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Effectiveness of interventions tackling loneliness

A literature review

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Contents

Foreword

This literature review is part of a broader series of activities that will take place in 2021-2023 in the context of a European Parliament pilot project on monitoring loneliness in Europe. The European Commission Directorate-General for Employment, Social Affairs & Inclusion (DG EMPL), in collaboration with the Joint Research Centre (JRC), will carry out a number of tasks, including the collection of pan-European data on loneliness, a review of existing literature, and identification of knowledge gaps, and the establishment of a web platform to monitor loneliness over time and across Europe. For more material and information, please visit the webpage

https://knowledge4policy.ec.europa.eu/projectsactivities/loneliness-european-union_en

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The views expressed in this report are those of the authors and do not necessarily reflect the position or opinion of the European Commission.

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Executive summary

In Western countries, one in ten people is severely affected by loneliness, resulting in human suffering and a **significant public health** burden. Due to the serious negative consequences of loneliness, **intervention strategies to combat loneliness are being sought worldwide**. A key question for both researchers and policymakers is **whether and what kind of interventions are effective** in reducing loneliness.

The present report provides an **overview of the empirical evidence on the effectiveness of interventions tackling loneliness** by summarizing available systematic reviews and meta-analyses on this topic. Despite the **high relevance**, research on the effectiveness of loneliness interventions is still a **relatively young endeavour**. However, there is an **increasing demand for intervention strategies** to address loneliness, even in the absence of a solid evidence base. In this context, the systematic reviews and meta-analyses summarized here provide **important insights** into whether loneliness interventions work, which loneliness interventions are particularly effective, and in which areas more research on loneliness interventions is needed.

From the results of this review, the following key messages can be extracted:

- **Objectives of loneliness interventions.** In essence, the main objective of loneliness interventions is to reduce loneliness among those who suffer from it. This involves changing maladaptive social cognitions, enhancing social skills and providing psychoeducation, supporting socialization and increasing opportunities for social interaction, for example. A separate stream of actions concerns loneliness prevention which aims to prevent loneliness among larger populations.
- **Overall effectiveness of loneliness interventions.** Across reviews and meta-analyses, most reviewed interventions reported reductions in loneliness. This is encouraging news for both service providers and users, as well as funders. However, the magnitude of reduction is greater for some types of interventions than for others and different age groups benefit more from specific interventions than others. Yet, most studies have methodological weaknesses that make drawing robust conclusions challenging.
- **Differential effectiveness of loneliness interventions by target group**. The majority of reviewed studies focused on older adults and concluded that most interventions are effective in reducing loneliness. For this age group, more recent studies look at the effectiveness of technology-based interventions, with mixed results depending on how the technology is used. Other target groups are not well represented in the existing literature. For instance, there have been very few loneliness intervention studies to date focusing on children and adolescents. Here, effectiveness has been shown for different types of interventions (e.g., social skills training, learning a new hobby, social and emotional support, enhancing social support and psychological therapy). The findings call for both increased research and policy focus on interventions for youth to prevent long-term consequences.
- **Differential effectiveness of loneliness interventions by type**. Overall, psychological treatment interventions (e.g., social cognitive training) seem to be promising approaches across different age groups. Social support interventions (i.e. offering regular contacts, care or companionship) also work,

albeit with less consistency across studies. Employing social networks and stimulating social activities also reduce loneliness. However, based on the existing evidence, it is not possible to identify the superiority of one intervention type.

- **Gaps of existing research**. This report illustrates that important information about interventions included in systematic reviews and meta-analyses is often missing, which hampers a full understanding of their effectiveness. Moreover, the vast majority of loneliness interventions reviewed by the scientific literature, and thus included in this review, focus on individual- and relationship-level interventions. Less is known on the effectiveness of interventions at community- and societal-level as well as in specific settings (e.g., school-based interventions). More research is needed in this direction. For such interventions to be scientifically evaluated and followed up beyond the short-term effects requires adequate resources and the use of consistent measurement tools for comparability. Implementing and scaling up what works best needs to go hand in hand with regular feedback loops and exchanges between service providers and users, as well as researchers and policymakers.
- **Policy implications**: Based on the evidence, there is a need for countries to provide a range of different low-threshold loneliness interventions to fit the needs of different target groups and situations. Access routes to such interventions may need to be simplified to encourage the inclusion and participation of people who suffer from loneliness in the relevant interventions while avoiding stigmatisation. At country level, intervention design and implementation will need to consider cultural factors; targeting of different age and risk groups and not only older adults; long-term approaches instead of one-off measures; as well as support for systematic evaluation of the intervention efforts.

1 Introduction

1.1 Motivation and theoretical considerations

Loneliness has been associated with numerous health problems as well as with an increased risk of premature mortality (i.e., Hawkley & Capitanio, 2015; Lim et al., 2020; McClelland et al., 2020; Solmi et al., 2020). In Western countries, one in ten people is severely affected by loneliness, and there is evidence suggesting that its prevalence is increasing over time (Buecker et al., 2021; Cacioppo et al., 2017; Cacioppo & Cacioppo, 2018; Holt-Lunstad et al., 2015). Forced isolation due to the COVID-19 pandemic magnified a problem that already existed in the European Union (Baarck et al., 2021), at least temporarily, and increased awareness of its negative consequences.[1] Due to the adverse impacts of loneliness on individual well-being, solutions and intervention strategies are being sought worldwide. Hence, a key question arises about whether and what kind of interventions are actually effective in reducing loneliness?

Several systematic reviews and meta-analyses have been published on interventions tackling loneliness. Both type of studies provide an overview of single studies that evaluate the effectiveness of different kinds of interventions. However, the type of information they synthetise is different. While reviews summarise qualitative evidence, meta-analyses focus on quantitative results and allow to grasp the effect size of the evaluated interventions on loneliness. Typically, an intervention is considered effective if it can sustainably (i.e., with lasting effectiveness) reduce the target characteristic (in this case, loneliness). The present *umbrella review*[2] provides an overview of the empirical evidence on the effectiveness of interventions tackling loneliness by summarizing available systematic reviews and meta-analyses on this topic. This approach provides the highest level of synthesis by presenting a composite overview of available systematic reviews and meta-analyses and allows for the comparison of findings (Ioannidis, 2017). This level of synthesis is especially valuable when the aim is to arrive at a clear understanding of a topic to inform policies (Jarvis et al., 2020).

Previous reviews and meta-analyses on interventions tackling loneliness are heterogeneous in nature with varying levels of evidence and focus on different aspects. For example, while several reviews focus on addressing loneliness in older adults (e.g., Baker et al., 2018), some focus on addressing loneliness in younger adults or adolescents (e.g., Eccles & Qualter, 2021). Moreover, some reviews focus on specific interventions, such as technology-based interventions (e.g., Chipps et al., 2017), whereas others broadly review different kinds of interventions (e.g., Bessaha et al., 2020). Overall, the interventions reviewed here included a range of target group (older adults, young people, and specific sub-groups), and ranged from in-person interventions (i.e., face-to-face; either in individual or in group settings) to technology-based interventions (e.g., using communication programs or apps) and animal-assisted interventions. Recently the number of reviews focusing on technology-

[1] Based on Baarck et al's (2021) analysis of survey data, loneliness in the EU increased from 12% in 2016 to 25% in the first months of 2020. Nevertheless, more research is needed to assess the long-term impact of the COVID-19 pandemic on loneliness.

[2] An *umbrella review* systematically reviews systematic reviews and meta-analyses (Jarvis et al., 2020). We opted for this study as our goal is to collect and synthetise available evidence on the effectiveness of interventions to reduce loneliness, both qualitative (through systematic reviews) and quantitative (through meta-analyses) with an eye toward informing policy making. Indeed, restricting our scope to only systematic reviews or meta-analyses would have led us to miss key insights emerging from the existing literature thus limiting our understanding of what works to reduce loneliness and for whom.

based interventions has increased (especially for the target group of older people). In this umbrella review, we aggregate and summarize this previous body of knowledge on loneliness interventions.

1.2 Methodology and applied structure of this review

1.2.1 Literature search

First, we conducted a standardized literature search in PsycInfo using the search engine Ovid in January 2022, applying the following search string (lonel* or "social isolation" or "social exclusion") and (intervention* or treatment* or therapy or program* or training) in title and abstract.[3] The following limits were set for the literature search in PsycINFO: only studies with human samples published in peer-reviewed journals and identified as "systematic review" or "meta-analysis" were included. No limitations were applied on publication year. The search was conducted in English and hence, the included studies were in English.

This search resulted in 146 studies. We conducted the coding of these studies in two steps which are demonstrated in the flow diagram (see ***Figure 1***). In Step 1, we screened the abstracts and titles for eligibility, and in Step 2, we consulted the remaining full texts. Before screening the abstracts, 14 studies were removed because they were duplicates. Consequently, we screened the abstract of 132 studies. A total of 104 studies were no meta-analyses or reviews focusing on loneliness interventions and were therefore excluded. We downloaded the full texts of all remaining articles and checked them for eligibility. We excluded one study because the full text made it clear that the article was no systematic review or meta-analysis (Alexandra et al., 2018). One further study was excluded because loneliness was not the main outcome, and it remained unclear which results were achieved regarding which outcome measure (e.g., social health including loneliness and social isolation, mental health, and physical health) (Dickens et al., 2011). The remaining 26 studies were included in this umbrella review. In addition to these 26 studies, we identified 11 studies via a manual search. Thus, the **total number of included studies is 37**.

1.2.2 Coding process

To gain an overview of the existing literature on loneliness interventions, one author coded the included studies using a predefined coding scheme. This coding scheme comprised information about the study design, included studies and their samples, type of interventions, and results. A detailed table with all extracted aspects is available from the authors upon request.

1.2.3 Structure of this umbrella review

The structure of this umbrella review is as follows. **Section 2** describes key concepts used throughout the document and their measurement. First of all, we briefly discuss the concept of loneliness. Then we define the

[3] Research on the topic of "loneliness interventions" is mainly conducted in the field of psychology. However, we opted to base our search on PsycINFO, which lists journals from multiple disciplines, including psychology. Furthermore, manual searches were performed and additional reviews and meta-analyses were included that were recommended by relevant scientists. Hence, we consider our literature search comprehensive for the purpose of this umbrella review.

term interventions, how effectiveness is measured, and describe a selected list of intervention types that have been introduced by related literature.

In the following section (**Section 3**), we summarize the results of the included studies. While the section includes results from both reviews and meta-analyses, it remains important to underline the difference between the types of information that the data sources offer (see also **Error! Reference source not found.**). Reviews **synthesize qualitative evidence** and often give information about the kinds of interventions and how many of the conducted interventions were effective. Meanwhile meta-analyses synthesize **quantitative results** and express the effectiveness of the included interventions in the **effect size**. Thus meta-analyses allow us to gain an overview of the robustness of an effect. Moreover, meta-analyses often conduct **moderator analyses** that examine whether the effectiveness across all different interventions is affected by certain characteristics of the sample or intervention. This allows examining whether – for example – the setting (i.e., group setting or individual setting) influences the effectiveness of the intervention.

Section 3 begins with a subsection on "Data" to describe the characteristics of the included reviews and meta-analyses. As a next step, the results are summarized by target groups as the interventions' effectiveness might differ between different target groups (i.e., older adults, young people, people with mental health problems, people living with an illness, persons with disabilities, parents and caregivers, (former) military members, immigrants and refugees, marginalized groups). The following subsection summarises the results regarding different intervention types. Finally, we summarize the meta-analytic results regarding the overall effect and the moderator analysis regarding intervention characteristics (i.e. type, setting, delivery mode, duration and loneliness scale used on the loneliness output) and sample characteristics (i.e. age and gender).

Section 4 summarizes the main findings of this umbrella review, discusses identified gaps, and provides recommendations for future research on loneliness interventions and their effectiveness. The Section ends with policy implications based on the existing literature.

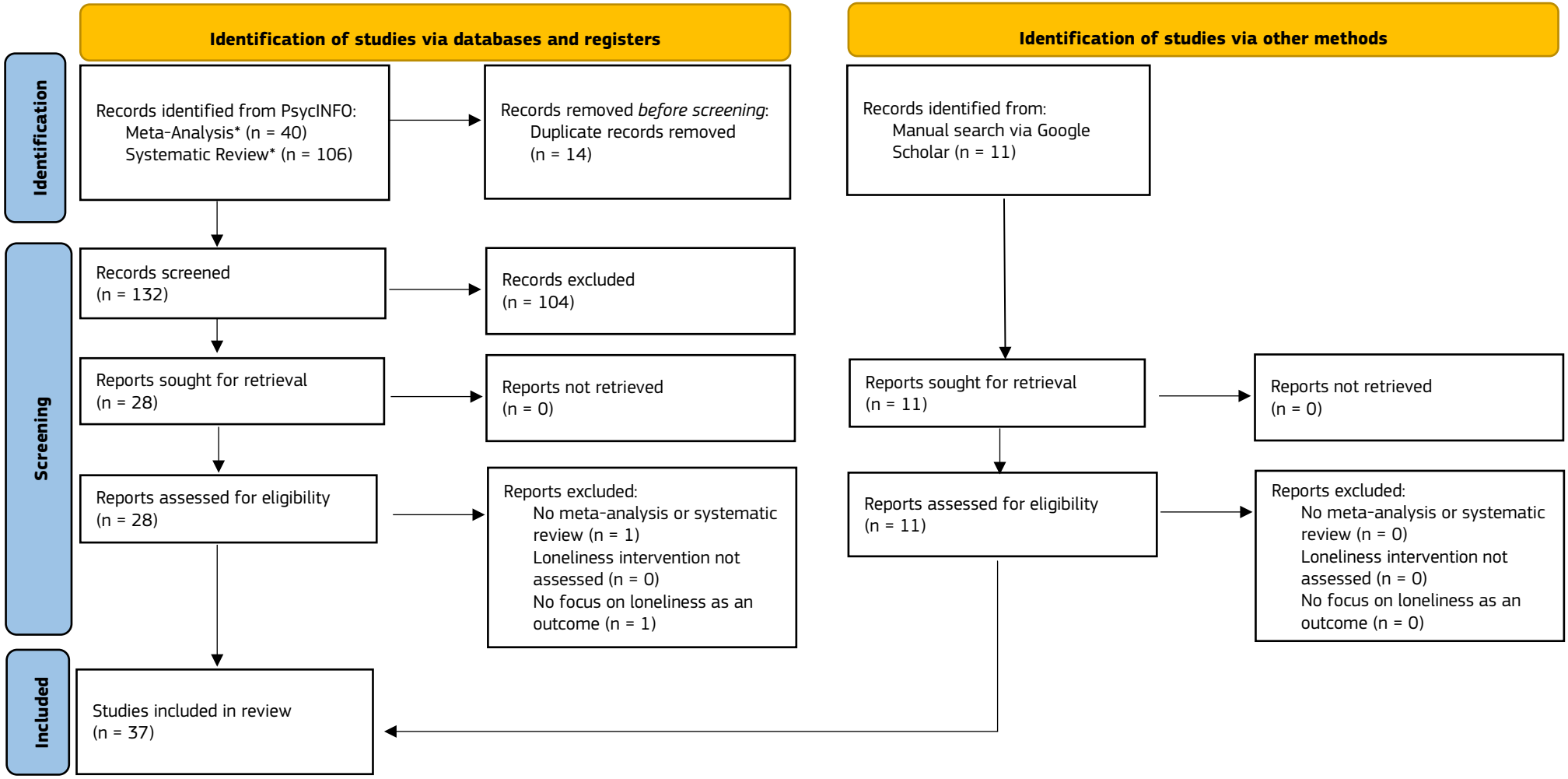
Box 1 Definition of Reviews and Meta-analyses

Reviews refer to the technique in which **research findings are qualitatively synthesized**. For example, a review could describe how often a specific intervention strategy was used in the included studies, how often a specific intervention type was effective, or which target groups it focused on.

In contrast, a **meta-analysis** is a statistical technique to **synthesize quantitative research results** from many studies. The studies that are included in a meta-analysis should be collected systematically and their quality rated. Meta-analyses allow to **gain an overview of the robustness of an effect**. For example, it is possible to test whether loneliness interventions that focus on changing cognitions are effective in reducing loneliness by aggregating the results of several studies. Moreover, meta-analyses enable a more precise estimation of the effect size and describe the range of the available effect sizes.

Source: Borenstein et al.(2009); Buecker et al. (2021)

Figure 1 PRISMA Flow Diagram



*Note. * These search hits were found using the following general limits: human sample, peer-reviewed journal. In addition, the search was limited once to "meta-analysis" and once to "systematic review". In the step of screening the abstracts, 104 reports were excluded because they were no meta-analyses or reviews focusing on loneliness interventions.*

Source: Page et al. (2021) For more information, visit: http://www.prisma-statement.org/

2 Key concepts and their measurement

2.1 Loneliness

Loneliness emerges due to a perceived discrepancy between the desired and the actual social relationships regarding their quality or quantity (Baarck et al., 2021; De Jong-Gierveld & van Tilburg, 2006; Hawkley & Cacioppo, 2010; Perlman & Peplau, 1981). The **subjective feeling of loneliness must be differentiated from social isolation**, which describes objective characteristics of the situation, for example, being alone (De Jong-Gierveld & van Tilburg, 2006). People can feel lonely despite being in a group or having large social networks, and people can perceive no loneliness despite the lack of a social network (Mund et al., 2020; Rokach, 2004). [4]

An important distinction has been made between **transient and chronic loneliness**. When people experience short and irregular loneliness, these subjective feelings are described as transient loneliness. Transient loneliness is a common human experience and is usually perceived as less of an issue in policy and intervention debates. Chronic loneliness is described as regular and lasting feelings of loneliness. An example of a specific definition of chronic loneliness has been proposed as more than two years of dissatisfaction regarding social interactions and relationships (Young, 1982). Interventions usually focus on this type of long-term experience of loneliness.

To measure loneliness, the papers reviewed here typically apply different versions of the UCLA Loneliness Scale or the De Jong Gierveld Loneliness Scale (e.g., De Jong-Gierveld & Kamphuls, 1985; Russell et al., 1980). Additionally, there were many other validated loneliness measures used (e.g., the Social and Emotional Loneliness Scale for Adults (SELSA), Di Tommaso & Spinner, 1993), but also single-items or non-validated scales were used (e.g., "How much of the time do you feel lonely?", Guest et al., 2006).

2.2 Interventions

2.2.1 What is an intervention?

Surprisingly, none of the included reviews and meta-analyses provided an explicit definition of what constituted an intervention tackling loneliness. In this umbrella review, we focus on meta-analyses and reviews assessing the effectiveness of **measures targeting people who already experience loneliness and aimed at improving their well-being by mitigating it**. Nonetheless, in some of the included studies, the target population and aim of the measure were less clearly described, resulting in a mixture of prevention and intervention (mitigation) strategies.

[4] For a more comprehensive definition of loneliness and its measurement see: Cuccu, L., Stepanova, E., Loneliness & social and civic behaviours, EUR 30929 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-45408-3, doi:10.2760/802268, JRC126983.

2.2.2 How to evaluate the effectiveness of an intervention?

There are international standards for identifying effective intervention programmes and policies (Flay et al., 2005). However, thus far, these standards are not often applied in current research on loneliness interventions, while they are more common in other fields, e.g. psychotherapeutic interventions.

In practice, the **effectiveness of loneliness interventions is evaluated through a variety of research designs**. The reviews and meta-analyses included in this review include studies that have evaluated effectiveness by using **qualitative study designs, cohort designs with and without control groups, cross-sectional designs** (through the use of surveys), **single-group pre-post comparison designs, quasi-experimental study designs, and randomized controlled trials (RCTs)**, which is the gold standard for testing the effectiveness of interventions. However, most studies reviewed in this report did not include a long-term follow-up, which makes it difficult to assess how sustainable or lasting the effects of loneliness interventions are. Moreover, the samples of the included studies are typically not representative of chronically lonely people and also consist of people from the general population recruited by convenient sampling methods.[5]

2.2.3 What kinds of loneliness interventions exist?

Different types of interventions have been proposed, and several studies have examined the effectiveness of such interventions.

Different categorisations of intervention types proposed by several authors are summarized in ***Table 1*** and described below. It is not an exhaustive overview of the categorisations as several others exist. Yet, the aim is to provide an idea of the types of interventions on the ground. It is noteworthy that interventions to tackle loneliness are often multifaceted and take place at different levels, and may belong to several categories or their interphase.

Based on a systematic review, **Mann et al. (2017)** proposed a differentiation between **direct and indirect interventions**. The indirect interventions are broader strategies focusing on health or well-being and thereby may indirectly affect loneliness, whereas the direct interventions explicitly tackle loneliness. The direct interventions were further divided into four intervention types: *changing cognitions, social skills training and psychoeducation, supported socialisation, and wider community approaches*. Interventions based on *changing cognitions* focus on the reduction of maladaptive cognitions, for example, cognitive biases or thoughts about social relationships. The second category, *social skills training and psychoeducation*, aims to empower the individual to connect with others and maintain social relationships. *Supported socialisation* interventions offer support in forming social connections. The last category, *wider community approaches*, focus on including lonely people, strengthening their confidence, and reducing stigmatisation by conducting interventions in community groups.

[5] From a policy perspective, another aspect for evaluating the effectiveness of loneliness interventions is cost-effectiveness. Yet, this aspect could not be covered in this literature review which solely builds on scientific literature on loneliness interventions.

Another categorisation system was proposed by **Masi et al. (2011)** that shows some similarities to the categorisation system by Mann et al. (2017). Masi and colleagues included **four different strategies of interventions to reduce social isolation and loneliness**: *improving social skills, enhancing social support, increasing opportunities for social interaction, and addressing maladaptive social cognition*.

Gardiner et al. (2018) proposed a categorisation based on their review that includes **six categories of intervention types**: *social facilitation*, *psychological therapies*, *health and social care provision*, *animal interventions*, *befriending*, and *leisure/skill development*. *Social facilitation* interventions facilitate social interactions with others such as through group based activities. *Psychological therapies* include therapeutic approaches that are delivered by health professionals or trained therapists. The *health and social care provision* category includes interventions where health and social care professionals support older people. *Animal interventions* are interventions that include interactions with an animal (e.g., dog, bird). *Befriending* interventions aim to support the lonely individual often through one-to-one approach and volunteer involvement. *Leisure/skill development* interventions focus on building new leisure activities and developing or strengthening skills.

National and international organisations working on loneliness have also developed categorisations to serve both analytical and policy purposes, as well as to highlight the importance of the involvement of different sectors. For instance, **World Health Organization (2021)** categorised interventions to address social isolation and loneliness among older adults into **three categories**. First, individual and relationship-level interventions focus on maintaining and supporting people's relationships and changing how people think and feel about them. Second, community-level strategies address infrastructures such as transportation, digital inclusion, and the built environment. Third, societal-level strategies include laws and policies. Similarly, the **UK Campaign to End Loneliness (2020)** developed a framework for loneliness interventions where a distinction was made between connector services, gateway infrastructure, and direct solutions.

Table 1 Examples of intervention categories

	Mann et al. (2017)	Masi et al. (2011)	Gardiner et al. (2018)	World Health Organization (2021)	Campaign to End Loneliness (2020)
Intervention categorisation	1. Indirect interventions: broader strategies focusing on health or well-being and thereby may indirectly affect loneliness 2. Direct interventions: - Changing cognitions - Social skills training and psychoeducation - Supported socialization - Wider community approaches	1. Improving social skills 2. Enhancing social support 3. Increasing opportunities for social interaction 4. Addressing maladaptive social cognition	1. Social facilitation 2. Psychological therapies 3. Health and social care provision 4. Animal interventions 5. Befriending 6. Leisure/skill development	1. Individual- & relationship-level interventions (e.g. one-to-one or group interventions; digital and face-to-face) 2. Community-level strategies (e.g., infrastructure, volunteering) 3. Societal-level strategies (e.g., laws and policies)	1. Connector services (reach, understand, support) 2. Gateway infrastructure (transport, digital, built environment) 3. Direct solutions (psychological approaches; one-to-one; groups)

3 Effectiveness of interventions tackling loneliness: An overview of empirical evidence

In this Section, we provide a summary of the results on the effectiveness of loneliness interventions from the empirical evidence. We first describe the characteristics of the identified reviews and meta-analyses that focused on the effectiveness of loneliness interventions. More information on the examined evidence is available in ***Table 2***. Then we synthesize the results on the effectiveness of interventions by target group and intervention type. Finally, we summarise the results regarding the overall effect and the moderating role of specific intervention and sample characteristics based on the meta-analyses included.

3.1 Data

Systematic reviews

Out of the 37 included studies, the majority, 26, were systematic reviews, and one of them was a second-order systematic review (Chipps et al., 2017).[6] Cattan et al. (2005) is the least recent included review. It includes primary studies published between 1979 and 2002. The most recent review is by Hsueh et al. (2022), which comprises primary studies that were published between 2012 and 2020.[7] In terms of countries covered, **the majority of the primary studies reporting this information were conducted in the USA**. Several systematic reviews (n = 12) also summarise findings of studies conducted in European Union countries, most notably Northern and Western European countries (e.g. the Netherlands, Sweden, Denmark, Austria).[8] The number of included primary studies in the reviews ranged from k = 5 (Franck et al., 2016) to k = 68 (Bessaha et al., 2020), and the sample sizes ranged from N = 953 (Casanova et al., 2021) to N = 17,359 (Reinhardt et al., 2021). Yet, the information about the sample size was often missing. Thus, these statistics only refer to the reviews that conveyed information about the sample size. Three of the included systematic reviews concentrated on the description of the interventions without analysing the interventions' efficacy (Baker et al., 2018; Cacioppo et al., 2015; Wilson et al., 2018).

Out of 27 systematic reviews, 16 focused on loneliness interventions for older adults (Baker et al., 2018; Casanova et al., 2021; Cattan et al., 2005; Chen & Schulz, 2016; Chipps et al., 2017; Franck et al., 2016; Gardiner et al., 2018; Gee & Mueller, 2019; Hagan et al., 2014; Ibarra et al., 2020; Jain et al., 2020; Khosravi et al., 2016; Morris et al., 2014; Pu et al., 2019; Quan et al., 2020; Shvedko et al., 2018). Contrary, **other risk groups like people with health problems and young people were not well represented.** Two systematic reviews focused on the interventions' effectiveness for people with mental health problems (Ma et al., 2020;

[6] A systematic second-order review systematically synthesizes the findings of meta-analyses and systematic reviews.

[7] More specifically, the distribution by year of the included systematic reviews is the following: 2005 (n = 1), 2014 (n = 2), 2015 (n = 2), 2016 (n = 4), 2017 (n = 2), 2018 (n = 5), 2019 (n = 2), 2020 (n = 5), 2021 (n = 3) and 2022 (n = 1).

[8] Based on the information provided by the included reviews and meta-analyses, Eastern, Central and Southern European countries are underrepresented in the literature on the effectiveness of loneliness interventions. Understanding the reasons for the richness of studies conducted in the USA and, albeit to a lesser degree, in Northern and Western European countries goes beyond the scope of this study. Nevertheless, one possible explanation could be the concentration of the field of study on loneliness in these regions thus facilitating the development of loneliness studies conducted in this part of the world.

Mann et al., 2017). The systematic review by Forgeron et al. (2018) explicitly focused on children and adolescents with a chronic physical condition. Wilson et al. (2018) investigated the interventions' effectiveness for military veterans. The systematic review by Bessaha et al. (2020) focused on non-elderly adults, and the other reviews did not specify their target group (Cacioppo et al., 2015; Gilbey & Tani, 2015; Pels & Kleinert, 2016; Reinhardt et al., 2021; Williams et al., 2021).

Regarding the interventions' focus, **the majority of the included systematic reviews focused only on technology-based interventions** (especially for older adults) (Baker et al., 2018; Casanova et al., 2021; Chen & Schulz, 2016; Chipps et al., 2017; Ibarra et al., 2020; Khosravi et al., 2016; Morris et al., 2014). The systematic reviews by Pels and Kleinert (2016) and Shvedko et al. (2018) investigated only the effect of **physical activity** interventions on loneliness. The effect of **pet ownership** and **animal interactions** on loneliness were investigated in three systematic reviews (Gee & Mueller, 2019; Gilbey & Tani, 2015; Jain et al., 2020). Other reviews examined the effectiveness of **social prescribing** (Reinhardt et al., 2021), **place-based interventions** (Hsueh et al., 2022), **health promotion interventions** (Cattan et al., 2005), and **social robots** (Pu et al., 2019). Often information about the interventions' duration, the duration and frequency of the intervention sessions, and the number of sessions per intervention was missing.

Meta-analyses

Out of the 37 included studies, **ten were meta-analyses**. The least recent meta-analysis is by Masi et al. (2011), which includes primary studies published between 1970 and 2020. There are five included meta-analyses published in 2021 covering primary studies published between 1980 and 2020.[9] Similarly to systematic reviews, the primary studies providing details on the country covered were for the majority conducted in the USA. This result is underlined by Lasgaard et al. (unpublished), who outlined that 47% of the studies included in their meta-analysis were conducted in Northern America. Some of the included meta-analyses (n = 5) also covered primary studies conducted in EU countries, most notably Western and Northern European countries (e.g. the Netherlands, Sweden). The number of included primary studies in the meta-analyses ranged from k = 4 to k = 128 and the sample sizes ranged from N = 133 to N = 12,270. The meta-analyses included different types of primary studies, for example, randomized controlled trials (RCT), quasi-experimental study designs, and single-group pre-post comparison designs.

Similar to the systematic reviews, meta-analyses **mostly focused on interventions targeted at older adults** (e.g., Bornemann, 2014; Choi et al., 2012). Other risk groups like people with health problems or young people were not well represented. The effectiveness of loneliness interventions for adult cancer survivors was investigated in one meta-analysis (McElfresh et al., 2021). The interventions' effectiveness for young people was only explicitly investigated in one meta-analysis (Eccles & Qualter, 2021).

Regarding the interventions' focus, one meta-analysis investigated the effectiveness of animal-assisted therapy (Virués-Ortega et al., 2012) and three meta-analyses focused on technology-based interventions (Bornemann,

[9] More specifically, the distribution by year of the included meta-analyses is as follows: 2011 (n = 1), 2012 (n = 1), 2014 (n = 2), 2021 (n = 5), unpublished (n = 1).

2014; Choi et al., 2012; Shah et al., 2021), while the other six meta-analyses included different intervention strategies. **Only five of the included meta-analyses conducted moderator-analyses or subgroup-analyses**, i.e. to test whether a specific factor (e.g., age, gender) could explain variation in the effectiveness (Eccles & Qualter, 2021; Lasgaard et al., unpublished; Masi et al., 2011; McElfresh et al., 2021; Zagic et al., 2022). We will discuss findings from this subgroup of studies in subsection 3.4.

Regarding the intervention setting, **the majority of the investigated interventions used a group setting and, in contrast to the systematic reviews, a non-technology-based delivery format (i.e., face-to-face)**. Unfortunately, there is very little information about the interventions' duration, the duration and frequency of the intervention sessions, and the number of sessions per intervention, all of which could be relevant factors for the effectiveness of the interventions.

3.2 Results on different target groups

Some of the reviews and meta-analyses included a focus on the general population, but others focused on specific target groups. As the results regarding the effectiveness of interventions tackling loneliness might differ between different target groups, below we present the results by target group (i.e., older adults, young people, people with mental health problems, people living with an illness, persons with disabilities, parents, and caregivers, (former) military members, immigrants and refugees, marginalised and/or vulnerable groups).

We first focus on reviews and meta-analyses that provide an overview of different types of interventions for **older adults, which is the most common target group investigated**, followed by reviews and meta-analyses focusing on other target groups. In studies examining loneliness at different stages of life, different categorisations are made for different age groups. For example, some studies categorise people as "older adults" from the age of 60, whereas other studies speak of "older adults" only when people are 70 or 80 years old. In Section 3.3., we will specifically address studies that focus on a particular type of intervention (e.g., technology-based interventions). Some of these studies also include older people in particular.

Older adults

Five systematic reviews included different types of loneliness interventions for older adults (Cattan et al., 2005; Franck et al., 2016; Gardiner et al., 2018; Hagan et al., 2014; Quan et al., 2020). In general, **most of the included primary studies in these reviews reported significant effects in reducing loneliness**. The percentage of effective interventions differs between the reviews: while Cattan et al. (2005) reported that one third of the included interventions showed significant effects on loneliness, Quan et al. (2020) summarised that 87% of the included interventions reported significant reductions in loneliness.

Regarding which intervention types were most commonly reported in the studies that the reviews looked at, the reviews demonstrated different results and arrived at different conclusions. Quan et al. (2020) outlined that in long-term care facilities, psychological therapies and leisure or skill development interventions were most common. In contrast, Gardiner et al. (2018) reported that most interventions were social facilitation interventions. The differences may be due to different countries where the interventions were offered, but Gardiner et al. (2018) do not give information about the geographical areas in which the studies took place.

The systematic reviews revealed **mixed results regarding differences in the effectiveness of interventions by type for older adults**. Gardiner et al. (2018) concluded that psychological therapy interventions (e.g., humor therapy, mindfulness-based stress reduction and reminiscence group therapy) achieve the most robust improvements in loneliness. Similarly, Quan et al. (2020) outlined that laughter therapy interventions showed the largest effect on loneliness. In contrast, Hagan et al. (2014) highlighted that effective interventions were distinctly different from one another and focused on different approaches. This may imply that **interventions can be effective for older adults notwithstanding their different characteristics.**

Some authors tried to summarise **interventions' characteristics that seemed to be associated with a better outcome**. Cattan et al. (2005) identified the following common characteristics of effective interventions for older adults: group-based interventions that focused on educational input or support activities, interventions that focused on specific target groups, and interventions that enabled some sort of control over the activities within the intervention on behalf of the participant and the facilitator. Moreover, ineffective interventions were mainly one-to-one interventions that were conducted in the participant's home. Contrary, Gardiner et al. (2018) argued that it remains unclear which factors are important for the interventions' effectiveness due to many different aspects that are included in different interventions.

The systematic review by Franck et al. (2016) aimed to examine the interventions' effectiveness for older adults living in rural areas. But all identified primary studies that focused on interventions in rural areas were of poor methodological quality.[10] Consequently, the effectiveness and feasibility of interventions targeting older adults living in rural areas remain unclear.

Turning to the meta-analyses, four of them focused on interventions for older adults, including three investigating technology-based interventions and one animal interaction intervention. The meta-analyses by Bornemann (2014), Choi et al. (2012), and Shah et al. (2021) investigated the effectiveness of technology-based **interventions/information and communication technology usage in older adults**. The meta-analytic **evidence is mixed**. On the one hand, Choi et al. (2012) found that computer and internet training interventions significantly reduced loneliness in older adults (Hedge's g = 0.546, 95 % *CI* [0.033, 1.059], p = 0.037).[11] On the other hand, Bornemann (2014) demonstrated that internet and communication technology use didn't significantly affect loneliness (*standardised mean difference, SMD* = -0.26, 95 % *CI* [-0.58, 0.06]).[12] These results should be interpreted with caution because Bornemann (2014) noted the methodological quality of the included k = 5 studies was weak. Additionally, only one primary study explicitly targeted people who were identified as being lonely and the included primary studies addressed interventions as well as non-intervention forms of internet and communication technology usage. However, a recent meta-analysis on the effectiveness of digital technology interventions supports the results by Bornemann (2014). Shah et al. (2021) reported no significant reduction in older adults' loneliness at the three months follow-up (k = 3, N = 106, *SMD* = 0.02, 95

[10] Assessed with the Downs and Black (1998) checklist for methodological quality assessment of randomized and nonrandomized studies of healthcare interventions (including quality of reporting, internal validity, and external validity).

[11] 'Hedge's g' is an effect size and often used in meta-analyses. In general, the smaller the value, the smaller the effect size. Read more, for instance: https://www.statology.org/hedges-g/.

[12] The standardised mean difference (SMD) is an alternative effect size to 'Hedge's g'.

% *CI* [-0.36, 040]), at the four months follow-up (*k* = 2, *N* = 105, *SMD* = -1.11, 95 % *CI* [-2.60, 0.38]), and at the six months follow-up (*k* = 2, *N* = 280, *SMD* = -0.11, 95 % *CI* [-0.54, 0.32]) compared to the control group who received care as usual. But the generalization of these results is limited because the evidence's quality was rated as low to moderate by the authors and is only based on a few studies.

Regarding older adults, one further meta-analysis investigated animal-assisted therapy interventions and their effectiveness (Virués-Ortega et al., 2012). This meta-analysis comprised *k* = 4 studies, which were conducted in the USA. The animal-assisted therapies were spontaneous interactions with fish, birds, and a (robotic) dog as well as one guided interaction intervention with a dog. While the intervention with the fish and birds were permanent and delivered individually, the interventions with dogs had an intensity of half hour per week, and one of them was organized in a group and individual setting. There was **no meta-analytic evidence for reduced loneliness due to animal interventions in older adults** (pooled effect size = -0.27, 95 % *CI* [-0.97, 0.43], *p* = .45). However, we would like to note that it is questionable how effective interventions can be that last only a few weeks (e.g., less than one and half weeks) and are based on spontaneous interactions with animals. These kinds of interventions do not picture the typical animal-assisted therapy. To summarise, there is more research needed to investigate the effectiveness of animal-assisted therapy interventions on loneliness for older adults.

All in all, interventions targeted at older adults are effective in reducing loneliness although the magnitude of the effectiveness differs across intervention types.

Young people

Only the meta-analysis by Eccles and Qualter (2021) explicitly focused on young people (i.e., 25 years or younger) and investigated the effectiveness of loneliness interventions. They conducted two meta-analyses separately for single-group studies (*k* = 14) and RCTs (*k* = 25). The single-group studies revealed a moderate reduction in loneliness (Hedge's *g* = .411, 95 % *CI* [0.25, 0.57]). The RCTs also showed a significant reduction in loneliness (Hedge's *g* = .316, 95 % *CI* [0.19, 0.44], *p* < .001). In summary, this meta-analysis supports the **evidence on the effectiveness of a range of various loneliness interventions (e.g., social skills training, learning a new hobby, social and emotional support, enhancing social support, and psychological therapy) for younger people**.

Yet, the fact that only one meta-analysis studied young people causes attention. Recent meta-analytic findings imply that – beyond other things - people who feel lonely at younger ages (e.g., in childhood) are likely to feel lonely also later in life. [13] Consequently, there is an **urgent need for a better understanding of loneliness interventions for young people to prevent long-term loneliness and associated health problems**.

People with mental health problems

[13] This result is based on evidence of relatively high mean-level and rank-order stability across the life span (Mund et al., 2020)

People with mental health problems are at a greater risk of experiencing loneliness. Three systematic reviews investigated the effectiveness of loneliness interventions for people with mental health problems (Bessaha et al., 2020; Ma et al., 2020; Mann et al., 2017).

The primary studies that were reviewed by Bessaha et al. (2020) had heterogeneous results, which may be due to the focus on several different mental health problems (e.g., affective disorders, body-focused repetitive behavioural disorders, social anxiety disorder, and sex offenders with severe mental health problems). Bessaha et al. (2020) outlined that four out of ten quantitative primary studies reported a significant decrease in loneliness. These four studies with effective loneliness interventions (in terms of significant reduction of loneliness) included a group-based online programme for people with affective disorders, a community-based mental health programme, support groups for people with depression, mindfulness-based stress reduction therapy for people with social anxiety, and group-based psychoeducation.

Ma et al. (2020) examined the effectiveness of six interventions for people with mental health problems. They found that two out of six interventions that focused on cognitive modification, one out of three interventions that used supported socialisation, and one out of four interventions that used social skills training or psychoeducation showed decreased loneliness. Although the majority of the included primary studies did not lead to reduced levels of loneliness, **the reviews showed that some interventions (i.e., changing cognitions, supported socialisation, and social skills training/psychoeducation) for people with mental health problems were effective**. Ma et al. (2020) argue that the primary target of the intervention might have an impact on the effectiveness' evaluation: **most interventions that focused on a reduction in loneliness as the primary aim reported decreased levels of loneliness**.

Mann et al. (2017) also reviewed existing literature regarding interventions with different approaches (e.g., support socialisation, changing cognitions) for people with mental health problems. The authors concluded that **interventions focusing on changing cognitions show the most promising evidence**. Moreover, the authors identified the following approaches as promising for the future: linking people with supportive social activities by using digital technology and programmes, offering several opportunities within local communities, and creating accepting communities by using public health initiatives. However, due to a lack of research on the effectiveness of loneliness interventions for people with mental health problems "no approaches have a robust evidence base" yet (p. 627).

It is not surprising that among people with mental health problems a number of intervention studies found no significant reduction in loneliness. Many mental disorders, especially those involving social interaction disorder (e.g., social anxiety disorder), are difficult to treat. For example, Leichsenring et al. (2014) found that the remission rate after psychotherapy is only 40% for social anxiety disorder. This means that a large proportion of people with social anxiety disorder still show psychopathological symptoms and meet the criteria for a mental disorder even after intensive one-by-one psychotherapy. Such therapeutic sessions typically last substantially longer than most loneliness interventions and are still not fully effective in all cases. In sum, from these results can be concluded that **lonely people with mental health problems may require an even more intensive or longer treatment** than is currently implemented in loneliness interventions.

People living with an illness

Another risk group for loneliness is people living with a chronic illness (e.g., Barlow et al., 2015). The interventions' effectiveness for people with a chronic illness was examined by two systematic reviews with different target groups: while Bessaha et al. (2020) focused on non-elderly adults, Forgeron et al. (2018) focused on children and adolescents. **For both age groups, the majority of interventions were effective in reducing loneliness**. In non-elderly adults, eight out of 15 quantitative primary studies showed a significant decrease in loneliness. Additionally, both qualitative primary studies reported less loneliness – mainly through group support (Bessaha et al., 2020). For women with breast cancer, a psychosocial support group achieved lower levels of loneliness in two studies, but telephone-based or internet-based support programmes did not change levels of loneliness. For people who are at risk for or living with HIV/AIDS, peer counseling and peer-led programmes showed a reduction in loneliness, but two other group-based interventions could not achieve significant changes in loneliness. However, all four studies did not focus on interventions that target loneliness as a primary outcome. **In fact, greater reductions in loneliness are usually observed when reducing loneliness is the primary target of the intervention** (Ma et al. 2020). Focusing on loneliness as primary outcome and designing the intervention accordingly may help ensure the interventions can be tailored to the lonely individual and ensure the most beneficial approach is adopted depending on the subjective cause of loneliness experienced (Eccles & Qualter, 2020). For youth with cystic fibrosis, cerebral palsy, or spina bifida, two interventions that used social skills training and included group-based settings showed a significant decrease in loneliness (Forgeron et al., 2018). Besides the **positive effects on youth's loneliness,** Forgeron et al. (2018) found that **interventions resulted in fewer peer problems and improvements in prosocial behaviour and social acceptance**.

Another specific target population that was represented were adult cancer survivors. McElfresh et al. (2021) reported **meta-analytic evidence that interventions significantly reduced loneliness in adult cancer survivors** (Hedge's g = -.32, 95 % *CI* [-0.50, -0.14], p < .001). However, two culturally adapted interventions[14] that took place in Iran and Japan reported a significant reduction in loneliness, but only one intervention that was conducted in the USA was effective in reducing loneliness. The Iranian study conducted an unstructured supportive-expressive discussion group on loneliness, hope, and quality of life for breast cancer survivors that lasted 12 weeks with 90-minute sessions. The Japanese study investigated a psychosocial group-based intervention and social support for women. The effective intervention that was conducted in the USA comprised a web-based approach in which women with breast cancer created a personal website and were trained in computer skills. The studies that reported no significant effect on loneliness were a two-hour class plus a cognitively-based compassion training group session, and telephone-based social support and education interventions.

[14] E.g., one "intervention was culturally tailored to incorporate cultural norms and structure to create an opportunity whereby the women felt they could share information" (McElfresh et al., 2021, p. 524)

Persons with disabilities

Regarding loneliness interventions for persons with disabilities, Bessaha et al. (2020) reported that three out of seven quantitative studies showed significantly decreased loneliness. Additionally, two out of three qualitative studies reported a reduction in loneliness. Interventions that showed a decrease in loneliness were **social and recreational programs** for persons with intellectual disabilities, a **peer support hotline** for persons with psychiatric disabilities, a **narrative therapy group** interventions for persons with learning disabilities, and a **social network** intervention for persons with intellectual disabilities. **Taken together, the majority of interventions for persons with disabilities were effective in reducing loneliness**.

Parents and caregivers

Bessaha et al. (2020) reviewed the research regarding loneliness interventions for parents and caregivers. While the majority of quantitative primary studies did not show significantly decreased loneliness scores (four out of six studies), all three qualitative studies reported decreased levels of loneliness. In the quantitative primary studies, the **participation in a child development programme** and a **cognitive group therapy** led to reduced loneliness. Qualitative studies, that reported less loneliness, included an **online support group** and a **text messaging intervention**. Taken together, the results are mixed, and based on quantitative studies, there is no robust evidence for the effectiveness of loneliness interventions for parents and caregivers. However, the results showed that **some interventions for parents and caregivers are effective in reducing loneliness.** Moreover, qualitative studies may have the potential to capture important elements of complex loneliness reduction processes that are not included in quantitative studies.

(Former) Military members

Two reviews explored the effectiveness of loneliness interventions for military members and military veterans (Bessaha et al., 2020; Wilson et al., 2018). Bessaha et al. (2020) reported that all four included interventions significantly reduced loneliness. These interventions focused on **reducing stress and improving training performance, maladaptive social cognitions, and volunteering at community-based civic service organisations or nonprofit organisations**. Wilson et al. (2018) noted that only three out of the 17 identified primary studies explored loneliness, and only one of them investigated the effectiveness of the intervention regarding loneliness. One intervention was care farming[15] where two out of five military veterans reported decreased loneliness scores in the follow-up. The authors summarised barriers to participating in social programmes mentioned by the veterans: **lack of interest, confusion around available services, and feeling exclusivity for these services.** Taken together, the intervention studies, that examined the effectiveness, reported **mostly positive effects on loneliness of (former) military members**. However, this result is based on **very few primary studies** (k = 7). Consequently, more research in this area is needed.

[15] Care farming "aims to improve individuals' health and well-being by working on farms and agricultural landscapes" (Wilson et al., 2018, p. 606)

Immigrants and refugees

Another risk group for increased loneliness are immigrants and refugees (e.g., De Jong-Gierveld et al., 2015). Bessaha et al. (2020) reviewed how effective loneliness interventions are for immigrants and refugees. One of two quantitative studies reported significant decreases in loneliness following a **support intervention**. Moreover, all three qualitative studies, which focused on **increasing social support**, showed decreased loneliness. In the qualitative studies, the authors also explored possible mechanisms and reported that **participants' loneliness decreased via social support, empowerment, and a sense of belonging**. Thus, the review by Bessaha et al. (2020) offers primary evidence for the effectiveness of loneliness interventions for immigrants and refugees. However, more evidence base is needed for this target group.

Marginalised and/or vulnerable groups[16]

Bessaha et al. (2020) reviewed loneliness interventions for marginalised groups and reported that **three out of five quantitative primary studies showed a significant reduction in loneliness**. Effective interventions were a writing programme for bereaved people, support groups for homeless youth, and the halfway house programme for parolees. A music intervention for survivors of intimate partner violence and cognitive behavioural therapy intervention for African American women who experienced stress, anxiety, and depression did not show significant changes in loneliness. The heterogeneity of the results could be due to the very different intervention approaches, target groups and the complex interlinkages of social problems and traumatic experiences among the target groups.

3.3 Results on different intervention types

Some studies included evaluated the effectiveness of specific intervention types or compared different intervention types regarding their effectiveness in tackling loneliness. Below, we summarize the main findings by intervention type (i.e., technology-based interventions, animal-based interventions, physical activity interventions, social prescribing interventions, place-based interventions, and psychological and skills training interventions).

Technology-based interventions

Out of the reviews that focused on a specific intervention type the **majority aimed to investigate the effectiveness of technology-based interventions tackling loneliness**. We identified seven systematic reviews focusing on technology-based interventions for older adults (Baker et al., 2018; Casanova et al., 2021; Chen & Schulz, 2016; Chipps et al., 2017; Ibarra et al., 2020; Khosravi et al., 2016; Morris et al. 2014).

Baker et al. (2018) investigated how technology is used to tackle loneliness and to increase social participation of older adults. The authors reported that the majority of included primary studies focused on **social network services** or technology-based activities that were based on the use of **touchscreens**. The authors suggested

[16] Including "parolees living in a halfway house, African American women, homeless youth, the bereaved, and survivors of intimate partner violence " (Bessaha et al., 2020, p. 119)

that research beyond these technology-based interventions is important because older adults use social media in their everyday life. The interventions' aim often was to support older adults to socially interact with friends, family members, and other older adults. Baker et al. (2018) additionally investigated which methodologies were used to examine the interventions' effectiveness and found that often the outcomes were not described sufficiently (e.g., it remained unclear what was meant by different social concepts like social isolation or social participation in the primary studies). Moreover, many primary studies used qualitative approaches with small sample sizes, which are not adequate for generalizable and robust results concerning the interventions' effectiveness.

Casanova et al. (2021) outlined that three included primary studies showed no significant pre-post-intervention differences in loneliness following the technology-based interventions. However, the same number of studies reported "beneficial effects on loneliness" (p. 10). One of these studies showed **significant long-term improvements in loneliness up to three years after the baseline measurement point**. This should be emphasised because the majority of intervention studies did not report follow-up measures of loneliness and thus the time frame of the effect of a loneliness intervention often remains unknown. Another included primary study revealed that women benefitted more commonly than men from the intervention and that the reduction in loneliness was associated with living alone or living in a town.

The systematic review by Chen and Schulz (2016) included 18 primary studies, that tested the effectiveness of technology-based interventions for older adults. Out of them, 15 showed a significant reduction in loneliness. Intervention strategies that focused on **communication programmes or high-technology apps** (e.g., Wii, TV gaming system, virtual pet companion) showed **consistently reduced loneliness**, but the **general computer or internet use, as well as social networking sites did not result in significant loneliness decreases**. A comparison of two studies that used videoconferencing interventions showed that **cultural factors might be important for the interventions effect**: while Slovenes did not report loneliness changes, Taiwanese showed decreased loneliness levels. However, the differences might also be due to a different study design or due to a combination of the cultural factors and the study design. How cultural factors might influence the effectiveness of interventions should be examined in future studies. All in all, the **majority of interventions showed positive effects on loneliness**. The authors also discussed different possible mechanisms, how the internet and communication technology use might reduce loneliness: connecting to the outside world, gaining social support, engaging in internet activities and boosting self-confidence. Besides these positive effects, Chen and Schulz (2016) noted that internet and communication technology-based intervention might be problematic, when the communication is not reciprocal, and then an increase of loneliness is possible. Therefore, the impact of technology-based interventions should be checked when applied and probably adapted to the interventions receiver's needs. Furthermore, the authors recognised that an unusually high number of older adults did not participate until the end of the intervention (due to physical and psychological conditions or the study duration). Based on this observation, they noted that internet and communication technology interventions might not be suitable for everyone. This is underlined by the mixed results regarding the use of social network sites by Khosravi et al. (2016): two studies reported no changes in loneliness, another two studies reported less

loneliness, and another study reported increased loneliness among seniors using social network sites compared to non-seniors.

The review by Morris et al. (2014) examined 18 studies that analysed the effectiveness of smart technologies in improving or maintaining the social connectedness of older people living at home. Yet, studies used **several outcome measures which limited robust comparisons** between them. Only five of the studies targeted specifically loneliness. Among these, three studies found positive results and two reported inconclusive findings. The interventions with positive effects on loneliness incorporated interactive web-based programmes and online discussion boards, or face-to-face visits by study volunteers which may have affected the positive results. Altogether, the authors concluded that while more research is needed in this area, there is emerging evidence that smart technologies (e.g. tailored internet programmes) may support older people to manage their health conditions which can subsequently have a positive impact on their social connectedness.

Two other reviews, that also focused on technology-based interventions for older adults, showed **mixed results regarding specific technology-based interventions** (Chipps et al., 2017; Ibarra et al., 2020). While three quasi-experimental studies showed reduced loneliness after computer and internet training or videoconferencing intervention, three RCTs did not find significantly reduced loneliness due to technology-based interventions (Chipps et al., 2017). Regarding video chat interventions, Ibarra et al. (2020) outlined inconsistent results: on the one hand, Skype helped older adults to strengthen familial relations, expand interpersonal connections, and motivated to learn how to use other technology-based tools. On the other, using Skype had no impact on loneliness. Furthermore, older adults who mainly used e-mails reported being less lonely after the computer training intervention. Similarly, interventions that used robotic pets or video games showed mixed results (Chipps et al., 2017). Chipps et al. (2017) concluded that there is no robust evidence for the effectiveness of training and the use of internet or computer interventions and that high-quality research is missing in this area.

Taken together**, the mixed results regarding different technology-based interventions that aim to tackle loneliness might depend on how the technology is used**. For social media use, for example, there are three different hypotheses discussed regarding the relationship between loneliness and social media. The *displacement hypothesis* assumes that relationships in the real world are displaced by online activities and this is the reason why loneliness is associated with social media and digital technology use (Nie et al., 2002; Schobin et al., 2021). Contrary, the *stimulation hypothesis* represents the view that digital media is helpful to reduce loneliness and social isolation: digital media offer the opportunities to maintain and strengthen existing relationships and to build new relationships (Schobin et al., 2021). Nowland et al. (2018) **combine these two hypotheses in a theoretical framework**: the dynamic adaptation hypothesis (Schobin et al., 2021). The authors argue that, on the one hand, social media use may reduce loneliness when users aim to enhance existing relationships and to extend their social networks (stimulation hypothesis). On the other hand, social media is associated with high levels of loneliness, when digital media use displaces activities in the real world (displacement hypothesis). Moreover, Nowland et al. (2018) assume that loneliness feelings have an impact on how people interact with digital media. For example, when social media is used to decompensate feelings of loneliness or deficits in social skills loneliness might rise. **These hypotheses underline that digital media**

use in general might have different effects on loneliness depending on the purpose of use and the individual needs of the users.[17]

Animal-based interventions

Three reviews synthesized research about animal based interventions and their effectiveness (Gee & Mueller, 2019; Gilbey & Tani, 2015; Jain et al., 2020). While Gee and Mueller (2019) and Jain et al. (2020) focused on older adults, Gilbey and Tani (2015) did not specify their target sample. For older adults, **most primary studies reported that animal-assisted interventions had positive effects on loneliness, and social interactions**, but six studies showed no significant effect (Gee & Mueller, 2019; Jain et al., 2020). However, it might be possible that animal-based interventions are **effective due to previous experiences with pets and joyful memories**. Indeed, Gee and Mueller (2019) showed a relation between decreased loneliness and previous pet ownership. To summarise, the results by Gee and Mueller (2019) suggest that older adults – especially those who have previous experiences with pets – might benefit from interactions with a pet. Contrary, Gilbey and Tani (2015) concluded that robust evidence for the effectiveness of pets is missing due to low-quality studies (e.g., inappropriate designs, small sample sizes[18]). The effectiveness of trained service animals seemed more promising, even though the causality remains unclear (i.e., decreased loneliness due to the animal interaction or the therapy part of the intervention?).

Physical activity interventions

Two reviews focused on the effect of physical activity interventions on loneliness (Pels & Kleinert, 2016; Shvedko et al., 2018). Pels and Kleinert (2016) reviewed how the physical activity effect differentiated across study types. Twelve cross-sectional studies reported a negative relation between physical activity and loneliness, i.e., higher physical activity is related to less loneliness and less physical activity is related to higher loneliness scores. However, due to the cross-sectional design it remains unclear whether loneliness results in physical inactivity or physical inactivity leads to loneliness. One longitudinal study revealed that gender might have an impact on the effectiveness of physical activity: physical activity led to reduced loneliness in women but not in men. **Intervention studies showed that physical activity programmes decreased loneliness compared to a non-active control group or a different intervention**. One of those studies outlined that the decrease in loneliness is **related to increased perceived social support** by the other course members. Therefore, the success of physical activity intervention might depend on the relationships' quality formed and maintained in this context. An experimental study showed that the **mental context can also influence the physical activity's effect**: reduced loneliness was achieved due to framing physical activity as beneficial for health and social skills. Pels and Kleinert (2016) concluded that physical activity interventions seem to promote forming new relationships and maintaining existing relationships. Contrary, Shvedko et al. (2018) concluded that physical activity interventions seem to be ineffective in reducing loneliness in older adults.

[17] The complexity of the relation between social media and loneliness is further discussed in the review by Blaskó and Castelli (2022).
[18] Small sample sizes have a lower probability of detecting an effect of practical importance, which may however be observed in the real world.

Social prescribing interventions

The results regarding social prescribing interventions[19] were only synthesized by Reinhardt et al. (2021). All primary studies reported **some kind of positive impact**, two primary studies showed a reduction in loneliness or more connectedness, and two other studies reported changed loneliness scores across the whole sample. The largest reported effect was a reduction of loneliness in 69% of the sample. Regarding age, one study showed that people younger than 60 years old benefited more from social prescribing interventions than adults over 60 years old. However, these results are not generalizable due to high heterogeneity of the study results related to the variability in the methods used (e.g., sampling method, definition of loneliness).

Place-based interventions

Hsueh et al. (2022) investigated the effectiveness of place-based interventions and synthesised the existing literature in their review. Place-based interventions refer to community-based interventions that address "built environment characteristics and related socio-spatial factors" (p. 1). The authors divided the seven identified interventions into three categories: *provision of community facilities* (k = 3), *active engagement in local green spaces* (k = 3), *and housing regeneration* (k = 1). Interventions that refer to *provision of community facilities* included interventions that were delivered in local public facilities (e.g., community canteens, clubhouses).

In their review, a seniors exercise park programme led to a reduction in loneliness at three-month follow-up, but this reduction diminished at nine-month follow-up compared to the baseline measurement. In China older people in rural areas were offered a community canteen giving the opportunity to eat together. This intervention led to higher social capital, life satisfaction and mental health, but loneliness was not explicitly measured. Another intervention belonging to the category *provision of community facilities* was the clubhouse for people with mental health problems in which staff and members work beside each other. Thereby this intervention offered opportunities for social interaction and provided social support. All in all, the **interventions that focused on community facilities were associated with improved social connectedness**. But the authors noted that the **effects might not last over the end of the intervention**.

Three primary studies covered in the review focused on active engagements in **local green spaces**. A gardening programme for refugees led to increased social support and offered opportunities to connect and form new relationships. Similarly, a community gardening and social participation intervention for people with mental health problems supported opportunities to connect and created a sense of community. Further, a gardening project for schoolchildren with behavioural, emotional, or social difficulties positively impacted the social networks and relationships, the sense of belonging and the perception of having a valued role. Although there is no quantitative evidence regarding the effectiveness of these interventions in reducing loneliness, there is **qualitative evidence for the positive impact on loneliness due to active engagements in local green spaces**. The *house regeneration intervention* included social interventions (e.g., community engagement

[19] Social prescribing (also community referral) allows health professionals to refer people to a range of local, non-clinical sevices to promote their physical and mental health and well-being.

activities) besides the "internal and external improvements to housing" (Hsueh et al., 2022, p. 10). This intervention **did not lead to significant changes in connectedness**.

Taken together, there are only few primary studies investigating the effectiveness of place-based interventions. The included studies showed **qualitative primary evidence for the beneficial effects of place-based interventions on loneliness**. However, it remains unclear which mechanisms lead to reduced loneliness and social isolation. For example, are activities in green spaces effective due to the place aspect or due to the relationship to nature and feeling of doing something meaningful together with people who experience similar feelings of loneliness?

Psychological and skills training interventions

Five **meta-analyses** investigated the effect of the intervention type (Eccles & Qualter, 2021; Hickin et al., 2021; Lasgaard et al., unpublished; Masi et al., 2011; Zagic et al., 2022). Eccles and Qualter (2021) reported the largest effect sizes for social and emotional skills training, social skills training, and psychological therapies for young people. However, they could **not find a statistically significant superiority of one intervention type in a moderator analysis**. Similarly, Hickin et al. (2021) reported no difference between cognitive behavioural therapy-based interventions and non-cognitive behavioural therapy-based interventions. Lasgaard et al. (unpublished) and Masi et al. (2011) found significant influences of the intervention type depending on the types of included studies. In the single-group pre-post studies and the non-randomized group studies, Masi et al. (2011) found no significant difference between the intervention types. In contrast, in the randomized group studies, they found the social cognitive training to achieve the greatest reduction in loneliness (Q_b = 7.73, *df* = 3, *p* = .05), while there were no differences between social support, social skills, and social access interventions. Lasgaard et al. (unpublished) found psychological treatment interventions (based on multi-cohort studies, *p* = .046) and social support interventions (based on single-cohort studies, p = .004) to have the largest reduction in loneliness. The intervention strategy employing social networks showed a significantly smaller effect in multi- (*p* = .02) and single-cohort studies (*p* = .03). Zagic et al. (2022) reported that only psychological interventions achieved a significant improvement in the perceived quality of social connections (*k* = 12, Hedge's *g* = -0.53, 95 % *CI* [-0.79, -0.26]) while the social support interventions and social access interventions did not result in a significant improvement. However, based on RCTs, they found no statistically significant differences. **Taken together, there is primary evidence for psychological interventions to have a larger effect on the reduction of loneliness**, but more research is needed to conclude whether one intervention type is superior. Further, future research should investigate which intervention type shows the largest reduction in loneliness and for which target group (e.g., young people, older adults, etc.).

3.4 Meta-analytic results on overall effect, intervention and sample characteristics

As explained in **Section 1**, meta-analyses allow the investigation of effect size and moderating effects. Regarding the latter, it is common in meta-analyses to conduct moderator analyses that examine whether the

effectiveness across all different interventions is affected by certain characteristics of the intervention or of the sample. Based on the meta-analyses, the results are summarised below.

3.4.1 Overall effect

Overall, **most of the included meta-analyses (seven out of ten) showed significant loneliness reduction across different interventions (and different intervention types), which underlines the effectiveness of those loneliness interventions** (Choi et al., 2012; Eccles & Qualter, 2021; Hickin et al., 2021; Lasgaard et al., unpublished; Masi et al., 2011; McElfresh et al., 2021; Zagic et al., 2022). Given the heterogeneity in the focus of the various meta-analyses (e.g., some focusing only on certain age groups, others focusing only on certain delivery forms of the intervention, such as technology-based forms), it is difficult to identify commonalities among those meta-analyses that reported significant reductions in loneliness on average.

Three meta-analyses found the loneliness interventions' effects to be non-significant (Bornemann, 2014; Shah et al., 2021; Virués-Ortega et al., 2012). Of those, two focused on technology-based interventions in older adults (Bornemann, 2014; Shah et al., 2021), and one investigated animal interaction interventions in older adults (Virués-Ortega et al., 2012). However, these studies only included a small number of primary studies (k = 4-5), therefore, these results might not be robust. **All in all, there is meta-analytic evidence for the effectiveness of loneliness interventions.** The majority of included meta-analyses conducted analyses to assess publication bias (i.e. studies with negative or insignificant results are less likely to be published), and all of them found no evidence for publication bias (Eccles & Qualter, 2021; Hickin et al., 2021; Lasgaard et al., unpublished; McElfresh et al., 2021; Virués-Ortega et al., 2012).

Regarding the efficacy of the interventions, the international standards for identifying effective intervention programmes and policies recommend at least one long-term follow-up (Flay et al., 2005). However, the **long-term effects of loneliness interventions were only investigated in one meta-analysis** (Lasgaard et al., unpublished). Thus, the long-term effects are often overlooked. Lasgaard et al. (unpublished) found the interventions to have small to moderate short-term and long-term effects on loneliness. But the long-term effects were limited to measurement points between one to six months post-intervention. In practice, it would be interesting to know whether the reduction in loneliness is lasting longer.

3.4.2 Role of intervention characteristics

In the following we examine the existing evidence regarding the moderating role of specific intervention characteristics (i.e., intervention setting, delivery mode, duration and frequency, loneliness scale on the loneliness output) for the interventions' effectiveness.

Role of intervention setting (group vs. individual)

Three meta-analyses investigated the role of intervention setting and found mixed results (Lasgaard et al., unpublished; Masi et al., 2011; Zagic et al., 2022). Masi et al. (2011) found no significant difference between group-based interventions and interventions that were delivered individually. Similarly, Lasgaard et al. (unpublished) reported no significant effect of the intervention setting on the short-term outcome (p = .006 -

.043). In contrast, Zagic et al. (2022) reported that only group settings significantly reduced deficits in perceived quality of social connections (k = 15, Hedge's g = -0.41, 95 % *CI* [-0.63, -0.18]), while individual settings (k = 12; Hedge's g =− 0.08, 95 % *CI* [- 0.24, 0.10]) or mixed intervention settings (k = 4; Hedge's g = − 0.48, 95 % *CI* [-1.20, 0.24]) showed no significant effects on loneliness.

Role of delivery mode (technology-based or face-to-face)

Four meta-analyses investigated whether the delivery mode influenced the effect on loneliness (Eccles & Qualter, 2021; Lasgaard et al., unpublished; Masi et al., 2011; Zagic et al., 2022). But the **results are mixed**. Eccles and Qualter (2021) and Lasgaard et al. (unpublished) (p = .06 - .42) found no significant effect of the delivery mode on loneliness reduction. Similarly, Zagic et al. (2022) reported that both technology-based interventions and non-technology-based interventions were effective in an improvement of the perceived quality of social connections, but the effect sizes of the non-technology-based interventions were larger. In contrast, Masi et al. (2011) found heterogeneous results depending on the included study types. In the studies with a non-randomized group comparison the technology-based interventions (k = 6) achieved a stronger reduction in loneliness compared to the non-technology-based interventions (k = 12) (Q_b = 5.71, df = 1, p = .02). But in randomized group comparison studies, they did not find a significant effect of the technology usage on loneliness.

Role of intervention duration and frequency

Only the meta-analysis by Masi et al. (2011) investigated the role of the intervention's duration and frequency. Neither the interventions' duration nor the number of interventions significantly influenced the reduction of loneliness. However, the meta-analysis only included studies that were published until September 2009, and therefore, **more research is needed to conclude whether the interventions' duration or frequency have an impact or not**. Additionally, this information about the intervention is often missing in the primary studies and therefore it is not possible to test their influence. In general, it might be that the duration and frequency, that is needed to show effective results, depends on the applied intervention type. For example, people might need only few intervention sessions using a psychological intervention but several months spent with a dog to feel less lonely.

Role of loneliness scale

Only the meta-analysis by Masi et al. (2011) investigated the effects of the used loneliness scale on the loneliness output and found mixed results. In the single-group pre-post studies, studies that used a version of the UCLA Loneliness Scale showed the largest effect sizes. In the non-randomized group comparison studies, those who used the De Jong-Gierveld Loneliness Scale showed the smallest effect sizes. Finally, in the randomized group comparison studies, there were no differences between studies using different loneliness scales. **The reasons why there might be differences in the effectiveness of the loneliness intervention depending on the loneliness measure are multifaceted**. First, some scales might be more sensitive to change than others and thus more easily reflect an effect of the intervention. Further research is needed on this issue. Second, although both the UCLA Loneliness Scale and the De Jong-Gierveld Loneliness Scale are usually highly correlated with each other (Tomás et al., 2017), they have a slightly different facet

structure. The De Jong-Gierveld Loneliness Scale distinguishes between the two facets of social and emotional loneliness (De Jong-Gierveld & van Tilburg, 2006). In the UCLA Loneliness Scale, collective loneliness is still listed as a third facet (Hawkley et al., 2005). It remains a **challenge for future research to clarify whether certain loneliness interventions may be more or less effective specifically for certain dimensions of loneliness**.

3.4.3 Role of sample characteristics

In the following we examine the existing evidence regarding the moderating role of specific sample characteristics (i.e., age and gender) for the interventions' effectiveness.

Role of age

Four meta-analyses tested whether the age of the participants had an effect on the intervention's effectiveness (Eccles & Qualter, 2021; Lasgaard et al., unpublished; Masi et al., 2011; Zagic et al., 2022). Eccles and Qualter (2021), who only investigated young people younger than 26 years found that age does not influence the effect of the interventions. Similarly, Lasgaard et al. (unpublished) found no significant effect of age on the effectiveness of the interventions across the three age groups (i.e., childhood and adolescence: 6-25 years, early and middle adulthood: 26-64 years, and old age: 65+ years).

In contrast, Masi et al. (2011) found in their meta-analysis, which included studies with a non-randomized group comparison design, a small negative correlation between the mean age and the effect size, which suggests that studies with younger samples (i.e., young adults and children) reported significantly larger effect sizes of the intervention on loneliness compared to studies with older adults. However, this result should be handled with caution because this meta-analysis consisted of 18 studies of which 14 focused on older adults (60+ years), only two focused on young adults, and two on children. Moreover, age was not found to be a significant moderator in the other meta-analyses by Masi et al. (2011) which included studies with a single-group pre-post design and a randomized group comparison design. Zagic et al. (2022) showed that young adults had the greatest reduction in deficits in perceived quality of social connections (k = 7, Hedge's g = -0.34, 95 % *CI* [-0.60, -0.08]).

Based on these meta-analyses, it remains unclear whether and how age influences the effectiveness of loneliness interventions.

Role of gender

Three meta-analyses investigated whether gender affected the effectiveness of the interventions and found heterogeneous results (Eccles & Qualter, 2021; Hickin et al., 2021; Masi et al., 2011). While Eccles and Qualter (2021) and Hickin et al. (2021) found no significant effect of gender, Masi et al. (2011) reported that (randomized group comparison) studies with a higher proportion of females in the sample "showed a smaller reduction in loneliness" (Masi et al., 2011, p. 256). The results by Masi et al. (2011) suggest, that samples with a higher proportion of men benefited more from the investigated interventions (e.g., improving social skills, enhancing social support, increasing opportunities for social contacts, and social cognitive training). As in many meta-analyses, these moderator analyses did not control for other sample and study characteristics.

Nevertheless, this finding may be especially relevant for the design of effective interventions against the background that being a woman has been identified as a risk factor for loneliness in the last years affected by the COVID-19 pandemic (Wickens et al., 2021). **However, further analyses are needed to enable robust conclusions on the role of gender.**

Taken together, the role of sample characteristics was only investigated in a few studies and the results are heterogeneous. Therefore, more research is needed to conclude **which target sample profits the most from which intervention**.

4 Discussion and conclusions

In this final section, we first present the main conclusions that can be drawn from the available systematic reviews and meta-analyses on the effectiveness of interventions tackling loneliness. Next, we highlight gaps and limitations of existing research and provide recommendations for future studies that could lead to a more comprehensive understanding of which kind of intervention tackling loneliness is effective and for whom. We conclude with some policy implications based on the main findings.

4.1 Main findings from the literature

Taken together, **effective interventions to reduce loneliness exist** and most of the interventions described in the literature reviews and meta-analyses discussed here showed some positive effects on loneliness. In particular, there is **primary evidence for psychological interventions to achieve a reduction** in loneliness (Eccles & Qualter, 2021; Gardiner et al., 2018; Lasgaard et al., unpublished; Masi et al., 2011) together with social support interventions, employing social networks and stimulating social activities. However, based on the existing literature, **it was not possible to identify one superior type of intervention**. In addition, most studies have methodological weaknesses that make drawing robust conclusions challenging.

Most meta-analyses and reviews focus on older adults. For this age group, more recent studies look at the effectiveness of technology-based interventions, with mixed results depending on how the technology is used. **Less explored is the effectiveness of interventions targeted at children and adolescents**, with only one study focusing on this target group (Eccles & Qualter, 2021). Here, the effectiveness of a range of various loneliness interventions has been shown (e.g., social skills training, learning a new hobby, social and emotional support, enhancing social support, and psychological therapy).

Moreover, it remains **unclear which factors play the most important role regarding the interventions' effectiveness**. There have been a couple of attempts to identify common characteristics of successful interventions (Cattan et al., 2005; Gardiner et al., 2018). But these studies focus on older adults making it hard to draw more general conclusions.

There are several possible reasons for the mixed results in the existing empirical literature. First, many primary studies were rated as low quality or only included small sample sizes. Second, interventions consist of several different aspects (e.g., intervention focus, intervention setting, delivery format, duration of the interventions, etc.). The impact of these aspects is often not specifically investigated in the existing literature and thus, remains unclear. Third, loneliness is a subjective feeling which can occur due to different causes (e.g., lack of a social network, perceived bad quality of relations, etc.) based on the individual needs that are not met. Consequently, **loneliness interventions may be more effective when adapted to the needs of the intervention's participants.** For example, interventions targeted at older adults may be more successful when they offer socially stimulating activities as loneliness in later stages of life is more likely related to transitions and disruptive life events, such as retirement, bereavement and children moving out, and thus increased social isolation and loss of opportunities for social interaction. Meanwhile, lonely younger adults may be more in need of social skills training to develop relationships in their already existing social networks (e.g. at school and/or

work). Last, but not least, **cultural factors might play a relevant role in determining the intervention's effectiveness**.

All in all, the majority of systematic reviews and meta-analyses on interventions tackling loneliness showed that they are—overall—**beneficial for participants**. Besides these positive effects on loneliness, several interventions achieved **further positive effects in other areas** (e.g., depressive symptoms, and social interactions). Forgeron et al. (2018) noted that the interventions led to less peer problems and improvements in prosocial behaviour and social acceptance. Moreover, whereas research on psychotherapy for mental disorders also discusses negative side effects of psychotherapy (Linden & Schermuly-Haupt, 2014), we did not identify evidence of such negative effects of loneliness interventions in the systematic review or meta-analysis (with one exception: Khosravi et al., 2016 reported increased loneliness among seniors that used social network sites, which were actually intended to reduce loneliness). Taken together, interventions themselves are unlikely to be harmful and the existing empirical studies provide encouraging evidence on the **usefulness of interventions tackling loneliness.**

4.2 Gaps and limitations of existing research

With this umbrella review, we identified several gaps in the existing literature on the effectiveness of loneliness interventions. First, most of the existing literature was of **poor methodological quality and had often small sample sizes**. Moreover, much important **information about the intervention or the target group was missing** in the reviews and meta-analyses as well as in the primary studies (e.g., Cattan et al., 2005; Forgeron et al., 2018). Often it remained **unclear whether the interventions targeted people who felt lonely at the beginning of the intervention or the more general population**. This is problematic due to the following reason: when an intervention also includes people who do not experience loneliness at the beginning of the intervention and the intervention shows no significant improvement in loneliness, it is unclear whether the intervention is ineffective due to the participation of non-lonely people or due to the intervention itself. **In fact, it may be questioned whether prevention programmes should be included in intervention reviews at all, but instead in separate evaluations**, as they may target the general or risk population rather than people experiencing loneliness. Moreover, **the existing studies do not provide details on which type of loneliness** (e.g. social loneliness, existential loneliness, emotional loneliness, etc.) is the intervention designed to tackle. Insofar as different intervention types work against different types of loneliness, this information is key to understand for whom the intervention works.

Another identified gap is the **lack of synthesising literature about loneliness interventions in the European Union Member States**. In the included reviews and meta-analyses there were not one that focused on loneliness interventions solely conducted in Europe. Most of the interventions took place in the USA. The generalisation of these results to countries of the European Union may not be straightforward. Some studies showed that the culture that people live in could also have an impact on the effectiveness of the intervention (McElfresh et al., 2021). Therefore, it is important to investigate loneliness interventions and their effectiveness in the European Union countries. Furthermore, our search only yielded one study investigating the effectiveness of loneliness interventions in rural areas (Franck et al., 2016). However, the identified study focused on older

adults and the included studies were rated as of poor methodological quality. People living in rural communities may face unique challenges that can impact their feelings of loneliness, such as geographical isolation and limited access to public transport. Hence, a better understanding of what types of interventions are effective to reduce feelings of loneliness in rural settings is much needed.[20]

Additionally, **we could not robustly identify factors that influence the interventions' effectiveness based on the existing literature**. The results regarding different characteristics of the sample or the intervention were too heterogeneous and – as mentioned above – often information was missing to conduct a meta-analysis in the included studies (Chen & Schulz, 2016; Forgeron et al., 2018; Franck et al., 2016; Pu et al., 2019; Reinhardt et al., 2021; Shvedko et al., 2018; Williams et al., 2021). Possibly, the heterogeneous results regarding different factors emerged due to variation in the setting, delivery mode, duration, etc. of the intervention. Therefore, we recommend to explicitly investigate which factors could have an influence and could improve the effectiveness, so that the interventions could be **developed strategically and cost-effectively so as to make a more persuasive case for scaling up successful loneliness interventions among policy circles**. Additionally, it would be helpful to know which intervention's effect lasts and for how long. But **often longer-term follow-up measurements based on international standards (Flay et al., 2005) are missing**. This is underlined by Bessaha et al. (2020) who reported that only eight out of 68 studies conducted a follow-up measurement at a year or more after the study completion. **In future research, the effect of the intervention should be regularly checked and followed for a longer time.** Furthermore, some authors (e.g., Bessaha et al., 2020; Mann et al., 2017) noted that it is unclear whether some interventions were effective due to a group setting, because they bring people together who experience similar things, or due to the intervention itself. This underlines the need for systematic research regarding the interventions' characteristics.

A further identified gap is that **especially risk groups like young people or people with mental or physical health problems are not well represented** in the research on loneliness interventions. Moreover, other marginalised groups like the LGBTQ+ community, immigrants and refugees and (former) military members were not well represented. The majority of included reviews and meta-analyses examined the interventions' effectiveness for older people (e.g., Casanova et al., 2021; Shah et al., 2021). Yet, based on research on loneliness prevalence, it is clear that research on the effectiveness of loneliness interventions should cover all age groups.

Finally, the vast majority of loneliness interventions reviewed by the scientific literature focus on individual- and relationship-level interventions. **Less is known on the effectiveness of interventions at community- and societal-level as well as in specific settings** (e.g., school-based interventions). Several interventions

[20] Williams et al. (2022) carry out a mixed-method review synthetizing the evidence on the effectiveness of loneliness and social isolation interventions in rural adult population worldwide. The authors find that interventions that focus on shared interests and common experiences can decrease loneliness in a rural context. However, they stress that these results are based on limited research and recommend for more well-conducted studies of the effectiveness of interventions for reducing loneliness in rural populations. This study was not included in this umbrella review because it was published after the literature search was conducted.

at community level have the potential to help reduce loneliness (WHO, 2021). For instance, interventions addressing the built environment (e.g. design of housing, public and green spaces and cultural places) may facilitate maintaining existing and forming new social connections.

To fill some of the existing research gaps, the Joint Research Centre of the European Commission is conducting **qualitative interviews with intervention experts** as part of a European Parliament pilot project on monitoring loneliness in Europe. These interviews will allow a more qualitative inquiry into the reality of loneliness interventions on the ground and aspects of interventions that are found crucial for the effectiveness by experts who design and/or implement interventions.

4.3 Recommendations for future research

For further research, we recommend **more systematic and good quality research** regarding the methods and definition of intervention used and recommend larger sample sizes, assessing participants' loneliness levels at the beginning of the intervention, at its end, and a reasonable time after the end, as well as distinction among different types of loneliness. Hence, the **use of consistent measurement tools** both regarding loneliness and intervention effectiveness would be beneficial.

Moreover, **qualitative research** focusing on the lived experience of loneliness may prove useful. The participants' feedback may provide insight into the needs that should be addressed in loneliness interventions and which parts of the interventions were most helpful. Additionally, the insights of practitioners can help, especially regarding understanding on the design and implementation of effective interventions.

Further, this umbrella review focused on interventions, but also **prevention efforts** are important to tackle loneliness and need to be investigated further (although ideally separately from mitigation measures).

In general, **future research should also reflect on whether the interventions and prevention programmes investigated in studies are those which are offered in reality**. For example, the amount of studies examining technology-based interventions for older adults rose in the last years. But it is unclear whether this reflects a rise in technology-based interventions on the ground. Another direction for future research on loneliness interventions might be to test placebo effects, i.e., whether it might not be the specific content of an intervention that is effective in reducing loneliness, but rather the experience of being involved in any type of intervention, including the expectation of a reduction in their feelings of loneliness.

- This umbrella review also illustrated that important information about interventions included in systematic reviews and meta-analyses are often missing. This hampers the identification of the types of intervention or aspects of interventions that may be especially relevant for the effectiveness. **Therefore, we propose a list of elements that should be available in publications investigating loneliness interventions and their effectiveness:** The target group of the intervention (e.g. children, adolescents, older adults, etc.)
- Information on the sample, including characteristics (e.g., sample size, sample selection and recruitment, mean age, age range, gender distribution and characteristics of the community/existing social networks)
- The baseline loneliness of the interventions' participants (e.g., mean loneliness and their standard deviation) and the type of loneliness that affects them (e.g., social, emotional, existential, etc.)
- Intervention strategy (e.g., social skills training, psychological approaches, social support, …)
- The duration of the interventions (e.g., e.g. two weeks or one year)

- The frequency of the intervention (e.g., weekly or monthly sessions)
- The delivery setting of the intervention (e.g., group, individual or mixed)
- The delivery format of the intervention (e.g., digital/technology-based or in-person)
- Information about measurement and follow-up time points, recommending that they should include a reasonably long time after the intervention ended.

Finally, **developing a commonly agreed framework or taxonomy to categorise loneliness interventions** could be helpful in **facilitating both research and intervention development.**

Furthermore, any future reviews will require more European Union based interventions on the ground to conduct evaluation studies. It is recommended that interventions would have resources to dedicate for good quality and theory-based built-in evaluations of the direct and long-term effect of the intervention using appropriate research methods, including pre-post comparison designs, quasi-experimental study designs, and ideally, randomised controlled trials. This would also allow a better comparison of intervention types and their impact. **More robust evaluations would add to the international knowledge base of interventions and help ensure that people who suffer from loneliness benefit from effective interventions.**

4.4 Policy implications

The research reviewed in this umbrella review provides some guiding and promising directions for designing interventions tackling loneliness. Overall, **psychological treatment interventions** (e.g., social cognitive training) and—with less consistency across studies—also **social support interventions seemed to be promising**. Also, **employing social networks and stimulating social activities** showed some effect on loneliness reduction. Thus, a strategy combining these types of interventions may have strong effects on loneliness reduction. As a result, access routes to psychotherapeutic and psychological care must be simplified to allow for low-threshold treatment (e.g., no long waiting times). In addition, psychotherapeutic and medical practitioners need to be sensitised to the issue of loneliness so that they can adequately help reduce loneliness.

The majority of meta-analyses reported no difference in the overall effectiveness of individual vs. group settings. In some European Union countries, such as Germany, it has recently become possible to bill statutory health insurers for psychotherapy in group settings (aerzteblatt.de, 2020). It could be examined whether this model is also useful for other countries in the European Union. However, it is also important to keep in mind that for certain individuals (e.g., those who have been lonely for a very long time and may lack social skills or shy away from larger groups), especially in the initial stages of tackling loneliness, one-on-one settings may be suitable and therefore recommended.

Another debate in the context of interventions tackling loneliness is the delivery mode. Especially in the last years, the number of studies evaluating the effectiveness of technology-based interventions on loneliness has sharply increased. A question that arises is whether technology-based interventions tackling loneliness work better, worse, or equally well as more traditional face-to-face interventions. The answer to this question is ambiguous due to the heterogeneous findings of the empirical studies on the topic. Some meta-analyses included in this umbrella review found no differences in effectiveness between technology-based and face-to-face interventions. This finding would mean that technology-based interventions, which can usually be used on a larger scale, can also be recommended. However, studies that found a difference between the two

delivery formats showed stronger positive effects for face-to-face interventions. When interventions to address loneliness are funded, the target population for the intervention should be considered when choosing a delivery mode. Digital interventions are not equally accessible for all people, which is often discussed as digital divide. For example, eHealth research suggests lower levels of eHealth literacy in certain groups such as older and low-income adults and unemployed people (Chesser et al., 2016). However, since these groups in particular are also vulnerable to chronic loneliness (Lim et al., 2020), they need intervention services. **Consequently, although technology-based interventions seem to be effective in most cases, not all interventions tackling loneliness should be offered exclusively digitally to be more inclusive for vulnerable populations**.[21] Moreover, digital interventions are connected with more ethical concerns (e.g. privacy issues, data protection, etc.). Thus, it is important to protect the rights to remain offline and offer alternatives to those who do not wish to connect digitally (WHO, 2021).

Finally, we **recommend offering a wide range of different low-threshold loneliness interventions**, so that everybody can take part in the intervention that attracts them the most and best suits their needs. As mentioned above, loneliness is a subjective feeling with many different possible causes, therefore person-centered interventions that are orientated at the individual needs of the participants, are possibly the most effective ones.

[21] Blasko and Castelli (2022) further discuss policy recommendation for interventions aimed at reducing loneliness through the use of social media across age groups (i.e. older adults vs. young people).

Table 2 Summary of the included systematic reviews and meta-analyses

No	Study	Data and Method(s)	Intervention Characteristics	Findings
1.	**Baker et al., 2018** https://doi.org/10.1111/ajag.12572	- Systematic review - Including 36 studies - Studies published between 2000 and 2016 - Unit of analysis: individual	- Focus: technology-based interventions aiming to support social participation - Target group: older adults	- Majority focuses on social network services or touchscreen-based interventions - Aim: support older adults to interact socially with other older adults, friends, and family members - Many studies did not describe the social concepts that were used as an outcome measure - Many studies used qualitative approaches with small sample sizes (< 10) - Identified gap: larger scale studies that evaluate the impact/effect of interventions that are conducted in the real life of older adults - Conclusion: need for more studies that evaluate the effectiveness (especially of the technology usage in the everyday life), especially of emerging technologies; current evidence is limited due to inadequate methodologies

2.	**Bessaha et al., 2020**
	
	https://doi.org/10.1007/s10615-019-00724-0
		- Systematic review
		- Including 68 studies:
		  • 54 quantitative
		  • 14 qualitative
		- *N* = 12,109
		- Studies published between 1988 and 2018
		- Countries: mostly USA, but also Sweden, Ireland, and the UK
		- Unit of analysis: individual
		- UCLA Loneliness Scale (42), De Jong-Gierveld Loneliness Scale (6)
			- Target group: non-elderly adults
			
			Target group: parents & caregivers (*k* = 9):
			
			- Setting: group (7), individual (1), mixed (1)
			
			Target group: people with mental health problems (*k* = 11):
			
			- Focus: social skills/peer-mentoring-based interventions (2), technology-based interventions (2), community-based interventions (4), mindfulness-based stress reduction (1), CBT (1), psychoeducation (1)
			- Setting: group (7), individual (2), mixed (2)
			
			Target group: people with disabilities (*k* = 10)
			
			- Focus: social and recreational programs (social participation; 2), CBT (1), community groups and mentorship (1), peer-run phone line (1)
			- Setting: group (8), individual (1), mixed (1)
				- Group and individual interventions decreased loneliness
				
				Target group: parents & caregivers (*k* = 9)
				
				- 2 out of 6 quantitative studies reported significant decreases in loneliness
				- All three qualitative studies reported decreased loneliness
				- Telephone-based peer support groups showed no significant reduction in loneliness among mothers with postpartum depression (2 studies)
				- Participating in a child development program reduced parents' loneliness
				- Cognitive group therapy significantly reduced loneliness in postpartum mothers who experienced "traumatizing provider interactions"
				- Telehealth intervention (online group intervention) led (via sharing experiences and making new friends) to a reduction in loneliness (qualitative)
				- A virtual online caregiver support group didn't show significant changes in loneliness

			Target group: people with chronic illness (*k* = 17) - Focus: group support structures or technology/online-based support interventions - Setting: group (13), mixed (4) **Target group: immigrants and refugees (*k* = 5)** - Focus: general wellbeing (1), support for breast-cancer survivors (1), general social support with a direct focus on loneliness (3) - Setting: group (2), mixed (2) **Target group: (former) military members (*k* = 4)** - Setting: group (2), mixed (2) **Target group: general population (*k* = 7)** - Focus: general wellness based interventions (3), internet-based interventions (3), subsidized meals program at a social cafe (1) - Setting: group (2), individual (3), mixed (2)	- An online support group (qualitative) and a SMS text messaging intervention (qualitative) reported less loneliness **Target group: people with mental health problems (*k* = 11):** - 4 out of 10 quantitative studies and the one qualitative study reported significantly decreased loneliness - A group based online program significantly reduced loneliness in people with affective disturbances - Mindfulness based stress reduction led to reduced loneliness in people with social anxiety disorder compared to the control group - Group psychoeducational intervention reduced loneliness - Support group for people with depression significantly reduced loneliness - Not effective were peer mentoring based interventions, the use of an internet forum, CBT

			Target group: marginalized groups (*k* = 5) - Setting: group (2), individual (2), mixed (1)	**Target group: people with disabilities (*k* = 10)** - 3 out of 7 quantitative and 2 out of 3 qualitative studies reported a significant decrease in loneliness - A social and recreational programs showed a reduction in loneliness (in people with intellectual disabilities) - Peer support hotline reduced loneliness among people with psychiatric disabilities - A narrative therapy group intervention showed decreased loneliness in people with learning disabilities - Social network intervention showed decreased loneliness in people with intellectual disabilities - Not effective were: community groups and mentorship from trained community members, a CBT intervention **Target group: people with chronic illness (*k* = 17)** - 8 out of 15 quantitative studies and both qualitative studies reported

				a significant decrease in loneliness - Among woman with breast cancer a psychosocial support group showed significantly reduced loneliness in two studies, while telephone support or internet-based support program interventions didn't change loneliness significantly - In people at risk for or living with HIV/AIDS peer counseling about safe sex and HIV prevention as well as a peer-led program significantly reduced loneliness, while the other 2 group based interventions didn't show changes in loneliness - 2 studies reported significantly decreased loneliness due to online asynchronous, peer-led support groups **Target group: immigrants and refugees (*k* = 5)** - One of the two quantitative studies reported a significant decrease in loneliness - All 3 qualitative studies reported decreased loneliness (via social

				support, empowerment, and sense of belonging) **Target group: (former) military members (*k* = 4)** - All 4 studies reported a significant decrease in loneliness - The effective interventions were: a "program to reduce stress and depression and improve training performance among Navy recruits", a "training program to improve maladaptive social cognition and loneliness", and veterans volunteering at community-based civic service organizations or volunteering at nonprofit **Target group: general population (*k* = 7)** - 5 out of 6 quantitative studies and the qualitative study reported a significant decrease in loneliness - Effective were: wellness-based interventions, and internet-based interventions **Target group: marginalized groups (*k* = 5)** - 3 out of the 5 quantitative studies reported a

				significant decrease in loneliness - Effective interventions: a writing program for bereaved, a halfway house program, and support groups for homeless youth - Ineffective interventions: a music intervention for survivors of intimate partner violence, and a CBT intervention for African American women experiencing stress, anxiety and depression
3.	**Cacioppo et al. (2015)** https://doi.org/10.1177/1745691615570616	- Systematic review		- Describes different types of interventions (group vs. individual vs. community setting) - Primary criterion for empirically supported interventions: efficacy in RCTs
4.	**Casanova et al. (2021)** https://doi.org/10.2196/23588	- Systematic review - Including 11 quantitative studies - *N* = 953 (age ranged from 58 to 95 years) - Studies published between 2002 and 2009 - Unit of analysis: individual - UCLA Loneliness Scale, Lubben Social Network Scale, Social Provisions Scale, RTLS-34 Scale	- Focus: information and communication technology based interventions - Target group: older adults - Intervention's duration: up to 3 years	- 3 studies reported "beneficial effect on loneliness" - BUT: it remained unclear whether the improvements were due to the interaction with a trainer or due to the intervention itself - One study outlined that reduced loneliness were more "common among woman than men"

				- 3 studies reported no significant pre-post-intervention differences
5.	**Cattan et al. (2005)** https://doi.org/10.1017/s0144686x04002594	- Systematic review - Including 30 quantitative studies - Studies published between 1979 and 2002 - Countries: USA, Canada, European countries - Unit of analysis: individual - UCLA Loneliness Scale (8), De Jong-Gierveld Loneliness Scale (2), single item (2), other measures (7)	- Focus: educational input, educational input combined with physical activity, bereavement support, social activation, service provision, community development approach, social support - Target group: older adults - Setting: group (17), individual (10)	- 10 interventions were effective in reducing loneliness (9 of them were group activities with an educational or support input) - In a community intervention trial, in which the majority of the people were not lonely, loneliness decreased significantly from pre-treatment to follow-up (possible reason for the success: offering a flexible approach to exercise) - Short-term self-help groups showed a decrease in loneliness at 10 months follow-up; additionally, the participants who had contact with group members besides the meetings, reported a continued decrease in loneliness, while those with no contact reported increasing loneliness at 10 months - The majority of one-to-one interventions were not significant in reducing loneliness - Shared characteristics of effective interventions:

				group interventions focusing on educational input or targeted support activities, targeting specific groups, enabling some sort of participant and/or facilitator control or consulting the target group before intervention-start

6.	**Chen & Schulz (2016)**
	
	https://doi.org/10.2196/jmir.4596
		- Systematic review
		- Including 30 studies (but loneliness were only tested in 18 studies):
		  · 16 quantitative
		  · 14 qualitative
		- Average age ranged from 66 to 83 years
		- Studies published between 2002 and 2015
		- Countries: Austria, Canada, Finland, Israel, the Netherlands, New Zealand, Norway, Slovenia, Sweden, Taiwan, UK, USA (9)
		- Unit of analysis: individual
		- UCLA Loneliness Scale (20), De Jong-Gierveld Scale, Kamphuis Loneliness Scale, Social Support Scale, Social and Emotional Loneliness Scale, others
			- Focus: technology-based interventions
			- Target group: older adults
				- 15 out of 18 studies reported a significant decrease in loneliness
				- Interventions focusing on communication programs or high-technology apps (Wii, TV gaming system, virtual pet companion) resulted consistently in a decrease of loneliness
				- The general use of computer or internet as well as the use of social networking sites were not significantly effective
				- Slovenes reported no change in loneliness after using videoconferencing while Taiwanese reported a significant decrease in loneliness. This might show the relevance of cultural factors
				- Possible mechanisms how internet and communication technologies can reduce social isolation: connecting to the outside world,

				gaining social support, engaging in activities of interest, and boosting self-confidence
7.	**Hagan et al. (2014)** https://doi.org/10.1080/13607863.2013.875122	- Systematic review - Including 17 studies - Age ranged from 52 to 103 years - Studies published between 2000 and 2012 - Countries: USA (8), Israel (1), the Netherlands (2), Finland (1), UK (3), Australia (1), Taiwan (1) - Unit of analysis: individual - UCLA Loneliness Scale (7), De Jong-Gierveld Loneliness Scale (3)	- Focus: mindfulness, self-management, befriending, supported living, technologies - Target group: older adults - Setting: group (9), individual (3)	- Significant effects showed: mindfulness based stress reduction programme, videoconferencing (at least once a week), playing Wii with a partner, an animal-assisted therapy - Interestingly those four effective interventions are all different types of interventions - Whether older adults attended day canter or not showed no significant difference in loneliness between these groups - CAUTION: small sample sizes
8.	**Forgeron et al. (2018)** https://doi.org/10.1080/02739615.2017.1328600	- Systematic review - Including 13 studies (but only 2 measured loneliness) - Age ranged from 8 to 15 years - Studies published between 1994 and 2016 - Countries: USA and Canada - Unit of analysis: individual - Asher Loneliness Scale	- Focus: psychoeducation, social skills, changing cognitions - Target group: children and adolescents with chronic physical conditions - Delivery of Intervention: in person (9), online (3), mixed (1)	- Interventions resulted in a decrease of loneliness and peer problems and improvements in prosocial behavior and social acceptance - Two studies focusing on social skills training reported a decrease in loneliness (moderate effect size between baseline and 6/9 month post-intervention) - One of these studies compared the intervention

				and control group at 9 months post intervention and showed an effect size of *d* = 0.22
9.	**Franck et al. (2016)** https://doi.org/10.1007/s11136-015-1197-y	- Systematic review - Including 5 quantitative studies: - Age ranged from 68 to 77 years - Studies published between 2009 and 2013 - Countries: Australia (1), USA (1), UK (1), China/Hong Kong (1), Taiwan (1) - Unit of analysis: individual - UCLA Loneliness Scale (3), single item (1)	- Focus: psychological interventions, social group intervention, indoor gardening program, Wii gaming, radio listening - Target group: older adults - Setting: group (3), individual (1), duo activity (1) - Intervention's duration: 8 weeks to 3 months - Session's duration: 1 hour to 1.5 hours - Frequency of sessions: once a day to once a week	- 3 interventions showed a decrease in loneliness: reminiscence therapy, playing Wii with a partner - Listening to a radio program showed no significant decrease in loneliness - The review aimed to investigate interventions in rural areas, but all single studies which were conducted in rural areas had a low quality and were therefore excluded from analysis. Therefore, the effectiveness and feasibility of the included interventions in rural areas is unclear.

10.	**Gardiner et al. (2018)**
	
	https://doi.org/10.1111/hsc.12367
		- Systematic review
		- Including 39 studies:
		  • 27 quantitative
		  • 10 qualitative
		  • 2 mixed
		- Studies published between 2003 and 2016
		- Unit of analysis: individual
		- UCLA Loneliness Scale, De Jong-Gierveld Scale, Lubben Social Network Scale, Single-items
			- Focus: social facilitation, psychological therapies, health and social care provision, animal interventions, befriending, leisure/skill development
			- Target group: older adults
				- Most interventions were classified as social facilitation interventions
				- 8 out of 10 social facilitation interventions reduced social isolation or loneliness
				- Interventions that focus on psychological therapies showed the most robust evaluation
				- Productive activities were related with a decrease in loneliness while passive

				consumptive activities were not - It remained unclear which factor contributed to the success of an intervention, because many interventions include different aspects - Qualitative studies identified three "common characteristics of effective interventions": adaptability of an intervention, community development approach (service users are involved in the design and implementation of interventions), productive engagement
11.	**Gilbey & Tani (2015)** https://doi.org/10.1080/08927936.2015.11435396	- Systematic review - Including 21 studies - Unit of analysis: individual - UCLA Loneliness Scale (15), singe item (5)	- Focus: (service) animals - No specific target group	- 5 animal assisted therapy trials reported significant effects - A cross sectional study which matched groups reported a significant relation between hearing-dog ownership with lower levels of loneliness - 6 studies (all cross-sectional) reported significant relation between companion animals and loneliness (in three of these studies the review's authors had concerns regarding the analysis)

				- BUT: In all except one of the included studies the authors identified limitations and low methodological quality
12.	**Gee & Müller (2019)** https://doi.org/10.1080/08927936.2019.1569903	- Systematic review - Including 32 studies - Studies published between 1965 and 2018 - Unit of analysis: individual	- Focus: animal interactions - Target group: older adults	- Most studies reported positive effects of animal assisted interventions on loneliness, social behaviors, and social interactions - 6 studies showed no significant effect - The decrease in loneliness was related to previous pet ownership
13.	**Hsueh et al. (2022)** https://doi.org/10.3390/ijerph19084766	- Systematic review - Including 7 studies - Studies published between 2011 and 2020 - Countries: Australia (3), USA (2), China (1), and England (1) - Unit of analysis: individual - UCLA Loneliness Scale	- Focus: place-based interventions - No specific target group	- 3 categories of different place-based interventions: provision of community facilities, active engagement in local green spaces, housing regeneration - Interventions focusing on community facilities were associated with improved social connectedness (but it is unclear, whether these effects last over the end of the intervention) - Qualitative evidence for positive affect of the active engagements in local green spaces on loneliness - The house regeneration intervention did not show changes in the perceived connectedness

14.	**Ibarra et al. (2020)**
	
	https://doi.org/10.1155/2020/2036842
		- Systematic review
		- Including 25 studies:
		  • 19 quantitative
		  • 6 qualitative
		- Studies published until 2020
		- Unit of analysis: individual
		- UCLA loneliness scale (13), De Jong-Gierveld loneliness scale (4)
			- Focus: technology-based interventions
			- Target group: older adults
			- Setting: group (20), individual (5)
				- Effect size Hedges *g* = .411, 95 % *CI* [0.25, 0.57]
				- 4 qualitative studies report a decrease in loneliness
				- Quantitative studies: 7 studies reported no significant change, 11 studies reported positive outcomes (decreased loneliness (9) and increased network size (2))
				- Inconsistent findings when using video chat interventions and social networks

15.	**Jain et al. (2020)**
	
	https://doi.org/10.1111/opn.12320
		- Systematic review
		- Including 43 studies (but only 5 studies assessed loneliness):
		  • 39 quantitative
		  • 4 qualitative
		- Mean age ranged from 55 to 85 years, 71 % female
		- Studies published between 2000 and 2019
		- Countries: mostly USA (36%) followed by Italy (16%)
		- Unit of analysis: individual
			- Focus: dog assisted interventions
			- Target group: older adults living in care facilities
			- Intervention's duration: 1 to 52 weeks
			- Session's duration: mostly between 30 to 90 min.
			- Frequency of sessions: mostly weekly
				- A reduction in loneliness were found in 5 studies that conducted dog assisted therapy interventions
				- A meta-analysis revealed a medium effect in favour of dog assisted therapy on reducing depressive or loneliness symptoms (pooled SMD = 0.66, 95%CI [0.21, 1.11]

16.	**Khosravi et al. (2016)** https://doi.org/10.1016/j.chb.2016.05.092	- Systematic review - Including 34 studies - Studies published between 2000 and 2015 - Countries: North America and Canada (15), European countries (8), Australia (2), other (3) - Unit of analysis: individual	- Focus: technology-based interventions - Target group: older adults	- General information and communication technologies: most studies reported significant decreased in loneliness - Robotic interventions were mostly effective - Playing Wii reduced loneliness

		- UCLA Loneliness Scale, De Jong-Gierveld Loneliness Scale		- Tele-care interventions showed reduced loneliness - Mixed results regarding social network sites
17.	**Ma et al. (2020)** https://doi.org/10.1007/s00127-019-01800-z	- Systematic review - Including 30 studies - *N* = 3,080 - Studies published between 1976 and 2016 - Countries: USA (13), Europe (11), Israel (3), China (2), Canada (1) - Unit of analysis: individual	- Focus: supported socialization, psychoeducation, social skills training, changing cognitions, mixed - Target group: people with mental health problems - Setting: individual (13), group (9), mixed (4) - Delivery of Intervention: online (4)	- Subjective social isolation interventions showed positive results in 2 out of 6 studies that used cognition modification, 1 out of 3 studies that used supported socialisation, 1 out of 4 studies that used social skills training/psychoeducation - Mixed interventions strategies to reduce subjective social isolation were non-significant - "In most trials in which subjective or objective social isolation was specifically targeted as the primary outcome, and interventions were tailored accordingly, positive results were reported: this specific focus may be important for intervention effectiveness" (p. 852) - No intervention focused on wider community approaches alone
18.	**Mann et al. (2017)**	- Systematic review	- Target group: people with mental health problems	- Only little research on loneliness interventions for people with mental health problems - Categorisation system: differentiating between

	https://doi.org/10.1007/s00127-017-1392-y			direct interventions (changing cognitions, social skills training and psychoeducation, supported socialisation or "socially-focused supporter", wider community approaches) and indirect interventions - Most promising evidence showed by changing cognition interventions, but no approach has a robust evidence yet
19.	**Morris et al. (2014)** https://doi.org/10.1111/ajag.12154	- Systematic review - Including 18 studies (but loneliness were only assessed in 5) - Studies published between 2000 and 2013 - Countries: mostly USA and the Netherlands - Unit of analysis: individual - UCLA Loneliness Scale (4)	- Focus: technology-based interventions - Target group: older adults	- Mixed effects of smart technology on loneliness, but the majority finds positive effects on loneliness - 3 studies reported lower loneliness in the experimental group compared with the control group - 1 study reported a significant decrease in loneliness after 3 years of intervention - 1 study could not find differences between the experimental group and control group
20.	**Pels & Kleinert (2016)**	- Systematic review - Including 37 studies - Age ranged from 14 to 18 years and above 64 years - Unit of analysis: individual	- Focus: physical activity interventions - Target group: adolescents (8) and older adults (15)	- 12 cross-sectional studies reported a direct negative association between physical activity and loneliness

	https://doi.org/10.1080/1750984X.2016.1177849	- UCLA Loneliness Scale (17), Loneliness and Social Dissatisfaction Questionannaire (6), De Jong-Gierveld Loneliness Scale (3), single item (8), qualitative method (1)		- Intervention studies: physical activity programs showed a decrease in loneliness compared to a non-active control group or a different intervention - Experimental study: "framing exercise as beneficial for health and framing exercise as beneficial for social skills - led to (...) a decrease in loneliness compared to a baseline measure"
21.	**Pu et al. (2019)** https://doi.org/10.1093/geront/gny046	- Systematic review - Including 11 studies - *N* = 1,042 - Studies published until 2017 - Countries: Denmark, Norway, New Zealand, United States, Australia, Japan, Spain - Unit of analysis: individual - UCLA Loneliness Scale	- Focus: social robots - Target group: older adults - Setting: group, individual - Intervention's duration: 5 to 12 weeks - Session's duration: 10 to 45 min.	- Two studies (conducted in NZ and USA, used Dog visits or "not receiving animal-assisted therapy" as a control) reported a decrease of loneliness
22.	**Quan et al. (2020)** https://doi.org/10.1080/13607863.2019.1673311	- Systematic review - Including 15 studies - Studies published between 2009 and 2019 - Countries: Taiwan (4), China (4), USA (1), New Zealand (1), Italy (1), Netherlands (1), Turkey (1), Egypt (1), Australia (1) - Unit of analysis: individual - UCLA loneliness scale (11), De Jong-Gierveld Loneliness Scale (2)	- Focus: leisure/skill development (6), psychological therapy (5), social facilitation (1), and animal support intervention (2) - Target group: older adults living in a long term care facility	- Psychological therapies and leisure/skill development interventions were most common in long term care facilities - 13 out of 15 studies reported a significant pre-post-difference or a significant difference between control and experimental group at post-time point - Loneliness score changes ranged from 3.6% to 25%

				- reduction in loneliness in the intervention group at follow-up - Largest pre-post-difference were reported from a laughter therapy intervention
23.	**Reinhardt et al. (2021)** https://doi.org/10.1177/1757913920967040	- Systematic review - Including 9 studies - At least *N* = 17,359 (age range: 16+ years) - Studies conducted between 2014 and 2019 - Countries: UK - Unit of analysis: individual - UCLA Loneliness Scale (3), Adult Social Care and Public Health Outcome Framework (1), Hawthorne Friendship Scale (1)	- Focus: social prescribing - No specific target group	- 2 studies reported less loneliness/more connectedness (interview) - 2 studies showed "changes in loneliness scores across the participant sample" - Highest reported impact: 69% of the sample reported feeling less lonely - Age: one study showed that the reduction in loneliness were larger for under 60 years old adults than 60+ years old people
24.	**Shvedko et al. (2018)** https://doi.org/10.1016/j.psychsport.2017.10.003	- Systematic review - Including 23 studies - N = 5,288 (mean age ranged from 51 to 82 years, 67 % female) - Studies published until 2017 - Countries: USA (7), UK (5), Japan (5), Australia (3), Taiwan (3), China (2), Canada (2), the Netherlands (2), New Zealand (1), Korea (1), Sweden (1), Denmark (1), Finland (1), Turkey (1), Spain (1), Brazil (1), Hungary (1), Georgia (1) - Unit of analysis: individual	- Focus: physical activity interventions - Target group: older adults - Setting: group (23), individual (10), mixed (5) - Intervention's duration: 6 weeks to 1 year - Session's duration: on average 45 to 60 min. - Frequency of sessions: on average 3 per week	- Physical activity interventions seem to be ineffective in reducing loneliness - Two studies compared the intervention setting group and individual regarding the outcomes social isolation and social networks: both showed no significant between group differences at follow-up - Other studies found that individual setting with non-physical activity interventions were more

		- single item question, UCLA loneliness scale and De Jong-Gierveld loneliness scale		effective in reducing loneliness in older adults
25.	**Williams et al. (2021)** https://doi.org/10.1371/journal.pone.0247139	- Systematic review - Including 58 studies (but loneliness were only measured in 45 studies) - Studies published between 1976 and 2018 - Countries: USA, Canada, UK, the Netherlands, China, Singapore, Turkey, Taiwan, Sweden, Hong Kong, Egypt - Unit of analysis: individual - UCLA Loneliness Scale, De Jong-Gierveld loneliness scale, single items	- Focus: leisure/skill development (20), psychological therapy (14), educational programmes (8), social facilitation (7), animal interventions (3), befriending interventions (3), health and social care provision (3) - Target group: older adults (51) and students (6)	- Psychological interventions seemed to be most effective: mindfulness-based interventions (2), weekly Tai Chi Qigong meditation class (1), and laughter therapy interventions (1) showed significant improvements - Robot-based animal interventions reported a significant improvement in loneliness (2), but animal, more specifically bird, based interventions were non-significant - Not effective were: befriending interventions and health and social care provision interventions, many of the leisure/skill development interventions - Interventions that were effective in nursing or care facilities: weekly interactions with robotic animal (2), Wii gaming (1), gardening (1), videoconferencing (2), cognitive/psychological interventions (3) - Female populations: effective in reducing loneliness were visual art

				discussions and neighbourhood group meetings - Student populations: effective in reducing loneliness were mindfulness-based therapies (2) and CBT (1)

26.	**Wilson et al. (2018)**
	
	https://doi.org/10.1093/occmed/kqy160
		- Systematic review
		- Including 17 studies:
		  • 12 quantitative
		  • 3 qualitative
		  • 2 mixed
		- Countries: USA (12), UK (1), Israel (4)
		- Unit of analysis: individual
		- UCLA Loneliness Scale, leave behind questionnaire, the loneliness scale, the Lubben social network scale
			- Target group: military veterans	- A community-based program for older veterans in the UK lacked evaluative evidence
				- Barriers that were mentioned by the veterans were lack of interest, confusion around available services, feeling of exclusivity for these services
				- Care farming as an intervention showed in two out of five veterans a decrease in loneliness

27.	**Chipps et al. (2017)** https://doi.org/10.1177/1357633X17733773	- Systematic second order review - Including 8 systematic reviews, 3 meta-analyses, 1 integrative review - Studies published between 2000 and 2017 - Unit of analysis: individual - UCLA Loneliness Scale, De Jong-Gierveld Loneliness Scale	- Focus: technology-based interventions - Target group: older adults	- The results of the primary RCT studies found no significant reduction in loneliness due to a computer/internet training - Videoconferencing interventions showed effective results in two quasi-experimental studies - The effectiveness of internet/computer training was mostly investigated using cross-sectional studies, which found

				"evidence for associations for reduced loneliness" - Conclusion: "training and the use of internet/computer e-Interventions were not supported with conclusive evidence"
28.	**Bornemann (2014)** (PDF) The impact of information and communication technology (ICT) usage on social isolation including loneliness in older adults. A systematic review. (researchgate.net)	- Meta-analysis - Including 5 studies - N = 455 - Studies published between 2002 and 2011 - Countries: the Netherlands (2), Israel (1), Taiwan (2) - Unit of analysis: individual - UCLA Loneliness Scale, De Jong-Gierveld Loneliness Scale	- Focus: technology use - Target group: older adults - Intervention's duration: 17 weeks to 3 years	- Internet and communication technology use and training showed no significant effects on loneliness - Standardized mean difference: *SMD* = -0.26, 95 % *CI* [-0.58, 0.06] - BUT: only one of the included single studies targeted people who were identified as being lonely - Methodological quality of the included studies were rated as very weak
29.	**Choi et al. (2012)** http://dx.doi.org/10.4258/hir.2012.18.3.191	- Meta-analysis - Including 5 quantitative studies: - *N* = 353 (age ranged from 66 to 83 years - Studies published between 2001 and 2012 - Countries: USA (2), the Netherlands (2), Israel (1) - Unit of analysis: individual - UCLA Loneliness Scale (2), De Jong-Gierveld Loneliness Scale (3)	- Focus: computer and internet training - Target group: older adults	- Computer and Internet training significantly decreased loneliness in older adults - Effect size Hedges *g* = .546, 95 % *CI* [0.03, 1.06]

30.	**Eccles & Qualter (2021)** https://doi.org/10.1111/camh.12389	- **Two meta-analyses:** 1. *k* = 14 single-group studies 2. *k* = 25 randomized control studies - *N* = 6,750 (age ranged from 3 to 25 years, 45 % female) - Studies published between 1980 and 2019 - Unit of analysis: individual - Loneliness and Social Dissatisfaction Questionnaire (24), UCLA Loneliness Scale (8), Peer Network and Dyadic Loneliness Scale (1), 16-item peer scale (1), Social and Emotional Loneliness Scale for Adults (1), LACA (1), Chinese College Loneliness Scale (1), Norway Loneliness Scale (1), Social Stress Scale (1)	- Target group: Children & youths **Single-group studies (*k* = 14):** - Focus: social skills (3), social and emotional skills (1), increased social interaction (3), enhancing social support (4), psychological therapies (2), social identity and acceptance (1) - Setting: group (9), individual (5) - Delivery of intervention: in-person (10), technology-based (4) **Randomized control trial studies (*k* = 25):** - Focus: social skills (5), social and emotional support (7), enhancing social support (4), psychological therapy (8), learning a new hobby (2) - Target group: Youth, at-risk clinical (13), at-risk nonclinical (5), general (7) - Setting: group (21), individual (4)	**Single-group studies (*k* = 14):** - Interventions were moderately successful in reducing loneliness scores in young people - Effect size Hedges *g* = .411, 95 % *CI* [0.25, 0.57] **Randomized control trial studies (*k* = 25):** - Effect size Hedges *g* = .316,95 % *CI* [0.19, 0.44] **Both:** - No significant differences between the intervention types (although the effect sizes of the different intervention types point that the interventions focusing on social and emotional skills, social skills training, psychological intervention might best reduce loneliness) - No significant differences in mean effect size depending on the use of technology (but the interventions delivered in person showed larger effect sizes)

			- Delivery of intervention: in-person (22), technology-based (3)	- Age, gender, and target sample were no significant moderators
31.	**Hickin et al. (2021)** https://doi.org/10.1016/j.cpr.2021.102066	- Meta-analysis - Including 18 studies - Studies published between 2003 and 2020 - *N* = 3039 (M_{age} = 45.20, 62.47 % female) - Countries: USA (13), China (2), Taiwan (2), the Netherlands (2), Sweden (1), South Africa (1), Australia (1), Japan (1), Israel (1), UK (1), Canada (1), Italy (1) - Unit of analysis: individual - UCLA Loneliness Scale (19), De Jong-Gierveld Loneliness Scale (4), Illinois Loneliness Scale (2), Chinese College Student Loneliness Scale (1), Social and Emotional Loneliness Scale for Adults (1), Patient-reported Outcomes Measurement Informational System (1)	- Focus: cognitive behavioral therapy techniques (9), integrative (6), mindfulness-based (3), social skills training programs (3), gratitude intervention (1), reminiscence therapy (1) - Setting: group (16), individual (8), combination of group and individual (7), face-to-face (24), via phone or internet (7) - Intervention's duration: between 5 days and 52 weeks (*M* = 10.11 weeks) - Session's duration: 1 or 2 hours - Frequency of sessions: mostly weekly - Sessions per intervention: *M* = 9.94	- Psychological interventions significantly reduced loneliness compared to control groups ($p < .001$) - Effect size Hedges g = 0.43, 95 % *CI* [0.18, 0.68] - Whether interventions were CBT-based did not significantly influence the loneliness outcome - Age and gender of the participants were no significant moderators
32.	**Lasgaard et al. (unpublished)**	- Meta-analysis - Including 128 studies - *N* = 12,270 - Studies published between 1980 and 2020 - Continents: Northern America (64), Western Europe (36), Middle East (14), Asia (11)	- Focus: social support (54), social network (53), social and emotional skills training (42), psychological treatment (33), psychoeducation (12) - No specific target group	- The effect of loneliness interventions can be rated as small to moderate - Psychological treatment, social support and social and emotional skills training seemed to be the most effective intervention

		- Unit of analysis: individual - UCLA Loneliness Scale (87), De Jong-Gierveld Scale (28), other loneliness measures (16), single-item (5)	- Setting: group (91), individual (39), group and individual (6) - Delivery of Intervention: in person (111), digital (25)	strategies (but no differences in RCTs found) **Short term effects:** - RCTs (54, n = 6379): significant moderate short-term effect of loneliness interventions: *SMD* = -0.47, 95% *CI* [-0.33, -0.61], $p < .001$ - multi-cohort (23, n = 2882): significant small short-term effect of loneliness interventions: *SMD* = -0.24, 95% *CI* [-0.12, -0.36], $p < .001$ - single-cohort (48, n = 3009): significant moderate short-term effect of loneliness interventions: *SMD* = -0.42, 95% *CI* [-0.31, -0.53], $p < .001$ - Age group, setting (group vs. individual) and delivery format (digital vs. non-digital) were no significant moderators across all study designs regarding the short-term effects of loneliness interventions - Interventions strategy: multi-cohort studies reported a significant larger effect of psychological treatment interventions ($p = .046$) while single-cohort studies

				showed a stronger effect of social support interventions (p = .004); but both study designs reported smaller effects of social network interventions **Long-term effects:** - RCT (18, n = 1826): significant moderate long-term effect: *SMD* = -0.49, 95% CI [-0.23, -0.76], p < .001 - Multi-cohort (9, n = 557): small significant long-term effect: *SMD* = -0.22, 95% CI [-0.05, -0.40], p = .01 - Single-cohort (14, n = 785): small to moderate long-term effect: *SMD* = -0.32, 95% *CI* [-0.06, -0.59], p < .001
33.	**Masi et al. (2011)** https://doi.org/10.1177/1088868310377394	- Meta-analysis - Including 50 studies - Studies published between 1970 and 2009 - Unit of analysis: individual - UCLA Loneliness Scale, De Jong-Gierveld loneliness scale, emotional/social loneliness inventory, social and emotional loneliness scale, loneliness and social dissatisfaction questionnaire, Asher loneliness scale,	- Focus: improving social skills, enhancing social support, increasing opportunities for social contacts, addressing maladaptive social cognition (social cognitive training) - No specific target group **Single-group pre-post designs (*k* = 12**	- Dividing interventions in four categories: social contact, social support, social skills and maladaptive social cognition **Single-group pre-post designs (*k* = 12):** - Interventions seem to be effective in reducing loneliness: mean effect

		Philadelphia geriatric morale scale on lonely dissatisfaction, Paloutzian and Ellison loneliness scale, single item	- Setting: individual (3), group (9) - Delivery of intervention: technical (2), non-technical (10) **Nonrandomized group comparison design (*k* = 18)** - Setting: individual (4), group (14) - Delivery of intervention: technical (6), non-technical (12) **Randomized group comparison design (*k* = 20)** - Setting: individual (10), group (10) - Delivery of intervention: technical (7), non-technical (13)	size = -0.367, 95 % *CI* [-0.55,-0.18], *p* < .001 - Type of loneliness measure significantly moderated the effect size: studies using the UCLA loneliness scale reported higher effect sized than studies using another loneliness measure - No significant moderators: intervention type, age, gender, intervention duration, number of intervention sessions **Nonrandomized group comparison design (*k* = 18)** - Interventions seem to be effective in reducing loneliness: mean effect size = -0.459, 95 % *CI* [-0.72, -0.20], *p* < .01 - Group-based interventions showed larger effect sizes than individual formats, but this difference is not significant - Technology was a significant moderator: mean effect size of technology usage was -1.04 and without technology -0.21 (*p* = .02) indicating that technology formats achieve a higher reduction in loneliness

				- Type of loneliness measure significantly moderated the effect size: studies using the De Jong-Gierveld questionnaire showed the smallest effect sizes (p < .01) - Gender: percentage of females correlated negatively with the effect size (b = 1.59, z = 3.15, p < .01) - Age: mean age of the sample correlated negatively with the effect size (b = 0.01, z = 1.93, p = .05) - No significant moderators: intervention type, intervention duration and number of intervention sessions **Randomized group comparison design (k = 20)** - Mean effect size = -0.198, 95 % *CI* [-0.32, -0.08], p < .01 - 6 studies were effective in reducing loneliness (but 14 studies showed no significant decrease in loneliness) - Intervention type was a significant moderator (p = .05): social cognitive training interventions

				achieved greater loneliness reduction - Gender were a significant moderator: a higher percentage of females showed a smaller decrease in loneliness - No significant moderators: group vs. individual, the usage of technology and the instrument to measure loneliness were no significant moderators
34.	**McElfresh et al. (2021)** https://doi.org/10.1080/07347332.2020.1867690	- Meta-analysis - Including 6 studies - N = 465 (age ranged from 18 to 83 years) - Studies published until 2019 - Countries: USA (6), Iran (1), Japan (1) - Unit of analysis: individual - UCLA Loneliness Scale (8)	- Focus: group interventions, telephone-based interventions, web-based interventions - Target group: adult cancer survivors - Setting: group (4), individual (4) - Delivery of Intervention: via telephone (3), via an internet platform (1) - Intervention's duration: 6 weeks to 13 months	- Overall the effect size indicates that interventions significantly reduced loneliness in cancer survivors: effect size Hedges g = -.32, , 95% CI [-0.50, -0.14], p < .001 - Weekly two-hour classes (8 weeks) and cognitively-based compassion training showed no difference in loneliness reduction between the participants and a wait-list control group - Effective interventions: creating a personal website + workshop (computer skills), telephone-based psychotherapy (only small effect, d = 0.19; 95 % CI [-0.34, 072]; p = 0.21)
35.	**Shah et al. (2021)**	- Meta-analysis - Including 5 studies	- Focus: technology-based interventions	- Follow-up at 3 months: no significant reduction of

	https://doi.org/10.2196/24712	- *N* = 646 (age ranged from 73 to 78 years, 66.1% female, 23.8% male) - Studies published between 2010 and 2019 - Countries: the Netherlands (1), UK (1), USA (1), Sweden (1), Taiwan (1), South Africa (1) - Unit of analysis: individual - UCLA Loneliness Scale (4), De Jong-Gierveld loneliness scale (2)	- Target group: older adults - Delivery of Intervention: 3 to 12 months	loneliness compared to the control group (*k* = 3, *N* = 106, *SMD* = 0.02; 95% *CI* [−0.36, 0.40]) - Follow-up at 4 months: no significant reduction in loneliness in the intervention group compared to the control group (*k* = 2, *N* = 105, *SMD* = −1.11; 95% *CI* [−2.60, 0.38]) - Follow-up at 6 months: small not-significant reduction in loneliness compared to the control group (*k* = 2, *n* = 280, *SMD* = −0.11; 95% *CI* [−0.54, 0.32]) - Conclusion: no evidence for the effectiveness of digital technology interventions that aim to reduce loneliness
36.	**Virués-Ortega et al. (2014)** https://doi.org/10.1080/17437199.2010.534965	- Meta-analysis - Including 21 studies (but only 4 measured loneliness) - Studies published between 1975 and 2009 - Countries: mostly USA - Unit of analysis: individual	- Focus: animal assisted therapy - Target group: older adults - Setting: individual (3), mixed (1) - Intervention's duration: 1.4 weeks to 26 weeks - Frequency of sessions: weekly to permanent	- No significant effects of animal assisted therapy interventions on loneliness - Pooled effect size: -0.27, 95% CI [-0.97, 0.43], p = .45 - Effect size when including only studies with a control group: -0.08, 95% CI [-0.95, 0.80], p = .87
37.	**Zagic et al. (2021)**	- Meta-analysis - Including 58 studies	- Focus: social skills training (2), social support (26), social	- Psychological interventions showed significantly decreasing deficits in

	https://doi.org/10.1007/s00127-021-02191-w	- N = 8,780 (age ranged from 18 to 103 years, 69.2 % female) - Studies published between 1980 and 2020 - Unit of analysis: individual	access (15), psychological (16) - Target group: adults - Setting: individual (23), group (27), mixed (7) - Delivery of Intervention: technology-based (16), non-technology-based (41), mixed (2) - Intervention's duration: M = 15.5 weeks - Sessions per Intervention: M = 13.5 (ranged from 1 to 75)	perceived quality of social connections (*k* = 12, *g* = -0.53, 95 % *CI* [-0.79, -0.26]) - Not significant were social support interventions (*k* = 10, *g* = -0.24, 95 % *CI* [-0.61, 0.14]) and social access interventions (*k* = 8, *g* = -0.13, 95 % *CI* [-0.41, 0.17]) - Young adults showed the greatest decline in deficits in perceived quality of social connections (*k* = 7, *g* = -0.34, 95 % *CI* [-0.60, -0.08]) - Group setting showed a significant reductions in deficits in perceived quality of social connections (*k* = 15, *g* = -0.41, 95 % *CI* [-0.63, -0.18]), but individual and a combinations of individual and group sessions showed no significant effect - Non-technology based interventions (*k* = 21, *g* = − 0.37, 95 % *CI* [− 0.62, − 0.13]) and technology-based interventions (k = 11, *g* =− 0.24,95 % *CI* [− 0.48, − 0.01]) showed a significant decrease in deficits in perceived quality of social connections

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