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Interventions to address loneliness and social isolation in young people: A systematic review of the evidence on acceptability and effectiveness

Tom Osborn[a,b], Peter Weatherburn[a], Rebecca S French[a]

a *Department of Public Health, Environments and Society, Faculty of Public Health and Policy, London School of Hygiene and Tropical Medicine, 15- 17 Tavistock Place, London, WC1H 9SH, UK*

b *Division of Psychology and Language Sciences, Faculty of Brain Sciences, UCL, 26 Bedford Way, London, WC1H 0AP, UK*

Abstract

Introduction: Loneliness is prevalent and associated with negative health outcomes in young people. Our understanding of how it can be best addressed is limited. This systematic review aims to assess the acceptability and effectiveness of interventions to reduce and prevent loneliness and social isolation in young people.

Methods: Six bibliographic databases were searched; references of included studies were screened for relevant literature. A pre-defined framework was used for data extraction. Quality appraisal was performed using the Mixed Method Appraisal Tool. Data were synthesised narratively.

Results: 9,358 unique references were identified; 28 publications from 16 interventions met the inclusion criteria. The majority of interventions were high intensity, individual or small group interventions, often targeted at specific 'at risk' populations. While 14 interventions were associated with a statistically significant reduction in loneliness or social isolation, the heterogeneous measures of loneliness, small sample sizes, short periods of follow-up and high attrition rates limit evidence on effectiveness. Interventions implemented in more general populations of young people appeared more acceptable than those in specific 'at risk' populations.

Conclusion: High intensity interventions are unlikely to be feasible at a population level. Further work is required to develop and evaluate theoretically-informed loneliness interventions for young people that reach wider audiences.

Keywords: young people; loneliness; intervention; effectiveness; acceptability; systematic review.

Implications and Contributions

- Interventions designed for general populations of young people tended to be most acceptable, but evidence to support replicability was very limited.
- The ability to reduce or prevent loneliness or social isolation in the longer term was not supported by current evidence.
- Further research is required to develop understanding of how young people conceptualise loneliness and social isolation, and their wider determinants, to inform theoretically-based interventions.

Introduction

Loneliness has been identified as an important public health issue, especially for older people (Malcolm et al., 2019; Scottish Public Health Network, 2017) but its impact among young people is gaining recognition. Up to 80% of young people report ever having experienced loneliness (Hawkley & Cacioppo, 2010), and around one in ten report "often" feeling lonely (Snape, 2018). In the United Kingdom (UK), organisations including, the National Society for the Prevention of Cruelty to Children (NSPCC), the Mental Health Foundation, Co-operative Foundation and the Children's Society, all identify actions to address loneliness among young people as a priority (Mental Health Foundation, 2010; Hutchinson & Woods, 2010; Co-op Foundation, 2018; The Children's Foundation, 2019).

Loneliness can be defined as a social pain resulting from a perceived deficit in the quality or quantity of an individual's social connections (Cacioppo & Hawkley, 2009; Matthews, Odgers, et al., 2019). This refers not only to a person's individual relationships but also to larger social entities, such as local communities (Hawkley et al., 2005; Matthews, Odgers, et al., 2019). Loneliness can be experienced in a mass of people and when one is by oneself (Perlman & Peplau, 1981). In the 1970s, Weiss theorised that different interactions provide different types of social support: parents for guidance, peers to form a sense of social integration and romantic partners may provide more stable attachment in adulthood (Weiss, 1973). More recently, loneliness has been seen from an evolutionary perspective, with human connection theorised as a survival need (Cacioppo & Cacioppo, 2018). Social isolation is often referred to interchangeably with loneliness, but it is distinct and refers to the "inadequate quality and quantity of social relations with other people at the different levels human interaction takes place" (Malcolm et al., 2019; Zavaleta et al., 2014). Both loneliness and social isolation are related to other concepts: social support, social networks, types of social capital, and alienation (Mann et al., 2017). Crucially, loneliness and social isolation have been associated with negative health outcomes (Hawkley & Cacioppo, 2010; Zavaleta et al., 2014). Despite loneliness being a common, universal experience for all human beings (Rotenberg & Hymel, 1999), chronic loneliness has consistently been shown to be distressing and deleterious to a person's physical and mental health (Caspi et al., 2006; Hawkley & Cacioppo, 2010; Matthews, Danese, et al., 2019).

Population-based research indicates that the distribution of loneliness across age groups in the UK and Denmark is U-shaped, being most prevalent below the age of 25 and above the age 65 (Lasgaard et al., 2016; Victor & Yang, 2012). Living in a deprived area, being

unemployed, having a low educational level and prolonged mental ill-health are associated with severe loneliness below the age of 25 (Lasgaard et al., 2016). Young people may be vulnerable to loneliness due to genetic, cognitive, social and cultural factors (Pitman et al., 2018). High value is often placed on friendship and romantic relationships at this age (Moore & Leung, 2002). Adolescence and young adulthood involves numerous big life transitions, such as leaving the parental home, when economic independence and forming an independent sense of identify can lead to changes in the quantity and quality of personal interactions (Heinrich & Gullone, 2006; Moore & Leung, 2002). Since the onset of the Covid-19 pandemic and the introduction of physical distancing measures young people are likely to be at increased risk of loneliness (Bu et al., 2020). The mechanisms by which loneliness leads to poor health outcomes are thought to be through changes in health behaviours, poor sleep, physiological responses to stress, social skills deficits, physical social connection and cognitive processes (Hawkley & Cacioppo, 2010; Moeller & Seehuus, 2019). Loneliness may be exacerbated by factors including social exclusion, discrimination, stigma, some forms of social media use, and moderated by factors such as trust (Hunt et al., 2018; Matthews, Odgers, et al., 2019; Moeller & Seehuus, 2019; Pitman et al., 2018; Teppers et al., 2014; Thomas et al., 2020). Furthermore, loneliness may be exacerbated by the pressure to be connected, mediated by factors such as low self-esteem (Matthews, Danese, et al., 2019; Pitman et al., 2018). However, these influences are often context-specific, varying between individuals, groups and cultures, and over time.

Cross-sectional research has demonstrated associations between loneliness and physiological changes and mental health problems (Hawkley & Cacioppo, 2010). In young people, the persistent and painful experiences of chronic loneliness are associated with both immediate and longer-term poor health outcomes (Caspi et al., 2006; Matthews, Danese, et al., 2019; Pitman et al., 2018). For example, in this age group chronic loneliness has been linked to depression, suicidal ideation, and correlated with anxiety, social phobias, self-harm and eating disorders (Lasgaard et al., 2011). However, it is difficult to determine the direction of many of these associations. Longitudinal research from the USA, UK and New Zealand has found lonely and socially isolated young people were significantly more likely to go on to develop cardiovascular risk factors, mental health issues and poor coping strategies in adulthood compared to those who were not (Caspi et al., 2006; Goosby et al., 2013; Matthews, Danese, et al., 2019). In a UK study, bullying, mental health issues and having lower self-esteem were more commonly experienced during childhood and adolescence among those reporting loneliness and social isolation at aged 18 (Matthews, Danese, et al., 2019). This

suggests that the relationship can be bi-directional, where poor health outcomes can lead to loneliness and loneliness can undermine health.

Research on loneliness and social isolation in older populations (Cattan et al., 2005; Cohen-Mansfield & Perach, 2015; Dickens et al., 2011; Findlay, 2003; O'Rourke et al., 2018; Windle et al., 2011), individuals with mental health problems (Mann et al., 2017), and across the life-course has suggested promising interventions (Masi et al., 2011). This research identified broad goals beneficial to addressing loneliness: improving social skills, enhancing social support, supported socialisation, increasing opportunities for social contact, and addressing maladaptive social cognitions. Interventions addressing maladaptive cognitions have the strongest evidence of effectiveness (Mann et al., 2017; Masi et al., 2011). The interventions to achieve these goals include: personal contact, counselling, education, befriending and mentoring, technological solutions to enhance social contact, social group schemes, community engagement projects and gatekeeper programmes that connect individuals to support services (Cattan et al., 2005; Cohen-Mansfield & Perach, 2015; Dickens et al., 2011; Findlay, 2003; O'Rourke et al., 2018; Windle et al., 2011).

Aim

The aim of this systematic review is to assess the acceptability and effectiveness of interventions that seek to prevent or reduce loneliness and/or social isolation in young people. The review asked three research questions:

1. What types of interventions to address loneliness and/or social isolation do young people find acceptable?
2. What types of interventions reduce the prevalence of loneliness and/or social isolation in young people?
3. Are there particular populations and/or settings where interventions are most effective and acceptable?

Method

A search strategy was developed based on the PICO (Population, Intervention, Comparator and Outcome) framework. Keywords and medical subject headings (MeSH) centred around three concepts: young people, intervention, and loneliness and social isolation (for a full search strategy, please see Supplementary Material). The following databases were searched: psycINFO, MEDLINE, Embase, CINAHL, Global Health and ADOLEC. The strategy

did not specify a particular time frame for the inclusion of articles. An initial search was conducted on 13th February 2018, repeated on the 8th February 2019 and on the 20th of November 2020 to identify any recently published research. Due to ADOLEC's limited search interface a 'print off' was created from the search results to manually check titles. Results from the remaining databases were exported directly to Endnote. Hand searching of reference lists of the included studies was undertaken. In addition, authors of four studies identified from abstracts were contacted to determine whether their studies met the inclusion criteria. Titles were individually screened for relevance to the research questions. A random sample of titles and abstracts (n=100 records) were screened by two authors (TO and RF). Inter-rater reliability (Cohen's Kappa) was 0.88, indicating near perfect agreement. Titles with no clear relevance were immediately excluded and duplicates removed. Abstracts with relevance to the research questions were put forward for full text review against the inclusion and exclusion criteria.

Inclusion and exclusion criteria

Inclusion criteria

1. Quantitative studies that used a comparator, such as before and after, non-experimental, and experimental designs to assess the effectiveness of an intervention.
2. All types of empirical studies, including qualitative, quantitative and mixed methods research to assess acceptability, and understand the setting where an intervention was implemented.
3. Studies with sample participants aged 10 to 25 years.
4. Studies where loneliness and social isolation were primary or secondary outcomes of the research.
5. Peer-reviewed literature published in English.

Exclusion criteria

1. Studies where only the abstract was available.
2. Studies with a broader age range where it was not possible to extract data for 10 to 25-year olds.

Data Extraction

A data extraction form was developed based on the concepts in the aim and research questions to maintain consistency. Data corresponding to each intervention were extracted, including: study participants and setting characteristics, geographical location, intervention

characteristics using an adapted version of the TIDieR checklist (Hoffmann et al., 2014), study design, data collection and data generation methods, data analysis methods, changes in the quantitative effectiveness measures over time, qualitative findings and results related to acceptability. The framework included all 12 items in the TIDieR checklist. Two additional items were included asking how the intervention was developed, and whether the intervention aimed to address loneliness or social isolation directly or indirectly by resolving another related issue. This framework was refined until all three reviewers (TO, RF, and PW) agreed on the structure. TO extracted data on all studies identified for inclusion, with RF and PW dividing the studies equally between them. Where there were disagreements between pairs the third reviewer (PW or RF) was consulted until agreement was reached.

Quality Appraisal

The review utilised the Mixed Method Appraisal Tool (MMAT) to assess the quality of included studies (Hong et al., 2018). This was chosen due to the expected heterogeneity of the designs and methods used to evaluate these types of interventions. The tool initially asks the reviewer to identify whether the study is empirical research through two screening questions. The MMAT then prompts the user to identify the study design and answer five corresponding questions to establish its methodological quality (see table 2).

Classifying the Interventions

The Behaviour Change Wheel (BCW) was initially chosen to classify the interventions, as it has been applied reliably to other public health interventions (Michie et al., 2011). The BCW asks you to first establish the intended purpose of the intervention (i.e, usually increasing motivation, capability or opportunity); then who is delivering the intervention; then requires you to code the intervention (i.e., "activities aimed to change behaviour") out of nine possible functions, and the policy requirements (i.e., 'actions by responsible authorities that enable or support interventions') out of a possible seven (Michie et al., 2011). However due to the limited depth and breadth of the intervention descriptions this could not be performed reliably. Therefore, the interventions were classified using the data extracted by: i) whether the intervention attempted to address loneliness or social isolation or both, ii) what activities were involved in the intervention, and iii) based on established definitions (Hillier-Brown et al., 2014), whether the intervention was delivered at individual, community or structural levels.

Data Synthesis and Analysis

A narrative synthesis was conducted (Popay et al., 2006). Meta-analysis or thematic synthesis were not possible due to the significant heterogeneity of the included study designs, outcome measures and limited breadth and depth of qualitative data. First, the classifications of the interventions; descriptions of their target populations and settings, and the authors' findings related to acceptability and effectiveness of the intervention were tabulated. Those studies deemed effective, based on a change in the quantitative outcome significant at the 5% level, and not effective, and those acceptable and not acceptable with the target population were grouped separately. Comparisons were then made between the groups, summarising any differences and similarities. These findings were assessed qualitatively based on the findings from the MMAT.

Results

Results of the Search Strategy

Academic database searches identified 11,214 publications. In total, 1,856 duplicates were removed. After screening the remaining titles, 235 abstracts were reviewed in full with 47 of these suitable for full text review. Of these 30 were excluded, leaving 17 papers in the review. Hand-searching of the included studies reference lists identified a further 11 publications. As a result of these search strategies 28 publications arising from 16 different studies were included in the review (see Figure 1).

Figure 1 PRISMA flow diagram of study selection process
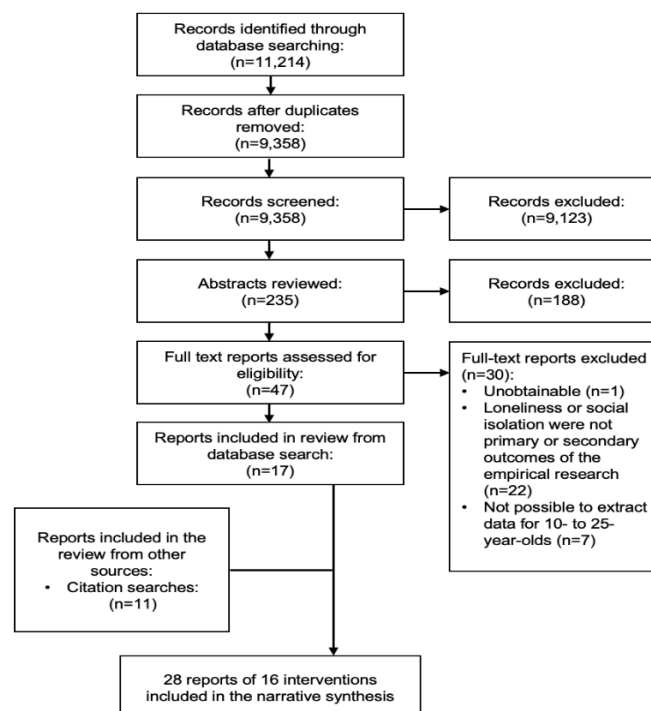
Intervention Characteristics

Table 1 provides a summary of the 16 studies and their associated papers. None of the intervention descriptions had a complete account of their underlying theoretical framework or likely mechanisms of action related to loneliness and/ or social isolation and most described the intervention components (aim, objective, setting, target group, resources required) relatively sparsely. The included interventions were heterogeneous in their design: 11 were delivered at an individual level (Alvarez-Jimenez et al., 2020; Bruehlman-Senecal et al., 2020; Coelho et al., 2017; Gantman et al., 2012; Lim et al., 2020; Lim et al., 2019; Orkibi et al., 2017; Rice et al., 2020; Saulsberry et al., 2013; Stewart et al., 2011; Zhang et al., 2018), with two of these having a community element (Alvarez-Jimenez et al., 2020; Rice et al., 2020), and one having a structural element (Coelho et al., 2017), and five were delivered solely at community level (Afsharnejad et al., 2020; Maslow et al., 2013; Matthews et al., 2018; Smith et al., 2017; Stewart et al., 2009). One targeted social isolation (Coelho et al., 2017), whereas the remaining 15 targeted loneliness (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Bruehlman-Senecal et al., 2020; Gantman et al., 2012; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Orkibi et al., 2017; Rice et al., 2020; Saulsberry et al., 2013; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009; Zhang et al., 2018). Apart from one school-based intervention that targeted all young people in the setting (n=628) (Coelho et al., 2017), all other interventions were delivered too small to modest (n=20 to 221) numbers of young people. Four targeted more general populations of young people, two in schools (Coelho et al., 2017; Orkibi et al., 2017), and two in university (Bruehlman-Senecal et al., 2020; Zhang et al., 2018), however two of these interventions pre-screened individuals to determine their need for the intervention (Orkibi et al., 2017; Zhang et al., 2018). The remaining 12 targeted specific sub-groups of young people hypothesised to be more vulnerable to loneliness because of: homelessness (Stewart et al., 2009), their sexual identity (Smith et al., 2017), mental health problems (Alvarez-Jimenez et al., 2020; Lim et al., 2020; Lim et al., 2019; Rice et al., 2020; Saulsberry et al., 2013), chronic health conditions (Maslow et al., 2013), physical disability (Stewart et al., 2011), or an autism spectrum disorder (Afsharnejad et al., 2020; Gantman et al., 2012; Matthews et al., 2018).

Most interventions incorporated multiple activities as part of their approach to address loneliness and/or social isolation (Afsharnejad et al., 2020; Bruehlman-Senecal et al. 2020; Coelho et al., 2017; Gantman et al., 2012; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Orkibi et al., 2017; Rice et al., 2020; Saulsberry et al., 2013; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009; Zhang et al., 2018). For example, The Adolescent Leadership Council (TALC) provided social support from peers and

professionals, sought to develop social skills through developing community projects and provided opportunities for social contact throughout the intervention (Maslow et al., 2013). The interventions were delivered across a range of time frames, between a week and two years (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Bruehlman-Senecal et al., 2020; Coelho et al., 2017; Gantman et al., 2012; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Orkibi et al., 2017; Rice et al., 2020; Saulsberry et al., 2013; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009; Zhang et al., 2018). In 12 of the interventions, the content was pre-determined but contained some adaptable elements (Afsharnejad et al., 2020; Alverez-Jimenez et al., 2020; Bruehlman-Senecal et al., 2020; Coelho et al., 2017; Gantman et al., 2012; Lim et al., 2020; Lim et al., 2019; Matthews et al., 2018; Rice et al., 2020; Saulsberry et al., 2013; Smith et al., 2017; Zhang et al., 2018). For example, participants in Project Positive Attitude received lessons from a curriculum, but the choice of lessons were based on a needs assessment of each class (Coelho et al., 2017). The content of the remaining four interventions were nearly entirely adapted, within the overall framework of the intervention, to meet participants' needs (Maslow et al., 2013; Orkibi et al., 2017; Stewart et al., 2011; Stewart et al., 2009). For example, the Psychodrama intervention used tailored arts therapy based on the needs of each participant (Orkibi et al., 2017). All interventions consisted of multiple sessions or modules, ranging from eight to 22 (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Bruehlman-Senecal et al. 2020; Coelho et al., 2017; Gantman et al., 2012; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Orkibi et al., 2017; Rice et al., 2020; Saulsberry et al., 2013; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009; Zhang et al., 2018). These sessions or modules were either fixed in length ranging from five minutes to four hours, or were flexible and participants could take their time completing them. Thirteen interventions involved a health or mental health professional or para-professional in the delivery, with four also explicitly involving peers (Maslow et al., 2013; Matthews et al., 2018; Smith et al., 2017; Stewart et al., 2009). Three digital interventions were self-directed (Bruehlman-Senecal et al., 2020; Lim et al., 2020; Lim et al., 2019). The fidelity of two interventions was reported (Maslow et al., 2013; Saulsberry et al., 2013), and one stated that fidelity was assessed, but how was not reported in the manuscript (Gantman et al., 2012). One study had such a limited intervention description, it was impossible to understand what had been done to address loneliness and social isolation (Orkibi et al., 2017).

Table 1: Characteristics of the Included Interventions

Intervention (Associated references)	Target of the Intervention	Level of Intervention Delivery	Intervention Description	Intervention Strategies Activities	Who Delivered the Intervention
Project Positive Attitude (Coelho et al., 2011; Coelho et al., 2015; Coelho et al., 2017; Coelho et al., 2017b)	n=628, 11–17-year-old male and female school students in school districts in Torres Vedras near Lisbon, Portugal.	Individual and Structural	An intervention drawing on social learning theory and Affective, Behavioural, Cognitive, Dynamic model of development. The intervention aimed to improve social and emotional competence of school pupils through a social and emotional learning programme (SEL). It did so through the promotion of self-management and relationships skills, developing and enhancing social awareness, and responsible decision-making. The SEL programme consisted of 13-week modular course of 45-minute sessions delivered in the classroom to students. The content of each module was fixed, but the choice of modules was based on the needs assessment of each class.	The main components: 1. Presentation and information on the intervention 2. Needs assessment of the school classes and on-going evaluation throughout the programme 3. The SEL programme with training for those delivering the intervention 4. "Positive transition": support for students transiting from elementary to middle school 5. Positive Attitude website with news about the programme, information and contact details of the staff 6. The integration of the SEL principles into all school activities 7. Active and public support of the school principle	• Trained psychologist • Class directors • Teachers

PEERs (Gantman et al., 2012)	n=12, 18–23-year-old male and females with autistic spectrum disorders. This took place in homes and buildings around University of California Los Angeles (UCLA), Los Angeles, United States of America (USA)	Individual	An intervention with no explicit theoretical basis aiming to improve social skills, social function and decrease loneliness. The programme consisted of 14 weekly, 90-minute lessons. The content was fixed, although the role-plays were adaptable.	The main components: 1. Didactic lessons using Socratic questioning to increase participation 2. Role play during lessons 3. Feedback on role play 4. Homework assignments to practice the social skills learnt in the lessons 5. Troubleshooting any issues encountered from homework assignments	• Trained psychologist • Caregivers
Project PRIDE (Smith, et al., 2016; Smith, et al., 2017)	n=33, 18–25-year-old gay, trans, pan and bisexual men HIV negative men who had one episode of condom less anal sex in the last three months. It took place in gay village areas of Toronto and Montreal, Canada.	Community	An intervention drawing on the theory of stress and coping, theory of minority stress and cognitive behavioural principles developed with gay and bisexual men in focus groups and with community advisory boards. It aimed to promote resilience in participants by developing effective coping strategies for dealing with minority stress to promote sexual health, reduce drug and alcohol use, ameliorate negative mental health outcomes and provide social support to reduce loneliness (thought to be a risk factor for the other issues). The programme consisted of 8, 2.5-hour sessions; content was fixed, although participants could identify their own goals.	The main components: 1. 8 group peer facilitated sessions providing education on the theories underlying the intervention and how they interact with health issues 2. Developing individual short- and long-term coping goals 3. Identifying motivators for and contexts that promote health behaviours	• Peer facilitator of similar age and sexual orientation • Psychologist or doctoral students in counselling psychology

| The Adolescent Leadership Council (TALC)

(Maslow, 2013) | n=20, adolescents aged 13-19 with a chronic health condition in a hospital and community setting in Rhode Island, USA. | Community | An intervention drawing on Positive Youth Development theory aiming to engage young people in leadership activities while developing long-term relationships with adults who possess the important life skills necessary to take care of their medical condition.

The programme consisting of monthly 2.5-hour dinner groups. The structure was fixed, whereas the discussions and activities were adaptable. | The main components:

1. Monthly two- and half-hour dinner meetings with participants and mentors with chronic health conditions led by resident doctors
2. Discussion groups taking place in the dinners to discuss a chosen topic
3. Participants were encouraged to act as leaders to design strategies to reach out to the broader community to educate others about the chosen topic
   • Topics included:
     o Diagnosis
     o Living with an illness
     o Interacting with doctors
     o School issues
     o Friends
     o Family relationships | • Program director
• Mentors who had previously participated in the intervention
• Healthcare professionals
• Enablement |

PEERs and PEERs with peers (Matthews et al., 2018)	n=44, 13–17-year-old male and female individuals with autistic spectrum disorders in the community (unspecified setting)	Community	An intervention with no specified theoretical basis aiming to improve social skills, social function and decrease loneliness with peer mentors with ASD. The programme delivered in 14 weekly, 90-minute lessons. Content was fixed, although the role-plays were adaptable. Peer led arm of the intervention: • One peer mentor for every adolescent participant • Peers delivering all main components of the intervention, excluding homework assignments	The main components: 1. Didactic lessons using Socratic questioning to increase participation 2. Role play during lessons 3. Feedback on role play 4. Homework assignments to practice the social skills learnt in the lessons 5. Troubleshooting any issues encountered from homework assignments	• Psychologists • Counsellor and behaviour analyst • Peer mentors with autism spectrum disorders
Psychodrama Intervention (no name) (Orkibi, 2017)	n=40, 13–16-year-old male and female school students 'deemed high risk' of loneliness by a psychologist within a school in a low socio-economic area of Israel	Individual	An intervention with an unclear theoretical basis aiming to develop to a positive self-concept through "social sense of competence" and to decrease loneliness. The programme was delivered across 16-22, 90-minute sessions. The structure and content was adaptable based on the needs of the participants.	The main components: 1. Needs assessment of each adolescent prior to their inclusion in the intervention 2. Therapist delivered arts-based psychodrama intervention to groups of students	• Therapist

Competent Adulthood Transition with Cognitive-Behavioural, Humanistic and Training (CATCH-IT) (Landback, et al. 2009; Saulsberry, et al. 2012; Van Voorhees, et al., 2007; Van Voorhees, et al., 2008; Van Voorhees, et al., 2009; Van Voorhees, et al., 2009b)	n=84, 14–21-year-old male and female individuals at risk of depression in Midwest and Southern, USA. The intervention took place in primary care facilities and patient's homes	Individual	An internet-based intervention drawing on behavioural activation, cognitive behavioural and interpersonal psychotherapy theories, and theory of reasoned action and resiliency concept. The intervention aimed to use goal setting, identify and reduce behaviour associated with increased vulnerability to depressive disorders, identify and develop protective behaviours associated with depressive disorders and provide motivational. It was unclear how it aimed to reduce loneliness or social isolation. The programme was internet based, consisting of 11 modules participants could complete in their own time. The structure and content were fixed, although participants could focus on modules, they felt were important.	The main components: 1. Motivational component: brief motivational interview (intervention group) or brief advice (control group) delivered by primary care physicians with follow-up calls performed by social workers (intervention group only) 2. 11 module internet curricula-based component 3. Parent component built into the internet-based component to develop parenting skills and act as a resource	• Physicians • Social workers • Participants (via the application)

Social Support Intervention using Ability Online Interface (no name)
 	
(Stewart et al., 2011)
	n=27, 12–18-year-old male and female individuals with cerebral palsy or spina bifida in Alberta, Canada. The intervention took place in patient's homes and in an internet forum	Individual	A social support intervention with no explicit theoretical basis. The intervention aimed to increase participants social network size and composition to reduce feelings of loneliness and objective social isolation.
			
			The programme was delivered in 25, 60-90 minute weekly online sessions over 6 months. The discussions and content were adaptable based on the participants needs.
				The main component:
				
				1. Online internet chat rooms to discuss topics of concerns
				    ○ Mentors and facilities who had cerebral palsy and spina bifida
				    ○ Psychologists facilitated the group
					• Participants
					• 22–39-year-old mentors and facilitators with spina bifida or cerebral palsy
					• Psychologists

Social Support Intervention using physical Community Services for Homeless Youths (Stewart et al., 2009)	n=70, 16–24-year-old male and female homeless individuals in Alberta, Canada. The intervention took place in a variety of existing homeless services	Community	A social support intervention with no explicit theoretical basis. It aimed to expand an individual's social network, ensure they are more satisfied with their level of social support to decrease loneliness and social isolation. The programme was delivered once a week for 3 to 4 hours over 5 months. The structure of the programme was fixed. The content and the choice of recreational activity were adaptable.	The main components: 1. Peer and professional support networks 2. Weekly social support group 3. Each support groups included a recreational activity based on the participants choice	• Professional mentors (social workers, psychologists and therapists) • Peer mentors (youths who had experienced homelessness
Mindfulness Based Cognitive Behavioural Therapy (MBCT) (Zhang et al., 2018)	n=50, 17–25-year-old male and female College students deemed high risk of loneliness in the People's Republic of China. The intervention took place in a University setting	Individual	Mindfulness based cognitive behavioural intervention with no explicit theoretical basis aiming to address underlying cognitions associated with loneliness, The programme consisted of 8 weekly, 2-hour group sessions. The structure and content was fixed.	The main components: 1. On-campus groups sessions 2. Participants learned theories 3. Practice mindfulness exercises 4. Home practice	• Unable to conclude who delivered the intervention based on the data in the study manuscript

Intervention	Sample	Setting	Description	Components	Facilitators
KONTAKT (Australian Cross-Cultural Adaptation) (Afsharnejad et al., 2020)	n=17, 12–17-year-old male and female adolescents with autism spectrum disorders in Perth, Western Australia, Australia. This took place in a health service setting.	Community	An intervention with no explicit theoretical basis aiming to improve social skills among autistic spectrum individuals. The programme consisted of 16 sessions. Parents were invited to take part at sessions one, eight and 16. A 'coffee shop' or 'café' where adolescents practiced social skills in a 'naturalistic context'. The content was fixed but in session activities were adaptable.	The main components: 1. Training for clinicians to deliver the program. 2. KONTAKT manual to facilitate each session. 3. The manual comprised a set of activities to following for each session. 4. Parental feedback sessions at first, middle and end.	• Two clinicians who were experienced working with young people who had autism spectrum disorder.
Moderated Online Social Therapy+ (MOST+) (Alverez-Jimenez et al., 2020)	n=157, 16–25-year-old male and female young people with concerns about mental health.	Individual and Community	A peer directed and moderated internet-based intervention with clinician oversight. It drew on Cognitive Behavioural Theory, Mindfulness, Self-compassion, and Positive Psychology. It aimed to improve access to mental health support for young people. The intervention aimed to increase social connectedness as part of the Steps component. Participants either had partial or full access for up to 9 weeks. Partial access consisted of components 1. and 5. Full access to all components after assessment. Structure of the intervention was fixed, but content was adaptable to the individual's needs.	The main components: 1. Interactive user-directed web-based therapy (*Steps*). 2. Peer-to-peer online social networking. 3. Peer moderated sessions where young people were encouraged to problem solve. 4. Expert moderation. 5. On-demand web chat with a clinician.	• Peer moderators. • Registered mental health clinician who had received training to deliver interventions (psychologists, social workers, occupational therapists, and mental health nurses).
Nod (Bruehlman-Senecal et al., 2020)	n=227, 18–25-year-old male and female college students at risk of loneliness in the USA. This took place in a university setting.	Individual	A smartphone app that was co-developed by academic and commercial partners. It drew on positive psychology, mindfulness-based self-compassion, and cognitive behavioural skill-building. The intervention aimed to address loneliness in 1st year college students.	The main components: 1. Social challenges that provided ideas to engage with other people. 2. Reflections using in-app exercises. 3. Testimonials from other students who had taken part to encourage a 'growth mindset'.	• Self-directed.

			The content was fixed but the structure was adaptable based on the students' needs.		
+Connect (Lim et al., 2019)	n=20, 18–25-year-old male and female people at risk of loneliness in Australia. Young people either had social anxiety disorder in a health service or had no diagnosable disorder in an Australian University.	Individual.	A smartphone app that draws on strengths based positive psychology. The intervention aimed to address loneliness directly. The intervention was designed to be interacted with for five minutes over 42 days or six weeks. Content was fixed but the structure was adaptable based on the individuals' needs.	The main components: 1. Mood evaluation tracker. 2. Daily task delivered either by text and images, lived experience videos, expert videos or by actors. 3. Questions related to the daily task.	• Self-directed.
+Connect for Individuals with Psychosis (Lim et al., 2020)	n=12, 16–25-year-old male and female people at risk of loneliness with a diagnosis of psychosis in Australia. It took place in a mental health service and on a smartphone app.	Individual.	A smartphone app based on +Connect but delivered in those who had a diagnosis of a psychotic disorder. The intervention drew on Positive Psychology. It aimed to address loneliness directly. The intervention was designed to be interacted with for five minutes over 42 days or six weeks. Content was fixed but the structure was adaptable based on the individuals' needs.	The main components: 1. Mood evaluation tracker. 2. Daily task delivered either by text and images, lived experience videos, expert videos or by actors. Questions related to the daily tasks.	Self-directed.
Entourage (Rice et al., 2020)	n=89, 14–25-year-old male and female people at risk of loneliness and probable social phobia in Australia. It took place in	Individual and Community.	A smartphone app that was adapted from the Moderated Online Social Therapy (MOST) intervention. The intervention draws on Cognitive Behavioural Therapy, Cognitive Theory for Social Anxiety, strengthens based Positive Psychology and Mindfulness. The Peer Support elements were theorised to increase belonging, coping, and reducing social	The main components: 1. Behavioural experiments. 2. Comic strips to portray experiences of psychological disorders. 3. Clinical moderation and peer support techniques.	• Self-directed. • Experienced health care professionals to moderate discussions. • Peer supporters to moderate discussions and online social networking.

| 'Headspace' services. | anxiety. It aimed address social anxiety in young people and young men in particular.

The content was fixed however the structure of the intervention could be tailored to the individuals' needs. | 4. Online social networking using peer-to-peer support.
5. Problem solving feature called 'Talk it Out'. |

Study Characteristics

All studies were conducted in high-income countries, predominantly in North America (n=7) and Australia (n=5). Five of the studies were randomised controlled trials (RCTs) (Bruehlman-Senecal et al., 2020; Gantman et al., 2012; Matthews et al., 2018; Saulsberry et al., 2013; Zhang et al., 2018), although in one both intervention and control groups received the intervention but received different motivational techniques (Saulsberry et al., 2013), seven were before and after studies (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Maslow et al., 2013; Rice et al., 2020; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009), one was a quasi-experimental design (Coelho et al., 2017), two used a repeated measures design (Lim et al., 2020; Lim et al., 2019), and one was a non-experimental design with a comparison group (Orkibi et al., 2017). Seven also utilised qualitative methods as part of a mixed method study design.(Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Lim et al., 2020; Lim et al., 2019; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009)

Table 2 provides a summary of the results of the studies. Sixteen publications reported on intervention effectiveness; with the remaining 12 being either process evaluations or formative studies. All studies reporting on intervention effectiveness did so by measuring loneliness or social isolation quantitatively. The only study to measure social isolation did so with the "Bateria de Socializacao-3" (Coelho et al., 2017). Of the 15 publications examining loneliness, nine utilised the University of California Los Angeles (UCLA) loneliness scale (Alvarez-Jimenez et al., 2020; Bruehlman-Senecal et al., 2020; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Rice et al., 2020; Smith et al., 2017; Stewart et al., 2009), one used the Social and Emotional Loneliness Scale for Adults (SELSA) (Gantman et al., 2012), one used the Asher and Wheeler Loneliness scale (Orkibi et al., 2017), one used the Li Scale (Zhang et al., 2018), one used an unnamed 16 item instrument (Stewart et al., 2011), one used the Perth A-Loneliness Scale (PALs) and the Everyday Emotional State (Afsharnejad et al., 2020), and one used a one-item "I felt lonely" four point scale (Saulsberry et al., 2013). Three studies also used qualitative methods to understand how the intervention worked (Afsharnejad et al., 2020; Stewart et al., 2011; Stewart et al., 2009).

Table 2: Table of Results

Intervention and associated references	Study Characteristics					Loneliness and Social Isolation Outcomes	Reported Themes	Findings related to acceptability	Methodological weaknesses identified with the MMAT
	Population	Sample size	Setting	Design	Time period				
Project Positive Attitude (Coelho et al., 2011; Coelho et al., 2015; Coelho et al., 2017; Coelho et al., 2017b)	11–17-year-old male and female school students in Portugal	Overall: n=628 Control: n=156 Intervention: n=472	School setting in Torres Vedras near Lisbon, Portugal	Quasi-experimental design	24 months	Self-reported social isolation (Bateria de Socializacao-3) • Cronbach alpha: 0.81 Difference (control): • Time point 1 (T1) mean: 1.98 • Time point 2 (T2) mean: 2.15 Difference (intervention) • T1 before intervention mean: 2.27 • T2 post intervention mean: 2.02 P-value for a difference between groups over time: 0.036	Not applicable (N/A)	• Lost to follow-up: 1%	• None identified
PEERs (Gantman et al., 2012)	18–23-year-old male and females with autistic spectrum disorders	Overall: n=12 Intervention: n=9 Control: n=8	"Community" within homes and buildings located around University of California Los Angeles (UCLA)	Randomised controlled trial	28 weeks	Self-reported loneliness (Social and Emotional Loneliness Scale for Adults SELSA) • Cronbach's Alpha: 0.89 Difference over the study period: • Treatment: -12.67 • Control: 4.50	N/A	• Lost to follow-up: 0%	• Randomisation not appropriately performed • Outcome assessors were not blinded to the intervention being provided

						P-value for a difference: <0.05			
Project PRIDE (Smith, et al., 2016; Smith, et al., 2017)	18–25-year-old gay, trans, pan and bisexual men HIV negative men with one episode of condom less anal sex in the last three months	Overall: n=33	Within the gay, bisexual and lesbian village areas of Toronto and Montreal, Canada	Before and after study with a mixed method process evaluation	6 months	Self-reported loneliness (UCLA loneliness scale): • Cronbach's alpha: 0.92 Difference: • Pre-post intervention effect size: -0.36 (-0.57, -0.15) • Pre intervention-follow up effect size: -0.35 (-0.67, -0.02)	N/A	• Lost to follow-up: 33% • Mean attendance 6.32/8 sessions (SD=1.25) • High satisfaction reported in those completing the intervention	• Qualitative approach inappropriate to answer the research question(s) • Qualitative findings inadequately derived from the data • Interpretation of the qualitative results insufficiently substantiated from the data • Incoherence between qualitative data sources, collection, analysis and interpretation • Incomplete outcome data • Confounders unaccounted for in design and analysis • Mixed methods ineffectively integrated to answer the research question(s) • Integration of mixed methods data inadequately described and interpreted • Divergences and inconsistencies between qualitative and quantitative data inadequately addressed

The Adolescent Leadership Council (TALC) (Maslow, 2013)	Adolescents aged 13-19 with a chronic health condition	Overall: n=20	Hospital and Community in Providence, Rhode Island, United States of America (USA)	Before and after study with a process evaluation	10 months	Self-reported loneliness (UCLA loneliness scale): • Cronbach's Alpha: Not reported. Difference: • Pre intervention: 44.7 (SD: 2.0) • Post-intervention: 39.2 (SD: 2.0) P-value for a difference over time: 0.01	N/A	• Lost to follow-up: 0% • 65% of study population attended meetings they were eligible to attend	• Confounders unaccounted for in the design and analysis
PEERs and PEERs with peers (Matthews et al., 2018)	13–17-year-old male and female individuals with autistic spectrum disorders	Overall: n=44 Traditional PEERS: n=15 Peer-mediated PEERS: n=16 Control: n=13	Community (not specified)	Randomised controlled trial	10 months	Self-reported loneliness (UCLA loneliness scale) • Cronbach's alpha: 0.94 Difference: • Intervention vs. control: 1.08 • P-value for a difference between groups over time: >0.05 Difference excluding extreme outliers: • Intervention vs. control: 1.43 P-value for a difference between group over time: <0.05	N/A	• Lost to follow-up: 18.1%	• Incomplete outcome data • Outcome assessors were not blinded to the intervention being provided

| Psychodrama Intervention (no name)

(Orkibi, 2017) | 13–16-year-old male and female school students 'deemed high risk' of loneliness by a psychologist | Overall:

n=40 | School in a low socio-economic area of Israel | Nonrandomised group comparison study | 1 'school year' | Self-reported loneliness (Asher and Wheeler scale)

• Cronbach's alpha: 0.87-89

Treatment:

• Before intervention mean (time 1): 2.18
• After intervention mean (time 2): 1.74

Control:

• Time 1 mean: 2.07
• Time 2 mean: 2.00

P-value for a difference between groups over time: <0.05 | N/A | • Lost to follow-up: 0% | • Study population not representative of the target population
• Confounders unaccounted for in the design and analysis |
| Competent Adulthood Transition with Cognitive-Behavioural, Humanistic and Training (CATCH-IT)

(Landback, et al. 2009; Saulsberry, et al. 2012; Van Voorhees, et al., 2007; Van Voorhees, et al., 2008; Van Voorhees, et al., 2009; Van Voorhees, et al., 2009b) | 14–21-year-old male and female individuals at risk of depression | Overall:

n=84

Treatment (motivational interview):

n=40

Control (brief advice):

n=43 | Primary care facilities and patient's homes in Midwest and Southern, United States of America | Randomised controlled trial and process evaluation. All participants received the intervention. | 12 months | Self-reported loneliness (1 item; "I felt lonely" 4-point scale):

• Cronbach's Alpha: not reported.

Total sample:

• Baseline mean score: 1.12
• One year mean score: 0.66

P-value for a difference over time: <0.001 | N/A | • Lost to follow-up: 15.5%
• Helpfulness of the intervention (scored using a Likert 1-5 scale) ranged between 3.1-4.6 for all modules | • None identified |

Social Support Intervention using Ability Online Interface (no name) (Stewart et al., 2011)	12-18 year old male and female individuals with cerebral palsy or spina bifida	Overall: n=27	Participant's homes and in an internet forum in Alberta, Canada	Before and after study and mixed method process evaluation	6 months	Loneliness and dissatisfaction score (24 item scale, 16 specifically focusing on loneliness) • Cronbach's alpha: 0.88 Difference: • Pre-intervention mean: 33.5 • Post-intervention mean: 32.3 • 3 month follow-up mean: 31.2 • P-value for a difference over time: 0.51	• Learnt strategies to communicate • Enhanced pre-existing friendships • Reported less loneliness and social isolation • Helped participants deal with negative feelings and be more patient and happy • Learned to cope with their disability • Increased confidence • Self awareness enhanced through social comparison • Helped understand their disability	• Lost to follow-up: 18.5% • The intervention was described by participants as a learning experience, a way to meet people with a similar disability, share knowledge and meet friends • 8.5 sessions completed on average out of 25	• Qualitative approach inappropriate to answer the research question(s) • Qualitative data collection methods inadequate to address the research question(s) • Incoherence between qualitative data sources, collection, analysis and interpretation • Incomplete outcome data • Confounders unaccounted for in the design and analysis • Mixed methods ineffectively integrated to answer the research question(s) • Integration of mixed methods data inadequately described and interpreted • Divergences and inconsistencies between qualitative and quantitative data inadequately addressed
Social Support Intervention using physical Community Services for Homeless Youths (Stewart et al., 2009)	16-24 year old male and female homeless individuals	n=70	Homeless services locations within Alberta Canada	Before and after study and mixed method process evaluation	Unclear	Self-reported loneliness (revised UCLA loneliness scale) • Cronbach's alpha: 0.62-0.94 Difference: • ANOVA revealed a significant decrease in loneliness over	• Felt less lonely following the intervention • More knowledge • Increased ability to cope • Improved social and support seeking skills • Increased self-confidence and efficacy • Overall enhanced	• Lost to follow-up: 80% Percentage of participants very satisfied with social support received: • Pre intervention: 17% • Post intervention: 29%	• Incomplete outcome data • Confounders unaccounted for in the design and analysis • Integration of mixed methods data inadequately described and interpreted • Divergences and inconsistencies between qualitative and quantitative

Intervention	Population	Sample	Setting	Study design	Duration	Outcome measure / results	Findings	Attendance / follow-up	Limitations
						time (f=4.6 (2.26)) • P-value for a difference over time: 0.04	mood, relaxation and stress relief in the positive environment created by the mentors • Decreased need for drugs and alcohol		data inadequately addressed
Mindfulness Based Cognitive Behavioural Therapy (MBCT) (Zhang et al., 2018)	17-25 year old male and female College students deemed high risk of loneliness	Overall: n=50 Intervention: n=34 Control: n=16	University campus in People's Republic of China	Randomised controlled trial and a process evaluation	6 months	Self-reported loneliness (indigenous Chinese, Li scale) • Cronbach's alpha: 0.62-0.89 Treatment • Pre-intervention mean: 47.79 • Post intervention mean: 38.17 Control • Pre-intervention mean: 47.56 • Post intervention mean: 42.71 Interaction effect (time X group): $F_{(1,41)}$=5.10 P-value: 0.03	• Enhanced emotion regulation (82.14%) • Increased self-acceptance (41.07%) • Increased self-awareness and self-care (37.50%) • Less judgmental (17.86%) • A positive outlook on the future (8.93%)	• Lost to follow-up: Intervention: 21% Control: 12.5% • Training group participants attendance: Average 6.18 sessions (SD = 2.04) • High level of satisfaction: Mean = 6.11 (SD = 0.63) out of 7	• Treatment and control were not comparable at baseline • Outcome assessors were not blinded to the intervention being provided
KONTAKT (Australian Cross-Cultural Adaptation) (Afsharnejad et al., 2020)	12–17-year-old male and female adolescents with autism spectrum disorders, their parents and KONTAKT trainers.	Adolescents: n=17 Parents: n=20 Trainers: n=10	Health service in Western Australia	Before and after study adolescents and focus group discussions with all participants.	16 weekly sessions plus 12-week follow-up.	Self-reported loneliness (Perth A-Loneliness Scale (PALs)) and (Everyday Emotional State) Cronbach's Alpha: not reported Difference: • PALs: pre-post intervention: ES: 0.54 P-value: 0.039.	Theme: • Experience with the group Sub-themes: • Friendship and connectivity. • A sense of safety and belonging. • Gender mix of the groups. Theme: • Impact on everyday social life.	• Lost to follow-up: 17.65% • 65% reported at least one negative effect during the programme. • Most common negative effect was quality of the programme (65%) or symptoms including anxiety (35%).	• Divergences and inconsistencies between qualitative and quantitative data inadequately addressed.

Intervention	Population	Sample	Setting	Study design	Duration	Loneliness outcome	Social connectedness	Feasibility / acceptability	Limitations
						• Everyday Emotional State: pre-post intervention effect Size: 0.50 (improvement) P-value: <0.001	Sub-themes: • Developing confidence. • Developing social skills		
Moderated Online Social Therapy+ (MOST+) (Alverez-Jimenez et al., 2020)	16–25-year-old male and female young people with concerns about mental health.	Overall: n=157 Full access to the intervention: n=72 Partial access to the intervention: n=83 Subgroup who participated in semi-structured interviews: n=93	National Internet based counselling service in Australia	Before and after study with follow-up semi-structured interviews with a subgroup of participants.	Unclear	Self-reported loneliness (UCLA Loneliness Scale) Cronbach's Alpha: not reported. Difference: • Cohen D: -0.23 (95% CI: -0.52 to - 0.06) • P-value: 0.04. In those with full access to the intervention: • Cohen D: -0.33 • P-value: 0.02.	• 86% (n=70/93) of participants said they felt more socially connected from using MOST+.	• Lost to follow-up: 40.8% • 98% (n=91/93) reported a positive experience. • 86% (n=80/93) considered MOST+ easy to use. • 88% (n=88/93) reported MOST+ relevant to their needs. • 82% (n=76/93) considered MOST+ helpful. • 92% (n=86/93) stated they would recommend it to other young people experiencing difficulties. • 82% (n=76/93) reported that using MOST+ helped them feel better.	• Confounders unaccounted for in the design and analysis.
Nod (Bruehlman-Senecal et al., 2020)	18–25-year-old male and female college students.	Overall: n=221 Experimental group: n=100 Control group: n=121	University and on the Internet in the USA.	Pilot randomised controlled trial.	8 weeks.	Self-reported loneliness (UCLA 8-Item Loneliness Scale). • Cronbach Alpha: 0.84. No treatment effect on loneliness.	N/A	• Lost to follow-up in experimental group: 6%. • 84% agreed content was easy to understand. • 76% agreed the app gave sound advice. • 74% agreed the app gave them something new to think about. • 46% agree they would like to continue to use the app.	• Incomplete outcomes data • Outcome assessors not blinded to the intervention

								• 41% used what they learnt.	
+Connect (Lim et al., 2019)	18–25-year-old male and female lonely young people at risk of loneliness either currently engaging with a health service, or students in Australian university.	Overall: n=20 With social anxiety disorder engaging with a health service: n=9. Student group: n=11.	Youth health service, an Australian university and on the Internet in Melbourne, Australia.	Repeated measures design with qualitative methods.	33 days with the App plus 3 months follow-up.	Self-reported loneliness (UCLA 20-Item Loneliness Scale). • Cronbach Alpha: 0.90-0.95. Difference: • Mean negative slope over time: (M = -3.82, 95% Credible Interval: -5.54 to -2.17) • Cohen's d = 0.94.	N/A	• Lost to follow-up social anxiety disorder group: 15.38% • Lost to follow-up student group: 30.76% • 50 to 73% said that they were somewhat or very satisfied on each acceptability criteria. • All participants found the App easy to understand. • 18 to 50% reported being not at all satisfied with several components of the intervention. • Participants described some modules as helpful and liked the actors in the shared experience videos. • A small minority found some elements of the app to be 'Wishy-washy' and the actors 'cheesy' and 'fake'.	• Qualitative data collection methods inadequate to address the research question

+Connect for Individuals with Psychosis (Lim et al., 2020)	16–25-year-old male and female lonely young people with a current diagnosis of a psychotic disorder	n=12	Health service and the Internet in Melbourne, Australia.	Repeated measures design with qualitative methods.	33 days with the App plus 3 months follow-up.	Self-reported loneliness (UCLA 20-Item Loneliness Scale). • Cronbach Alpha: 0.91-0.94. Difference: • Mean negative slope (M = -0.34, SD = 0.24).	N/A	• Lost to follow-up: 16.67% • 80% (n=8) agreed the app was useful. • 90% (n=9) enjoyed the app. • 70% (n=7) were very satisfied with each acceptability criteria. • Increased positive affect. • Improved social interactions. • Increased social confidence. • Intent to apply in future. • Encouraged learning and self-reflection.	• Qualitative data collection methods inadequate to address the research question
Entourage (Rice et al., 2020)	14–25-year-old male and female with probable social phobia.	n=89.	Health service and the internet in Melbourne, Australia.	Before and after study.	12 weeks.	Self-reported loneliness (UCLA Loneliness Scale). • Cronbach's Alpha: 0.90-0.93. Difference: • Significant and reliable improvement: (Cohen's d = 0.63, p < 0.001).	N/A	• Lost to follow-up: 15% • 25.8% logged on at least 10 times over 10 weeks. • 60.7% logged on weekly over 5 weeks. • 74.4% reported the App provided timely support. • 77.0% reported the App 'somewhat helpful'.	• None identified

Quality appraisal

The MMAT identified methodological weaknesses in all but three of the study designs (Table 2) (Coelho et al., 2017; Rice et al., 2020; Saulsberry et al., 2013). In the RCTs (Bruehlman-Senecal et al. 2020; Gantman et al., 2012; Matthews et al., 2018; Saulsberry et al., 2013; Zhang et al., 2018), randomisation was not performed adequately in one (Gantman et al., 2012), the groups were not comparable at baseline in one (Zhang et al., 2018), outcome assessors were not blinded to the intervention in four (Bruehlman-Senecal et al., 2020; Gantman et al., 2012; Matthews et al., 2018; Zhang et al., 2018), and two had incomplete outcome data (Bruehlman-Senecal et al., 2020; Matthews et al., 2018). For the purposes of quality appraisal, the remaining 11 studies were classified as non-experimental or descriptive designs using the MMAT criteria (Afsharnejad et al. 2020; Alvarez-Jimenez et al., 2020; Coelho et al., 2017; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Orkibi et al., 2017; Rice et al., 2020; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009). Of these 11 studies, one had a study population not representative of their target population (Orkibi et al., 2017), six did not account for confounders (Alvarez-Jimenez et al., 2020; Maslow et al., 2013; Orkibi et al., 2017; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009), and five had incomplete outcome data (Alvarez-Jimenez et al., 2020; Rice et al., 2020; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009). Of the seven studies that utilised qualitative methods as part of a mixed methods study (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Lim et al., 2020; Lim et al., 2019; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009), the qualitative approach was not appropriate to answer the research question in four (Lim et al, 2019; Lim et al., 2020; Smith et al., 2017; Stewart et al., 2009), the qualitative data collection methods were inadequate to address the research question in one (Stewart et al., 2011), the qualitative findings were not adequately derived from the data in one (Stewart et al., 2009), and not substantiated by the data in one (Smith et al., 2017), and there was no coherence between the qualitative data sources, collection, analysis and interpretation in two (Smith et al., 2017; Stewart et al., 2011). In the seven studies that utilised mixed methods, the quantitative and qualitative components were not integrated effectively in two (Smith et al., 2017; Stewart et al., 2011), the integration of the qualitative and quantitative data was inadequately interpreted in one (Smith et al., 2017), and the divergences and inconsistencies between the qualitative and quantitative data were inadequately addressed in four (Afsharnejad et al., 2020; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009). In 13 studies it was not possible to answer at least one of the MMAT questions (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Coelho et al., 2017; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Orkibi et al., 2017; Rice et al., 2020; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009; Zhang et al., 2018). Inter-rated reliability

(Cohen's Kappa) of the MMAT between TO and RF was 0.54 indicating moderate agreement, and between TO and PW it was 0.68 indicating substantial agreement.

What types of interventions seeking to address loneliness and/ or social isolation do young people find acceptable?

None of the studies reported on direct measures of intervention acceptability to participants, though ten reported on similar concepts: satisfaction with the intervention (Lim et al., 2020; Lim et al., 2019; Smith et al., 2017; Stewart et al., 2009; Zhang et al., 2018), helpfulness of the intervention (Alvarez-Jimenez et al., 2020; Rice et al., 2020; Saulsberry et al., 2013), negative and positive aspects of the intervention (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020), and whether they intended or would recommend others take part in the intervention in the future (Alvarez-Jimenez et al., 2020; Bruehlman-Senecal et al., 2020). All assessed these concepts at the end of the study period, using quantitative or qualitative methods. The Mindfulness Based Cognitive Behavioural Therapy (MCBT), Project PRIDE, +Connect and +Connect in individuals with psychosis reported high levels of satisfaction with the intervention following its completion (Lim et al., 2020; Lim et al., 2019; Smith et al., 2017; Zhang et al., 2018). The Social Support Intervention showed an increase from 17% to 29% of participants satisfied with the social support they were receiving from the beginning to the end of the study period (Stewart et al., 2009). Project PRIDE and the Social Support intervention had moderate to high loss to follow up: 33% and 75% respectively. Both interventions took place in community settings with mobile populations. This suggests acceptability may not have been high in all those taking part in the intervention (Smith et al., 2017). Both +Connect interventions had low loss to follow-up, both were digital interventions connected to a health service or a university (Lim et al., 2020; Lim et al., 2019).

Three studies assessed helpfulness of the intervention: Moderated Online Social Therapy+, Entourage and Competent Adulthood Transition with Cognitive Behavioural Humanistic and Training (CATCH-IT). All reported high levels of helpfulness (Alverez-Jimenez et al., 2020; Rice et al., 2020., Saulsberry et al., 2013). Further, all interventions had low numbers of participants lost to follow-up across study periods between three to 12 months (Alverez-Jimenez et al., 2020; Rice et al., 2020., Saulsberry et al., 2013). Two other studies reported on attendance, which may indicate some aspect of acceptability. TALC and the Online Social Support Intervention found participants attended 65% and 34%, respectively, of sessions they were eligible to attend (Maslow et al., 2013; Stewart et al., 2011). The remaining four studies inferred in their discussion that acceptability was high but reported no direct assessment.

What types of interventions reduce the prevalence of loneliness and/or social isolation in young people participating over the course of the study period?

Fourteen of the 16 included effectiveness studies found reduction in prevalence over the study period, indicated by the quantitative outcome used to measure loneliness or social isolation (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Coelho et al., 2017; Gantman et al., 2012; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Orkibi et al., 2017; Rice et al., 2020; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009; Zhang et al., 2018). The interventions that demonstrated the most robust evidence of a reduction in either social isolation or loneliness were from a large quasi-experimental study of Project Positive Attitude (Coelho et al., 2017), and from the randomised control trial (RCT) of CATCH-IT (Saulsberry et al., 2013). There were four other RCTs studying interventions aiming to effect loneliness (Bruehlman-Senecal et al., 2020; Gantman et al., 2012; Matthews et al., 2018; Zhang et al., 2018). One RCT did not find a change in loneliness (Bruehlman-Senecal et al., 2020), whereas the others did. However, three of these studies had small sample sizes and methodological weaknesses (Gantman et al., 2012; Matthews et al., 2018; Zhang et al., 2018).

A further nine studies demonstrated a reduction in the quantitative outcome used to measure loneliness, all used before and after, repeated measures or non-experimental study designs to assess this and had methodological limitations (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Orkibi et al., 2017; Rice et al., 2020; Smith et al., 2017; Stewart et al., 2009). Two utilised qualitative methods to explore the intervention's effect on participants, helping understand how the intervention may have led to the observed quantitative reduction in loneliness (Afsharnejad et al., 2020; Stewart et al., 2009). The two interventions reporting no change in the quantitative outcome were both delivered completely online (Bruehlman-Senecal et al., 2020; Stewart et al., 2011). One was a high quality RCT of a digital self-directed intervention, called 'Nod', delivered over an eight week period to university students (Bruehlman-Senecal et al., 2020). In this study only a minority of participants (46%) agreed they would continue to use the intervention.

Are there particular populations and/or settings where an intervention is most effective and acceptable?

Two of the interventions implemented in educational settings appeared to demonstrate the strongest evidence of acceptability and/or effectiveness. These were: the MBCT intervention

in Chinese university students deemed at high risk of loneliness (Zhang et al., 2018), and a school-based social skills and support intervention to address potential social isolation in all Portuguese school students (11-17 year olds) (Coelho et al., 2017). The CATCH-IT online intervention targeting individuals at risk of depression also reported a reduction in loneliness and was acceptable (Saulsberry et al., 2013). Of the 14 remaining interventions, 12 were implemented in specific sub-groups of young people (Afsharnejad et al., 2020; Bruehlman-Senecal et al., 2020; Coelho et al., 2017; Gantman et al., 2012; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Rice et al., 2020; Saulsberry et al., 2013; Smith et al., 2017; Zhang et al., 2018). Two similar social skills interventions were delivered to autistic spectrum individuals and both were found to be effective in preventing and reducing loneliness (Gantman et al., 2012; Matthews et al., 2018).

Interventions delivered in more institutional settings, for example schools, universities, and health services tended to show evidence of acceptability and effectiveness (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Coelho et al., 2017; Lim et al., 2020; Lim et al., 2019; Rice et al., 2020; Zhang et al., 2018). Whereas those in less structured settings or targeting young people with other specific needs (such as homeless services) tended to be less effective and potentially less acceptable (Smith et al., 2017; Stewart et al., 2009), or demonstrated no evidence of a reduction in loneliness (Stewart et al., 2011).

Discussion

This systematic review assessed the acceptability and effectiveness of interventions seeking to reduce and prevent loneliness and social isolation in young people. Sixteen studies were identified, only three of which had appeared in previously published reviews focusing on other populations (Mann et al., 2017; Masi et al., 2011; Saulsberry et al., 2013; Stewart et al., 2009; Zhang et al., 2018). However, there was lack of clarity on what most of the interventions included, heterogeneity in the way loneliness or social isolation was measured and very limited assessments on whether they were implemented as originally intended. Therefore, it was difficult to draw firm conclusions on whether the interventions were effective in reducing or preventing loneliness or social isolation. These problems were compounded by mostly vague theoretical underpinnings outlining exactly how the authors thought their intervention might alter the participant's experience of loneliness or social isolation.

Most of the interventions targeted specific sub-groups of young people in culturally specific contexts (Smith et al., 2017; Stewart et al., 2009), and/ or with health conditions that may predispose them to being lonely or socially isolated (Alvarez-Jimenez et al., 2020; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Rice et al., 2020; Saulsberry et al., 2013; Stewart et al., 2011). Apart from three interventions that targeted a broader range of young people (Coelho et al., 2017; Orkibi et al., 2017; Zhang et al., 2018), generalisability of these findings to the whole population of young people is not advisable. Similar to literature reviews of interventions in other populations (Cattan et al., 2005; Cohen-Mansfield & Perach, 2015; Dickens et al., 2011; Findlay, 2003; Mann et al., 2017; Masi et al., 2011; O'Rourke et al., 2018; Windle et al., 2011), with the exception of Project Positive Attitude in Portugal (Coelho et al., 2017), all were either delivered to individuals or small groups and would require significant investment per beneficiary. Furthermore, most of the studies evaluated interventions that included a number of components or activities and could be considered complex interventions. The interventions elements were mostly poorly described and few provided sufficient description for replication, let alone scale-up or roll-out (Craig et al., 2008).

Most of the interventions were associated with a reduction in the prevalence of loneliness or social isolation (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Coelho et al., 2017; Gantman et al., 2012; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Matthews et al., 2018; Orkibi et al., 2017; Rice et al., 2020; Smith et al., 2017; Stewart et al., 2009; Zhang et al., 2018). However, whether these interventions were effective in reducing loneliness or social isolation is less clear. For example, most of the interventions were evaluated using non-experimental study designs (Afsharnejad et al., 2020; Alvarez-Jimenez et al., 2020; Lim et al., 2020; Lim et al., 2019; Maslow et al., 2013; Rice et al., 2020; Smith et al., 2017; Stewart et al., 2011; Stewart et al., 2009), and few utilised qualitative methods to understand the mechanisms of action (Afsharnejad et al., 2020; Stewart et al., 2011; Stewart et al., 2009). As loneliness is often transient (Rotenberg & Hymel, 1999), any observed quantitative reductions in loneliness may not reflect the participant's experience of the intervention, or any reduction could be due to other factors.

The interventions that demonstrated evidence of preventing loneliness or social isolation (Coelho et al., 2017; Gantman et al., 2012; Matthews et al., 2018; Zhang et al., 2018), usually had goals similar to those interventions identified in other systematic reviews (Mann et al., 2017; Masi et al., 2011). For example, by addressing social skills deficits (Gantman et al., 2012; Matthews et al., 2018), through providing support and opportunities for social interaction

(Coelho et al., 2017; Gantman et al., 2012; Matthews et al., 2018; Zhang et al., 2018), or addressing cognitive aspects of loneliness (Zhang et al., 2018). However, all four interventions were implemented in institutional settings where retention and follow-up were relatively straightforward (Coelho et al., 2017; Gantman et al., 2012; Matthews et al., 2018; Zhang et al., 2018). Within the wider group of interventions, those that were implemented in less formal settings and more mobile populations tended to experience higher loss to follow-up (Smith et al., 2017; Stewart et al., 2009). As only one study followed-up participants for longer than 12 months (Coelho et al., 2017), the duration of any impact is not clear. Furthermore, only this intervention addressed wider structural factors leading to loneliness or social isolation (Coelho et al., 2017), by implementing a transition programme for students moving between schools. Given the noted wider determinants of loneliness and social isolation (Lasgaard et al., 2016; Matthews, Danese, et al., 2019; Pitman et al., 2018), it may be difficult to prevent loneliness and social isolation effectively only using the individual-focused approaches deployed by the majority of these studies.

Following the original submission of this systematic review, another systematic review of interventions to alleviate loneliness in young people was published by Eccles et al (2020). Both reviews are consistent in finding that interventions can help alleviate loneliness in young people, but to date have targeted specific groups. Eccles et al (2020) conducted a meta-analysis and found that interventions had large effect sizes when evaluated by either single group designs (g = 0.411; 95% CI: 0.25, 0.57, p <.001) or randomised controlled trials (g = 0.316; 95% CI: 0.19, 0.44, p < .001). The findings from our review adds to their findings by looking at intervention development and implementation, acceptability and which settings may contribute to the success of an intervention.

Strengths and limitations

This review was systematic and rigorously conducted. This is the first review to ask questions relevant to the implementation and replication in the 'real world' of interventions that seek to address loneliness in young people. It has identified a number of weaknesses with the current approach to addressing loneliness and social isolation in young people.

In terms of limitations, this review did not double screen titles and may have missed relevant articles due to the complex nature of loneliness and social isolation, and the broad range of disciplines researching it, despite employing a sensitive search strategy. There was significant

heterogeneity in the interventions, settings, populations, methods and study designs used to evaluate these interventions, all having methodological weaknesses. Finally, most studies occurred in North America and Australia among specific sub-populations of young people, limiting the generalisability of these findings beyond these settings and specific sub-populations (Craig et al., 2008).

Implications for Practice, Policy and Research

Given the public health significance of loneliness and social isolation, greater awareness of both issues is needed among those working with young people (Caspi et al., 2006; Hawkley & Cacioppo, 2010; Lasgaard et al., 2016; Matthews, Danese, et al., 2019). If they and the young people they work with identify loneliness or social isolation as an issue, solutions suitable to the young person's specific needs should be identified and developed, ideally with them.

Addressing loneliness and social isolation in young people should be a priority at a national level to provide the necessary policy space for stakeholders to develop appropriate responses (Caspi et al., 2006; Hawkley & Cacioppo, 2010; Lasgaard et al., 2016; Matthews, Danese, et al., 2019). This should include raising awareness of the issue among young people. As the current evidence base is limited, policy makers should identify existing policies and interventions that may address issues related to loneliness and social isolation and evaluate how these may ameliorate or mitigate feelings of loneliness and / or social isolation in young people. For example, in the UK forms of social prescribing have been scaled up and adapted, potentially including digital elements, since the onset of the Covid-19 pandemic (NHS England, 2019). Finally, it may be helpful taking a systems perspective when commissioning and developing programmes with young people to help better understand what is feasible to implement within that context at any given time (Moore et al., 2019).

When evaluating interventions, a thorough description of the intervention, its component parts and its theory of change, alongside rigorous process evaluations, should be provided to aid replicability. When investigating a counter-factual question related to an intervention's effect on loneliness or social isolation robust, high quality study designs should be utilised, including RCTs where possible. Qualitative research is needed to understand how young people experience, refer to and conceptualise loneliness and social isolation in the context of their daily lives. While digital interventions may help ameliorate loneliness, there needs to be a

greater understanding of the influence social media and other digital technologies. Finally, research should understand the structural, environmental, and cultural determinants of loneliness and social isolation in young people to help develop and target interventions.

Conclusion

This review sought to assess the acceptability and effectiveness of interventions seeking to reduce and prevent social isolation and loneliness among young people. Interventions that appeared successful were targeted at the specific needs of the population and the determinants of loneliness or social isolation specific to the context, and implemented in more institutional settings. However, the interventions were mostly intensive, individual or small group approaches that were often poorly described. Given loneliness and social isolation are common and pervasive issues it is unlikely these approaches could be scaled to the wider population. Structural and wider community level, context-specific approaches should be developed alongside individual level interventions to address this complex issue.

Ethics approval and consent to participate
Not applicable.

Consent for publication

Not applicable.

Availability of data and material

The data extraction forms used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors have no conflicts of interest or competing interest to disclose.

Reference list

Afsharnejad, B., Falkmer, M., Black, M. H., Alach, T., Lenhard, F., Fridell, A., Coco, C., Milne, K., Chen, N. T. M., Bolte, S., & Girdler, S. KONTAKT© for Australian adolescents on the autism spectrum: protocol of a randomized control trial [Clinical Trial Protocol]. *Trials [Electronic Resource], 20*(1), 687.

Afsharnejad, B., Falkmer, M., Black, M. H., Alach, T., Lenhard, F., Fridell, A., Coco, C., Milne, K., Chen, N. T. M., Bolte, S., & Girdler, S. (2020). *Cross-cultural adaptation to australia of the kontakt© social skills group training program for youth with autism spectrum disorder: A feasibility study*. Journal of Autism and Developmental Disorders. 2020, pp. No Pagination Specified.

Alvarez-Jimenez, M., Rice, S., D'Alfonso, S., Leicester, S., Bendall, S., Pryor, I., Russon, P., McEnery, C., Santesteban-Echarri, O., Da Costa, G., Gilbertson, T., Valentine, L., Solves, L., Ratheesh, A., McGorry, P. D., & Gleeson, J. (2020). A novel multimodal digital service (moderated online social therapy+) for help-seeking young people experiencing mental ill-health: Pilot evaluation within a national youth e-mental health service. *Journal of Medical Internet Research, 22*(8), Article e17155.

Bruehlman-Senecal, E., Hook, C. J., Pfeifer, J. H., FitzGerald, C., Davis, B., Delucchi, K. L., Haritatos, J., & Ramo, D. E. (2020). Smartphone App to Address Loneliness Among College Students: Pilot Randomized Controlled Trial. *JMIR Mental Health, 7*(10), e21496.

Bu, F., Steptoe, A., & Fancourt, D. (2020). Who is lonely in lockdown? Cross-cohort analyses of predictors of loneliness before and during the COVID-19 pandemic. *Public Health, 186*, 31-34. https://doi.org/https://doi.org/10.1016/j.puhe.2020.06.036.

Cacioppo, J. T., & Cacioppo, S. (2018). Chapter Three - Loneliness in the Modern Age: An Evolutionary Theory of Loneliness (ETL). In J. M. Olson (Ed.), *Advances in Experimental Social Psychology* (Vol. 58, pp. 127-197). Academic Press. https://doi.org/https://doi.org/10.1016/bs.aesp.2018.03.003

Cacioppo, J. T., & Hawkley, L. C. (2009). Perceived Social Isolation and Cognition Trends in Cognitive Sciences. *Trends in Cognitive Sciences, 13*(10), 447-454.

Caspi, A., Harrington, H., Moffitt, T. E., Milne, B. J., & Poulton, R. (2006). Socially isolated children 20 years later: Risk of cardiovascular disease. *Archives of Pediatrics and Adolescent Medicine, 160*(8), 805-811.

Caspi, A., Harrington, H., & Morritt, T. E. e. a. (2006). Socially Isolated Children 20 Years Later: Risk of Cardiovascular Disease. *Achieves of Paediatric and Adolescent Medicine, 160*(8), 805-811.

Cattan, M., White, M., Bond, J., & Learmouth, A. (2005). Preventing social isolation and loneliness among older people: a systematic review of health promotion interventions. *Ageing and Society, 25*(1), 41-67. https://doi.org/10.1017/S0144686X04002594

Coelho, V., Figueira, A. (2011). Project "Positive Attitude": Promoting school success through social and emotional abilities development. Design for elementary and middle school students, in Portugal. *Revista Interamericana de Psicología/Interamerican Journal of Psychology, 45*(2),185-191.[fecha de Consulta 28 de Agosto de 2021]. ISSN: 0034-9690. Disponible en: https://www.redalyc.org/articulo.oa?id=28422741009

Coelho, V. A., Marchante, M., & Sousa, V. (2015). "Positive attitude": A multilevel model analysis of the effectiveness of a social and emotional learning program for Portuguese middle school students. *Journal of Adolescence, 43,* 29-38. https://doi.org/10.1016/j.adolescence.2015.05.009

Coelho, V., Sousa, V., Raimundo, R., & Figueira, A. (2017). The impact of a Portuguese middle school social-emotional learning program. *Health Promotion International, 32*(2), 292-300.

Coelho, V. A., & Sousa, V. (2017b). Comparing Two Low Middle School Social and Emotional Learning Program Formats: A Multilevel Effectiveness Study. *Journal of youth and adolescence*, *46*(3), 656–667. https://doi.org/10.1007/s10964-016-0472-8

Cohen-Mansfield, J., & Perach, R. (2015). Interventions for alleviating loneliness among older persons: a critical review. *Am J Health Promot, 29*(3), e109-125. https://doi.org/10.4278/ajhp.130418-LIT-182

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Petticrew, M. (2008). Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ, 337*. https://doi.org/10.1136/bmj.a1655

Dickens, A. P., Richards, S. H., Greaves, C. J., & Campbell, J. L. (2011). Interventions targeting social isolation in older people: a systematic review. *BMC Public Health, 11*, 647-647. https://doi.org/10.1186/1471-2458-11-647

Eccles, A. M., Qualter, P. (2020). Review: Alleviating loneliness in young people – a meta-analysis of interventions. *Child Adolesc Ment Health. 26*, 17-33. https://doi.org/10.1111/camh.12389

Findlay, R. A. (2003). Interventions to reduce social isolation amongst older people: where is the evidence? *Ageing and Society, 23*(5), 647-658. https://doi.org/10.1017/S0144686X03001296

Gantman, A., Kapp, S. K., Orenski, K., & Laugeson, E. A. (2012). Social skills training for young adults with high-functioning autism spectrum disorders: A randomized controlled pilot study. *Journal of Autism and Developmental Disorders, 42*(6), 1094-1103.

Goosby, B. J., Bellatore, A., Walsemann, K. M., & Cheadle, J. (2013). Adolescent Loneliness and Health in Early Adulthood. *Sociological Inquiry, 83*(4), 505-536.

Mental Health Foundation. (2010). *The Lonely Society?* Retrieved from: https://www.mentalhealth.org.uk/sites/default/files/the_lonely_society_report.pdf.

Hawkley, L. C., Browne, M. W., & Cacioppo, J. T. (2005). How can I connect with thee? Let me count the ways. *Psychological Science, 16*(10), 798-804. https://doi.org/https://dx.doi.org/10.1111/j.1467-9280.2005.01617.x

Hawkley, L. C., & Cacioppo, J. T. (2010). Loneliness Matters: A Theoretical and Empirical Review of Consequences and Mechanisms. *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine, 40*(2), 10.1007/s12160-12010-19210-12168. https://doi.org/10.1007/s12160-010-9210-8

Heinrich, L. M., & Gullone, E. (2006). The Clinical Significance of Loneliness: a Literature Review. *Clinical Psychology Review, 26*(6), 695-718.

Hillier-Brown, F. C., Bambra, C. L., Cairns, J., Kasim, A., Moore, H. J., & Summerbell, C. D. (2014). A systematic review of the effectiveness of individual, community and societal level interventions at reducing socioeconomic inequalities in obesity amongst children. *BMC Public Health, 14*(1), 834. https://doi.org/10.1186/1471-2458-14-834

Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., Altman, D. G., Barbour, V., Macdonald, H., Johnston, M., Lamb, S. E., Dixon-Woods, M., McCulloch, P., Wyatt, J. C., Chan, A., & Michie, S. (2014). Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ : British Medical Journal, 348*, g1687. https://doi.org/10.1136/bmj.g1687

Hong, Q. N., Fabregues, S., & Bartlett, G. e. a. (2018). The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Education for Information, 34*(4), 285-291.

Hunt, M. G., Marx, R., Lipson, C., & Young, J. (2018). No More FOMO: Limiting Social Media Decreases Loneliness and Depression. *Journal of Social and Clinical Psychology, 37*(10), 751-768. https://doi.org/10.1521/jscp.2018.37.10.751

Hutchinson, D., & Woods, R. (2010). *ChildLine casenotes: Children talking to ChildLine about Loneliness.*

Landback, J., Prochaska, M., Ellis, J., Dmochowska, K., Kuwabara, S. A., Gladstone, T., Larson, J., Stuart, S., Gollan, J., Bell, C., Bradford, N., Reinecke, M., Fogel, J., & Van Voorhees, B. W. (2009). From prototype to product: Development of a primary care/internet based depression prevention intervention for adolescents (CATCH-IT). *Community Mental Health Journal, 45*(5), 349–354. https://doi.org/10.1007/s10597-009-9226-3

Lasgaard, M., Friis, K., & Shevlin, M. (2016). "Where are all the lonely people?" A population-based study of high-risk groups across the life span. *Soc Psychiatry Psychiatr Epidemiol, 51*(10), 1373-1384. https://doi.org/10.1007/s00127-016-1279-3

Lasgaard, M., Goossens, L., & Elklit, A. (2011). Loneliness, depressive symptomatology, and suicide ideation in adolescence: cross-sectional and longitudinal analyses. *Journal of Abnormal Child Psychology, 39*(1), 137-150. https://doi.org/https://dx.doi.org/10.1007/s10802-010-9442-x

Lim, M. H., Gleeson, J. F. M., Rodebaugh, T. L., Eres, R., Long, K. M., Casey, K., Abbott, J.-A. M., Thomas, N., & Penn, D. L. (2020). A pilot digital intervention targeting loneliness in young people with psychosis. *Social psychiatry and psychiatric epidemiology, 55*(7), 877-889. https://doi.org/10.1007/s00127-019-01681-2

Lim, M. H., Rodebaugh, T. L., Eres, R., Long, K. M., Penn, D. L., & Gleeson, J. F. M. (2019). A Pilot Digital Intervention Targeting Loneliness in Youth Mental Health. *Frontiers in Psychiatry, 10 (no pagination)*, Article 604.

Co-op Foundation. (2018). *Listening to Children and Young People to Help us Tackle Loneliness Together.* Retrieved 22/04/2019 from https://blog.coopfoundation.org.uk/index.php/2018/12/07/listening-to-children-and-young-people-to-help-us-tackle-loneliness-together/

Malcolm, M., Frost, H., & Cowie, J. (2019). Loneliness and social isolation causal association with health-related lifestyle risk in older adults: a systematic review and meta-analysis protocol. *Systematic Reviews, 8*(1), 48. https://doi.org/10.1186/s13643-019-0968-x

Mann, F., Bone, J. K., Lloyd-Evans, B., Frerichs, J., Pinfold, V., Ma, R., Wang, J., & Johnson, S. (2017). A life less lonely: the state of the art in interventions to reduce loneliness in people with mental health problems [Review]. *Social psychiatry and psychiatric epidemiology, 52*(6), 627-638. https://doi.org/10.1007/s00127-017-1392-y

Masi, C. M., Chen, H., Hawkley, C. L., & Cacioppo, J. T. (2011). A Meta-Analysis of Interventions to Reduce Loneliness. *Personality and Social Psychology Review, 15*(3). https://doi.org/10.1177/1088868310377394

Maslow, G., Adams, C., Willis, M., Neukirch, J., Herts, K., Froehlich, W., Calleson, D., & Rickerby, M. (2013). An evaluation of a positive youth development program for adolescents with chronic illness. *Journal of Adolescent Health, 52*(2), 179-185.

Matthews, N. L., Orr, B. C., Warriner, K., DeCarlo, M., Sorensen, M., Laflin, J., & Smith, C. J. (2018). Exploring the Effectiveness of a Peer-Mediated Model of the PEERS Curriculum: A Pilot Randomized Control Trial. *Journal of Autism and Developmental Disorders, 48*(7), 2458-2475.

Matthews, T., Danese, A., Caspi, A., Fisher, H. L., Goldman-Mellor, S., Kepa, A., Moffitt, T. E., Odgers, C. L., & Arseneault, L. (2019). Lonely young adults in modern Britain: findings from an epidemiological cohort study. *Psychol Med, 49*(2), 268-277. https://doi.org/10.1017/s0033291718000788

Matthews, T., Odgers, C. L., Danese, A., Fisher, H. L., Newbury, J. B., Caspi, A., Moffitt, T. E., & Arseneault, L. (2019). Loneliness and Neighborhood Characteristics: A Multi-Informant, Nationally Representative Study of Young Adults. *Psychological Science, 30*(5), 765-775. https://doi.org/10.1177/0956797619836102

Scottish Public Health Network (2017). *Scottish Isolation and loneliness: what is the scope for public health action?* Retrieved from: https://www.scotphn.net/wp-content/uploads/2017/05/2017_05_16-Loneliness-Scoping-Note-Final-formatted.pdf.

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science, 6*(1), 42. https://doi.org/10.1186/1748-5908-6-42

Moeller, R. W., & Seehuus, M. (2019). Loneliness as a mediator for college students' social skills and experiences of depression and anxiety. *Journal of Adolescence, 73*, 1-13. https://doi.org/https://doi.org/10.1016/j.adolescence.2019.03.006

Moore, G. F., Evans, R. E., Hawkins, J., Littlecott, H., Melendez-Torres, G. J., Bonell, C., & Murphy, S. (2019). From complex social interventions to interventions in complex social systems: Future directions and unresolved questions for intervention development and evaluation. *Evaluation, 25*(1), 23-45. https://doi.org/10.1177/1356389018803219

The Children's Foundation. (2019). *Loneliness in Childhood: Exploring Loneliness and Well-being* Among 10-17 year olds. Retrieved from: https://www.childrenssociety.org.uk/sites/default/files/2021-01/loneliness_in_childhood.pdf

Moore, S., & Leung, C. (2002). Young people's romantic attachment styles and their associations with well-being. *Journal of Adolescence, 25*(2), 243-255.

O'Rourke, H. M., Collins, L., & Sidani, S. (2018). Interventions to address social connectedness and loneliness for older adults: a scoping review. *BMC Geriatrics, 18*(1), 214. https://doi.org/10.1186/s12877-018-0897-x

Orkibi, H., Azoulay, B., Snir, S., & Regev, D. (2017). In-session behaviours and adolescents' self-concept and loneliness: A psychodrama process-outcome study. *Clinical psychology & psychotherapy, 24*(6), O1455-O1463.

Perlman, D., & Peplau, L. A. (1981). *Toward a Social Psychology of Loneliness*. Academic Press.

Pitman, A., Mann, F., & Johnson, S. (2018). Advancing our understanding of loneliness and mental health problems in young people. *The Lancet Psychiatry, 5*(12), 955-956. https://doi.org/10.1016/S2215-0366(18)30436-X

Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., Roen, K., & Duffy, S. (2006). Guidance on the conduct of narrative synthesis in systematic reviews. *A product from the ESRC methods programme Version, 1*, b92.

Rice, S., O'Bree, B., Wilson, M., McEnery, C., Lim, M. H., Hamilton, M., Gleeson, J., Bendall, S., D'Alfonso, S., Russon, P., Valentine, L., Cagliarini, D., Howell, S., Miles, C., Pearson, M., Nicholls, L., Garland, N., Mullen, E., McGorry, P. D., & Alvarez-Jimenez, M. (2020). Leveraging the social network for treatment of social anxiety: Pilot study of a youth-specific digital intervention with a focus on engagement of young men. *Internet Interventions, 20 (no pagination)*, Article 100323.

Rotenberg, K. J., & Hymel, S. (1999). *Childhood and Adolescent Loneliness: An Introduction*. Cambridge University Press.

Saulsberry, A., Marko-Holguin, M., Blomeke, K., Hinkle, C., Fogel, J., Gladstone, T., Bell, C., Reinecke, M., Corden, M., & Van Voorhees, B. W. (2013). Randomized clinical trial of a primary care Internet-based intervention to prevent adolescent depression: One-year outcomes. *Journal of the Canadian Academy of Child and Adolescent Psychiatry / Journal de l'Academie canadienne de psychiatrie de l'enfant et de l'adolescent, 22*(2), 106-117.

Smith, N. G., Hart, T. A., Moody, C., Willis, A. C., Andersen, M. F., Blais, M., & Adam, B. (2016). Project pride: A cognitive-behavioral group intervention to reduce HIV risk behaviors among HIV-negative young gay and bisexual men. *Cognitive and Behavioral Practice, 23*(3), 398–411. https://doi.org/10.1016/j.cbpra.2015.08.006

Smith, N. G., Hart, T. A., Kidwai, A., Vernon, J. R. G., Blais, M., & Adam, B. (2017). Results of a Pilot Study to Ameliorate Psychological and Behavioral Outcomes of Minority Stress Among Young Gay and Bisexual Men. *Behavior Therapy, 48*(5), 664-677.

Snape, D. M., S. Hassell, C. Osborn, E. Martin, G. Sidney, I. Pyle, E. Cochrane, A. (2018). Children's and Young People's Experiences of Loneliness: 2018. Retrieved from: https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/articles/childrensandyoungpeoplesexperiencesofloneliness/2018.

NHS England. (2019). *Social prescribing and community-based support: Summary Guide*. (2019). Retrieved from: https://www.england.nhs.uk/wp-content/uploads/2020/06/social-prescribing-summary-guide-updated-june-20.pdf.

Stewart, M., Barnfather, A., Magill-Evans, J., Ray, L., & Letourneau, N. (2011). Brief report: an online support intervention: perceptions of adolescents with physical disabilities [Research Support, Non-U.S. Gov't]. *Journal of Adolescence, 34*(4), 795-800. https://doi.org/https://dx.doi.org/10.1016/j.adolescence.2010.04.007

Stewart, M., Reutter, L., Letourneau, N., & Makwarimba, E. (2009). A support intervention to promote health and coping among homeless youths. *Canadian Journal of Nursing Research, 41*(2), 55-77.

Teppers, E., Luyckx, K., Klimstra, T. A., & Goossens, L. (2014). Loneliness and Facebook motives in adolescence: A longitudinal inquiry into directionality of effect. *Journal of Adolescence, 37*(5), 691-699.

Thomas, L., Orme, E., & Kerrigan, F. (2020). Student Loneliness: The Role of Social Media Through Life Transitions. *Computers & Education, 146*, 103754. https://doi.org/https://doi.org/10.1016/j.compedu.2019.103754.

Van Voorhees, B. W., Ellis, J. M., Gollan, J. K., Bell, C. C., Stuart, S. S., Fogel, J., Corrigan, P. W., & Ford, D. E. (2007). Development and process evaluation of a primary care internet-based intervention to prevent depression in emerging adults. *Primary care companion to the Journal of clinical psychiatry, 9*(5), 346-355.

Van Voorhees, B. W., Vanderplough-Booth, K., Fogel, J., Gladstone, T., Bell, C., Stuart, S., Gollan, J., Bradford, N., Domanico, R., Fagan, B., Ross, R., Larson, J., Watson, N., Paunesku, D., Melkonian, S., Kuwabara, S., Holper, T., Shank, N., Saner, D., . . . Reinecke, M. A. (2008). Integrative Internet-based depression prevention for adolescents: A randomized clinical trial in primary care for vulnerability and protective factors. *Journal of the Canadian Academy of Child and Adolescent Psychiatry / Journal de l'Académie canadienne de psychiatrie de l'enfant et de l'adolescent, 17*(4), 184–196.

Van Voorhees BW, Fogel J, Reinecke MA, Gladstone T, Stuart S, Gollan J, Bradford N, Domanico R, Fagan B, Ross R, Larson J, Watson N, Paunesku D, Melkonian S, Kuwabara S, Holper T, Shank N, Saner D, Butler A, Chandler A, Louie T, Weinstein C, Collins S, Baldwin M, Wassel A, Vanderplough-Booth K, Humensky J, Bell C. Randomized clinical trial of an Internet-based depression prevention program for adolescents (Project CATCH-IT) in primary care: 12-week outcomes. Journal of developmental and behavioral pediatrics 2009; 30(1): 23-37.

Van Voorhees, B. W., Fogel, J., Pomper, B. E., Marko, M., Reid, N., Watson, N., Larson, J., Bradford, N., Fagan, B., Zuckerman, S., Wiedmann, P., & Domanico, R. (2009b). Adolescent dose and ratings of an Internet-based depression prevention program: A randomized trial of primary care physician brief advice versus a motivational interview. *Journal of Cognitive and Behavioral Psychotherapies, 9*(1), 1–19.

Victor, C. R., & Yang, K. (2012). The Prevalence of Loneliness Among Adults: a Case Study of the United Kingdom. *Journal of Psychology, 146*, 85-104.

Weiss, R. S. (1973). *Loneliness: The Experience of Emotional and Social Isolation*. MIT Press.

Windle, K., Francis, J., & Coomber, C. (2011). *Preventing loneliness and social isolation: interventions and outcomes*. Social Care Institute for Excellence London.

Zavaleta, D., Samuel, K., & C., M. (2014). Social Isolation: A Conceptual and Measurement Proposal. *Oxford Poverty & Human Development Initiative (OPHI), Oxford*.

Zhang, N., Fan, F. M., Huang, S. Y., & Rodriguez, M. A. (2018). Mindfulness training for loneliness among Chinese college students: A pilot randomized controlled trial. *International journal of psychology : Journal international de psychologie, 53*(5), 373-378.