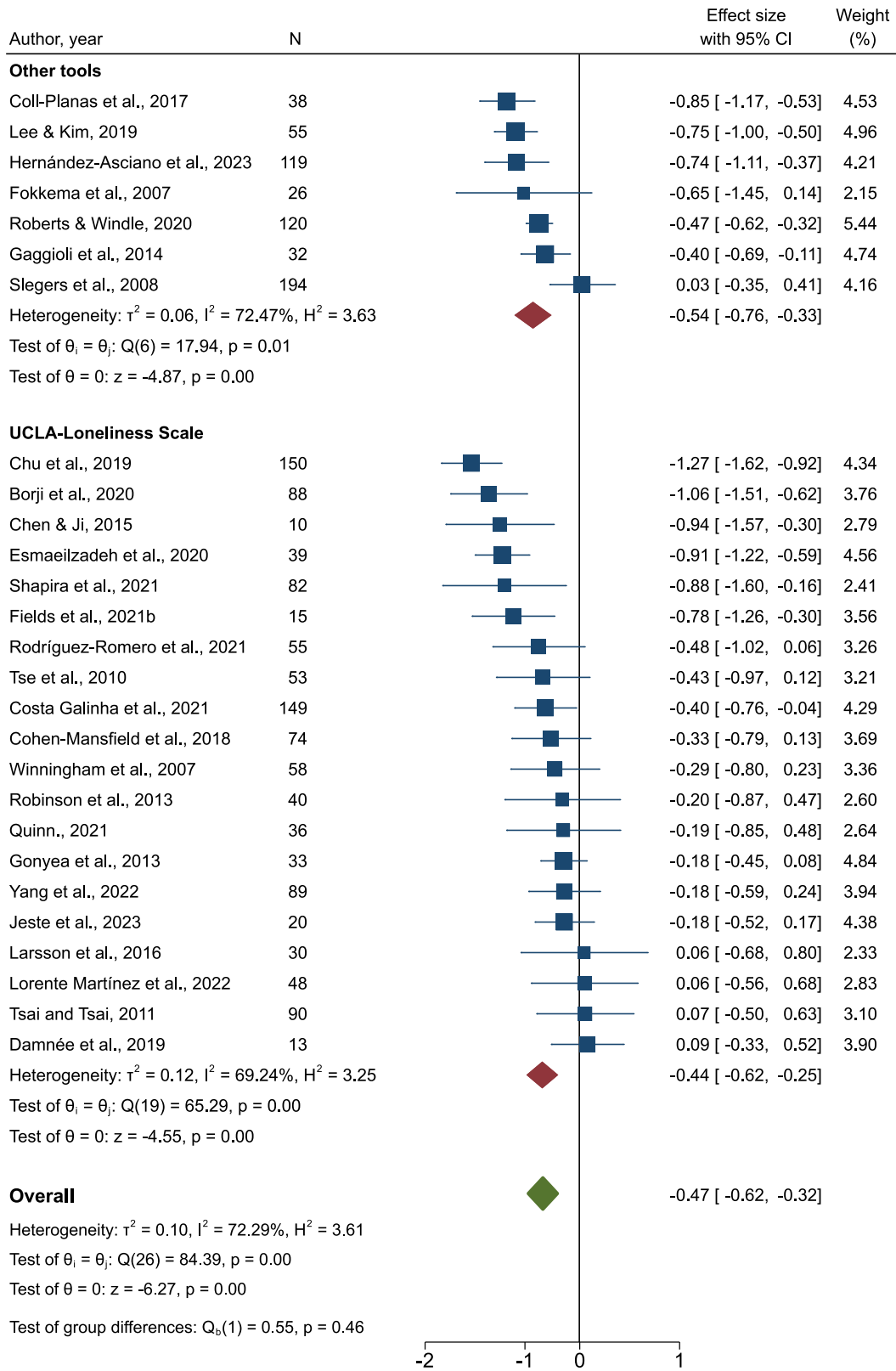


**Supplementary Figure 3.** Forest plot of included quantitative studies assessing the effectiveness of interventions for social isolation in older people.





Supplementary Figure 4. Subgroup meta-analysis by study design conducted as part of the sensitivity analyses.



Supplementary Figure 5. Subgroup meta-analysis by study tool conducted as part of the sensitivity analyses.



**Supplementary Figure 6.** Representation of proposed mechanisms of effective interventions, clustered according to their overarching category.

#### Supplementary Table 1

Keyword Profile and Specifiers Used for the Systematic Literature Search in the MEDLINE, PsycINFO, and CINAHL Databases, Using the EBSCOhost Search Engine.

MEDLINE: Human; Age Related: Aged: 65+ years; Language: Dutch/ Flemish, English, French, German	(TI(Loneliness* OR "social Isolation" OR "Socially Isolated" OR Lonesome* OR Solitude) OR AB(Loneliness* OR "social Isolation" OR "Socially Isolated" OR Lonesome* OR Solitude)) and (TI(Intervention OR Program* OR Initiative OR Project OR Volunteer* OR intergeneration* OR "Inter Generation**" OR Inter-generation* OR Transgeneration* OR Multigeneration* OR Multi-generation* OR Crossgeneration* OR Cross-generation* OR "between Generations") OR AB(Intervention OR Program* OR Initiative OR intergeneration* OR "Inter Generation**" OR Inter-generation* OR Transgeneration* OR Multigeneration* OR Multi-generation* OR Crossgeneration* OR Cross-generation* OR "between Generations")) and (TI(Old OR Older OR Elder* OR Senior* OR Age*) OR AB(Old OR Older OR Elder* OR Senior* OR Age*)) Not TI(drug* OR Medic*)
PsycINFO: Language: Dutch, English, French, German; Age Groups: Aged (65 yrs & older); Population Group: Human	
CINAHL: Human, Age Groups: Aged 65+ years; Language: Dutch/ Flemish, English, French, German	

**Supplementary Table 2**

## Standardized Data-Extraction Protocol

Descriptive Information	Author, year, Country, Study Design, Main Outcome (Loneliness, Social Isolation, or Both)
Participant information	Number of participants*, study population, setting (community-dwelling or institutionalized), mean age*, percentage of female participants*
Intervention	Description of intervention, duration, intergenerational component (yes or no), outcome measurement, time points of follow-up measurement (if applicable), whether there were significant changes/differences in loneliness/social isolation scores*, whether these were sustained at follow-up*, mean values and standard deviations of outcome measures*

\*This information was extracted separately for intervention and control groups (if applicable).

**Supplementary Table 3**

## Cutoff Values Used for Categorizing Participants as Lonely/Not Lonely at Baseline

Scale	Not Lonely	Lonely	Range
De Jong Gierveld Loneliness Scale (11 items; De Jong Gierveld and Van Tilburg, 2010)	0–2	3–11	0–11
De Jong Gierveld Loneliness Scale (6 items; De Jong Gierveld and Van Tilburg, 2006)	0–1	2–6	0–6
UCLA- Loneliness Scale (4 items; Hughes et al., 2004)	3–5	6–9	3–9
UCLA Loneliness Scale (10 items; Russell, 1996)*	10–23	24–40	10–40
UCLA- Loneliness Scale (20 items; Russell, 1996)	20–34	35–80	20–80

\*Subsection of the 20-item version.

**Supplementary Table 4**Results of the Quality Assessment of Studies With Qualitative Outcomes (MMAT<sup>27</sup>)

Author, year	Is the Qualitative Approach Appropriate to Answer the Research Question?	Are the Qualitative Data Collection Methods Adequate to Address the Research Question?	Are the Findings Adequately Derived From the Data?	Is the Interpretation of Results Sufficiently Substantiated by Data?	Is There Coherence Between Qualitative Data Sources, Collection, Analysis, and Interpretation?
Cattan et al, 2011	Yes	Yes	Yes	Yes	Yes
Coll-Planas et al, 2021	Yes	Yes	Yes	Yes	Yes
Damnée et al, 2019	Yes	Yes	Yes	No	Yes
Ekwonye & Gerdes, 2022	Yes	Yes	Yes	Yes	Yes
Hudson et al, 2020	Yes	Yes	Yes	No	Yes
Hwang et al. 2019	Yes	Yes	Yes	Yes	Yes
Sen & Prybutok, 2021	Yes	Yes	Yes	Yes	Yes
Teater & Baldwin, 2014	Yes	Yes	Yes	Yes	Yes

**Supplementary Table 5**Results of the Quality Assessment of RCTs (MMAT<sup>27</sup>)

Author, year	Is Randomization Appropriately Performed?	Are the Groups Comparable at Baseline?	Are There Complete Outcome Data?	Are Outcome Assessors Blinded to the Intervention Provided?	Did the Participants Adhere to the Assigned Intervention?
Borji & Tarjoman, 2020	Yes	Yes	Can't tell	Can't tell	Yes
Bruce et al, 2021	Can't tell	Can't tell	Yes	Can't tell	Yes
Chan et al, 2017	Yes	Yes	No	Yes	Can't tell
Choi et al, 2020	Can't tell	Yes	Yes	Can't tell	Yes
Chu et al, 2019	Yes	Yes	Yes	Yes	Yes
Cohen-Mansfield et al, 2018	Can't tell	Yes	Yes	Can't tell	Yes
Creswell et al, 2012	Yes	Yes	Yes	Yes	Can't tell
Fields et al, 2021b	Can't tell	Yes	Yes	Can't tell	Yes
Galinha et al, 2022	Can't tell	Yes	Can't tell	Yes	Can't tell
Gustafsson et al, 2017	Yes	No	Yes	Yes	Yes
Hernández-Ascanio et al, 2023	Yes	No	Yes	Can't tell	Yes
Jones et al, 2019	Can't tell	Can't tell	Yes	Can't tell	Yes
Kahlon et al, 2021	Yes	Can't tell	Yes	Yes	Yes
Lai et al, 2020	Yes	Yes	Yes	No	Yes
Larsson et al, 2016	Yes	Yes	Yes	Yes	Yes
Ollonqvist et al, 2008	Yes	Yes	Yes	Yes	Yes
Pandya, 2021	Yes	Yes	Yes	Can't tell	Yes
Quinn, 2021	Can't tell	Can't tell	Yes	Can't tell	Yes
Robinson et al, 2013	Yes	Yes	Yes	Can't tell	Yes
Rodríguez-Romero et al, 2021	Can't tell	Yes	Yes	No	Yes
Routasalo et al, 2009	Yes	Yes	Can't tell	Can't tell	Yes
Saito et al, 2012	Yes	Yes	Yes	No	No
Shapira et al, 2021	Yes	Yes	Yes	Yes	Yes
Slegers et al, 2008	Can't tell	Yes	Yes	Yes	Can't tell
Taube et al, 2018	Yes	Yes	Yes	No	Yes
White et al, 2002	Can't tell	Yes	Yes	Can't tell	Yes
Yang et al, 2023	Can't tell	Yes	Yes	Can't tell	Can't tell

**Supplementary Table 6**Results of the Quality Assessment of Single-Group Pre-Posttest Studies and Pre-Posttest Studies With Nonequivalent Groups (MMAT<sup>27</sup>)

Author, year	Are the Participants Representative of the Target Population?	Are Measurements Appropriate Regarding Both the Outcome and Intervention (or Exposure)?	Are There Complete Outcome Data?	Are the Confounders Accounted for In the Design and Analysis?	During the Study Period, Is the Intervention Administered (or Exposure Occurred) as Intended?
Barbosa et al, 2021	Can't tell	Yes	Yes	No	Yes
Chen & Ji, 2015	Yes	Yes	Can't tell	Yes	Yes
Chen et al, 2020	Yes	Yes	Yes	No	Yes
Coll-Planas et al, 2017	Yes	Yes	Yes	No	Yes
Collins & Benedict, 2006	Can't tell	Yes	Yes	Yes	Can't tell
Damnée et al, 2019	No	Yes	Yes	No	Yes
Ehsan et al, 2021	Yes	Yes	No	Yes	Can't tell
Elsherbiny & Al Maamari, 2018	Yes	Yes	Yes	Can't tell	Yes
Esmailzadeh & Oz, 2020	Yes	Yes	Yes	No	Yes
Fields et al, 2021a	Yes	Yes	Can't tell	No	Yes
Fokkema & Knipscheer, 2007	Yes	Yes	No	Can't tell	Yes
Follmann et al, 2021	Can't tell	Yes	Can't tell	No	Yes
Franke et al, 2021	Yes	Yes	Yes	Yes	Yes
Gaggioli et al, 2014	Can't tell	Yes	Yes	No	Yes
Gonyea & Burnes, 2013	Can't tell	Yes	Yes	No	Can't tell
Heller et al, 1991	Yes	Yes	Yes	Can't tell	Yes
Honigh-De Vlaming et al, 2013	Yes	Yes	No	Yes	Yes
Jeste et al, 2023	Yes	Yes	Yes	No	Yes
Knowles et al, 2017	Yes	Yes	Yes	Yes	Yes
Lee & Kim, 2019	Yes	Yes	Yes	No	Yes
Lin et al, 2020	Yes	Yes	Yes	Yes	Yes
Lorente-Martínez et al, 2022	Yes	Yes	Yes	No	Yes
Mays et al, 2021	Yes	Yes	No	Yes	Yes
Roberts & Windle, 2020	Yes	Yes	Yes	No	Yes
Stewart et al, 2001	Yes	Yes	No	Can't tell	Yes
Tkatch et al, 2021	Yes	Yes	No	Yes	Can't tell
Travers & Bartlett, 2011	Yes	Yes	No	No	Yes
Tsai & Tsai, 2011	Yes	Yes	Yes	Yes	No
Tsai et al, 2020	Yes	Yes	No	Yes	Can't tell
Tse, 2010	Yes	Yes	Yes	Can't tell	Yes
Vrbanac et al, 2013	No	Yes	Yes	No	Yes
Winningham & Pike, 2007	Yes	Yes	Yes	No	Yes
Xu et al, 2016	Can't tell	Yes	Yes	Can't tell	Yes

**Supplementary Table 7**Results of the Quality Assessment of Mixed-Method Studies (MMAT<sup>27</sup>)

Author, year	Is There an Adequate Rationale for Using a Mixed-Methods Design to Address the Research Question?	Are the Different Components of the Study Effectively Integrated to Answer the Research Question?	Are the Outputs of the Integration of Qualitative and Quantitative Components Adequately Interpreted?	Are Divergences and Inconsistencies Between Quantitative and Qualitative Results Adequately Addressed?	Do the Different Components of the Study Adhere to the Quality Criteria of Each Tradition of the Methods Involved?
Damnée et al, 2019	Yes	Yes	Yes	No	No