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Interventions for social isolation in older adults who have experienced a fall: A systematic review

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ABSTRACT

Objectives: The objective of our systematic review was to identify effective interventions to prevent or mitigate social isolation in older adults who experienced a fall.

Design: Systematic review

Data Sources: MEDLINE, Embase, the Cochrane Central Register of Controlled Trials, and Ageline were searched (inception to February 2020).

Methods: Studies were eligible if they described any intervention for social isolation in older adults living in a community setting who experienced a fall, and reported outcomes related to social isolation or loneliness.

Two independent reviewers screened citations, abstracted data, and appraised risk of bias. The results were summarized descriptively.

Results: After screening 4,069 citations and 55 full-text articles, 4 studies were included. The four studies varied in study design, including a randomized controlled trial, non-randomized controlled trial, an uncontrolled before-after study, and a quasi-experimental study. Interventions varied widely, and included singing in a choir, a patient-centred, interprofessional primary care team-based approach, a multifactorial assessment targeting fall risk, appropriate medication use, loneliness and frailty, and a community-based care model that included comprehensive assessments and multilevel care coordination. Outcome measures varied and included scales for loneliness, social isolation, social interaction, social networks, and social satisfaction. Mixed results were found, with three studies reporting no differences in social isolation after the intervention. Only the multifactorial assessment intervention demonstrated a small positive effect on loneliness compared to the control group after adjustment (B= -0.18, 95% CI= -0.35 to -0.02).

Conclusions: Few studies examined interventions for social isolation in older adults who experienced a fall. More research is warranted in this area.

Systematic Review Registration: PROSPERO (CRD42020198487)

Word count: 260 (abstract), 2671 (main text)

Keywords: systematic review, older adults, falling, social isolation, loneliness, interventions

Strengths and limitations of this study:

- We conducted a comprehensive search of 4 databases, using a search strategy which was peer-reviewed by a second librarian, and supplemented this by searching grey literature and scanning references of included studies and relevant reviews.
- We followed the methodology outlined by the Cochrane Handbook, with screening, data abstraction, and risk of bias appraisal being conducted in duplicate by independent reviewers, and our findings were reported using the PRISMA-2020 checklist.
- We deviated from our protocol slightly due to the limited of data on older adults in a community setting who had experienced a fall, and expanded our inclusion criteria to include studies where some participants (not all) had a history of falling.
- Our included studies were plagued by risk of bias across several components, including poor allocation concealment, lack of random sequence generation, and a lack of blinding of participants, personnel, and outcome assessors.
- A lack of standardization was observed across the outcomes assessed in the included studies, due to lack of consensus on measures for social isolation and loneliness.

INTRODUCTION

Worldwide, more than 37 million falls occur requiring medical attention every year[1]. Almost 650,000 people die every year from a fall, with those aged 65 years and older experiencing the greatest number of fatal falls[1]. Falls are associated with considerable negative outcomes on older adults, such as physical inactivity, anxiety, depressive symptoms, and fear of falling[2, 3].

Social isolation is a serious consequence among older adults who have experienced a fall[4]. Social isolation is a complex phenomenon that can be characterized by five key attributes: decreased number of social contacts, decreased feeling of belonging, reduced or lack of fulfilling relationships, decreased engagement with others, and reduced quality of the members in one's network[5]. Recent studies examined the bidirectional relationship between falling and social isolation, and some research focused on the risk of falling amongst older adults who were socially isolated[6-8]. Other research has focused on the risk of social isolation after experiencing a fall, since people who have experienced a fall are less likely to continue their activities of daily living[4]. For example, one study reported a statistically significant relationship between feelings of loneliness and social exclusion after experiencing a fall[4].

Regardless of the direction of the relationship, social isolation among older adults is associated with many adverse health outcomes, including cognitive decline, depression, anxiety, and dementia[9]. Interventions to mitigate social isolation after older adults experience a fall is of paramount importance. The objective of our systematic review was to identify effective interventions to mitigate social isolation in older adults who lived independently in a community setting with a history of falling.

METHODS

Protocol

The protocol for this systematic review was developed in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) checklist, with consultation from knowledge users and clinical experts and was registered on PROSPERO (CRD42020198487). This systematic review was conducted according to methodology outlined in the Cochrane Handbook[10], and the PRISMA checklist (Supplementary File 1) was used to guide the reporting of our results[11].

Search strategy and selection criteria

A comprehensive literature search strategy was developed by an experienced information specialist and peer-reviewed by a second information specialist using the Peer Review of Electronic Search Strategies (PRESS) checklist[12]. MEDLINE, Embase, the Cochrane Central Register of Controlled Trials, and Ageline were searched from inception until February 25, 2020 (Appendix 1). The reference lists of included studies and relevant reviews were also scanned. A search for grey literature was conducted using the Canadian Agency for Drugs and Technologies in Health (CADTH)'s Grey Matters checklist[13].

Our eligibility criteria are summarized in Table 2. Studies were eligible for inclusion if they described any intervention for social isolation in older adults (mean age 65 years and older) with a history of falling and who lived independently in a community setting. Eligible study designs included randomized controlled trials (RCTs), cohort studies, case control studies, non-randomized controlled trials, quasi-experimental studies, interrupted time series or controlled/uncontrolled before after studies. Case reports, case series, cross-sectional studies, qualitative studies, and reviews were not eligible for inclusion. Outcomes of interest included any changes in social isolation as measured using validated scales, such as the De Jong Gierveld

loneliness scale[14] and the Bude & Lantermann scale for social exclusion[15], or any other quantitative measure of social isolation or loneliness.

All citations were screened by two independent reviewers after the entire team completed a training exercise on 50 citations and 78% agreement was achieved. Full-text screening by two independent reviewers began after a training exercise on 22 articles amongst the team with an agreement of 75%. Discrepancies for both levels of screening were resolved by a third reviewer or through discussion.

Data abstraction and risk of bias appraisal

Data abstraction and risk of bias appraisal were also conducted independently by pairs of reviewers after a training pilot exercise reached sufficient agreement, and discrepancies were resolved by a third reviewer. The risk of bias appraisal was conducted using the Cochrane Effective Practice and Organisation of Care (EPOC) risk of bias tool, as it was expected that a mixture of study designs would be included[16].

Synthesis

The findings of this review were summarized descriptively, reporting study and patient characteristics, quality appraisal assessment, and intervention details. As outlined in our review protocol, we planned to conduct a meta-analysis if more than one study evaluated the same intervention, and a network meta-analysis for connected networks of trials with pre-specified intervention nodes if over 10 trials were available and the number of trials was greater than the number of interventions. However, as these conditions were not met, no statistical analyses were conducted.

Patient and Public Involvement

A patient partner with previous experience of a fall was identified and involved in this study from the protocol development stage. The patient partner provided input on our research question and outcome measures to ensure that the patient perspective was incorporated. They also participated in the screening training exercises for citations and full-text articles, provided feedback on screening eligibility criteria, and reviewed the manuscript as a coauthor.

RESULTS

Study flow

After screening 4,069 citations and 55 full-text articles against our eligibility criteria, 4 studies[17-19] met the eligibility criteria and were included in this review (Figure 1).

Study and patient characteristics

Study and patient characteristics are summarized in Table 1 and detailed characteristics are reported in Appendices 1 and 2. The mean age of participants across included studies was 77.8 years (range: 76 to 79.5 years). Three of the included studies were conducted in North America (75.0%) and one in Europe (25.0%) and they were conducted in a variety of settings including the community setting, a combination of participant homes and community setting, a combination of primary care and community setting, or a combination of participant homes and primary care. Only one study provided data on frailty of the included participants, reporting 20.2% of participants with frailty (Appendix 2). The four studies varied in study design, including a randomized controlled trial, a non-randomized controlled trial, an uncontrolled before-after study, and a quasi-experimental study in which data from one randomized site was combined with data from four controlled before-after sites. Two of the studies had a study duration of 12 months, and the other two had a duration of 6 months. The sample size in the studies ranged from 21 to 2325 and, on average, 71.3% of participants were female.

Risk of bias results

An overall summary of risk of bias across the four studies can be found in Appendix 3, and detailed risk of bias assessments can be found in Appendix 4. All of the studies had low risk of bias for baseline outcome measurements (100% low, 0% unclear, 0% high), and other bias (100% low, 0% unclear, 0% high). Two of the studies had low risk and two had unclear risk of bias for selective reporting (50% low, 50% unclear, 0% high). One study had high risk, two studies unclear risk, and one had low risk of bias for incomplete outcome data (25% low, 50% unclear, 25% high). However, three of four studies had high risk of bias for blinding of outcome assessment (25% low, 0% unclear, 75% high), blinding of participants and personnel (25% low, 0% unclear, 75% high), random sequence generation (25% low, 0% unclear, 75% high), and allocation concealment (25% low, 0% unclear, 75% high).

Outcome results

The relevant findings from the four included studies are summarized in Appendix 6.

Cohen et al. (2006) conducted a non-randomized controlled trial in the United States assessing the effects of singing in a chorale compared to usual care in 166 older adults. The chorale intervention involved attendance at weekly singing rehearsals and several public performances, while the usual care group continued their usual activities. Both groups had a similar baseline history of falling over the past 12 months (average of 0.40 falls per person in the intervention group, and 0.36 per person in the control group). After 12 months of follow-up, they noted a reduction in loneliness (as measured using the UCLA Loneliness Scale-III) in both groups (chorale: baseline mean: 35.1 (SD, 8.1) and follow-up mean: 34.6 (SD, 7.9); usual care: baseline mean: 38.3 (SD, 10.1) and follow-up mean: 37.0 (SD, 10.3). While the chorale intervention

reported lower loneliness scores than the usual care group after 12 months of follow-up, no statistically significant difference was observed (F (1,126) = 3.08; p = 0.08).

Scharlach et al. (2015) conducted an uncontrolled before-after study in the United States assessing the effectiveness of their ElderHelp Concierge Club intervention in a sample of 21 participants. The Concierge Club intervention was a community-based care model that provided different tiers of services to their members including information and referrals, transportation, or in-house assessments. The baseline mean number of falls over the past 6 months was 1.3. They noted that social isolation, as measured using an unnamed 3-item scale[20], did not change significantly after 6 months of follow-up (baseline mean: 8.7 (SD, 3.2) and follow-up mean: 7.0 (SD, 3.8)). Similarly, although all participants reported having contact with friends/relatives after the intervention, this was not found to be a significant change from baseline (baseline: 76% of participants, follow-up: 100% of participants).

Franse et al. (2018) conducted a quasi-experimental study comparing the effectiveness of the Urban Health Centres Europe (UHCE) approach compared to usual care in a sample of 1,844 older adults across the United Kingdom, Greece, Croatia, the Netherlands, and Spain. The UHCE approach involved a preventative multidimensional health assessment, which informed the coordination of specific care pathways targeting the individual's needs (such as fall risk, appropriate medication use, loneliness, and frailty). The usual care group received their usual care and had access to any already existing services. At baseline, 30.2% of participants reported having experienced a fall in the past 12 months. Their adjusted analysis found a small positive effect of the UHCE approach on loneliness, as measured using the short De Jong Gierveld Loneliness scale[21], when compared to usual care (B= -0.18, 95% CI= -0.35 to -0.02).

Dolovich et al. (2019) conducted a randomized controlled trial comparing the effectiveness of the Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening qualitY) intervention compared to usual care in a sample of 312 older adults in Canada. This intervention involved the collection of information on patients' health goals and needs by trained volunteers, who then summarized these findings in a report for the interprofessional primary care team. The primary care team used these reports to generate and act on plans of care for how the team, community agencies, and volunteers could help address each patient's goals. The control group received usual care. Approximately 9.3% of participants reported experiencing at least one fall. After 6 months of follow-up, they found no statistically significant difference between the intervention and control groups in terms of their social network scores (mean difference, 0.038 (95% CI: –0.25 to 0.33) and social satisfaction scores (mean difference, 0.102 (95% CI, –0.35 to 0.55), as measured using the Duke Social Support Index[22].

DISCUSSION

We conducted a comprehensive systematic review of interventions to mitigate social isolation and loneliness in older adults living independently in a community setting who experienced a fall. Very few studies were identified that fulfilled our eligibility criteria, indicating a dearth of evidence on this important topic. Only 4 studies were included and as each examined different types of interventions, this precluded any statistical pooling of results. Furthermore, studies varied on the proportion of participants who reported experiencing a fall and multiple types of outcomes were assessed for loneliness and social isolation, making it challenging to provide any meaningful interpretation of results.

Across the four studies in this systematic review, only the quasi-experimental study by Franse et al. (2018)[19], which assessed the impact of multifactorial health assessments and coordinated care pathways targeting fall risk, medication use, loneliness and frailty, found a small positive effect on loneliness (i.e. reduction) when comparing those that received the intervention with the control group. However, given the paucity of data in older adults with a history of falling, the most effective intervention for preventing or reducing social isolation remains unclear. Only one randomized controlled trial was identified in this review, highlighting the need for more robust research in this important area.

Gardiner et al. (2016) conducted an integrative review on interventions for social isolation in older adults[23]. While this review was not specific to individuals who had experienced a fall, it discusses characteristics of effective social isolation interventions in the broader older adult population and could be applicable to the subset of this population that experiences falling. While the majority of interventions they identified showed at least a moderate positive effect on social isolation or loneliness, they noted that the quality of the evidence was poor, making it difficult to identify a particular intervention as most effective[23]. This is consistent with our determination of the need for more robust research on the effectiveness of social isolation interventions in older adults with a history of falling. They identified adaptability to local contexts, community participation in the design and implementation of the intervention, and productive engagement (as opposed to passive activities) as common features among successful interventions[23]. Future studies should consider these factors in the development and evaluation of interventions for social isolation.

Across our included studies, all four interventions appeared to be adapted to their local contexts. The UHCE approach by Franse et al. (2018) and the Health TAPESTRY intervention

by Dolovich et al. (2019) also involved strong community participation by tailoring their intervention to each participant's health care needs, however it is unclear whether the subsequent care pathways or plans allowed for productive engagement. Cohen et al. (2006)'s chorale intervention provided productive engagement to participants but may have benefited from further community participation in the implementation of the intervention.

There are many strengths to our systematic review. Our search strategy was peer-reviewed by a second librarian and was comprehensive through the inclusion of four databases, searching grey literature and scanning references of included studies and relevant reviews. Our methodology was informed by the Cochrane Handbook[10], with screening, data abstraction, and risk of bias appraisal being conducted in duplicate by independent reviewers, and our findings were reported using PRISMA-2020[11]. However, there are some limitations. We deviated from our protocol slightly to allow for inclusion of studies where only some participants had a history of falling, given the paucity of data on older adults in a community setting who had experienced a fall. Further, studies were plagued by risk of bias across several components, including to risk of bias from poor allocation concealment, lack of random sequence generation, and a lack of blinding of participants, personnel, and outcome assessors. A lack of standardization was observed across the outcomes assessed in the included studies, suggesting that future work could focus on developing consensus on measures for social isolation and loneliness that have already been validated to establish a core outcomes dataset. Indeed, a study by Cornwell et al. (2009) highlights the wide variation in indicators for isolation and loneliness and proposed combining these varying indicators to develop two parsimonious scales to measure social disconnectedness and perceived isolation [24], however, these scales were not used by the included studies here.

We recommend updating this systematic review as more literature becomes available on this topic. Effective interventions are necessary to support older people who are at increased risk of social isolation, particularly after experiencing a fall. In addition, further work is required to examine the relationship between social isolation and falling, and the directionality of this relationship, as different intervention approaches may be warranted depending on which experience comes first.

In conclusion, we identified four studies examining interventions for social isolation amongst older adults with a history of falling. The interventions examined varied widely, from singing in a chorale to community-base care coordination, as did the outcome measures used to assess the effectiveness of the interventions. We identified only one quasi-experimental study which demonstrated that multifactorial health assessments and coordinated care pathways resulted in a small positive effect on loneliness in this population. Future research is warranted in this under-studied area.

LIST OF ABBREVIATIONS

CADTH	Canadian Agency for Drugs and Technologies in Health
CI	Confidence interval
EPOC	Effective Practice and Organisation of Care
IQR	Interquartile range
PRESS	Peer Review of Electronic Search Strategies
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomized controlled trial
SD	Standard deviation

DECLARATIONS

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Ethics approval

Not required.

Consent for publication

Not applicable.

Availability of data and materials

The full dataset is available from the corresponding author upon reasonable request.

Conflict of interests

All authors do not have any potential (or perceived) conflicts of interest.

Role of the funder

The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

SUPPLEMENTAL FILES

Supplemental File 1: PRISMA Checklist

Supplemental File 2: Appendices

FIGURES

Figure 1 – PRISMA study flow of included studies (n=4)

TABLES

Table 1 – Study and Patient Characteristics

Summary characteristics	
Mean age (range)	77.8 (76 to 79.6)*
Mean % of female participants (range)	71.3 (60.8 to 91)**
Mean sample size (range)	837.3 (21 to 2325)
Mean % of participants living alone (range)	52.6 (38.1 to 67)*
Mean % of participants with history of falling (range)	19.6 (9.3 to 30.2)*
Individual study details	
Cohen, 2006 → Chorale intervention Country of conduct: United States Study design: Non-randomized controlled trial Study duration: 12 months Sample size: 166 Intervention setting: Community	
Scharlach, 2015 → ElderHelp Concierge Club (CC) intervention Country of conduct: United States Study design: Uncontrolled before-after study Study duration: 6 months Sample size: 21 Intervention setting: Participant homes and community	
Franse, 2018 → Urban Health Centres Europe (UHCE) approach Country of conduct: United Kingdom, Greece, Croatia, the Netherlands, Spain Study design: Quasi-experimental (one site randomized, four sites controlled before-after) Study duration: 12 months Sample size: 2325 Intervention setting: Primary care and community settings	
Dolovich, 2019 → Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening QualitY) intervention Country of conduct: Canada Study design: Randomized controlled trial Study duration: 6 months Sample size: 312 Intervention setting: Participant homes and primary care	

*Only two of four studies reported on these variables
**Only three of four studies reported on this variable

Table 2 – Screening Eligibility Criteria

Population	Older adults (mean age 65 years and older) living independently in a community setting with a history of falling
Intervention	Any intervention for social isolation
Comparator	Usual care or another intervention for social isolation
Outcomes	Any quantitative measures of changes in social isolation Ex: the quantity of social interactions, Lubben Social Network Scale for social isolation, De Jong Gierveld Loneliness Scale, Bude & Lantermann scale for social exclusion, etc.
Study designs	Randomized controlled trial (RCT), non-RCT, quasi-experimental, interrupted time series, controlled or uncontrolled before-after, case control studies, cohort studies
Time	No time restrictions

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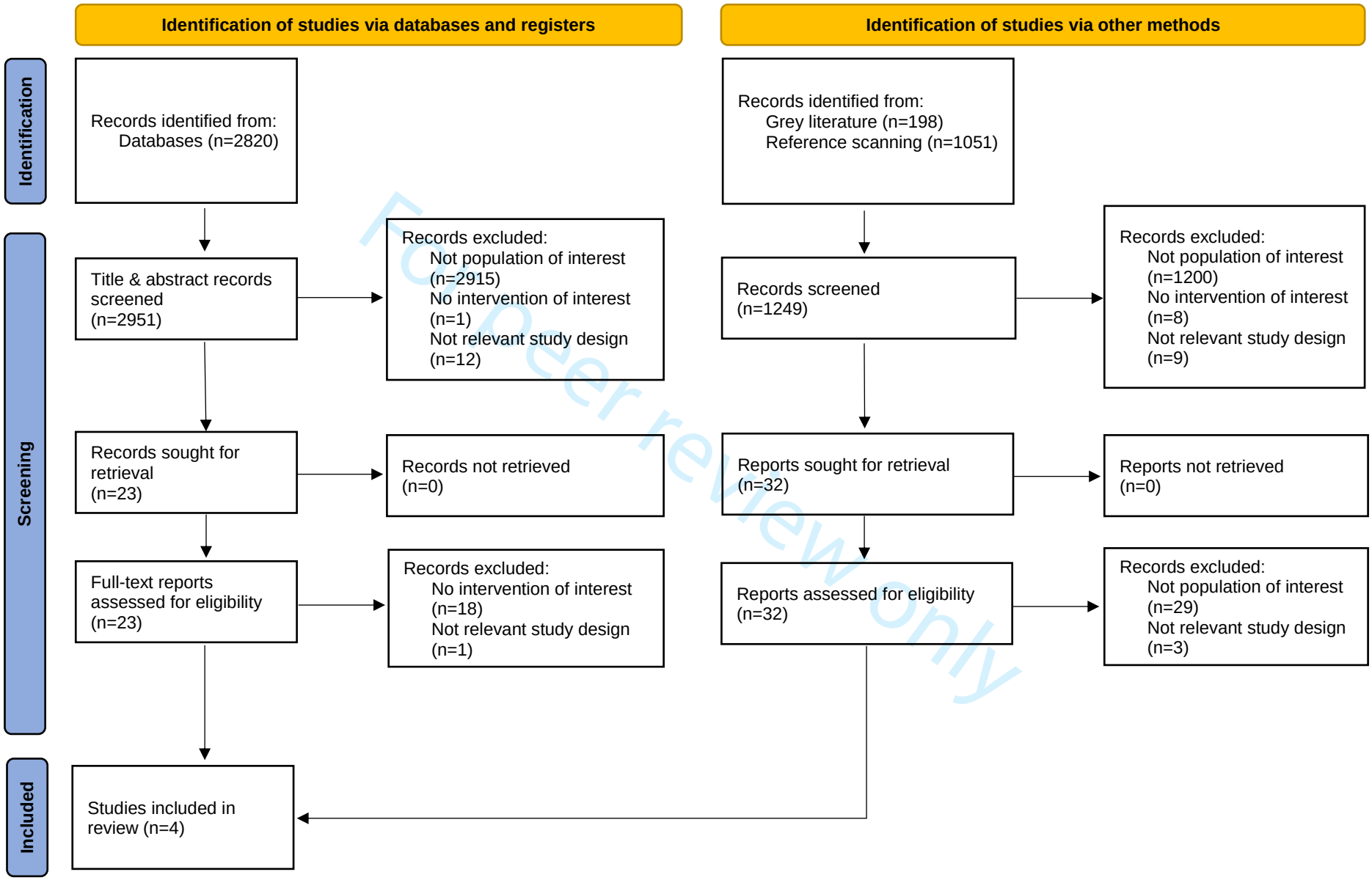
Figure 1 – PRISMA study flow of included studies (n=4)



Supplementary File 1: PRISMA Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	3-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	5
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	5
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	6, Table 2
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	6
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix 1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	7
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	6-7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	7
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	N/A
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	7
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	7
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	7

Section and Topic	Item #	Checklist item	Location where item is reported
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	7
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	7
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	8, Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	N/A
Study characteristics	17	Cite each included study and present its characteristics.	9-11, Table 1, Appendix 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	9, Appendix 5
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	9-11, Appendix 6
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	11-13
	23b	Discuss any limitations of the evidence included in the review.	13
	23c	Discuss any limitations of the review processes used.	13
	23d	Discuss implications of the results for practice, policy, and future research.	14
OTHER INFORMATION			

Section and Topic	Item #	Checklist item	Location where item is reported
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	6
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	13
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	15-16
Competing interests	26	Declare any competing interests of review authors.	16
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	16

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71
For more information, visit: http://www.prisma-statement.org/

Supplementary File 2: Appendices

Appendix 1 – Database Search Strategies

Ovid MEDLINE(R) ALL <1946 to Feb 25, 2020>

1 Accidental Falls/
2 (slip* or trip* or stumbl* or tumbl*).tw,kf.
3 (fall* or fell or "fall-related" or "near-fall").tw,kf.
4 or/1-3
5 limit 4 to "all aged (65 and over)"
6 exp Aged/ or geriatrics/
7 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).tw,kf.
8 4 and (6 or 7)
9 5 or 8
10 Social Isolation/
11 loneliness/
12 exp social support/
13 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).tw,kf.
14 ((lack or absence or minimi*) adj2 (contact or communication or support*)).tw,kf.
15 or/10-14
16 9 and 15
17 animals/ not humans/
18 16 not 17

PsycINFO <1806 to February Week 4 2020>

1 falls/
2 (slip* or trip* or stumbl* or tumbl*).tw.
3 (fall* or fell or "fall-related" or "near-fall").tw.
4 or/1-3
5 limit 4 to "380 aged <age 65 yrs and older>"
6 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).tw.
7 4 and 6
8 5 or 7
9 social isolation/ or loneliness/ or social support/ or friendship/
10 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).tw.
11 ((lack or absence or minimi*) adj2 (contact or communication or support*)).tw.
12 or/9-11
13 8 and 12
14 Limit 13 to human

Embase Classic+Embase <1947 to 2020 February 25>

1 falling/
2 (slip* or trip* or stumbl* or tumbl*).tw.
3 (fall* or fell or "fall-related" or "near-fall").tw.
4 or/1-3
5 limit 4 to aged <65+ years>
6 loneliness/ or social support/ or friendship/
7 exp social isolation/
8 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).tw.
9 ((lack or absence or minimi*) adj2 (contact or communication or support*)).tw.
10 or/6-9
11 5 and 10
12 limit 11 to human

Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to February 25, 2020>, EBM Reviews - ACP Journal Club <1991

to February 2020>, EBM Reviews - Cochrane Clinical Answers <February 2020>, EBM Reviews - Database of Abstracts of Reviews of Effects <1st Quarter 2016>

1 (slip* or trip* or stumbl* or tumbl*).mp.
2 (fall* or fell or "fall-related" or "near-fall").mp.
3 1 or 2
4 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).mp.
5 3 and 4
6 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).mp.
7 ((lack or absence or minimi*) adj2 (contact or communication or support*)).mp.
8 6 or 7
9 5 and 8

Joanna Briggs Institute EBP Database - <Current to February 25, 2020>

1 (slip* or trip* or stumbl* or tumbl*).mp.
2 (fall* or fell or "fall-related" or "near-fall").mp.
3 1 or 2
4 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).mp.
5 3 and 4
6 (social barrier* or social isolation* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).mp.
7 ((lack or absence or minimi*) adj2 (contact or communication or support*)).mp.
8 6 or 7
9 5 and 8

AMED (Allied and Complementary Medicine) <1985 to February 2020>

1 (slip* or trip* or stumbl* or tumbl*).mp.
2 (fall* or fell or "fall-related" or "near-fall").mp.
3 1 or 2
4 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).mp.
5 3 and 4
6 (social barrier* or social isolation* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).mp.
7 ((lack or absence or minimi*) adj2 (contact or communication or support*)).mp.
8 6 or 7
9 5 and 8

Appendix 2 – Study Characteristics

Author, year	Study title	Journal name	Country	Study design	Study duration (months)
Cohen, 2006	The impact of professionally conducted cultural programs on the physical health, mental health, and social functioning of older adults	The Gerontologist	United States	Non-randomized controlled trial	12
Scharlach, 2015	An Integrated Model of Co-ordinated Community-Based Care	The Gerontologist	United States	Uncontrolled before-after study	6
Franse, 2018	The effectiveness of a coordinated preventive care approach for healthy ageing (UHCE) among older persons in five European cities: A pre-post controlled trial	International Journal of Nursing Studies	United Kingdom, Greece, Croatia, the Netherlands, Spain	Quasi-experimental (one site was randomized, four sites were controlled before-after)	12
Dolovich, 2019	Combining volunteers and primary care teamwork to support health goals and needs of older adults: a pragmatic randomized controlled trial	Canadian Medical Association Journal	Canada	Randomized controlled trial	6

Appendix 3 – Patient Characteristics

DEMOGRAPHICS						
Author, year	**Overall sample size**	**Overall age value**	**Overall age type**	**Overall age variance value**	**Overall age variance type**	**% female***
Cohen, 2006	166	NR (Reported mean age by group: intervention - 79.0 years, comparison - 79.6 years)	NR	NR	NR	NR
Scharlach, 2015	21	76	median	NR	NR	91
Franse, 2018	2325	79.5	mean	5.6	SD	60.8
Dolovich, 2019	312	NR (Reported mean age by group: intervention - 78.1 years, control - 79.1 years)	NR	NR	NR	62.2

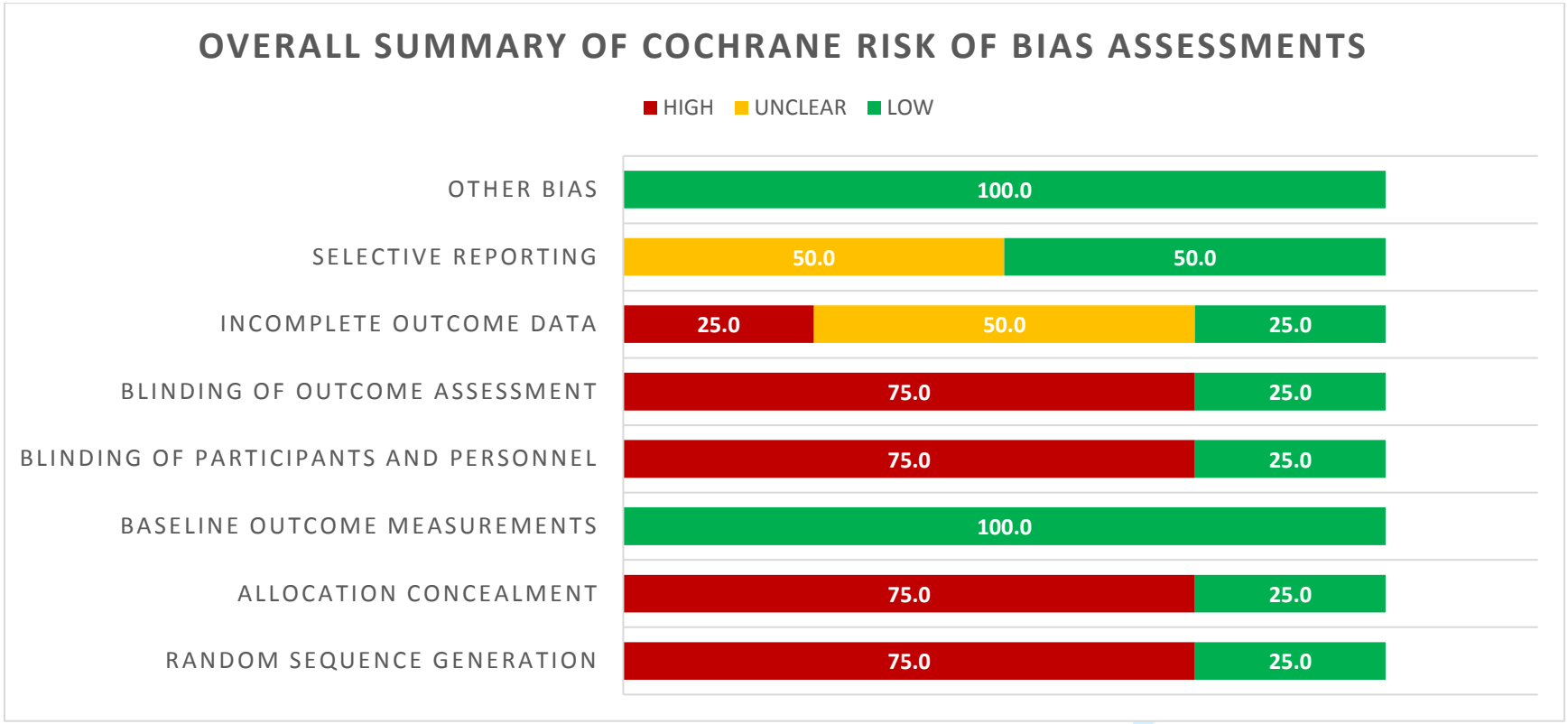
SETTING DATA				
Author, year	**Intervention Setting**	**Participants living alone (%)**	**Description of access to caregivers**	**Description of baseline social network**
Cohen, 2006	Community	NR	NR	NR
Scharlach, 2015	Participant homes and community	67	NR	NR
Franse, 2018	Primary care and community settings	38.1	Care use i.e., hours per week receiving help in household work due to health problems and hours per week receiving help in caring for oneself was assessed. Hours/wk household help = control: 1.5 (5.3); intervention 1.0 (3.3).	NR
Dolovich, 2019	Participant homes and primary care	NR	NR	NR

FALLS AND FRAILTY DATA								
Author, year	**Participants with history of falling**	**List of comorbidities**	**Participants with frailty (%)**	**Frailty scale**	**Overall frailty score**	**Overall frailty score type**	**Frailty variance value**	**Frailty variance type**
Cohen, 2006	baseline average falls per person - intervention: 0.40 control: 0.36	NR	NR	NR	NR	NR	NR	NR

Scharlach, 2015	mean of 1.3 falls at baseline	NR	NR	NR	NR	NR	NR	NR
Franse, 2018	30.2% had a fall in the previous year	NR	20.2	Tilburg Frailty indicator (TFI)	5.1	mean	3.2	SD
Dolovich, 2019	9.3% of participants had experienced 1 or more falls	NR	NR	NR	NR	NR	NR	NR

Abbreviations: NR, not reported; SD, standard deviation
*No studies reported having individuals who do not identify as female or male

Appendix 4 – Overall risk of bias across included studies (n=4)



Appendix 5 – Quality appraisal assessments using Cochrane Risk of Bias tool modified by EPOC

Author, Year	Trial identifier	Random sequence generation	Allocation concealment	Baseline outcome measurements	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias	Funding details:
Cohen, 2006	NR	High risk	High risk	Low risk	High risk	High risk	Unclear risk	Unclear risk	Low risk	National Endowment for the Arts (lead sponsor); Center for Mental Health Services, Substance Abuse and Mental Health Services Administration, Department of Health and Human Services; National Institute of Mental Health, National Institutes of Health; National Retired Teachers Association/ AARP; International Foundation for Music Research; Stella and Charles Guttman Foundation, New York City.
Scharlach, 2015	NR	High risk	High risk	High risk	High risk	High risk	Unclear risk	Unclear risk	Low risk	The SCAN Foundation
Franse, 2018	NR	High risk	High risk	Low risk	High risk	High risk	High risk	Low risk	Low risk	European Union, CHAFEA, third Health programme, grant number 20131201
Dolovich, 2019	NCT02283723	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Health Canada (grant no. 6817-06-2013/5570001), Government of Ontario (grant no. 06547 for INSPIRE-PHC), McMaster University & McMaster Family Health Organization

Appendix 6 – Outcome summary table for included studies (n=4)

Author, Year	Treatment arms	History of falls	Results	Text description of effectiveness
Cohen, 2006 *Design: non-RCT*	**Singing in a chorale** (n=90) The intervention consisted of participating in a professionally conducted chorale in which there were weekly singing rehearsals for 30 weeks as well as public performances several times during the intervention period. **Usual activities** (n=76) Participants in the comparison group continued their regular activities as usual, with the study introducing no changes other than the assessments.	Baseline average of 0.40 falls per person in the intervention group, and 0.36 per person in the control group in the past 12 months	**UCLA Loneliness scale III** Baseline: 35.1 (SD, 8.1) Follow-up: 34.6 (SD, 7.9) Baseline: 38.3 (SD, 10.1) Follow-up: 37.0 (SD, 10.3)	Both groups evidenced a slight decrease in loneliness at the 12-month follow-up; however, the decrease in loneliness was greater for the intervention group than for the comparison. Analysis of covariance of the 12-month follow-up assessment continued to demonstrate a marginally significant difference between the two groups, F (1,126) = 3.08; p = .08.
Scharlach, 2015 *Design: Uncontrolled before-after*	**ElderHelp Concierge Club (CC)** (n=21) Integrated community-based care model that includes comprehensive personal and environmental, assessment, multilevel care co-ordination, a mix of professional and volunteer service providers, and a capitated, income-adjusted fee model. When individuals contact CC for information or services, they receive a brief assessment designed to determine their eligibility for CC services, as well as the type of services they appear to need: information and referral services only (Tier 1), transportation services only, or other CC services including in-home assessment by the CC Intake Specialist (Tiers 2 and 3).	Baseline mean of 1.3 falls over the past 6 months	**Social Isolation (3-item scale)** Baseline: 8.7 (SD, 3.2) Follow-up: 7.0 (SD, 3.8) **Social interaction** *Interact with friends/relatives weekly* Baseline: 76% of participants Follow-up: 100% of participants *Attend monthly meetings* Baseline: 33% of participants Follow-up: 48% of participants	Social isolation did not change significantly; nor did contact with friends and relatives or participation in meetings of organized groups.

Franse, 2018 *Design: one site randomized, 4 sites controlled before-after design; results combined all sites, so classified as quasi-experimental*	**Urban Health Centres Europe (UHCE) approach** (n=986) Preventive multidimensional health assessment and if person at risk, coordinated care pathways targeted at fall risk, appropriate medication use, loneliness and frailty **Usual Care** (n=858) Usual care included access to their GP	30.2% of participants experienced a fall in the previous year	**Loneliness (short JG scale)** Baseline: 0.6 (SD, 0.7) Follow-up: 0.6 (SD, 0.7) Baseline: 0.6 (SD, 0.7) Follow-up: 0.7 (SD, 0.7)	When comparing persons who enrolled in any type of care-pathway with all persons in the control group there was a positive effect on loneliness after adjusting for city clustering, age, gender, living situation, education, and baseline status of outcome (B= -0.18, 95% CI= -0.35 to -0.02).
Dolovich, 2019 *Design: RCT*	**Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening QualitY) intervention** (n=158) Trained community volunteers visited patients to collect information on their life and health goals, risks and needs, daily life activities and general health, using structured surveys and unstructured narratives. The volunteers sent a report summarizing patients' goals, alerts, key issues and observations to the primary care interprofessional "huddle" team at the clinics. These interprofessional teams reviewed the reports and then generated, prioritized and acted upon plans of care for how the team, community agencies and volunteers could address clients' goals and health issues, with iterative follow-up **Usual Care** (n=154) The control group received usual care and did not have volunteer visits. There was no restriction on receiving care from the same team members as the intervention group	9.3% of participants experienced 1 or more falls	**Social network score (DSSI-10)** Baseline: Mean, 8.84 (SD, 1.52) Follow-up: Mean, 8.75 (SD, 1.52) **Social satisfaction score (DSSI-10)** Baseline: Mean, 18.89 (SD, 2.41) Follow-up: Mean, 18.96 (SD, 2.87) **Social network score (DSSI-10)** Baseline: Mean, 8.74 (SD, 1.61) Follow-up: Mean, 8.69 (SD, 1.53) **Social satisfaction score (DSSI-10)** Baseline: Mean, 19.19 (SD, 2.37) Follow-up: Mean, 19.04 (SD, 2.76)	There were no statistically significant between-group differences in participant ratings of self-efficacy, quality of life, optimal aging, social support

BMJ Open

Interventions for social isolation in older adults who have experienced a fall: A systematic review

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Secondary Subject Heading:	Rehabilitation medicine
Keywords:	REHABILITATION MEDICINE, GERIATRIC MEDICINE, PREVENTIVE MEDICINE

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Interventions for social isolation in older adults who have experienced a fall: A systematic review

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ABSTRACT

Objectives: The objective of our systematic review was to identify effective interventions to prevent or mitigate social isolation and/or loneliness in older adults who experienced a fall.

Design: Systematic review

Data Sources: MEDLINE, Embase, the Cochrane Central Register of Controlled Trials, and Ageline were searched (inception to February 2020).

Methods: Studies were eligible if they described any intervention for social isolation in older adults living in a community setting who experienced a fall, and reported outcomes related to social isolation or loneliness.

Two independent reviewers screened citations, abstracted data, and appraised risk of bias using the Cochrane risk-of-bias tool. The results were summarized descriptively.

Results: After screening 4,069 citations and 55 full-text articles, 4 studies were included. The four studies varied in study design, including a randomized controlled trial, non-randomized controlled trial, an uncontrolled before-after study, and a quasi-experimental study. Interventions varied widely, and included singing in a choir, a patient-centred, interprofessional primary care team-based approach, a multifactorial assessment targeting fall risk, appropriate medication use, loneliness and frailty, and a community-based care model that included comprehensive assessments and multilevel care coordination. Outcome measures varied and included scales for loneliness, social isolation, social interaction, social networks, and social satisfaction. Mixed results were found, with three studies reporting no differences in social isolation or loneliness after the intervention. Only the multifactorial assessment intervention demonstrated a small positive effect on loneliness compared to the control group after adjustment (B= -0.18, 95% CI= -0.35 to -0.02).

Conclusions: Few studies examined interventions for social isolation or loneliness in older adults who experienced a fall. More research is warranted in this area.

Systematic Review Registration: PROSPERO (CRD42020198487)

Word count: 266 (abstract), 2953 (main text)

Keywords: systematic review, older adults, falling, social isolation, loneliness, interventions

Strengths and limitations of this study:

- We conducted a comprehensive search of 4 databases, using a search strategy which was peer-reviewed by a second librarian, and supplemented this by searching grey literature and scanning references of included studies and relevant reviews.
- We followed the methodology outlined by the Cochrane Handbook, with screening, data abstraction, and risk of bias appraisal being conducted in duplicate by independent reviewers, and our findings were reported using the PRISMA-2020 checklist.
- We deviated from our protocol slightly due to the limited of data on older adults in a community setting who had experienced a fall and expanded our inclusion criteria to include studies where some participants (not all) had a history of falling.
- Our included studies were plagued by risk of bias across several components, including poor allocation concealment, lack of random sequence generation, and a lack of blinding of participants, personnel, and outcome assessors.
- A lack of standardization was observed across the outcomes assessed in the included studies, due to lack of consensus on measures for social isolation and loneliness.

INTRODUCTION

Worldwide, more than 37 million falls occur requiring medical attention every year(1). Almost 650,000 people die every year from a fall, with those aged 65 years and older experiencing the greatest number of fatal falls(1). Falls are associated with considerable negative outcomes on older adults, such as physical inactivity, anxiety, depressive symptoms, and fear of falling(2, 3).

Social isolation is a serious consequence among older adults who have experienced a fall(4). Social isolation is a complex phenomenon that can be characterized by five key attributes: decreased number of social contacts, decreased feeling of belonging, reduced or lack of fulfilling relationships, decreased engagement with others, and reduced quality of the members in one's network(5). Loneliness is another consequence that may occur after a fall and can be defined as "the unpleasant experience that occurs when a person's network of social relations is deficient in some way, either quantitatively or qualitatively"(6). Some research has focused on the risk of social isolation and loneliness after experiencing a fall, since people who have experienced a fall are less likely to continue their activities of daily living(4). For example, one study reported a statistically significant relationship between feelings of loneliness and social exclusion after experiencing a fall(4).

Although social isolation and loneliness are related, it is important to note that they are two distinct concepts(7). Social isolation is more objective, as it can be measured by examining the presence or absence of relationships with other people, whereas loneliness is a person's subjective experience and is more difficult to measure. This distinction is important, as different interventions might be required for each of these outcomes after experiencing a fall.

Social isolation and loneliness among older adults is associated with many adverse health outcomes, including cognitive decline, depression, anxiety, and dementia(8). Interventions to

mitigate social isolation and loneliness after older adults experience a fall is of paramount importance. Examples of interventions may include participating in social activities, outreach calls from peers or healthcare workers, and group exercise. The objective of our systematic review was to identify effective interventions to mitigate social isolation and loneliness in older adults who lived independently in a community setting with a history of falling.

METHODS

Protocol

The protocol for this systematic review was developed in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) checklist, with consultation from knowledge users and clinical experts and was registered on PROSPERO (CRD42020198487). This systematic review was conducted according to methodology outlined in the Cochrane Handbook(9), and the PRISMA checklist (Supplementary File 1) was used to guide the reporting of our results(10).

Search strategy and selection criteria

A comprehensive literature search strategy was developed by an experienced information specialist and peer-reviewed by a second information specialist using the Peer Review of Electronic Search Strategies (PRESS) checklist(11). MEDLINE, Embase, the Cochrane Central Register of Controlled Trials, and Ageline were searched from inception until February 25, 2020 (Appendix 1). The reference lists of included studies and relevant reviews were also scanned. A search for grey literature was conducted using the Canadian Agency for Drugs and Technologies in Health (CADTH)'s Grey Matters checklist(12).

Our eligibility criteria are summarized in Table 1. Studies were eligible for inclusion if they described any intervention for social isolation or feelings of loneliness in older adults (mean

age 65 years and older) with any participant reporting a history of falling (i.e., regardless of the proportion of the sample who fell) and who lived independently in a community setting. Eligible study designs included randomized controlled trials (RCTs), cohort studies, case control studies, non-randomized controlled trials, quasi-experimental studies, interrupted time series or controlled/uncontrolled before after studies. Case reports, case series, cross-sectional studies, qualitative studies, and reviews were not eligible for inclusion. Outcomes of interest included any changes in social isolation or loneliness as measured using validated scales, such as the De Jong Gierveld loneliness scale(13) and the Bude & Lantermann scale for social exclusion(14), or any other quantitative measure of social isolation or loneliness. Social isolation was defined as a decrease in the number of social contacts, decreased feeling of belonging, reduced or lack of fulfilling relationships, decreased engagement with others, and reduced quality of the members in one's network(5). Loneliness was defined as "the unpleasant experience that occurs when a person's network of social relations is deficient in some way, either quantitatively or qualitatively(6).

All citations were screened by two independent reviewers after the entire team completed a training exercise on 50 citations and 78% agreement was achieved. Full-text screening by two independent reviewers began after a training exercise on 22 articles amongst the team with an agreement of 75%. Discrepancies for both levels of screening were resolved by a third reviewer or through discussion.

Data abstraction and risk of bias appraisal

Data abstraction and risk of bias appraisal were also conducted independently by pairs of reviewers after a training pilot exercise reached sufficient agreement, and discrepancies were resolved by a third reviewer. The risk of bias appraisal was conducted using the Cochrane

Effective Practice and Organisation of Care (EPOC) risk of bias tool, as it was expected that a mixture of study designs would be included(15).

Synthesis

The findings of this review were summarized descriptively, reporting study and patient characteristics, quality appraisal assessment, and intervention details. As outlined in our review protocol, we planned to conduct a meta-analysis if more than one study evaluated the same intervention, and a network meta-analysis for connected networks of trials with pre-specified intervention nodes if over 10 trials were available and the number of trials was greater than the number of interventions. However, as these conditions were not met, no statistical analyses were conducted.

Patient and Public Involvement

A patient partner with previous experience of a fall was identified and involved in this study from the protocol development stage. The patient partner provided input on our research question and outcome measures to ensure that the patient perspective was incorporated. They also participated in the screening training exercises for citations and full-text articles, provided feedback on screening eligibility criteria, and reviewed the manuscript as a coauthor.

RESULTS

Study flow

After screening 4,069 citations and 55 full-text articles against our eligibility criteria, 4 studies(16-18) met the eligibility criteria and were included in this review (Figure 1).

Study and patient characteristics

Study and patient characteristics are summarized in Table 2 and detailed characteristics are reported in Appendices 1 and 2. The mean age of participants across included studies was 77.8 years (range: 76 to 79.5 years). Three of the included studies were conducted in North America (75.0%) and one in Europe (25.0%) and they were conducted in a variety of settings including the community setting, a combination of participant homes and community setting, a combination of primary care and community setting, or a combination of participant homes and primary care. Only one study provided data on frailty of the included participants, reporting 20.2% of participants with frailty (Appendix 2). The four studies varied in study design, including a randomized controlled trial, a non-randomized controlled trial, an uncontrolled before-after study, and a quasi-experimental study in which data from one randomized site was combined with data from four controlled before-after sites. Two of the studies had a study duration of 12 months, and the other two had a duration of 6 months. The sample size in the studies ranged from 21 to 2325 and, on average, 71.3% of participants were female.

Risk of bias results

An overall summary of risk of bias across the four studies can be found in Appendix 3, and detailed risk of bias assessments can be found in Appendix 4. All studies had low risk of bias for baseline outcome measurements (100% low, 0% unclear, 0% high), and other bias (mainly funding bias; 100% low, 0% unclear, 0% high). Two of the studies had low risk and two had unclear risk of bias for selective reporting (50% low, 50% unclear, 0% high). One study had high risk, two studies unclear risk, and one had low risk of bias for incomplete outcome data (25% low, 50% unclear, 25% high). However, three of four studies had high risk of bias for blinding of outcome assessment (25% low, 0% unclear, 75% high), blinding of participants and personnel

(25% low, 0% unclear, 75% high), random sequence generation (25% low, 0% unclear, 75% high), and allocation concealment (25% low, 0% unclear, 75% high).

Outcome results

The relevant findings from the four included studies are summarized in Appendix 6.

Cohen et al. (2006) conducted a non-randomized controlled trial in the United States assessing the effects of singing in a chorale to reduce loneliness compared to usual care in 166 older adults. The chorale intervention involved attendance at weekly singing rehearsals and several public performances, while the usual care group continued their usual activities. Both groups had a similar baseline history of falling over the past 12 months (average of 0.40 falls per person in the intervention group, and 0.36 per person in the control group). After 12 months of follow-up, they noted a reduction in loneliness (as measured using the UCLA Loneliness Scale-III) in both groups (chorale: baseline mean: 35.1 (SD, 8.1) and follow-up mean: 34.6 (SD, 7.9); usual care: baseline mean: 38.3 (SD, 10.1) and follow-up mean: 37.0 (SD, 10.3). While the chorale intervention reported lower loneliness scores than the usual care group after 12 months of follow-up, no statistically significant difference was observed ($F(1,126) = 3.08$; $p = 0.08$).

Scharlach et al. (2015) conducted an uncontrolled before-after study in the United States assessing the effectiveness of their ElderHelp Concierge Club intervention on social isolation in a sample of 21 participants(17). The Concierge Club intervention was a community-based care model that provided different tiers of services to their members including information and referrals, transportation, or in-house assessments. The baseline mean number of falls over the past 6 months was 1.3. They noted that social isolation, as measured using an unnamed 3-item scale(19), did not change significantly after 6 months of follow-up (baseline mean: 8.7 (SD, 3.2) and follow-up mean: 7.0 (SD, 3.8)). Similarly, although all participants reported having contact

with friends/relatives after the intervention, this was not found to be a significant change from baseline (baseline: 76% of participants, follow-up: 100% of participants).

Franse et al. (2018) conducted a quasi-experimental study comparing the effectiveness of the Urban Health Centres Europe (UHCE) approach compared to usual care on loneliness in a sample of 1,844 older adults across the United Kingdom, Greece, Croatia, the Netherlands, and Spain(18). The UHCE approach involved a preventative multidimensional health assessment, which informed the coordination of specific care pathways targeting the individual's needs (such as fall risk, appropriate medication use, loneliness, and frailty). The usual care group received their usual care and had access to any already existing services. At baseline, 30.2% of participants reported having experienced a fall in the past 12 months. Their adjusted analysis found a small positive effect of the UHCE approach on loneliness, as measured using the short De Jong Gierveld Loneliness scale(20), when compared to usual care (B= -0.18, 95% CI= -0.35 to -0.02).

Dolovich et al. (2019) conducted a randomized controlled trial comparing the effectiveness of the Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening qualitY) intervention compared to usual care on social isolation in a sample of 312 older adults in Canada(21). This intervention involved the collection of information on patients' health goals and needs by trained volunteers, who then summarized these findings in a report for the interprofessional primary care team. The primary care team used these reports to generate and act on plans of care for how the team, community agencies, and volunteers could help address each patient's goals. The control group received usual care. Approximately 9.3% of participants reported experiencing at least one fall. After 6 months of follow-up, they found no statistically significant difference between the intervention and control groups in terms of their

social network scores (mean difference, 0.038 (95% CI: –0.25 to 0.33) and social satisfaction scores (mean difference, 0.102 (95% CI, –0.35 to 0.55), as measured using the Duke Social Support Index(22).

DISCUSSION

We conducted a comprehensive systematic review of interventions to mitigate social isolation and loneliness in older adults living independently in a community setting who experienced a fall. Very few studies were identified that fulfilled our eligibility criteria, indicating a dearth of evidence on this important topic. Only 4 studies were included and as each examined different types of interventions, this precluded any statistical pooling of results. Furthermore, studies varied on the proportion of participants who reported experiencing a fall and multiple types of outcomes were assessed for loneliness and social isolation, making it challenging to provide any meaningful interpretation of results.

Across the four studies in this systematic review, only the quasi-experimental study by Franse et al. (2018)(18), which assessed the impact of multifactorial health assessments and coordinated care pathways targeting fall risk, medication use, loneliness and frailty, found a small positive effect on loneliness (i.e. reduction) when comparing those that received the intervention with the control group. However, given the paucity of data in older adults with a history of falling, the most effective intervention for preventing or reducing social isolation remains unclear. Only one randomized controlled trial was identified in this review, highlighting the need for more robust research in this important area.

We searched for previous reviews that were related and only one was identified. Gardiner et al. (2016) conducted an integrative review on interventions for social isolation in older adults(23). While this review was not specific to individuals who had experienced a fall, it

discusses characteristics of effective social isolation interventions in the broader older adult population and could be applicable to the subset of this population that experiences falling. While the majority of interventions they identified showed at least a moderate positive effect on social isolation or loneliness, they noted that the quality of the evidence was poor, making it difficult to identify a particular intervention as most effective(23). This is consistent with our determination of the need for more robust research on the effectiveness of social isolation interventions in older adults with a history of falling. They identified adaptability to local contexts, community participation in the design and implementation of the intervention, and productive engagement (as opposed to passive activities) as common features among successful interventions(23). Future studies should consider these factors in the development and evaluation of interventions for social isolation.

Across our included studies, all four interventions appeared to be adapted to their local contexts. The UHCE approach by Franse et al. (2018) and the Health TAPESTRY intervention by Dolovich et al. (2019) also involved strong community participation by tailoring their intervention to each participant's health care needs, however it is unclear whether the subsequent care pathways or plans allowed for productive engagement. Cohen et al. (2006)'s chorale intervention provided productive engagement to participants but may have benefited from further community participation in the implementation of the intervention.

There are many strengths to our systematic review. Our search strategy was peer-reviewed by a second librarian and was comprehensive through the inclusion of four databases, searching grey literature and scanning references of included studies and relevant reviews. Our methodology was informed by the Cochrane Handbook(9), with screening, data abstraction, and risk of bias appraisal being conducted in duplicate by independent reviewers, and our findings

were reported using PRISMA-2020(10). However, there are some limitations. We deviated from our protocol slightly to allow for inclusion of studies where only some participants had a history of falling, given the paucity of data on older adults in a community setting who had experienced a fall. We were unable to update our literature search due to a lack of sufficient funding. Further, studies were plagued by risk of bias across several components, including to risk of bias from poor allocation concealment, lack of random sequence generation, and a lack of blinding of participants, personnel, and outcome assessors. A lack of standardization was observed across the outcomes assessed in the included studies, suggesting that future work could focus on developing consensus on measures for social isolation and loneliness that have already been validated to establish a core outcomes dataset. Indeed, a study by Cornwell et al. (2009) highlights the wide variation in indicators for isolation and loneliness and proposed combining these varying indicators to develop two parsimonious scales to measure social disconnectedness and perceived isolation (24), however, these scales were not used by the included studies here. Furthermore, additional examination of tailoring interventions to reduce loneliness and/or social isolation is warranted, as there was a dearth of included studies to examine this fully in this systematic review with two studies each focusing on social isolation and loneliness separately. Further research is warranted on this, as social isolation and loneliness are distinct concepts and different interventions may be required to target each outcome separately.

We recommend updating this systematic review as more literature becomes available on this topic. Effective interventions are necessary to support older people who are at increased risk of social isolation, particularly after experiencing a fall. In addition, further work is required to examine the relationship between social isolation, loneliness, and falling, and whether other variables influence this relationship, as this may warrant different intervention approaches.

In conclusion, we identified four studies examining interventions for social isolation amongst older adults with a history of falling. The interventions examined varied widely, from singing in a chorale to community-base care coordination, as did the outcome measures used to assess the effectiveness of the interventions. We identified only one quasi-experimental study which demonstrated that multifactorial health assessments and coordinated care pathways resulted in a small positive effect on loneliness in this population. Future research is warranted in this under-studied area.

LIST OF ABBREVIATIONS

CADTH	Canadian Agency for Drugs and Technologies in Health
CI	Confidence interval
EPOC	Effective Practice and Organisation of Care
IQR	Interquartile range
PRESS	Peer Review of Electronic Search Strategies
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomized controlled trial
SD	Standard deviation

DECLARATIONS

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Ethics approval

Not required.

Consent for publication

Not applicable.

Author Contribution

Substantial contributions to the conception or design of the work (ACT, SMT, JW, SES); acquisition, analysis, or interpretation of data for the work (all authors); drafting the work (ACT, SMT) or revising it critically for important intellectual content (AR, NR, GM, JF, YJ, MdG, KA, JB, AG-B, JW, SES); final approval of the version to be published (all authors); agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved (all authors)

Availability of data and materials

The full dataset is available from the corresponding author upon reasonable request.

Conflict of interests

All authors do not have any potential (or perceived) conflicts of interest.

Role of the funder

The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

SUPPLEMENTAL FILES

Supplemental File 1: PRISMA Checklist

Supplemental File 2: Appendices

FIGURES

Figure 1 – PRISMA study flow of included studies (n=4)

TABLES

Table 1 – Screening Eligibility Criteria

Population	Older adults (mean age 65 years and older) living independently in a community setting with any participant reporting a history of falling (i.e., regardless of the proportion of the sample who fell)
Intervention	Any intervention for social isolation or loneliness
Comparator	Usual care or another intervention for social isolation or loneliness
Outcomes	Any quantitative measures of changes in social isolation or loneliness Ex: the quantity of social interactions, Lubben Social Network Scale for social isolation, De Jong Gierveld Loneliness Scale, Bude & Lantermann scale for social exclusion, etc.
Study designs	Randomized controlled trial (RCT), non-RCT, quasi-experimental, interrupted time series, controlled or uncontrolled before-after, case control studies, cohort studies
Time	No time restrictions

Table 2 – Study and Patient Characteristics

Summary characteristics	
Mean age (range)	77.8 (76 to 79.6)*
Mean % of female participants (range)	71.3 (60.8 to 91)**
Mean sample size (range)	837.3 (21 to 2325)
Mean % of participants living alone (range)	52.6 (38.1 to 67)*
Mean % of participants with history of falling (range)	19.6 (9.3 to 30.2)*
Individual study details	
Cohen, 2006 → Chorale intervention Country of conduct: United States Study design: Non-randomized controlled trial Study duration: 12 months Sample size: 166 Intervention setting: Community	
Scharlach, 2015 → ElderHelp Concierge Club (CC) intervention Country of conduct: United States Study design: Uncontrolled before-after study Study duration: 6 months Sample size: 21 Intervention setting: Participant homes and community	
Franse, 2018 → Urban Health Centres Europe (UHCE) approach Country of conduct: United Kingdom, Greece, Croatia, the Netherlands, Spain Study design: Quasi-experimental (one site randomized, four sites controlled before-after) Study duration: 12 months Sample size: 2325 Intervention setting: Primary care and community settings	
Dolovich, 2019 → Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening QualitY) intervention Country of conduct: Canada Study design: Randomized controlled trial Study duration: 6 months Sample size: 312 Intervention setting: Participant homes and primary care	

*Only two of four studies reported on these variables

**Only three of four studies reported on this variable

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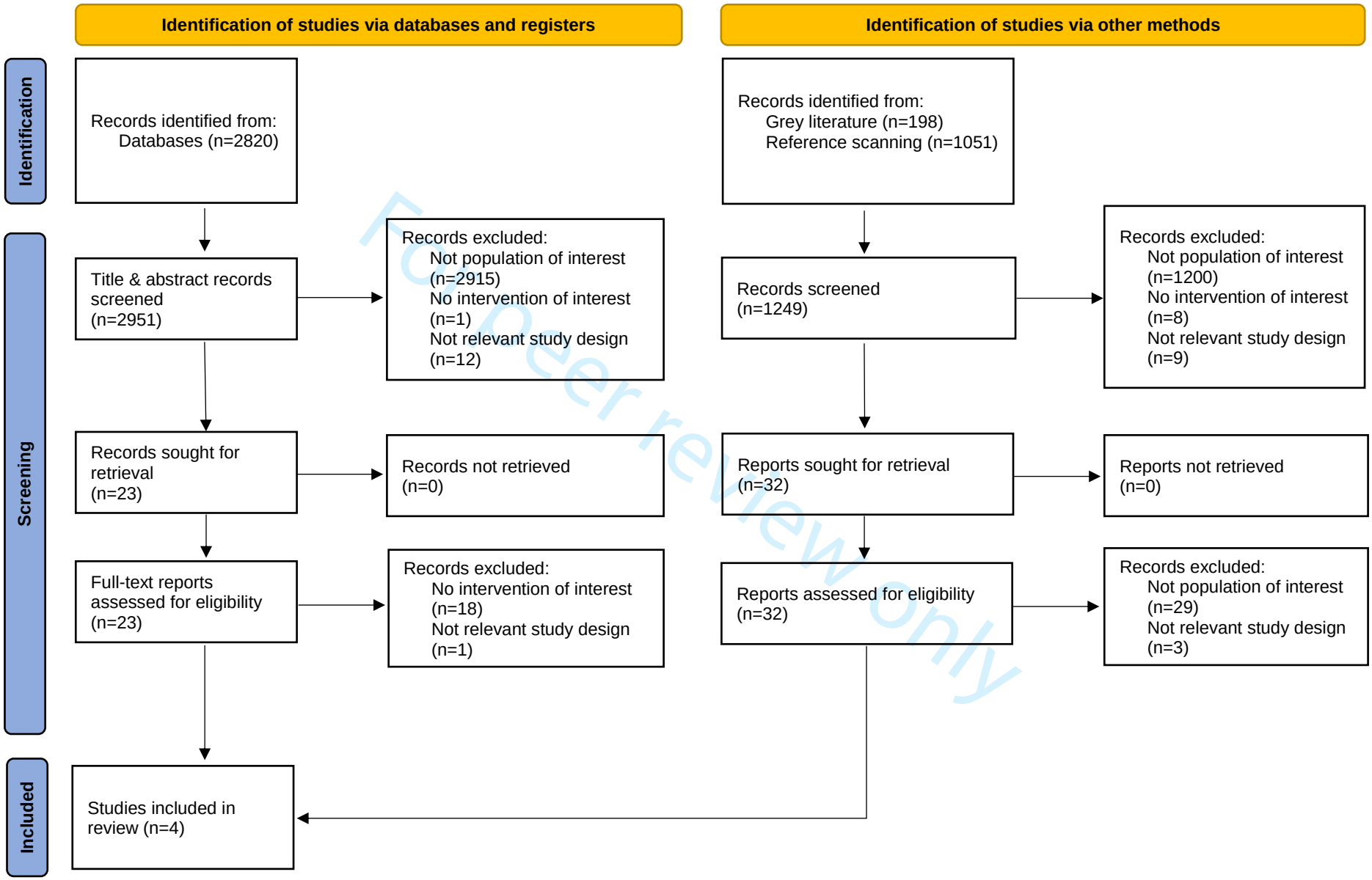
Figure 1 – PRISMA study flow of included studies (n=4)



Supplementary File 1: PRISMA Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	3-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	5
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	5
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	6, Table 1
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	6
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix 1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	6-7
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	8
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	N/A
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	8
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	8

Section and Topic	Item #	Checklist item	Location where item is reported
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	8
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	8
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	9, Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	N/A
Study characteristics	17	Cite each included study and present its characteristics.	9-11, Table 2, Appendix 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	9, Appendix 5
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	9-11, Appendix 6
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	12-14
	23b	Discuss any limitations of the evidence included in the review.	14
	23c	Discuss any limitations of the review processes used.	14
	23d	Discuss implications of the results for practice, policy, and future research.	13-15
OTHER INFORMATION			

Section and Topic	Item #	Checklist item	Location where item is reported
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	4
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	6
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	14
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	16-17
Competing interests	26	Declare any competing interests of review authors.	17
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	17

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71
For more information, visit: http://www.prisma-statement.org/

Supplementary File 2: Appendices

Appendix 1 – Database Search Strategies

Ovid MEDLINE(R) ALL <1946 to Feb 25, 2020>

1 Accidental Falls/
2 (slip* or trip* or stumbl* or tumbl*).tw,kf.
3 (fall* or fell or "fall-related" or "near-fall").tw,kf.
4 or/1-3
5 limit 4 to "all aged (65 and over)"
6 exp Aged/ or geriatrics/
7 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).tw,kf.
8 4 and (6 or 7)
9 5 or 8
10 Social Isolation/
11 loneliness/
12 exp social support/
13 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).tw,kf.
14 ((lack or absence or minimi*) adj2 (contact or communication or support*)).tw,kf.
15 or/10-14
16 9 and 15
17 animals/ not humans/
18 16 not 17

PsycINFO <1806 to February Week 4 2020>

1 falls/
2 (slip* or trip* or stumbl* or tumbl*).tw.
3 (fall* or fell or "fall-related" or "near-fall").tw.
4 or/1-3
5 limit 4 to "380 aged <age 65 yrs and older>"
6 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).tw.
7 4 and 6
8 5 or 7
9 social isolation/ or loneliness/ or social support/ or friendship/
10 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).tw.
11 ((lack or absence or minimi*) adj2 (contact or communication or support*)).tw.
12 or/9-11
13 8 and 12
14 Limit 13 to human

Embase Classic+Embase <1947 to 2020 February 25>

1 falling/
2 (slip* or trip* or stumbl* or tumbl*).tw.
3 (fall* or fell or "fall-related" or "near-fall").tw.
4 or/1-3
5 limit 4 to aged <65+ years>
6 loneliness/ or social support/ or friendship/
7 exp social isolation/
8 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).tw.
9 ((lack or absence or minimi*) adj2 (contact or communication or support*)).tw.
10 or/6-9
11 5 and 10
12 limit 11 to human

Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to February 25, 2020>, EBM Reviews - ACP Journal Club <1991

to February 2020>, EBM Reviews - Cochrane Clinical Answers <February 2020>, EBM Reviews - Database of Abstracts of Reviews of Effects <1st Quarter 2016>

1 (slip* or trip* or stumbl* or tumbl*).mp.
2 (fall* or fell or "fall-related" or "near-fall").mp.
3 1 or 2
4 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).mp.
5 3 and 4
6 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).mp.
7 ((lack or absence or minimi*) adj2 (contact or communication or support*)).mp.
8 6 or 7
9 5 and 8

Joanna Briggs Institute EBP Database - <Current to February 25, 2020>

1 (slip* or trip* or stumbl* or tumbl*).mp.
2 (fall* or fell or "fall-related" or "near-fall").mp.
3 1 or 2
4 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).mp.
5 3 and 4
6 (social barrier* or social isolation* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).mp.
7 ((lack or absence or minimi*) adj2 (contact or communication or support*)).mp.
8 6 or 7
9 5 and 8

AMED (Allied and Complementary Medicine) <1985 to February 2020>

1 (slip* or trip* or stumbl* or tumbl*).mp.
2 (fall* or fell or "fall-related" or "near-fall").mp.
3 1 or 2
4 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).mp.
5 3 and 4
6 (social barrier* or social isolation* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).mp.
7 ((lack or absence or minimi*) adj2 (contact or communication or support*)).mp.
8 6 or 7
9 5 and 8

Appendix 2 – Study Characteristics

Author, year	Study title	Journal name	Country	Study design	Study duration (months)
Cohen, 2006	The impact of professionally conducted cultural programs on the physical health, mental health, and social functioning of older adults	The Gerontologist	United States	Non-randomized controlled trial	12
Scharlach, 2015	An Integrated Model of Co-ordinated Community-Based Care	The Gerontologist	United States	Uncontrolled before-after study	6
Franse, 2018	The effectiveness of a coordinated preventive care approach for healthy ageing (UHCE) among older persons in five European cities: A pre-post controlled trial	International Journal of Nursing Studies	United Kingdom, Greece, Croatia, the Netherlands, Spain	Quasi-experimental (one site was randomized, four sites were controlled before-after)	12
Dolovich, 2019	Combining volunteers and primary care teamwork to support health goals and needs of older adults: a pragmatic randomized controlled trial	Canadian Medical Association Journal	Canada	Randomized controlled trial	6

Appendix 3 – Patient Characteristics

DEMOGRAPHICS						
Author, year	**Overall sample size**	**Overall age value**	**Overall age type**	**Overall age variance value**	**Overall age variance type**	**% female***
Cohen, 2006	166	NR (Reported mean age by group: intervention - 79.0 years, comparison - 79.6 years)	NR	NR	NR	NR
Scharlach, 2015	21	76	median	NR	NR	91
Franse, 2018	2325	79.5	mean	5.6	SD	60.8
Dolovich, 2019	312	NR (Reported mean age by group: intervention - 78.1 years, control - 79.1 years)	NR	NR	NR	62.2

SETTING DATA				
Author, year	**Intervention Setting**	**Participants living alone (%)**	**Description of access to caregivers**	**Description of baseline social network**
Cohen, 2006	Community	NR	NR	NR
Scharlach, 2015	Participant homes and community	67	NR	NR
Franse, 2018	Primary care and community settings	38.1	Care use i.e., hours per week receiving help in household work due to health problems and hours per week receiving help in caring for oneself was assessed. Hours/wk household help = control: 1.5 (5.3); intervention 1.0 (3.3).	NR
Dolovich, 2019	Participant homes and primary care	NR	NR	NR

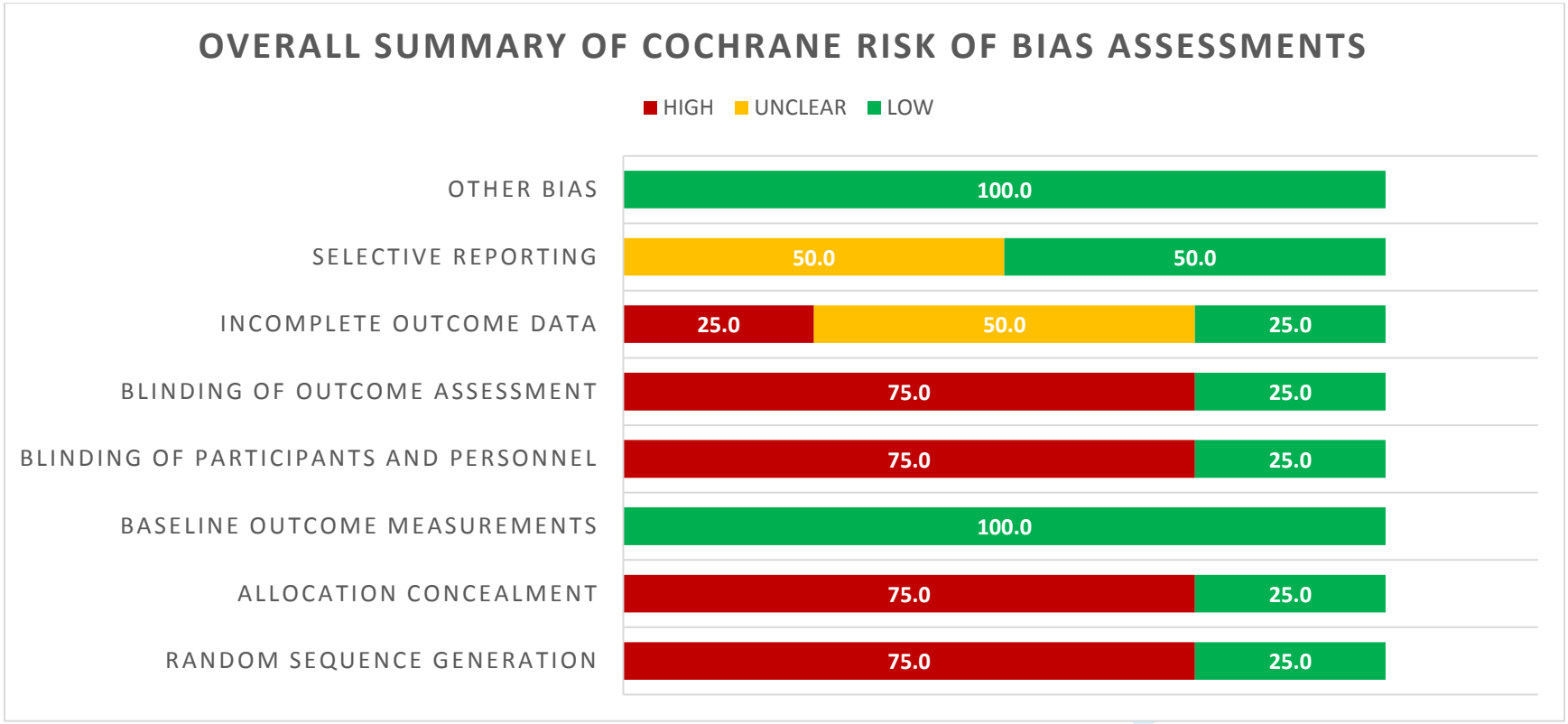
FALLS AND FRAILTY DATA								
Author, year	**Participants with history of falling**	**List of comorbidities**	**Participants with frailty (%)**	**Frailty scale**	**Overall frailty score**	**Overall frailty score type**	**Frailty variance value**	**Frailty variance type**
Cohen, 2006	baseline average falls per person - intervention: 0.40 control: 0.36	NR	NR	NR	NR	NR	NR	NR

Scharlach, 2015	mean of 1.3 falls at baseline	NR	NR	NR	NR	NR	NR	NR
Franse, 2018	30.2% had a fall in the previous year	NR	20.2	Tilburg Frailty indicator (TFI)	5.1	mean	3.2	SD
Dolovich, 2019	9.3% of participants had experienced 1 or more falls	NR	NR	NR	NR	NR	NR	NR

Abbreviations: NR, not reported; SD, standard deviation

*No studies reported having individuals who do not identify as female or male

Appendix 4 – Overall risk of bias across included studies (n=4)



Appendix 5 – Quality appraisal assessments using Cochrane Risk of Bias tool modified by EPOC

Author, Year	Trial identifier	Random sequence generation	Allocation concealment	Baseline outcome measurements	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias	Funding details:
Cohen, 2006	NR	High risk	High risk	Low risk	High risk	High risk	Unclear risk	Unclear risk	Low risk	National Endowment for the Arts (lead sponsor); Center for Mental Health Services, Substance Abuse and Mental Health Services Administration, Department of Health and Human Services; National Institute of Mental Health, National Institutes of Health; National Retired Teachers Association/ AARP; International Foundation for Music Research; Stella and Charles Guttman Foundation, New York City.
Scharlach, 2015	NR	High risk	High risk	High risk	High risk	High risk	Unclear risk	Unclear risk	Low risk	The SCAN Foundation
Franse, 2018	NR	High risk	High risk	Low risk	High risk	High risk	High risk	Low risk	Low risk	European Union, CHAFEA, third Health programme, grant number 20131201
Dolovich, 2019	NCT02283723	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Health Canada (grant no. 6817-06-2013/5570001), Government of Ontario (grant no. 06547 for INSPIRE-PHC), McMaster University & McMaster Family Health Organization

Appendix 6 – Outcome summary table for included studies (n=4)

Author, Year	Treatment arms	History of falls	Results	Text description of effectiveness
Cohen, 2006 *Design: non-RCT*	**Singing in a chorale** (n=90) The intervention consisted of participating in a professionally conducted chorale in which there were weekly singing rehearsals for 30 weeks as well as public performances several times during the intervention period. **Usual activities** (n=76) Participants in the comparison group continued their regular activities as usual, with the study introducing no changes other than the assessments.	Baseline average of 0.40 falls per person in the intervention group, and 0.36 per person in the control group in the past 12 months	**UCLA Loneliness scale III** Baseline: 35.1 (SD, 8.1) Follow-up: 34.6 (SD, 7.9) Baseline: 38.3 (SD, 10.1) Follow-up: 37.0 (SD, 10.3)	Both groups evidenced a slight decrease in loneliness at the 12-month follow-up; however, the decrease in loneliness was greater for the intervention group than for the comparison. Analysis of covariance of the 12-month follow-up assessment continued to demonstrate a marginally significant difference between the two groups, F (1,126) = 3.08; p = .08.
Scharlach, 2015 *Design: Uncontrolled before-after*	**ElderHelp Concierge Club (CC)** (n=21) Integrated community-based care model that includes comprehensive personal and environmental, assessment, multilevel care co-ordination, a mix of professional and volunteer service providers, and a capitated, income-adjusted fee model. When individuals contact CC for information or services, they receive a brief assessment designed to determine their eligibility for CC services, as well as the type of services they appear to need: information and referral services only (Tier 1), transportation services only, or other CC services including in-home assessment by the CC Intake Specialist (Tiers 2 and 3).	Baseline mean of 1.3 falls over the past 6 months	**Social Isolation (3-item scale)** Baseline: 8.7 (SD, 3.2) Follow-up: 7.0 (SD, 3.8) **Social interaction** *Interact with friends/relatives weekly* Baseline: 76% of participants Follow-up: 100% of participants *Attend monthly meetings* Baseline: 33% of participants Follow-up: 48% of participants	Social isolation did not change significantly; nor did contact with friends and relatives or participation in meetings of organized groups.

Franse, 2018 *Design: one site randomized, 4 sites controlled before-after design; results combined all sites, so classified as quasi-experimental*	**Urban Health Centres Europe (UHCE) approach** (n=986) Preventive multidimensional health assessment and if person at risk, coordinated care pathways targeted at fall risk, appropriate medication use, loneliness and frailty **Usual Care** (n=858) Usual care included access to their GP	30.2% of participants experienced a fall in the previous year	**Loneliness (short JG scale)** Baseline: 0.6 (SD, 0.7) Follow-up: 0.6 (SD, 0.7) Baseline: 0.6 (SD, 0.7) Follow-up: 0.7 (SD, 0.7)	When comparing persons who enrolled in any type of care-pathway with all persons in the control group there was a positive effect on loneliness after adjusting for city clustering, age, gender, living situation, education, and baseline status of outcome (B= -0.18, 95% CI= -0.35 to -0.02).
Dolovich, 2019 *Design: RCT*	**Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening QualitY) intervention** (n=158) Trained community volunteers visited patients to collect information on their life and health goals, risks and needs, daily life activities and general health, using structured surveys and unstructured narratives. The volunteers sent a report summarizing patients' goals, alerts, key issues and observations to the primary care interprofessional "huddle" team at the clinics. These interprofessional teams reviewed the reports and then generated, prioritized and acted upon plans of care for how the team, community agencies and volunteers could address clients' goals and health issues, with iterative follow-up **Usual Care** (n=154) The control group received usual care and did not have volunteer visits. There was no restriction on receiving care from the same team members as the intervention group	9.3% of participants experienced 1 or more falls	**Social network score (DSSI-10)** Baseline: Mean, 8.84 (SD, 1.52) Follow-up: Mean, 8.75 (SD, 1.52) **Social satisfaction score (DSSI-10)** Baseline: Mean, 18.89 (SD, 2.41) Follow-up: Mean, 18.96 (SD, 2.87) **Social network score (DSSI-10)** Baseline: Mean, 8.74 (SD, 1.61) Follow-up: Mean, 8.69 (SD, 1.53) **Social satisfaction score (DSSI-10)** Baseline: Mean, 19.19 (SD, 2.37) Follow-up: Mean, 19.04 (SD, 2.76)	There were no statistically significant between-group differences in participant ratings of self-efficacy, quality of life, optimal aging, social support

BMJ Open

Interventions for social isolation in older adults who have experienced a fall: A systematic review

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Keywords:	REHABILITATION MEDICINE, GERIATRIC MEDICINE, PREVENTIVE MEDICINE

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Interventions for social isolation in older adults who have experienced a fall: A systematic review

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ABSTRACT

Objectives: The objective of our systematic review was to identify effective interventions to prevent or mitigate social isolation and/or loneliness in older adults who experienced a fall.

Design: Systematic review

Data Sources: MEDLINE, Embase, the Cochrane Central Register of Controlled Trials, and Ageline were searched (inception to February 2020).

Methods: Studies were eligible if they described any intervention for social isolation in older adults living in a community setting who experienced a fall, and reported outcomes related to social isolation or loneliness.

Two independent reviewers screened citations, abstracted data, and appraised risk of bias using the Cochrane risk-of-bias tool. The results were summarized descriptively.

Results: After screening 4,069 citations and 55 full-text articles, 4 studies were included. The four studies varied in study design, including a randomized controlled trial, non-randomized controlled trial, an uncontrolled before-after study, and a quasi-experimental study. Interventions varied widely, and included singing in a choir, a patient-centred, interprofessional primary care team-based approach, a multifactorial assessment targeting fall risk, appropriate medication use, loneliness and frailty, and a community-based care model that included comprehensive assessments and multilevel care coordination. Outcome measures varied and included scales for loneliness, social isolation, social interaction, social networks, and social satisfaction. Mixed results were found, with three studies reporting no differences in social isolation or loneliness after the intervention. Only the multifactorial assessment intervention demonstrated a small positive effect on loneliness compared to the control group after adjustment (B= -0.18, 95% CI= -0.35 to -0.02).

Conclusions: Few studies examined interventions for social isolation or loneliness in older adults who experienced a fall. More research is warranted in this area.

Systematic Review Registration: PROSPERO (CRD42020198487)

Word count: 266 (abstract), 3055 (main text)

Keywords: systematic review, older adults, falling, social isolation, loneliness, interventions

Strengths and limitations of this study:

- We conducted a comprehensive search of 4 databases, using a search strategy which was peer-reviewed by a second librarian, and supplemented this by searching grey literature and scanning references of included studies and relevant reviews.
- We followed the methodology outlined by the Cochrane Handbook, with screening, data abstraction, and risk of bias appraisal being conducted in duplicate by independent reviewers, and our findings were reported using the PRISMA-2020 checklist.
- We deviated from our protocol slightly due to the limited of data on older adults in a community setting who had experienced a fall and expanded our inclusion criteria to include studies where some participants (not all) had a history of falling.
- Our included studies were plagued by risk of bias across several components, including poor allocation concealment, lack of random sequence generation, and a lack of blinding of participants, personnel, and outcome assessors.
- A lack of standardization was observed across the outcomes assessed in the included studies, due to lack of consensus on measures for social isolation and loneliness.

INTRODUCTION

Worldwide, more than 37 million falls occur requiring medical attention every year(1). Almost 650,000 people die every year from a fall, with those aged 65 years and older experiencing the greatest number of fatal falls(1). Falls are associated with considerable negative outcomes on older adults, such as physical inactivity, anxiety, depressive symptoms, and fear of falling(2, 3).

Social isolation is a serious consequence among older adults who have experienced a fall(4). Social isolation is a complex phenomenon that can be characterized by five key attributes: decreased number of social contacts, decreased feeling of belonging, reduced or lack of fulfilling relationships, decreased engagement with others, and reduced quality of the members in one's network(5). Loneliness is another consequence that may occur after a fall and can be defined as "the unpleasant experience that occurs when a person's network of social relations is deficient in some way, either quantitatively or qualitatively"(6). Some research has focused on the risk of social isolation and loneliness after experiencing a fall, since people who have experienced a fall are less likely to continue their activities of daily living(4). For example, one study reported a statistically significant relationship between feelings of loneliness and social exclusion after experiencing a fall(4).

Although social isolation and loneliness are related, it is important to note that they are two distinct concepts(7). Social isolation is more objective, as it can be measured by examining the presence or absence of relationships with other people, whereas loneliness is a person's subjective experience and is more difficult to measure. This distinction is important, as different interventions might be required for each of these outcomes after experiencing a fall.

Social isolation and loneliness among older adults is associated with many adverse health outcomes, including cognitive decline, depression, anxiety, and dementia(8). Interventions to

mitigate social isolation and loneliness after older adults experience a fall is of paramount importance. Examples of interventions may include participating in social activities, outreach calls from peers or healthcare workers, and group exercise. We are unaware of a previous systematic review that examined this important issue. As such, the objective of our systematic review was to identify effective interventions to mitigate social isolation and loneliness in older adults who lived independently in a community setting with a history of falling.

METHODS

Protocol

The protocol for this systematic review was developed in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) checklist, with consultation from knowledge users from the Public Health Agency of Canada who commissioned this work and clinical experts on the team and was registered on PROSPERO (CRD42020198487). This systematic review was conducted according to methodology outlined in the Cochrane Handbook(9), and the PRISMA checklist (Supplementary File 1) was used to guide the reporting of our results(10).

Search strategy and selection criteria

A comprehensive literature search strategy was developed by an experienced information specialist and peer-reviewed by a second information specialist using the Peer Review of Electronic Search Strategies (PRESS) checklist(11). MEDLINE, Embase, the Cochrane Central Register of Controlled Trials, and Ageline were searched from inception until February 25, 2020 (Appendix 1). The reference lists of included studies and relevant reviews were also scanned. A search for grey literature was conducted using the Canadian Agency for Drugs and Technologies in Health (CADTH)'s Grey Matters checklist(12).

Our eligibility criteria are summarized in Table 1. Studies were eligible for inclusion if they described any intervention for social isolation or feelings of loneliness in older adults (mean age 65 years and older) with any participant reporting a history of falling (i.e., regardless of the proportion of the sample who fell). The knowledge users from the Public Health Agency of Canada requested that we focus this systematic review on participants who lived independently in a community setting. Eligible study designs included randomized controlled trials (RCTs), cohort studies, case control studies, non-randomized controlled trials, quasi-experimental studies, interrupted time series or controlled/uncontrolled before after studies. Case reports, case series, cross-sectional studies, qualitative studies, and reviews were not eligible for inclusion. Outcomes of interest included any changes in social isolation or loneliness as measured using validated scales, such as the De Jong Gierveld loneliness scale(13) and the Bude & Lantermann scale for social exclusion(14), or any other quantitative measure of social isolation or loneliness. Social isolation was defined as a decrease in the number of social contacts, decreased feeling of belonging, reduced or lack of fulfilling relationships, decreased engagement with others, and reduced quality of the members in one's network(5). Loneliness was defined as "the unpleasant experience that occurs when a person's network of social relations is deficient in some way, either quantitatively or qualitatively(6).

All citations were screened by two independent reviewers who worked in pairs after the entire team completed a training exercise on 50 citations and 78% agreement was achieved. Full-text screening by two independent reviewers who worked in pairs began after a training exercise on 22 articles amongst the team with an agreement of 75%. Discrepancies for both levels of screening were resolved by a third reviewer or through discussion.

Data abstraction and risk of bias appraisal

Data abstraction and risk of bias appraisal were also conducted independently by pairs of reviewers who worked in pairs after a training pilot exercise reached sufficient agreement, and discrepancies were resolved by a third reviewer. The risk of bias appraisal was conducted using the Cochrane Effective Practice and Organisation of Care (EPOC) risk of bias tool, as it was expected that a mixture of study designs would be included(15).

Synthesis

The findings of this review were summarized descriptively, reporting study and patient characteristics, quality appraisal assessment, and intervention details. As outlined in our review protocol, we planned to conduct a meta-analysis if more than one study evaluated the same intervention, and a network meta-analysis for connected networks of trials with pre-specified intervention nodes if over 10 trials were available and the number of trials was greater than the number of interventions. However, as these conditions were not met, no statistical analyses were conducted.

Patient and Public Involvement

A patient partner with previous experience of a fall was identified and involved in this study from the protocol development stage. The patient partner provided input on our research question and outcome measures to ensure that the patient perspective was incorporated. They also participated in the screening training exercises for citations and full-text articles, provided feedback on screening eligibility criteria, and reviewed the manuscript as a coauthor.

RESULTS

Study flow

After screening 4,069 citations and 55 full-text articles against our eligibility criteria, 4 studies(16-18) met the eligibility criteria and were included in this review (Figure 1).

Study and patient characteristics

Study and patient characteristics are summarized in Table 2 and detailed characteristics are reported in Appendices 1 and 2. The mean age of participants across included studies was 77.8 years (range: 76 to 79.5 years). Three of the included studies were conducted in North America (75.0%) and one in Europe (25.0%) and they were conducted in a variety of settings including the community setting, a combination of participant homes and community setting, a combination of primary care and community setting, or a combination of participant homes and primary care. Only one study provided data on frailty of the included participants, reporting 20.2% of participants with frailty (Appendix 2). The four studies varied in study design, including a randomized controlled trial, a non-randomized controlled trial, an uncontrolled before-after study, and a quasi-experimental study in which data from one randomized site was combined with data from four controlled before-after sites. Two of the studies had a study duration of 12 months, and the other two had a duration of 6 months. The sample size in the studies ranged from 21 to 2325 and, on average, 71.3% of participants were female.

Risk of bias results

An overall summary of risk of bias across the four studies can be found in Appendix 3, and detailed risk of bias assessments can be found in Appendix 4. All studies had low risk of bias for baseline outcome measurements (100% low, 0% unclear, 0% high), and other bias (mainly funding bias; 100% low, 0% unclear, 0% high). Two of the studies had low risk and two had unclear risk of bias for selective reporting (50% low, 50% unclear, 0% high). One study had high risk, two studies unclear risk, and one had low risk of bias for incomplete outcome data (25%

low, 50% unclear, 25% high). However, three of four studies had high risk of bias for blinding of outcome assessment (25% low, 0% unclear, 75% high), blinding of participants and personnel (25% low, 0% unclear, 75% high), random sequence generation (25% low, 0% unclear, 75% high), and allocation concealment (25% low, 0% unclear, 75% high).

Outcome results

The relevant findings from the four included studies are summarized in Appendix 6.

Cohen et al. (2006) conducted a non-randomized controlled trial in the United States assessing the effects of singing in a chorale to reduce loneliness compared to usual care in 166 older adults. The chorale intervention involved attendance at weekly singing rehearsals and several public performances, while the usual care group continued their usual activities. Both groups had a similar baseline history of falling over the past 12 months (average of 0.40 falls per person in the intervention group, and 0.36 per person in the control group). After 12 months of follow-up, they noted a reduction in loneliness (as measured using the UCLA Loneliness Scale-III) in both groups (chorale: baseline mean: 35.1 (SD, 8.1) and follow-up mean: 34.6 (SD, 7.9); usual care: baseline mean: 38.3 (SD, 10.1) and follow-up mean: 37.0 (SD, 10.3). While the chorale intervention reported lower loneliness scores than the usual care group after 12 months of follow-up, no statistically significant difference was observed ($F(1,126) = 3.08$; $p = 0.08$).

Scharlach et al. (2015) conducted an uncontrolled before-after study in the United States assessing the effectiveness of their ElderHelp Concierge Club intervention on social isolation in a sample of 21 participants(17). The Concierge Club intervention was a community-based care model that provided different tiers of services to their members including information and referrals, transportation, or in-house assessments. The baseline mean number of falls over the past 6 months was 1.3. They noted that social isolation, as measured using an unnamed 3-item

scale(19), did not change significantly after 6 months of follow-up (baseline mean: 8.7 (SD, 3.2) and follow-up mean: 7.0 (SD, 3.8)). Similarly, although all participants reported having contact with friends/relatives after the intervention, this was not found to be a significant change from baseline (baseline: 76% of participants, follow-up: 100% of participants).

Franse et al. (2018) conducted a quasi-experimental study comparing the effectiveness of the Urban Health Centres Europe (UHCE) approach compared to usual care on loneliness in a sample of 1,844 older adults across the United Kingdom, Greece, Croatia, the Netherlands, and Spain(18). The UHCE approach involved a preventative multidimensional health assessment, which informed the coordination of specific care pathways targeting the individual's needs (such as fall risk, appropriate medication use, loneliness, and frailty). The usual care group received their usual care and had access to any already existing services. At baseline, 30.2% of participants reported having experienced a fall in the past 12 months. Their adjusted analysis found a small positive effect of the UHCE approach on loneliness, as measured using the short De Jong Gierveld Loneliness scale(20), when compared to usual care (B= -0.18, 95% CI= -0.35 to -0.02).

Dolovich et al. (2019) conducted a randomized controlled trial comparing the effectiveness of the Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening qualitY) intervention compared to usual care on social isolation in a sample of 312 older adults in Canada(21). This intervention involved the collection of information on patients' health goals and needs by trained volunteers, who then summarized these findings in a report for the interprofessional primary care team. The primary care team used these reports to generate and act on plans of care for how the team, community agencies, and volunteers could help address each patient's goals. The control group received usual care. Approximately 9.3% of

participants reported experiencing at least one fall. After 6 months of follow-up, they found no statistically significant difference between the intervention and control groups in terms of their social network scores (mean difference, 0.038 (95% CI: –0.25 to 0.33) and social satisfaction scores (mean difference, 0.102 (95% CI, –0.35 to 0.55), as measured using the Duke Social Support Index(22).

DISCUSSION

We conducted a comprehensive systematic review of interventions to mitigate social isolation and loneliness in older adults living independently in a community setting who experienced a fall. Very few studies were identified that fulfilled our eligibility criteria, indicating a dearth of evidence on this important topic. Only 4 studies were included and as each examined different types of interventions, this precluded any statistical pooling of results. Furthermore, studies varied on the proportion of participants who reported experiencing a fall and multiple types of outcomes were assessed for loneliness and social isolation, making it challenging to provide any meaningful interpretation of results.

Across the four studies in this systematic review, only the quasi-experimental study by Franse et al. (2018)(18), which assessed the impact of multifactorial health assessments and coordinated care pathways targeting fall risk, medication use, loneliness and frailty, found a small positive effect on loneliness (i.e. reduction) when comparing those that received the intervention with the control group. However, given the paucity of data in older adults with a history of falling, the most effective intervention for preventing or reducing social isolation remains unclear. Only one randomized controlled trial was identified in this review, highlighting the need for more robust research in this important area.

We searched for previous reviews that were related and only one was identified. Gardiner et al. (2016) conducted an integrative review on interventions for social isolation in older adults(23). While this review was not specific to individuals who had experienced a fall, it discusses characteristics of effective social isolation interventions in the broader older adult population and could be applicable to the subset of this population that experiences falling. While the majority of interventions they identified showed at least a moderate positive effect on social isolation or loneliness, they noted that the quality of the evidence was poor, making it difficult to identify a particular intervention as most effective(23). This is consistent with our determination of the need for more robust research on the effectiveness of social isolation interventions in older adults with a history of falling. They identified adaptability to local contexts, community participation in the design and implementation of the intervention, and productive engagement (as opposed to passive activities) as common features among successful interventions(23). Future studies should consider these factors in the development and evaluation of interventions for social isolation. Finally, we focused on the community setting at the request of the Public Health Agency of Canada who felt that these results were most relevant to their decision-making needs.

Across our included studies, all four interventions appeared to be adapted to their local contexts. The UHCE approach by Franse et al. (2018) and the Health TAPESTRY intervention by Dolovich et al. (2019) also involved strong community participation by tailoring their intervention to each participant's health care needs, however it is unclear whether the subsequent care pathways or plans allowed for productive engagement. Cohen et al. (2006)'s chorale intervention provided productive engagement to participants but may have benefited from further community participation in the implementation of the intervention.

There are many strengths to our systematic review. Our search strategy was peer-reviewed by a second librarian and was comprehensive through the inclusion of four databases, searching grey literature and scanning references of included studies and relevant reviews. Our methodology was informed by the Cochrane Handbook(9), with screening, data abstraction, and risk of bias appraisal being conducted in duplicate by independent reviewers, and our findings were reported using PRISMA-2020(10). However, there are some limitations. We deviated from our protocol slightly to allow for inclusion of studies where only some participants had a history of falling, given the paucity of data on older adults in a community setting who had experienced a fall. We were unable to update our literature search due to a lack of sufficient funding. Further, studies were plagued by risk of bias across several components, including to risk of bias from poor allocation concealment, lack of random sequence generation, and a lack of blinding of participants, personnel, and outcome assessors. A lack of standardization was observed across the outcomes assessed in the included studies, suggesting that future work could focus on developing consensus on measures for social isolation and loneliness that have already been validated to establish a core outcomes dataset. Indeed, a study by Cornwell et al. (2009) highlights the wide variation in indicators for isolation and loneliness and proposed combining these varying indicators to develop two parsimonious scales to measure social disconnectedness and perceived isolation (24), however, these scales were not used by the included studies here. Furthermore, additional examination of tailoring interventions to reduce loneliness and/or social isolation is warranted, as there was a dearth of included studies to examine this fully in this systematic review with two studies each focusing on social isolation and loneliness separately. Further research is warranted on this, as social isolation and loneliness are distinct concepts and

different interventions may be required to target each outcome separately. Finally, we focused our review on the community setting, at the request of the

We recommend updating this systematic review as more literature becomes available on this topic. Effective interventions are necessary to support older people who are at increased risk of social isolation, particularly after experiencing a fall. In addition, further work is required to examine the relationship between social isolation, loneliness, and falling, and whether other variables influence this relationship, as this may warrant different intervention approaches.

In conclusion, we identified four studies examining interventions for social isolation amongst older adults with a history of falling. The interventions examined varied widely, from singing in a chorale to community-base care coordination, as did the outcome measures used to assess the effectiveness of the interventions. We identified only one quasi-experimental study which demonstrated that multifactorial health assessments and coordinated care pathways resulted in a small positive effect on loneliness in this population. Future research is warranted in this under-studied area.

LIST OF ABBREVIATIONS

CADTH	Canadian Agency for Drugs and Technologies in Health
CI	Confidence interval
EPOC	Effective Practice and Organisation of Care
IQR	Interquartile range
PRESS	Peer Review of Electronic Search Strategies
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomized controlled trial
SD	Standard deviation

DECLARATIONS

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Ethics approval

Not required.

Consent for publication

Not applicable.

Author Contribution

Substantial contributions to the conception or design of the work (ACT, SMT, JW, SES); acquisition, analysis, or interpretation of data for the work (all authors); drafting the work (ACT, SMT) or revising it critically for important intellectual content (AR, NR, GM, JF, YJ, MdG, KA, JB, AG-B, JW, SES); final approval of the version to be published (all authors); agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved (all authors)

Availability of data and materials

The full dataset is available from the corresponding author upon reasonable request.

Conflict of interests

All authors do not have any potential (or perceived) conflicts of interest.

Role of the funder

The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

SUPPLEMENTAL FILES

Supplemental File 1: PRISMA Checklist

Supplemental File 2: Appendices

FIGURES

Figure 1 – PRISMA study flow of included studies (n=4)

TABLES

Table 1 – Screening Eligibility Criteria

Population	Older adults (mean age 65 years and older) living independently in a community setting with any participant reporting a history of falling (i.e., regardless of the proportion of the sample who fell)
Intervention	Any intervention for social isolation or loneliness
Comparator	Usual care or another intervention for social isolation or loneliness
Outcomes	Any quantitative measures of changes in social isolation or loneliness Ex: the quantity of social interactions, Lubben Social Network Scale for social isolation, De Jong Gierveld Loneliness Scale, Bude & Lantermann scale for social exclusion, etc.
Study designs	Randomized controlled trial (RCT), non-RCT, quasi-experimental, interrupted time series, controlled or uncontrolled before-after, case control studies, cohort studies
Time	No time restrictions

Table 2 – Study and Patient Characteristics

Summary characteristics	
Mean age (range)	77.8 (76 to 79.6)*
Mean % of female participants (range)	71.3 (60.8 to 91)**
Mean sample size (range)	837.3 (21 to 2325)
Mean % of participants living alone (range)	52.6 (38.1 to 67)*
Mean % of participants with history of falling (range)	19.6 (9.3 to 30.2)*
Individual study details	
Cohen, 2006 → Chorale intervention Country of conduct: United States Study design: Non-randomized controlled trial Study duration: 12 months Sample size: 166 Intervention setting: Community	
Scharlach, 2015 → ElderHelp Concierge Club (CC) intervention Country of conduct: United States Study design: Uncontrolled before-after study Study duration: 6 months Sample size: 21 Intervention setting: Participant homes and community	
Franse, 2018 → Urban Health Centres Europe (UHCE) approach Country of conduct: United Kingdom, Greece, Croatia, the Netherlands, Spain Study design: Quasi-experimental (one site randomized, four sites controlled before-after) Study duration: 12 months Sample size: 2325 Intervention setting: Primary care and community settings	
Dolovich, 2019 → Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening QualitY) intervention Country of conduct: Canada Study design: Randomized controlled trial Study duration: 6 months Sample size: 312 Intervention setting: Participant homes and primary care	

*Only two of four studies reported on these variables

**Only three of four studies reported on this variable

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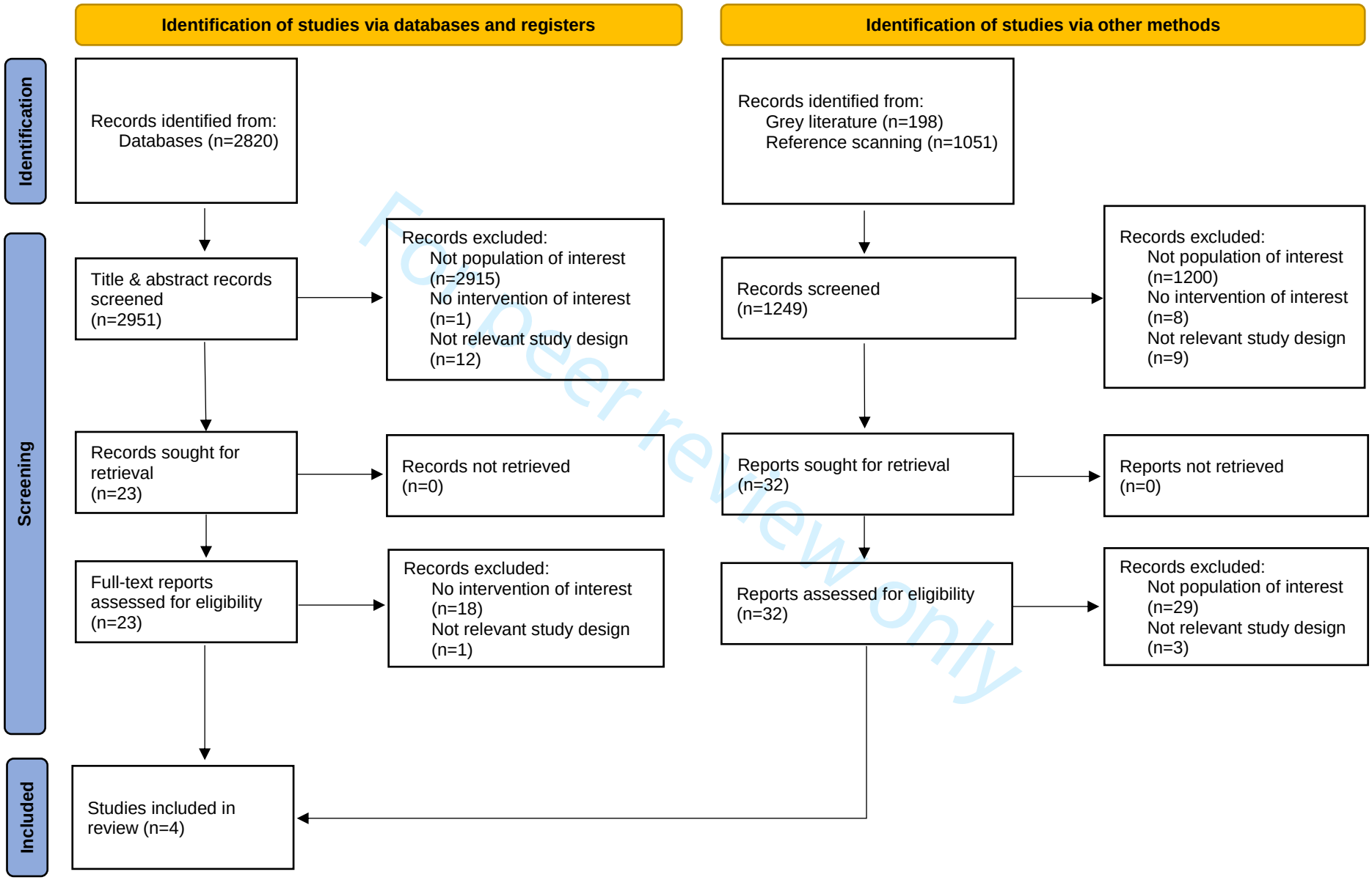
Figure 1 – PRISMA study flow of included studies (n=4)



Supplementary File 1: PRISMA Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	3-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	5
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	5
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	6, Table 1
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	6
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix 1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	6-7
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	8
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	N/A
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	8
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	8

Section and Topic	Item #	Checklist item	Location where item is reported
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	8
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	8
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	9, Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	N/A
Study characteristics	17	Cite each included study and present its characteristics.	9-11, Table 2, Appendix 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	9, Appendix 5
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	9-11, Appendix 6
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	12-14
	23b	Discuss any limitations of the evidence included in the review.	14
	23c	Discuss any limitations of the review processes used.	14
	23d	Discuss implications of the results for practice, policy, and future research.	13-15
OTHER INFORMATION			

Section and Topic	Item #	Checklist item	Location where item is reported
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	4
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	6
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	14
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	16-17
Competing interests	26	Declare any competing interests of review authors.	17
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	17

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71
For more information, visit: http://www.prisma-statement.org/

Supplementary File 2: Appendices

Appendix 1 – Database Search Strategies

Ovid MEDLINE(R) ALL <1946 to Feb 25, 2020>

1 Accidental Falls/
2 (slip* or trip* or stumbl* or tumbl*).tw,kf.
3 (fall* or fell or "fall-related" or "near-fall").tw,kf.
4 or/1-3
5 limit 4 to "all aged (65 and over)"
6 exp Aged/ or geriatrics/
7 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).tw,kf.
8 4 and (6 or 7)
9 5 or 8
10 Social Isolation/
11 loneliness/
12 exp social support/
13 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).tw,kf.
14 ((lack or absence or minimi*) adj2 (contact or communication or support*)).tw,kf.
15 or/10-14
16 9 and 15
17 animals/ not humans/
18 16 not 17

PsycINFO <1806 to February Week 4 2020>

1 falls/
2 (slip* or trip* or stumbl* or tumbl*).tw.
3 (fall* or fell or "fall-related" or "near-fall").tw.
4 or/1-3
5 limit 4 to "380 aged <age 65 yrs and older>"
6 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).tw.
7 4 and 6
8 5 or 7
9 social isolation/ or loneliness/ or social support/ or friendship/
10 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).tw.
11 ((lack or absence or minimi*) adj2 (contact or communication or support*)).tw.
12 or/9-11
13 8 and 12
14 Limit 13 to human

Embase Classic+Embase <1947 to 2020 February 25>

1 falling/
2 (slip* or trip* or stumbl* or tumbl*).tw.
3 (fall* or fell or "fall-related" or "near-fall").tw.
4 or/1-3
5 limit 4 to aged <65+ years>
6 loneliness/ or social support/ or friendship/
7 exp social isolation/
8 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).tw.
9 ((lack or absence or minimi*) adj2 (contact or communication or support*)).tw.
10 or/6-9
11 5 and 10
12 limit 11 to human

Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to February 25, 2020>, EBM Reviews - ACP Journal Club <1991

to February 2020>, EBM Reviews - Cochrane Clinical Answers <February 2020>, EBM Reviews - Database of Abstracts of Reviews of Effects <1st Quarter 2016>

1 (slip* or trip* or stumbl* or tumbl*).mp.
2 (fall* or fell or "fall-related" or "near-fall").mp.
3 1 or 2
4 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).mp.
5 3 and 4
6 (social barrier* or social isolat* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).mp.
7 ((lack or absence or minimi*) adj2 (contact or communication or support*)).mp.
8 6 or 7
9 5 and 8

Joanna Briggs Institute EBP Database - <Current to February 25, 2020>

1 (slip* or trip* or stumbl* or tumbl*).mp.
2 (fall* or fell or "fall-related" or "near-fall").mp.
3 1 or 2
4 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).mp.
5 3 and 4
6 (social barrier* or social isolation* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).mp.
7 ((lack or absence or minimi*) adj2 (contact or communication or support*)).mp.
8 6 or 7
9 5 and 8

AMED (Allied and Complementary Medicine) <1985 to February 2020>

1 (slip* or trip* or stumbl* or tumbl*).mp.
2 (fall* or fell or "fall-related" or "near-fall").mp.
3 1 or 2
4 (geriatric* or elder* or age* or "of age" or aging or senior* or older adult* or retired or retiree* or elder* or pensioner* or older people or older patient* or gerontology or Sexagenarian* or septuagenarian* or octogenarian or nonagenarian* or centenarian* or sixties or seventies or eighties or nineties).mp.
5 3 and 4
6 (social barrier* or social isolation* or social support* or social car* or psychosocial support* or psycho-social support* or social frailt* or friendship* or "social* connected*" or connectedness or lonely or loneliness or "feel* alone*" or companionship).mp.
7 ((lack or absence or minimi*) adj2 (contact or communication or support*)).mp.
8 6 or 7
9 5 and 8

Appendix 2 – Study Characteristics

Author, year	Study title	Journal name	Country	Study design	Study duration (months)
Cohen, 2006	The impact of professionally conducted cultural programs on the physical health, mental health, and social functioning of older adults	The Gerontologist	United States	Non-randomized controlled trial	12
Scharlach, 2015	An Integrated Model of Co-ordinated Community-Based Care	The Gerontologist	United States	Uncontrolled before-after study	6
Franse, 2018	The effectiveness of a coordinated preventive care approach for healthy ageing (UHCE) among older persons in five European cities: A pre-post controlled trial	International Journal of Nursing Studies	United Kingdom, Greece, Croatia, the Netherlands, Spain	Quasi-experimental (one site was randomized, four sites were controlled before-after)	12
Dolovich, 2019	Combining volunteers and primary care teamwork to support health goals and needs of older adults: a pragmatic randomized controlled trial	Canadian Medical Association Journal	Canada	Randomized controlled trial	6

Appendix 3 – Patient Characteristics

DEMOGRAPHICS						
Author, year	**Overall sample size**	**Overall age value**	**Overall age type**	**Overall age variance value**	**Overall age variance type**	**% female***
Cohen, 2006	166	NR (Reported mean age by group: intervention - 79.0 years, comparison - 79.6 years)	NR	NR	NR	NR
Scharlach, 2015	21	76	median	NR	NR	91
Franse, 2018	2325	79.5	mean	5.6	SD	60.8
Dolovich, 2019	312	NR (Reported mean age by group: intervention - 78.1 years, control - 79.1 years)	NR	NR	NR	62.2

SETTING DATA				
Author, year	**Intervention Setting**	**Participants living alone (%)**	**Description of access to caregivers**	**Description of baseline social network**
Cohen, 2006	Community	NR	NR	NR
Scharlach, 2015	Participant homes and community	67	NR	NR
Franse, 2018	Primary care and community settings	38.1	Care use i.e., hours per week receiving help in household work due to health problems and hours per week receiving help in caring for oneself was assessed. Hours/wk household help = control: 1.5 (5.3); intervention 1.0 (3.3).	NR
Dolovich, 2019	Participant homes and primary care	NR	NR	NR

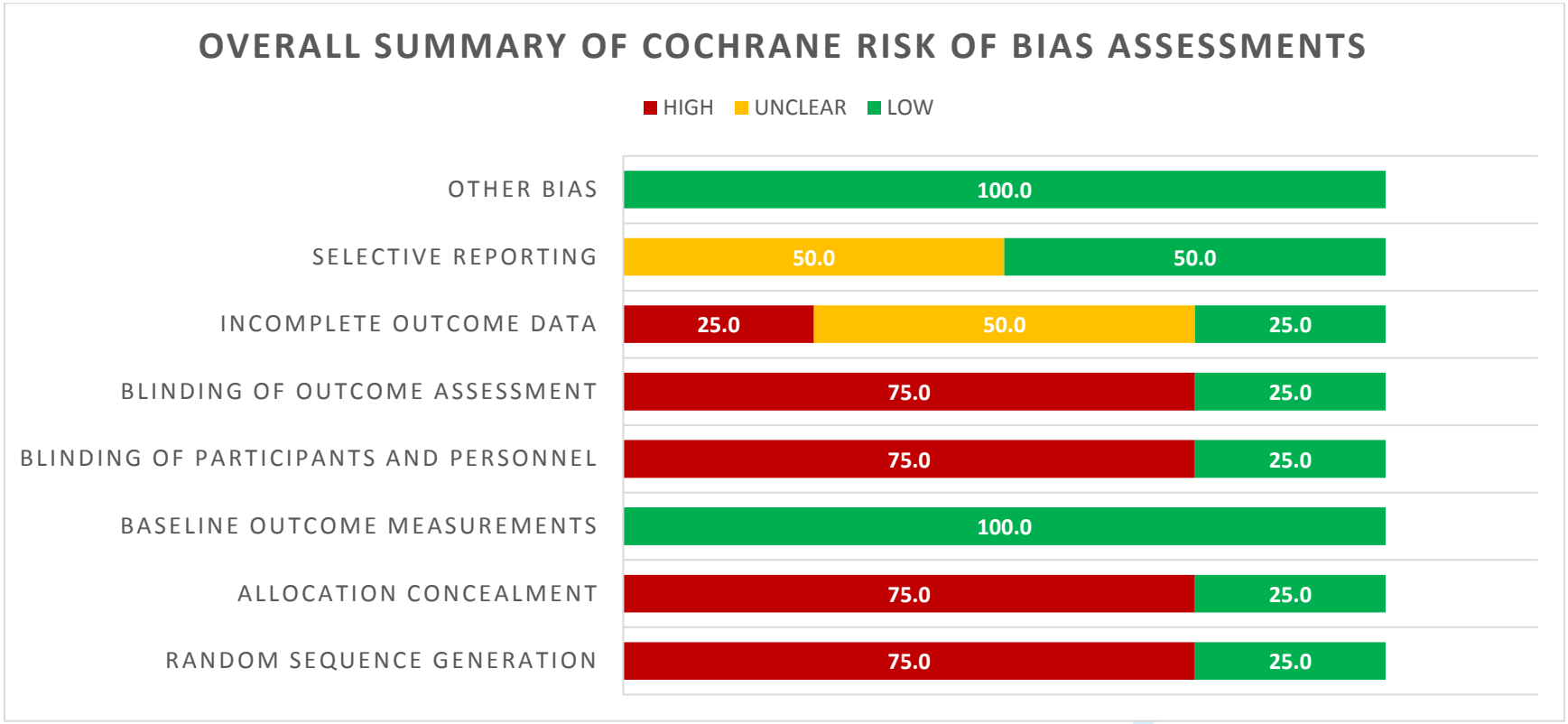
FALLS AND FRAILTY DATA								
Author, year	**Participants with history of falling**	**List of comorbidities**	**Participants with frailty (%)**	**Frailty scale**	**Overall frailty score**	**Overall frailty score type**	**Frailty variance value**	**Frailty variance type**
Cohen, 2006	baseline average falls per person - intervention: 0.40 control: 0.36	NR	NR	NR	NR	NR	NR	NR

Scharlach, 2015	mean of 1.3 falls at baseline	NR	NR	NR	NR	NR	NR	NR
Franse, 2018	30.2% had a fall in the previous year	NR	20.2	Tilburg Frailty indicator (TFI)	5.1	mean	3.2	SD
Dolovich, 2019	9.3% of participants had experienced 1 or more falls	NR	NR	NR	NR	NR	NR	NR

Abbreviations: NR, not reported; SD, standard deviation

*No studies reported having individuals who do not identify as female or male

Appendix 4 – Overall risk of bias across included studies (n=4)



Appendix 5 – Quality appraisal assessments using Cochrane Risk of Bias tool modified by EPOC

Author, Year	Trial identifier	Random sequence generation	Allocation concealment	Baseline outcome measurements	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias	Funding details:
Cohen, 2006	NR	High risk	High risk	Low risk	High risk	High risk	Unclear risk	Unclear risk	Low risk	National Endowment for the Arts (lead sponsor); Center for Mental Health Services, Substance Abuse and Mental Health Services Administration, Department of Health and Human Services; National Institute of Mental Health, National Institutes of Health; National Retired Teachers Association/ AARP; International Foundation for Music Research; Stella and Charles Guttman Foundation, New York City.
Scharlach, 2015	NR	High risk	High risk	High risk	High risk	High risk	Unclear risk	Unclear risk	Low risk	The SCAN Foundation
Franse, 2018	NR	High risk	High risk	Low risk	High risk	High risk	High risk	Low risk	Low risk	European Union, CHAFEA, third Health programme, grant number 20131201
Dolovich, 2019	NCT02283723	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Health Canada (grant no. 6817-06-2013/5570001), Government of Ontario (grant no. 06547 for INSPIRE-PHC), McMaster University & McMaster Family Health Organization

Appendix 6 – Outcome summary table for included studies (n=4)

Author, Year	Treatment arms	History of falls	Results	Text description of effectiveness
Cohen, 2006 *Design: non-RCT*	**Singing in a chorale** (n=90) The intervention consisted of participating in a professionally conducted chorale in which there were weekly singing rehearsals for 30 weeks as well as public performances several times during the intervention period. **Usual activities** (n=76) Participants in the comparison group continued their regular activities as usual, with the study introducing no changes other than the assessments.	Baseline average of 0.40 falls per person in the intervention group, and 0.36 per person in the control group in the past 12 months	**UCLA Loneliness scale III** Baseline: 35.1 (SD, 8.1) Follow-up: 34.6 (SD, 7.9) Baseline: 38.3 (SD, 10.1) Follow-up: 37.0 (SD, 10.3)	Both groups evidenced a slight decrease in loneliness at the 12-month follow-up; however, the decrease in loneliness was greater for the intervention group than for the comparison. Analysis of covariance of the 12-month follow-up assessment continued to demonstrate a marginally significant difference between the two groups, F (1,126) = 3.08; p = .08.
Scharlach, 2015 *Design: Uncontrolled before-after*	**ElderHelp Concierge Club (CC)** (n=21) Integrated community-based care model that includes comprehensive personal and environmental, assessment, multilevel care co-ordination, a mix of professional and volunteer service providers, and a capitated, income-adjusted fee model. When individuals contact CC for information or services, they receive a brief assessment designed to determine their eligibility for CC services, as well as the type of services they appear to need: information and referral services only (Tier 1), transportation services only, or other CC services including in-home assessment by the CC Intake Specialist (Tiers 2 and 3).	Baseline mean of 1.3 falls over the past 6 months	**Social Isolation (3-item scale)** Baseline: 8.7 (SD, 3.2) Follow-up: 7.0 (SD, 3.8) **Social interaction** *Interact with friends/relatives weekly* Baseline: 76% of participants Follow-up: 100% of participants *Attend monthly meetings* Baseline: 33% of participants Follow-up: 48% of participants	Social isolation did not change significantly; nor did contact with friends and relatives or participation in meetings of organized groups.

Franse, 2018 *Design: one site randomized, 4 sites controlled before-after design; results combined all sites, so classified as quasi-experimental*	**Urban Health Centres Europe (UHCE) approach** (n=986) Preventive multidimensional health assessment and if person at risk, coordinated care pathways targeted at fall risk, appropriate medication use, loneliness and frailty **Usual Care** (n=858) Usual care included access to their GP	30.2% of participants experienced a fall in the previous year	**Loneliness (short JG scale)** Baseline: 0.6 (SD, 0.7) Follow-up: 0.6 (SD, 0.7) Baseline: 0.6 (SD, 0.7) Follow-up: 0.7 (SD, 0.7)	When comparing persons who enrolled in any type of care-pathway with all persons in the control group there was a positive effect on loneliness after adjusting for city clustering, age, gender, living situation, education, and baseline status of outcome (B= -0.18, 95% CI= -0.35 to -0.02).
Dolovich, 2019 *Design: RCT*	**Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening QualitY) intervention** (n=158) Trained community volunteers visited patients to collect information on their life and health goals, risks and needs, daily life activities and general health, using structured surveys and unstructured narratives. The volunteers sent a report summarizing patients' goals, alerts, key issues and observations to the primary care interprofessional "huddle" team at the clinics. These interprofessional teams reviewed the reports and then generated, prioritized and acted upon plans of care for how the team, community agencies and volunteers could address clients' goals and health issues, with iterative follow-up **Usual Care** (n=154) The control group received usual care and did not have volunteer visits. There was no restriction on receiving care from the same team members as the intervention group	9.3% of participants experienced 1 or more falls	**Social network score (DSSI-10)** Baseline: Mean, 8.84 (SD, 1.52) Follow-up: Mean, 8.75 (SD, 1.52) **Social satisfaction score (DSSI-10)** Baseline: Mean, 18.89 (SD, 2.41) Follow-up: Mean, 18.96 (SD, 2.87) **Social network score (DSSI-10)** Baseline: Mean, 8.74 (SD, 1.61) Follow-up: Mean, 8.69 (SD, 1.53) **Social satisfaction score (DSSI-10)** Baseline: Mean, 19.19 (SD, 2.37) Follow-up: Mean, 19.04 (SD, 2.76)	There were no statistically significant between-group differences in participant ratings of self-efficacy, quality of life, optimal aging, social support