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REVIEW ARTICLE

Interventions to improve the health and wellbeing of older people living alone: a mixed-methods systematic review of effectiveness and accessibility

Georgina Johnstone[1]*, Marissa Dickins[1,2], Judy Lowthian[1,3,4,5], Emma Renehan[1,6], Joanne Enticott[2,7], Duncan Mortimer[8] and Rajna Ogrin[1,9,10,11]

[1]Bolton Clarke Research Institute, Melbourne, Australia, [2]Southern Synergy, Department of Psychiatry at Monash Health, Southern Clinical School, Monash University, Melbourne, Australia, [3]School of Public Health and Preventive Medicine, Monash University, Melbourne, Australia, [4]Faculty of Health and Behavioural Sciences, University of Queensland, Brisbane, Australia, [5]Institute of Future Environments, Queensland University of Technology, Brisbane, Queensland, Australia, [6]Beyond Blue, Hawthorn, Victoria, Australia, [7]Department of General Practice, School of Primary and Allied Health Care, Monash University, Melbourne, Australia, [8]Centre for Health Economics, Monash Business School, Monash University, Clayton, Australia, [9]Department of International Business and Asian Studies, Griffith University, Brisbane, Australia, [10]Biosignals for Affordable Healthcare, Royal Melbourne Institute of Technology University, Melbourne, Australia and [11]Austin Health Department of Medicine, University of Melbourne, Melbourne, Australia
*Corresponding author. Email: gjohnstone@boltonclarke.com.au

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Abstract

The global population is ageing and the likelihood of living alone increases with age. Services are necessary to help older people living alone to optimise health and wellbeing. This systematic review aimed to summarise the effectiveness and accessibility of interventions to improve the health and wellbeing of older people living alone. Relevant electronic databases (CINAHL, MEDLINE, PsycINFO and Scopus) were searched for all years up to August 2018. Studies were included if they involved older people (aged ⩾55 years) living alone, and an intervention with measured health and wellbeing outcomes. All study types were included. The Theory of Access was used to assess interventions across dimensions of accessibility, availability, acceptability, affordability, adequacy and awareness. Twenty-eight studies met the eligibility criteria; 17 studies focused on ageing safely in place and 11 on psychological and social wellbeing. Studies comprised quantitative (N = 19), qualitative (N = 4) and mixed-methods (N = 5) approaches. Dimensions from the Theory of Access were poorly addressed in the studies, particularly those of higher-quality methodology. Studies were heterogeneous, preliminary in scope and lacked consistent study design, methodology or measurement. Services that do not address user accessibility in design or evaluation may be limited in their uptake and impact. It is recommended that dimensions of access and co-creation principles be integrated into service design processes and be evaluated alongside clinical effectiveness.

Keywords: older adults; living alone; access; health; wellbeing; ageing in place

Introduction

In Australia, older people, aged 65 or over, make up 15 per cent of the population and are expected to account for more than 20 per cent of the population by 2050 (Australian Institute of Health and Welfare, 2018). Globally, the older population is the fastest growing cohort, at 3 per cent per year, and all regions of the world except Sub-Saharan Africa are expected to have nearly a quarter or more of their population aged over 60 by 2050 (United Nations, Department of Economic and Social Affairs and Population Division, 2017). Worldwide, studies report that most older people wish to age in place, that is, to continue living safely and independently in their current residence in the community, rather than in institutional care (Australian Institute of Health and Welfare, 2013; National Association of Area Agencies on Aging, National Council on Aging and UnitedHealthcare, 2015; Stepler, 2016). This preference is not only because of an emotional attachment to home, but also a desire to remain connected to a familiar community and services, retaining autonomy and independence, with associated life satisfaction and quality of life (Olsberg and Winters, 2005). There are many factors that facilitate ageing in place, including personal characteristics such as resilience, adaptability and independence; and individual, environmental and services factors, such as health, information, assistance, finances, physical and mental activity, company, transport and safety (Grimmer *et al.*, 2015). Ageing in place also has economic benefits compared to institutional care (Chappell *et al.*, 2004). In combination, these factors suggest the need for community services to support older individuals to remain living independently in the community.

As people age, they are more likely to live alone; in Western society, more than one in four people aged 65 and over live alone (Australian Bureau of Statistics, 2015; United Nations, Department of Economic and Social Affairs and Population Division, 2017). The number of Australians living alone is projected to double by 2026, in line with predicted population growth and increases in life expectancy (Australian Bureau of Statistics, 2006). Whilst for some, living alone may not be the desired living arrangement following relationship breakdown, or death or relocation of a spouse; for others it can be an active decision that promotes personal values, including enhanced privacy, independence, freedom, self-reliance and a reduction in demands on others (de Vaus and Qu, 2015*b*).

Despite positive reasons for ageing in place, concerns around the safety and capability of older adults who live alone permeate almost all narratives surrounding the issue in both academic and public discourse (Iliffe *et al.*, 1992; Kharicha *et al.*, 2007). Being unable to receive timely help when needed is a real fear for many older adults living alone, as well as their families (Huang and Lin, 2002). This concern is not unfounded, as the mortality rate for those who injure themselves and cannot call for help is as high as 28 per cent (Gurley *et al.*, 1996; Holland and Rodie, 2011). Further, older adults living alone have an increased risk of poor health and functioning, falls and difficulties with activities of daily living, compared to those living with others (Kharicha *et al.*, 2007). Individuals living alone are also faced with additional social difficulties, including losses in their support network (*e.g.* death of partner or friends), a perceived lack of social support resources and companionship, loss of previous social roles, and a decrease in functional abilities

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that can make social engagement more challenging (Adams and Blieszner, 1995; Cheng *et al.*, 2008). These social factors, along with increasing functional disability and physical illness, may affect the psychological wellbeing and mental health of the older person living alone (Asakawa *et al.*, 2000; Savikko *et al.*, 2005; Lucas, 2007; Richard *et al.*, 2017).

Given the potential issues facing individuals who live alone, ensuring access to appropriate and effective services to support independence and wellbeing is of high priority. While supply of effective and appropriate care is an essential feature of evidence-based practice, demand-side barriers to access may exclude some populations from the benefits of effective and appropriate care (Ensor and Cooper, 2004). Penchansky and Thomas (1981) developed the Theory of Access (recently updated by Saurman, 2015) which outlines the six dimensions of service access (*see* Table 1). These independent yet interconnected dimensions revolve around a simple concept; the better the service fits the needs of the user, the better the access (Saurman, 2015). Despite the enduring nature of this theory, many services continue to treat their users as a homogenous group, without considering those in need of assistance who are not optimally accessing services.

Given the importance of these barriers to service use, interventions to optimise the health, wellbeing and quality of life of older people living alone should be developed and evaluated for their accessibility as well as against clinical effectiveness. Building this evidence base is a necessary first step in designing services that will allow older people living alone to age in place. In this context, we aimed to identify and synthesise the evidence regarding the effectiveness of previously implemented interventions to improve the health, wellbeing and quality of life of older people who live alone. Based on findings from included studies, we then assessed each intervention against the six dimensions of service access: accessibility, availability, acceptability, affordability, adequacy and awareness. This systematic review builds on previous reviews which focused on a narrower set of interventions (interventions targeting social isolation in older people) than included in the present study (Findlay, 2003; Cattan *et al.*, 2005; Dickens *et al.*, 2011; Masi *et al.*, 2011; Cohen-Mansfield and Perach, 2015; Gardiner *et al.*, 2018).

Methods

We conducted and reported this systematic review in accordance with the PRISMA Statement (Moher *et al.*, 2009). This review was registered in PROSPERO (2017 CRD42017053298).

Data sources and search strategy

We conducted an electronic search of CINAHL (1937 to present), MEDLINE (1946 to present), PsycINFO (1806 to present) and Scopus (1823 to present) databases, in August 2018. A library scientist guided the development of the search strategy, which used a combination of keywords, wildcards and appropriate truncations tailored for each database. No limits on publication date were applied (for the search strategies, *see* Figure 1). We manually searched the reference lists of included studies to identify additional studies.

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Table 1. The dimensions of access

Dimension of access	Definition	Dimension components and examples
Accessibility	Location	An accessible service is within reasonable proximity to the consumer in terms of time and distance
Availability	Supply and demand	An available service has sufficient services and resources to meet the volume and needs of the consumers and communities served
Acceptability	Consumer perception	An acceptable service responds to the attitude of the provider and the consumer regarding characteristics of the service and social or cultural concerns
Affordability	Financial and incidental costs	Affordable services examine the direct costs for both the service provider and the consumer
Adequacy (accommodation)	Organisation	An adequate service is well organised to accept clients, and clients are able to use the services. Considerations of adequacy include hours of operation (after-hours services), referral or appointment systems, and facility structures (wheelchair access)
Awareness	Communication and information	A service maintains awareness through effective communication and information strategies with relevant users (clinicians, patients, the broader community), including consideration of context and health literacy

Source: Adapted from Saurman (2015).

	Concept A: Older persons	Concept B: Living alone	Concept C: Social care/interventions
Example subject headings	Ageing/ Gerontology/ Geriatrics/	Social isolation/ Living alone/ Social distance/ Community living/	Social services/ Community services/ Community health services/ Programme evaluation/ Social problems/ Social welfare/ Experimental studies/ Gerontologic care/ Health services for the aged/
Example search terms	(aged or elder* or ag?ing or senior* or pension*) ((old* or senior*) adj (person* or people* or adult* or citizen*))	liv* alone liv* independent* social* isolat*	intervention program* service*

Figure 1. Example search strategy.

Study selection

Two of three authors (ER, MD, GJ) independently screened titles and abstracts of studies retrieved using the search strategy and those from included reference lists to

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identify studies that potentially met the inclusion criteria. We retrieved full texts of potentially eligible studies which were independently assessed for inclusion; with any discrepancies resolved by consensus.

Inclusion criteria

As our preliminary scan of the literature revealed little research in this area, we used a broad approach to the inclusion and exclusion criteria. We included studies if they reported outcomes for an intervention intended to increase the health and wellbeing of individuals who were: aged 55 years or older, and living alone in the community (*i.e.* not living in a residential care facility), or reported results for an intervention for those living alone separately to those who lived with others. The age restriction was set at 55 years to capture issues surrounding the tension between biological and functional age (Levine and Crimmins, 2018) and the associated services (*e.g.* aged care) and entitlements (*e.g.* withdrawing superannuation, pension) that individuals are eligible to access. Although two studies (Graham *et al.*, 2014, 2018) may have involved a small number of individuals aged under 55 (*see* Table 2), as the focus of the intervention was older adults, we included them in this review. We included interventions if they reported (a) health and wellbeing outcomes; (b) information relating to the duration, content and context of the intervention; and (c) information relating to the evaluation method of the provided intervention. All study types were included. We excluded articles that did not report primary studies (*e.g.* editorials, commentaries, opinion pieces), or were in a language other than English.

Data extraction and quality assessment

Two of three authors (GJ, GM, MD) independently extracted data from the included studies, using forms developed prior to the review. Information on study aims, methodology, population, context, intervention and outcomes were collected. We used two checklists developed by Kmet *et al.* (2004) for quantitative and qualitative studies as a framework to assess the risk of bias of the included studies. We extracted data including study design, context, sampling, intervention, outcome measures, analysis and results, with different criteria outlined for qualitative and quantitative studies. For mixed-methods studies, we used both qualitative and quantitative checklists. The checklists were completed independently, and consensus was reached through discussion with a third author.

We used the Theory of Access (Penchansky and Thomas, 1981; Saurman, 2015) to evaluate each intervention against the six dimensions of access outlined in the Introduction. Each intervention was reviewed on two considerations, whether (a) any of the dimensions of access were explicitly addressed in the design of the intervention, and (b) whether any of the dimensions of access were explicitly evaluated in the results. Two authors (GJ, MD) completed this independently, with consensus reached through discussion.

Data synthesis

Due to heterogeneity, we used the narrative synthesis method. Narrative synthesis collates the collective findings into a coherent, textual narrative, and is highly

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Table 2. Characteristics of quantitative studies

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
Ageing safely in place:					
Morgenstern *et al.* (2015) Single Centre Study, University of Michigan, USA	The goal of this study was to examine the feasibility and benefit of wearing medical alert devices to activate emergency medical systems for elderly women living alone	Wearable medical alert device. • 90-day trial • Device works with range up to 120 metres from speakerphone • Small call button (wristband or necklace) which is pressed signals ambulance service, who contact individual and generate immediate emergency response if required	Block RCT N = 265 (133, 132) Mean age: intervention = 76.96; control = 75.05 100% female	*Time-frames* Baseline, 90 days *Outcome measures* Total number of healthy days; anxiety and depression; social connectedness	No significant difference for any measure
Ahn *et al.* (2018) Public Health Centres, Korea	To examine the effects of an individualised nutritional education and support programme implemented by home-visiting nurses and dietitians, on the	Nutritional education and support. 8 weeks. Two parts: • Individualised nutritional education 60–90 minutes	Pre–post controlled quasi-experimental N = 71 (37, 34) Mean (SD) age: 77.61 (5.38) 81.7% female	*Time-frames* Baseline and 8 weeks *Outcome measures* Dietary habits; nutritional knowledge; nutritional intake	*Dietary habits* Significant interaction of group by time ($p < 0.001$, $\eta^2 = 0.438$). Intervention: significant increase compared to control ($p < 0.001$, SMD = 1.750). *Nutritional knowledge* Significant interaction of group by time ($p < 0.001$, $\eta^2 = 0.242$). Intervention: significant increase ($p < 0.001$, SMD = 1.125).

	dietary habits, nutritional knowledge and nutritional status of older people living alone in the community	• 8 × (weekly) 30-minute follow-up phone calls with continuing education, counselling and dietary menus			*Nutritional intake* • Protein: significant interaction of group by time ($p = 0.001$, $\eta^2 = 0.161$). Intervention: significant increase ($p < 0.001$, SMD = 0.866). • Calcium: significant interaction of group by time ($p = 0.007$, $\eta^2 = 0.101$). Intervention: significant increase ($p = 0.006$, SMD = 0.244). • Iron: significant interaction of group by time ($p = 0.006$, $\eta^2 = 0.161$). Intervention: significant increase ($p = 0.005$, SMD = 0.676). • Vitamin B2: significant interaction of group by time ($p = 0.015$, $\eta^2 = 0.083$. Intervention: significant increase ($p < 0.013$, SMD = 0.589). • Vitamin C: significant interaction of group by time ($p = 0.001$, $\eta^2 = 0.144$). Intervention: significant increase ($p = 0.001$, SMD = 0.808). • Vitamin A: non-significant interaction of group by time ($p = 0.193$, $\eta^2 = 0.024$). Intervention: non-significant increase ($p = 0.001$, SMD = 0.313).
Huang *et al.* (2004) Home-based nursing, Taiwan	To evaluate the efficacy of a home-based nursing programme in the diabetic control of elderly people with diabetes mellitus living alone	Home-based nursing programme. Group 1 (i1): • Daily visits for 6 weeks • Supervise diet preparation, exercise performance, medication, self-monitoring of blood sugar	Pre–post quasi-experimental N = 44 (i1 = 15, i2 = 15, control = 14) Mean (SD) age: i1 = 76.7 (6.0); i2 = 75.9 (6.1); control = 75.9 (6.6) i1: 46.7% female; i2: 46.7% female;	*Time-frames* Baseline, 6 weeks *Outcome measures* Fasting blood sugar; post-meal blood sugar; HbA1c; total cholesterol; high-density lipoprotein; low-density lipoprotein;	*Fasting blood sugar* Significant decrease for Group 1 ($z = -3.408$, $p < 0.01$) and Group 2 ($z = 2.727$, $p < 0.01$). Groups 1 and 2 had significantly greater change than control group ($z = -4.214$, $z = -2.681$, $p < 0.001$), with Group 1 having significantly higher decrease than Group 2 ($z = -4.109$, $p < 0.001$). *Post-meal blood sugar* Significant decrease for Group 1 ($z = -3.408$) and Group 2 ($z = -2.615$, $p < 0.001$); with Group 1 having significantly greater

Table 2. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
		• Group 2 (i2): • 20–30 minutes once per week over 6 weeks • Education sessions, health education information and self-monitoring of blood sugar	control: 42.9% female	triglyceride; fasting body weight; diabetes knowledge; depression; quality of life	change ($z = -4.109$, $p < 0.001$). *HbA1c* Significant decrease for Group 1 ($z = -3.412$, $p < 0.01$). Mean difference of Group 1 higher than Group 2 ($z = -2.455$, $p < 0.05$), which was higher than the control group ($z = -2.282$, $p < 0.05$). *Fasting body weight* Significant decrease for Group 1 ($z = -3.426$, $p < 0.01$) and Group 2 ($z = -2.268$, $p < 0.05$). Significant mean differences between the two groups ($z = -3.489$, $p = 0.00$). *Diabetes knowledge* Significant increase for Group 1 ($z = 3.447$, $p < 0.01$) and Group 2 ($z = 3.428$, $p < 0.01$). *Depression* Significant decrease for Group 2 ($z = -3.025$, $p < 0.01$). *Quality of life* Significant increase for Group 1 ($z = 2.385$, $p < 0.05$).

Jung and Lee (2017) Two senior centres in two communities from the Songpa-Gu area of Seoul, Korea	To examine the effect of eHealth self-management intervention on self-efficacy, self-care behaviours and blood pressure in elderly who lived alone	eHealth self-management system. • 4 × 1-hour weekly classes on hypertension management • Community centre-based eHealth monitoring and monthly telephone counselling for 24 weeks	Non-randomised, quasi-experimental, parallel group N = 64 (31, 33) Mean (SD) age: intervention = 80.9 (8.6); control = 81.2 (4.1) Intervention: 77.4% female; control: 87.0% female	*Time-frames* Baseline, 24 weeks *Outcome measures* Systolic and diastolic blood pressure; self-efficacy; hypertension self-care behaviours; social support	*Systolic blood pressure* Intervention significantly greater improvement ($t = -3.582$, $p = 0.001$). *Self-efficacy* Intervention significantly greater improvement ($t = 3.853$, $p = 0.000$). *Self-care behaviours* Intervention significantly greater improvement ($t = 3.474$, $p = 0.001$). *Social support* Intervention significantly greater improvement ($t = 2.197$, $p = 0.033$).
Schmitt *et al.* (2010) Adult Day Health Centre programmes, San Francisco, USA	The purpose of this study was to assess the association between Adult Day Health Centre participation and health-related quality of life	Adult Day Health Centre. • Daily outpatient support services • Multi-disciplinary team: nursing, therapeutic activities, occupation therapy, speech therapy, dietician, personal care, social services • One full meal, transportation to and from centre	Prospective case-control study N = 154 (75, 79) Mean age: intervention = 76.9; control = 78.7. Gender: intervention = 69.3% female; control = 68.4% female	*Time-frames* Baseline, 6 months, 12 months *Outcome measures* Health-related quality of life (SF-36): physical functioning; role physical; social functioning; role emotional; mental health	*Overall* • Role physical: significantly different trends, Intervention steadily increasing scores, control steadily declining scores ($p = 0.01$). • Role emotional: significantly different trends, intervention steadily increasing scores, control steadily declining scores ($p = 0.02$). *Living alone* • Physical functioning: baseline status significant negative contributor at 6 months (-6.53, $p < 0.05$) but not baseline or 12 months. • Mental health: baseline status significant positive contributor at 6 months (0.05, $p < 0.05$).

Table 2. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
Bly and Kissick (1994) Wissahickon Hospice and home hospice care community, Philadelphia, USA	To establish success of the hospice in enabling patients living alone to die at home, the ability of staff to provide for the safety and security of patients and service needs and costs	Home-based hospice care, with services including nursing, medical alert system, lock box, home health aides, volunteers, pastoral counselling, social work	Cross-sectional, controlled post-test study, parallel group N = 130 (34, 105) Mean age: intervention = 72.2; control = 72.7 Intervention: 76% female; control: 56% female	*Time-frames* Post-intervention *Outcome measures* Length of stay; patient safety; maintenance at home; visits; patient costs	*Visits* Intervention had significantly more case time ($p = 0.037$). Intervention had significantly more visits by aides ($p = 0.01$), case manager ($p = 0.0001$), social worker ($p = 0.04$).
Graham *et al.* (2018) Seven Villages, California, USA	To assess the changes Village members experience in the first year of membership in confidence ageing in place, social connectedness and health	Villages	12-month longitudinal/ pre–post N = 222, 7 Villages Age: 3.8% 50–59; 20.4% 60–69; 35% 70–79; 33.9% 80–89; 7% 90 and older 79% female	*Time-frames* Intake, 12-month follow-up *Outcome measures* Both retrospective and pre–post; confidence ageing in place; social connectedness; health	*Confidence ageing in place* *Retrospective*: 79% more likely to stay in their own home; 29% have easier time taking care of their home; 35% have easier time taking care of themselves. *Pre–post*: significantly fewer considering moving to alternative housing ($p = 0.0113$). Respondents significantly more confident that they could get the help they needed to stay in their current residence ($p = 0.0017$), with those living alone significantly more likely than those living with others ($\chi^2 = 9.8$, $p = 0.0074$), with 39% of those living alone compared to 24% living with others.

Significantly fewer indicated that they needed home modifications ($p = 0.0046$). No significant changes in confidence in being able to afford to stay in their home, or in how long they wanted to stay there.

Social connectedness
Retrospective: 74% know more people than they used to; 61% talk to more people than they used to; 54% feel more connected with other people; 55% participate in activities more than they used to; 40% leave their home more; 48% are less lonely; 82% are more likely to know how to get assistance when they need it; 50% use more community services.

Pre–post: significantly more likely to have someone to count on for assistance with routine activities ($p \leqslant 0.0001$). Significant decrease in frequency in talking to friends and neighbours ($p = 0.0425$). No significant differences in getting together socially nor feelings of belonging to a community. Significant decreases in frequency of attending organised group meetings ($p = 0.0065$) and volunteering ($p = 0.0251$).

No difference for those living alone on any of the above.

Health
Retrospective: 37% feel more likely to get the medical help they need when they need it; 38% feel healthier than they used to; 51% feel happier than they used to; 62% have better quality of life.

Table 2. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
					Pre–post: significant increase in ability to walk across the room ($p = 0.0047$). No significant changes in self-rated health status, falls, ADL/IADLs. Increased number of hospitalisations ($p = 0.032$); increased 911 calls ($p = 0.0079$). No significant changes in re-hospitalisation, emergency department visits, skilled nursing facility stays, delayed medical care. No difference for those living alone on any of the above.
Graham *et al.* (2017) Twenty-eight Villages, USA	To examine perceived impacts of Village membership on member social engagement, health and wellbeing, and ability to age in place, and identify characteristics and activities that predict perceived benefits of Village membership	Villages. Consumer-directed model that brings together older adults in a neighbourhood or community who have a mutual interest in ageing in place. Goal: promote members' independence and prevent undesired relocations. Enables social and civic engagement, social support and service access. Yearly membership fee	Cross-sectional survey N = 1,753, 28 Villages Age: 41.5% 74 or younger; 36.9% 75–84; 21.6% 85 or older 71.3% female	*Time-frames* February to December 2015 *Outcome measures* Social engagement; civic engagement; health and quality of life; ageing in place	Because of your membership in the Village… *Social engagement* • Get together socially: more often = 30.2%. • Sense of connection: increased = 55.8%. • Ability to count on others: increased = 55.1%. *Civic engagement* • Volunteer work: increased = 26.6%. • Attend meetings of organised groups: more often = 29%. *Health and quality of life* • Physical health: better = 8%. No significant difference based on household composition.

					• Ability to get medical care: better = 16.8%. Those living alone were significantly more likely to report increased access to medical care (AOR = 1.89, $p < 0.001$). • Quality of life: better = 46.9%. *Ageing in place* • Getting to places you need or want to go: easier = 19.8%. Those living alone significantly more likely to report increased ability (AOR = 1.7, $p < 0.001$). • Ability to get the help you need: increased = 49.9%. • Ability to take care of your home: increased = 28.8%.
Graham *et al.* (2014) Five Villages, California, USA	To assess the perceived impact of Village membership on social engagement, service and health access, health and wellbeing, self-efficacy and independence. Secondary aim to examine the characteristics of individuals most likely to benefit from Village membership, as well as the relationship between service use and self-reported impacts	Villages	Cross-sectional survey N = 282, 5 Villages Age: 2.5% 50–59; 17.7% 60–69; 41.5% 70–79; 30.1% 80–89; 5% 90 and older 71% female	*Time-frames* Not applicable *Outcome measures* Social impact; service access; health and wellbeing; self-efficacy; service use	*Social impact* • The mean social impact score across the six items was 2.65, indicating that the Village had had a small positive impact on the social lives of participants. • Higher social impact scores were associated with more frequent volunteering ($p < 0.01$), greater use of companionship services ($p < 0.001$), and more frequent participation in social activities ($p < 0.001$) (model $R^2 = 0.389$). Living alone status was not a significant contributor ($\beta = 0.010$). *Health and wellbeing* • The mean health and wellbeing score was 2.46, indicating that the Village had little impact on the health and wellbeing of participants. • Higher health and wellbeing impact was associated with greater use of technology

Table 2. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
					services ($p < 0.01$), (model $R^2 = 0.205$). Living alone status was not a significant contributor ($\beta = -0.259$). *Service access* • The mean service/health-care access score was 2.66, indicating that the Village had a small positive impact on service access. • Greater impact on service access was associated with higher use of companionship services ($p < 0.001$) and attending social activities ($p < 0.001$) (model $R^2 = 0.249$). Living alone status was not a significant contributor ($\beta = -0.468$). *Self-efficacy* • The mean score for the three self-efficacy statements was 2.46, indicating that the Village had little impact on the self-efficacy of participants. While 77% of the participants agreed that they were more likely to stay in their own home as they got older, less than 30% reported that they have an easier time taking care of themselves or their home. • Greater impact on self-efficacy was associated with participants in better health ($p < 0.01$) and who participated

					more in social activities ($p < 0.001$) (model $R^2 = 0.232$). Living alone status was not a significant contributor ($\beta = 0.027$).
Moore *et al.* (2006) Independent Living Program for Older Individuals Who Are Blind, USA	To assess satisfaction with (a) quality and timeliness of services and (b) functional outcome levels in visually impaired individuals accessing the Independent Living Program for Older Individuals Who Are Blind	Independent living services for blind individuals. Programme includes services to help correct blindness, the provision of visual devices, and other specific services designed to assist older individuals in adjusting to visual impairment, maintaining independence, and becoming more mobile and self-sufficient	Cross-sectional survey N = 1,025 Mean age: 79.2 70% female	*Time-frames* 1999, 2004 *Outcome measures* Consumer satisfaction; functional outcomes ratings (2004 only)	*Functional outcomes* Significantly more confident in ability to • Perform activities ($F = 23.979$, $p < 0.0005$, $\eta^2 = 0.012$). • Move around where I live ($F = 51.895$, $p < 0.0005$, $\eta^2 = 0.027$). • Prepare meals, $F = 57.803$, $p < 0.0005$, $\eta^2 = 0.032$ (greater for living alone $p < 0.04$, $\eta^2 = 0.009$). • Manage housekeeping, $F = 31.241$, $p < 0.0005$, $\eta^2 = 0.017$ (greater for living alone, $p < 0.04$, $\eta^2 = 0.005$). • Manage paperwork ($F = 4.291$, $p = 0.038$, $\eta^2 = 0.002$). • Access reading materials, $F = 45.354$, $p < 0.0005$, $\eta^2 = 0.024$ (greater for living with others, $p < 0.04$, $\eta^2 = 0.012$). • Participate in community ($F = 23.044$, $p < 0.0005$, $\eta^2 = 0.012$). *Consumer satisfaction* (no significant difference for living status) • Satisfied by quality of services: agreed (23%), strongly agreed (72%). • Satisfied with the timeliness of services: agreed (33%); strongly agreed (60%). • Satisfied with helping to achieve goals agreed (36%), strongly agreed (54%).

Table 2. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
Moore *et al.* (2001) Independent Living Program for Older Individuals Who Are Blind, USA	To assess whether the perceived gains in programme-related consumer outcomes for older people served under the Independent Living Program for Older Individuals Who Are Blind related to demographic characteristics	Independent living services for blind individuals. As above	Cross-sectional survey N = 940 Mean age: 78.5 74% female	*Time-frames* 1998 *Outcome measures* Consumer satisfaction	Those living alone felt significantly • Better able to move confidently around their house, apartment or yard ($F = 8.18$, $p < 0.01$, MSE = 0.43). • Better able to prepare meals for themselves ($F = 13.62$, $p < 0.01$, MSE = 0.53). • Better able to manage housekeeping tasks ($F = 18.91$, $p < 0.01$, MSE = 0.53). • More in control of making decisions important in their life ($F = 7.48$, $p < 0.01$, MSE = 0.47). Overall, those living alone rated the services higher than those living with others ($F = 3.80$, $p < 0.05$).
Toien *et al.* (2018) Homes in a municipality, Norway	To assess older persons' perceived benefits and opinions of a PHV service and explore associations between perceived benefits from PHV and relevant socio-demographic/ health-related factors	Preventive home visit service. Free annual home visit for those 75 and older by Registered Nurse, to assess older person's situation and offers support to promote health and sustain functional ability and independence	Cross-sectional design N = 161 Mean (SD) age: 82.1 (4.1) 45.3% female	*Time-frames* Spring 2013 *Outcome measures* Perceived benefits from PHV; safety; ability to stay at home; good life in my own home; overall satisfaction; importance of service	*Safety* 39% felt it contributed to safety. Living alone not a significant association with safety ($p = 0.77$, OR = 0.90, 95% CI = 0.44–1.83). *Ability to stay at home* 66% felt it supported their ability to live at home. The univariate analysis revealed that those living alone were 52% less likely to indicate that PHV contributed to their ability to stay at home ($p = 0.05$, OR = 0.48, 95% CI = 0.23–0.99). The multivariable analysis revealed those living alone were

					77% less likely to indicate that PHV contributed to their ability to stay at home after adjusting for personal values and dispositional optimism, social support, age and gender. *Good life* 72% felt it enabled them to have a good life in their own home. Living alone not significantly associated. *Satisfaction* 83% felt satisfied with the service. Living alone was not associated with satisfaction ($p = 0.45$, OR = 0.76, 95% CI = 0.38–1.55). *Importance* 91% felt the service was important for older people in the community. The univariate analysis revealed that those living alone were 64% less likely to indicated that the PHV is very important for older people in the municipality ($p = 0.02$, OR = 0.36, 95% CI = 0.18–0.89). The multivariable analysis revealed that those living alone were 65% less likely to indicate that the PHV is very important for older people in the municipality after controlling for gender, age and social support ($p = 0.05$, OR = 0.35, 95% CI = 0.12–1.02).
Psychological and social wellbeing:					
Andersson (1985) Small neighbourhood group meetings, Stockholm, Sweden	To evaluate the impact of an intervention programme designed to strengthen the social	• Small social DG meetings. • 4 group meetings (two of which were attended by	RCT, parallel groups N = 57 (35, 22) Mean age: 77	*Time-frames* Baseline, 6 months (pre–post) *Outcome measures*	*Social integration* *Loneliness*: Significant decreases ($p = 0.037$). *Social contacts*: Significant increase ($p = 0.014$).

Table 2. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
	network of elderly women with a hypothesised problem in coping with loneliness	home-help assistant) • 3–5 people • Particular subject discussed (*i.e.* residential area, retirees, social and medication services, leisure activities)	100% female	*Social integration*: loneliness; social contacts *Alienation*: meaninglessness; powerlessness *Psychological resources*: self-esteem; inability to trust *Health resources*: psychosomatic complaints; subjective health; drugs taken; blood pressure (systolic, diastolic) *Activities*: participation in organised activities; leisure activities; vacation trip	*Alienation* *Meaninglessness*: Significant decrease ($p = 0.010$). *Psychological resources* *Self-esteem*: Significant increase ($p = 0.002$). *Health resources* *Systolic blood pressure*: Significant decrease ($p = 0.007$). *Diastolic blood pressure*: Significant decrease ($p = 0.004$). *Activities* *Participation in organised activities*: Significant increase ($p = 0.042$). *Vacation trip*: Significant increase ($p = 0.22$). When baseline measurements controlled for, significant increases in social contacts ($p < 0.05$); decreases in systolic blood pressure ($p < 0.05$) and leisure activities ($p < 0.01$).

Calsyn *et al.* (1984) Friendly visitor programme, non-institutional setting, USA	To evaluate the effectiveness of friendly visitor programmes in increasing clients' life satisfaction	Friendly visitor programme. 12-week programme, one visit per week by trained volunteer. • Study 1: Face-to-face visiting or phone visiting, compared to no treatment • Study 2: Face-to-face visiting comparing two approaches: personal history or companionship	Block RCT, parallel groups; two-component studies Study 1: N = 58 (i1 = 21, i2 = 16, control = 13, dropout = 8); Study 2: N = 34 (i1 = 16, i2 = 17, dropout = 1) Mean age: Study 1 = 76.77; Study 2 = 77.34 Study 1: 81.0% female; Study 2: 82.4% female	*Time-frames* Two weeks before first visit, 2 weeks after last visit *Outcome measures* Life satisfaction	*Life satisfaction* • Study 1: No significant differences. • Study 2: Those living with someone increased life satisfaction more than those living alone ($F = 5.07$, $p < 0.03$).
McHugh Power *et al.* (2016) Homes of older adults living alone, Ireland	To assess the effects of a novel mealtime intervention on self-efficacy, food enjoyment and energy intake	Mealtime peer visitor. • 8 × 90-minute weekly visits in participants' home • Participant–volunteer dyad choose, prepare and share a meal together, supported by guidebook	RCT, parallel groups N = 100 (50, 50) Mean (SD) age: intervention = 75.3 (7.82); control = 74.4 (7.61) Intervention: 76% female; control: 72% female	*Time-frames* Baseline, 8, 12, 26 weeks *Outcome measures* Self-efficacy; food enjoyment; energy intake	*Food enjoyment* Treatment group improved food enjoyment significantly more over all four time-points ($F_{1,227} = 5.838$, $p < 0.05$; $t_{227} = 2.416$, $p < 0.05$; 95% CI 0.09–0.895)

Table 2. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
Zingmark *et al.* (2014) Mid-sized city in northern Sweden	To evaluate three different occupation-focused interventions for older people on leisure engagement and ability in ADLs and identify the most effective intervention	Occupational engagement programmes. (a) Individual intervention (IG): • Client-centred collaboration; 1.5-hour sessions, between 3 and 8 times over 10 weeks; led by trained occupation therapist, in participants home (b) Activity group (AG): • Engagement in occupation; 5–8 people • 8 × 1.5-hour weekly meetings; led by trained occupation therapist; in community centre	Single-blind, four-group exploratory RCT N = 177 (IG = 41, AG = 49, DG = 41, control = 46) Mean age: IG = 82; AG = 79; DG = 79; control = 79 IG: 82.9% female; AG: 81.6% female; DG: 82.9% female; control: 82.6% female	*Time-frames* Baseline (T1), 3 months (T2), 12 months (T3) *Outcome measures* Leisure engagement; ADL ability	*Leisure engagement* • Decline in all groups between T1 and T2. DG reduced rate of decline ($d = 0.27$), negligible effect of IG ($d = 0.14$) and AG ($d = 0.19$). • Decline in all groups between T1 and T3. Small effect of IG on decline ($d = 0.41$). Negligible effect for AG ($d = -0.12$), DG ($d = 0.07$) and control. *ADL ability* • Between T1 and T2, IG and DG remained stable (change 0.01 and 0.03, respectively) and had small effect of IG ($d = 0.29$) and DG on maintaining ADL ability. Decline for AG and control. • Between T1 and T3, declined in all groups. All effect sizes small; AG ($d = 0.38$); DG ($d = 0.30$), IG ($d = 0.30$).

		(c) One-meeting DG: • Education; 7–9 people • 2 hours; occupation focused; in community centre			
Clarke *et al.* (1992) Town of Melton Mowbray, Leicestershire, England	To demonstrate the effect of social intervention in terms of mortality and morbidity of those aged 75 and over who lived alone	Case worker-delivered support packages. • Interventions initiated by case worker • Tailored to individual need • Included: social and social services, financial; housing; nursing; medical • Between 1.25 and 2 years duration	Pragmatic RCT N = 523 (262, 261) Age: not reported Gender: not reported	*Time-frames* Pre–post (1985, 1988) *Outcome measures* ADLs; loneliness; morale; social contact; perceived health status; mortality	*Perceived health status* Significant improvement in perceived health status in experimental group
Liu *et al.* (2007) Public nursing home in community for elderly, northern Taiwan	To explore the effects of reminiscence group therapy on raising self-esteem, lowering depression, reducing loneliness and improving life satisfaction among elderly people living alone	Reminiscence group therapy. • 10 × 1-hour reminiscence group therapy sessions • Small groups led by principal investigator • Recall and reconstruct experience	Pre-post controlled quasi-experimental N = 26 (12, 14) Mean (SD) age: intervention = 75.1 (3.4), control = 74.6 (5.4) Intervention: 20%	*Time-frames* Baseline and post intervention (10 weeks) *Outcome measures* Self-esteem; depression; loneliness; life satisfaction	*Self-esteem* Intervention had significantly greater improvement ($p < 0.001$). *Depression* Intervention had significantly greater improvement ($p = 0.047$). *Loneliness* Intervention had significantly greater improvement ($p < 0.001$).

Table 2. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
		Topics including 'It is good to know you', 'Memorable people'; Important life experiences' and 'Feeling sad when parting'	female; control: 7.1% female		*Life satisfaction* Intervention had significantly greater improvement ($p < 0.001$).
Cheung and Ngan (2000) Social networking project in one of the 18 districts in Hong Kong, China	To examine the effects of the volunteer's contact and helpfulness perceived by the senior on quality-of-life outcomes, by controlling the prior quality of life and background characteristics	Volunteer social networking service. • Trained and matched volunteers • Visit in pairs or in teams Aims to (re)-create a social network for isolated seniors by strengthening their contact with volunteers, friends, relatives, neighbours	Longitudinal cohort study, two-wave panel N = 125 Mean age: 76.9 65.5% female	*Time-frames* Baseline and 6 months (T2) *Outcome measures* Anxiety; social integration; knowledge about senior services; health; contact with the volunteer; volunteer helpfulness; sickness	*Anxiety* Significant decrease ($p < 0.05$). Contact with the volunteer (T2) had significant negative effect (SE = −0.209, $p < 0.05$); anxiety (T1) had significant positive effect (SE = 0.373, $p < 0.05$). *Knowledge of services* Significant increase ($p < 0.05$). Significant positive effects of volunteer helpfulness (T2) (SE = 0.250, $p < 0.05$); contact with volunteer (T2) (SE = 0.186, $p < 0.05$); knowledge of services (T1) (SE = 0.396, $p < 0.05$); social integration (T1) (SE = 0.191, $p < 0.05$). Negative effect of contact with volunteer (T1) (SE = −0.197, $p < 0.05$).

Notes: ADL: activities of daily living. AOR: Adjusted Odds Ratio. CI: confidence interval. DG: discussion group. IADL: instrumental activities of daily living. MSE: mean squared error. OR: odds ratio. PHV: preventive health visit. RCT: randomised controlled trials. SD: standard deviation. SE: standard error. SMD: standardised mean difference. USA: United States of America.

appropriate when examining the needs and/or preferences of a specific population group (*i.e.* older people living alone) (Popay *et al.*, 2006).

We grouped included studies together based on their focus on improving or maintaining aspects of life for older people living alone. Four authors (GJ, MD, JL, RO) developed these overarching themes through discussion, with studies included in the most relevant categories as designated through consensus.

Results

Search results are summarised in Figure 2. Twenty-eight articles met the inclusion criteria for the narrative synthesis. Studies were published between 1984 and 2018, and comprised quantitative (N = 19), qualitative (N = 4) and mixed-methods (N = 5) approaches. Quantitative studies included six randomised controlled trials (RCTs), four quasi-experimental studies, two uncontrolled pre-post studies, five cross-sectional studies, one control post-test and one case control. Mixed-methods studies included one each of: pre-post with control, post-intervention with control, during and post-intervention without control, one pre-post without control and one pre-post trial without control. Qualitative studies involved two phenomenological case studies, and one each of semi-structured interviews and qualitative survey data. Over half of the studies (N = 17, 61%) were undertaken in English-speaking countries (United States of America (USA) N = 13; United Kingdom (UK) N = 2; Canada N = 1; Ireland N = 1). The remaining studies originated from Europe (N = 6; The Netherlands N = 2; Sweden N = 2; Austria N = 1, Norway N = 1) and Asia (N = 5; China N = 1; Taiwan N = 2; Korea N = 2).

Overall, the mean age of participants was 77.1 years. For those that reported gender, the majority of studies (N = 20) included more females than males, with four studies including only women. Sample sizes ranged from N = 7 participants (Rose, 2006; Pripfl *et al.*, 2016) to N = 1,753 participants (Graham *et al.*, 2017), and the majority of studies (N = 15) had samples of 100 participants or fewer. Tables 2–4 outline the key characteristics and summary outcome results of included studies.

Overall, the studies performed poorly on addressing the dimensions of access in both design and evaluation of interventions. Accessibility was the most considered dimension in the design of interventions, included in 75 per cent of studies. The most popular way in which accessibility was addressed was through the provision of services in the home, particularly in the ageing safely in place category. Acceptability (25% of studies) (*e.g.* consideration of user needs), affordability (21%) (provision of a free service), availability (18%) (frequency of service provision) and adequacy (14%) (staffing and access hours) were the next most addressed dimensions, with awareness only being considered by two of the 28 studies.

Acceptability was the most evaluated dimension of access, with 57 per cent of studies examining the perception of the user of the service. Availability (39%; could the user access services when they needed), adequacy (32%; functionality), accessibility (25%) and affordability (21%) were the next most evaluated dimensions. Again, awareness was evaluated least frequently, by just five of the 28 (18%) studies. The performance of each study on the dimensions of access is outlined in Table 5.

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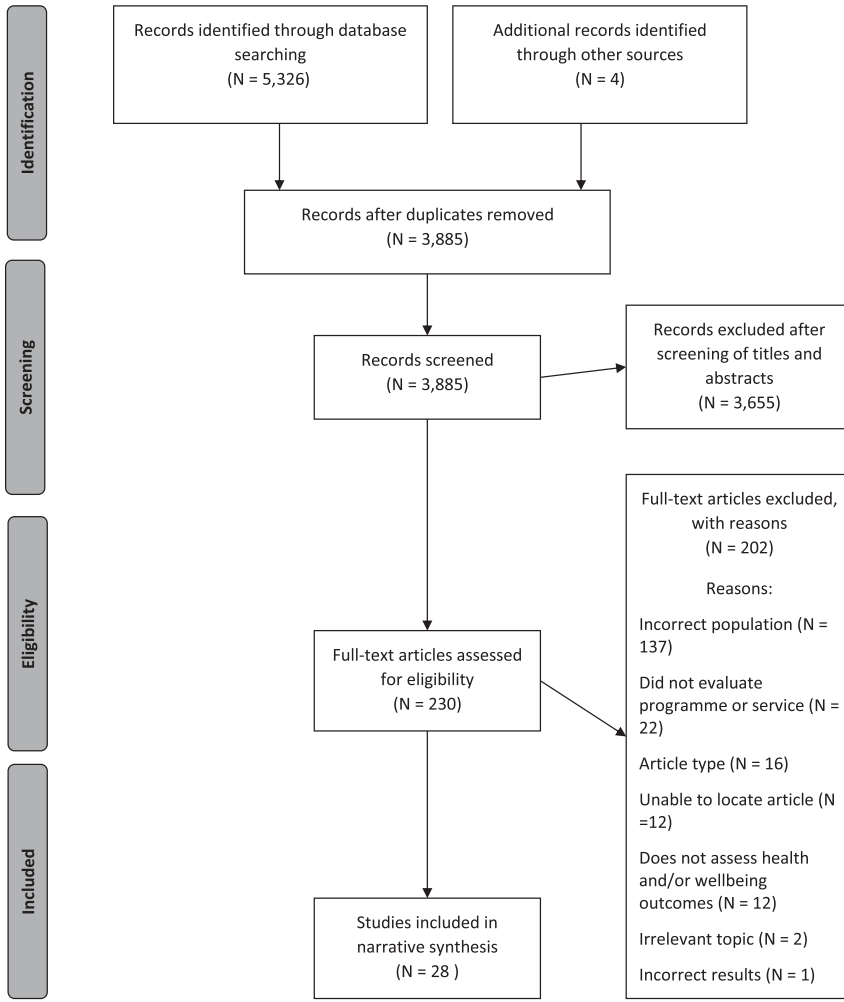

Figure 2. Search results.

We categorised the interventions into two overarching themes: those that were assessed to promote (a) ageing safely in place (N = 17) and (b) psychological and social wellbeing (N = 11).

Ageing safely in place

Studies in this category involved interventions aiming to keep participants living safely in the community setting, falling under two sub-groups: service provision and assistive technology. Studies in this category were predominately delivered in the home to increase accessibility for users.

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Table 3. Characteristics of qualitative studies

Authors, setting and country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Results
Ageing safely in place:				
Lee and Raiz (2015) Suburban Illinois, USA	To examine differences in perceived benefits and recommendations for the home-delivered meals programme between older adults living alone and those living with others	Home-delivered meals. Recipients from 23 service providers	Analysis of secondary data from client satisfaction survey N = 199 Mean age: 79.1 70.4% female	Benefits of programme included food security, better nutrition and the convenience of home delivery. The accessibility, financial benefits and social support provided by the programme were more important to those living alone.
Rose (2006) Phoenix area and Maricopa County, USA	To explore the impact of home-care services on the emotional functioning, wellbeing and cognitive perceptions of housebound elderly individuals living alone in the community	Home-care services. Senior Adult Independent Living Services. Housebound individuals, requiring weekly hands-on assistance with two ADLs/IDLs	Phenomenological case study N = 7 Mean age: 73 85.7% female	Programme influenced life satisfaction, emotional wellbeing and functioning, including: needing reassurance, a connection to others and a sense of control over circumstances; as well as confidence that someone cared for their welfare; that they could live alone relatively independently, while receiving help from their case manager if necessary.
Psychological and social wellbeing:				
Andrews *et al.* (2003) Voluntary sector, Age Concern Buckinghamshire, UK	To examine the opinions of the users of a local home-visiting befriending service	Home-visiting befriending service. • Frail and isolated older people • 1 × 1-hour visit per week Providing undivided attention, emphasis on listening skills	Semi-structured interviews N = 13 Mean age: 86.5 76.9% female	*Initiating and negotiating contact* Most users referred to service by female relatives, neighbours or health professionals, rather than approaching service provider. Commitments of befriender-determined visits. *Combining other services* Befriending service often only one of the services received in the home, however, had greatest social impact due to the voluntary nature and focus on building relationships.

Table 3. (*Continued.*)

Authors, setting and country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Results
				Reliability and compatibility Reliability of befrienders was key, as was good matching. *Intimacy and reciprocity* Majority of relationships were perceived to be close, with reciprocity important. *Doing extra* Befrienders undertook tasks outside their role, suggesting a tension between friendship and befriending service.
Bidonde *et al.* (2009) Mid-sized urban city, Canada	To explore the meaning of a group fitness programme to older women; to understand the group fitness programme, the meaning of these experiences and the role of physical activity	Group fitness programme. Paid, twice weekly × 60 minutes fitness programme for all genders, run by instructors and administered by participants	Hermeneutic phenomenological instrumental case study N = 9 Mean age: 75 All female	*Trading roles* Changing familial roles necessitated a need to find new social networks. *A happier me* Involvement in the programme improved social networks and health. *It's our programme* Participants took pride, responsibility and ownership of the programme to meet their needs. Programme needed to be financially accessible. Access to transport was a challenge to participation.

Notes: ADL: activities of daily living. IADL: instrumental activities of daily living. USA: United States of America.

Table 4. Characteristics of mixed-methods studies

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
Ageing safely in place:					
Ganong *et al.* (2013) Rural adults and support network members, USA	To evaluate an intervention designed to train family members or friends as to how to help older adults who were living alone make plans to maintain independence safely in their homes and to make behavioural and household changes to enhance safety	Training support network members to develop safe household plans for older adults. Support members taught to use multiple segment vignettes in collaboration with older adults over two training sessions (1.5 hours and 1 hour), and created individualised vignettes to use with their older adult, whom they met with to develop a household safety plan	Post-intervention with control group N = 40 dyads (19, 21) Mean age: older adults = 83.05; control = 83.95 Older adults: 89.74% female; control: 98.48% female	*Time-frames* Post-intervention *Outcome measures* Safety, feasibility and thoroughness of plan; behavioural and household changes	*Safety plans* • Safer plans in intervention ($p < 0.10$, Cramer's $V = 0.27$) • 'Extremely safe' plans: intervention (59%); control (29%). Included elaboration, contingencies and redundancies, both human and technological resources; considering their schedules and who would notice any changes, availability and contact with support network, • 'Unsafe' plans: intervention (31%); control (48%). Simple strategies, with no prior planning. *Behavioural and household changes* More changes made by older adults in the intervention group ($p < 0.01$, Cohen's $w = 0.51$); including daily calling plans, alert devices and removing hazards

Table 4. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
Mahoney *et al.* (2009) Three Independent Living Residences, USA	To gain an understanding of the elders, families and staff concerns in Independent Living Residences and to investigate whether remote residential monitoring, using off-the-shelf wireless sensors, might address these concerns	Remote residential monitoring. Automated Technology for Elder Assessment, Safety and Environment (AT EASE) remote home monitoring system. Independent Living Residences. Motion data sent to website; accessible by family member and alerts generated. 4-month minimum trial	Pre- and post-intervention N = 10 dyads Mean age: 83 60% female	*Time-frames* Pre–post *Outcome measures* Emotional health; physical health; system addressed needs; intrusive; substitute for staff; level of concern for relative; level of security; programme satisfaction	*Emotional health*: Significantly different worsening. *Physical health*: Slight worsening. *System addressed needs*: Yes, no change. *Intrusive*: No, no change. *Substitute for staff*: No, no change. *Security*: Categorical drop from a pre-intervention of 'strongly agree' to post-intervention 'somewhat agree'. *Level of concern for relative*: Slight increase. Safely moving around house: 50% to 20%. *Programme satisfaction*: 6/10 found very useful, somewhat useful = 1, not very useful = 2. Recommend to others: 6/10.
Pripfl *et al.* (2016) Living laboratory and households of senior adults, Austria	To develop and evaluate a fully autonomous social support robot able to reduce the risk of falling, to detect falls and handle emergencies in private homes, in particular	Social service robot – 'HOBBIT'. 3-week trial of robot to support older adults in private homes	Field trial and prototype development N = 7 Mean age: 79 85.7% female	*Time-frames* Pre–post *Outcome measures* Attitudes towards robots; perceived safety; qualitative interviews	*Attitudes* Significant change in emotions in interactions with robots ($p = 0.042$). *Perceived safety* No change. *Interviews* Usability negatively influenced by lack of robustness:

	focusing on technology market readiness, utility, usability and affordability under real-world conditions				functionality, processing speed and reliability of features. Based on current costs robot was too expensive to rent or buy.
Stevens (2001) Local agency for senior services, Nijmegen, The Netherlands	To assess an intervention developed to support older women to achieve friendship-related goals	Educational programme on friendship enrichment. • 12 weekly lessons offered to groups of 8–12 women Based on four-stage model on the effect of relational competence in different phases of relationships	During and post-intervention questionnaires and interviews N = 40 Mean age: 63.7 All female	*Time-frames* During and post *Outcome measures* Friendship; loneliness	*Friendship* • 70% made new friends; 35% developing close friendships and 58% developing activity-based friendships. • 48% improved friendships. • Friendships appeared in significantly more circles of the friendship convoy ($p < 0.01$); increase in reporting friends in the inner circle ($p < 0.05$). • More women with a combination of intimate friendships and social friendships. Changes in family relationships and changes related to the self and self-esteem. *Loneliness* Significant reduction in average loneliness ($p < 0.001$), which did not differ significantly between marital or living status.

Table 4. (*Continued.*)

Authors, setting, country	Study aim	Intervention elements	Study design, sample size (intervention, control), age and gender	Time-frames and outcome measures	Results (only significant results reported)
Psychological and social wellbeing:					
Fokkema and Knipscheer (2007) Internet at home, The Netherlands	To evaluate an internet-at-home intervention that intended to decrease loneliness among chronically ill and physically handicapped older adults through introducing them to the use of an electronic communication facility	Internet at home –Esc@pe. • Loaned PC and peripheral equipment for three years • 5 × 2-hour lessons on email and internet use • Support every 2–3 weeks from a home volunteer visitor • Ongoing PC help and maintenance	Pre–post with control N = 26 Mean age: intervention = 66; control = 68. Intervention: 91.7% female; control: 58.3% female	*Time-frames* Baseline (T0), 2 years (T1), 3 years (T2) *Outcome measures* Loneliness: social and emotional	*Loneliness* • Reduction ($p = 0.05$) in overall loneliness over time for intervention. • Social loneliness: no significant decrease. • Emotional loneliness: decrease between T0 and T1 ($p = 0.039$), and T0 and T2 ($p = 0.008$). *Qualitative findings* Internet allowed connection despite poor health, increased self-confidence through new computer competencies and allowed participants to distract from their loneliness by meaningfully passing time on the internet.

Notes: PC: personal computer. USA: United States of America.

Table 5. Performance of studies on the dimensions of access

Study		Dimensions of access					
		Accessibility (location)	Availability (supply and demand)	Acceptability (consumer perception)	Affordability (financial and incidental cost)	Adequacy (organisational factors)	Awareness (communication and information)
Ageing safely in place:							
Ahn *et al.* (2018)	Design	✓	X	✓	X	X	X
	Evaluation	X	X	X	X	X	X
Bly and Kissick (1994)	Design	✓	✓	X	✓	✓	X
	Evaluation	X	✓	X	✓	✓	X
Ganong *et al.* (2013)	Design	X	X	X	X	X	X
	Evaluation	X	X	X	X	X	X
Graham *et al.* (2018)	Design	✓	X	X	✓	X	X
	Evaluation	X	✓	✓	X	X	✓
Graham *et al.* (2017)	Design	✓	X	X	X	X	X
	Evaluation	✓	✓	✓	X	X	X
Graham *et al.* (2014)	Design	✓	X	X	X	X	✓
	Evaluation	X	✓	✓	X	X	✓
Huang *et al.* (2004)	Design	✓	✓	X	X	X	X
	Evaluation	✓	✓	X	X	X	X
Jung and Lee (2017)	Design	✓	✓	✓	X	X	✓
	Evaluation	X	X	X	X	X	X

Table 5. (*Continued.*)

Study		Dimensions of access					
		Accessibility (location)	Availability (supply and demand)	Acceptability (consumer perception)	Affordability (financial and incidental cost)	Adequacy (organisational factors)	Awareness (communication and information)
Lee and Raiz (2015)	Design	✓	X	X	X	X	X
	Evaluation	✓	✓	✓	✓	X	X
Mahoney *et al.* (2009)	Design	✓	✓	✓	X	✓	X
	Evaluation	X	✓	✓	✓	✓	X
Moore *et al.* (2006)	Design	X	X	X	X	X	X
	Evaluation	X	✓	✓	X	X	X
Moore *et al.* (2001)	Design	X	X	X	X	X	X
	Evaluation	X	X	✓	X	X	X
Morgenstern *et al.* (2015)	Design	✓	X	X	X	X	X
	Evaluation	X	X	✓	✓	✓	X
Pripfl *et al.* (2016)	Design	✓	X	✓	✓	X	X
	Evaluation	✓	X	✓	✓	✓	X
Rose (2006)	Design	✓	X	X	X	✓	X
	Evaluation	X	X	✓	X	✓	X
Schmitt *et al.* (2010)	Design	✓	X	X	X	X	X
	Evaluation	X	X	X	X	X	X
Toien *et al.* (2018)	Design	✓	X	✓	✓	X	X
	Evaluation	X	X	✓	X	X	X

Psychological and social wellbeing:							
Andersson (1985)	Design	✓	X	X	X	X	X
	Evaluation	X	X	X	X	X	X
Andrews *et al.* (2003)	Design	✓	✓	X	X	X	X
	Evaluation	✓	✓	✓	X	✓	✓
Bidonde *et al.* (2009)	Design	X	X	X	X	✓	X
	Evaluation	✓	X	✓	✓	✓	X
Calsyn *et al.* (1984)	Design	✓	X	X	✓	X	X
	Evaluation	✓	X	X	X	✓	X
Cheung and Ngan (2000)	Design	✓	X	X	X	X	X
	Evaluation	X	✓	✓	X	X	X
Clarke *et al.* (1992)	Design	✓	X	✓	X	X	X
	Evaluation	X	X	X	X	X	X
Fokkema and Knipscheer (2007)	Design	✓	X	X	✓	X	X
	Evaluation	X	X	X	X	✓	✓
Liu *et al.* (2007)	Design	X	X	X	X	X	X
	Evaluation	X	X	✓	X	X	X
McHugh Power *et al.* (2016)	Design	✓	X	X	✓	X	X
	Evaluation	X	X	X	X	X	X
Stevens (2001)	Design	X	X	X	X	X	X
	Evaluation	X	X	✓	X	X	✓
Zingmark *et al.* (2014)	Design	X	X	X	X	X	X
	Evaluation	X	X	X	X	X	X

Notes: ✓: addressed in study. X: not addressed in study.

Service provision

Seventeen studies addressed ageing in place by providing services to individuals who live alone.

Hospice care. Bly and Kissick (1994) evaluated a demonstration programme that provided home hospice care to individuals living alone in Philadelphia, USA. The service was designed considering all but one of the dimensions of access: with accessibility (provided in home), availability (staffing and service adequacy); affordability (payment sources) and adequacy (admission requirements, functions and continuity of care) addressed. Whilst the acceptability to users was not considered, staff's initial concerns about the service were taken into account. Although the home hospice allowed individuals to receive care and die at home, without compromised safety, evaluation of availability and affordability showed that providing hospice care at home was more costly than regular hospice care, and required greater service intensity, particularly on the part of case managers.

Home-care services. Rose (2006) explored the impact of case-managed home-care services such as domestic assistance and meal delivery to housebound older individuals living alone. Six themes emerged from interviews with seven individuals, including discussions of acceptability and adequacy, with themes such as: needing reassurance, a connection to others and a sense of control over circumstances; confidence that someone cared for their welfare; and that they could live alone relatively independently, while receiving help from their case manager if necessary.

Home nursing. Three studies were designed to be accessible to older individuals living alone by utilising home-visiting nurses. Ahn *et al.* (2018) explored the impact of an eight-week nutritional education and support programme for older adults living alone in Korea. Implemented by home-visiting nurses and dieticians, the intervention was designed to be accessible and acceptable, as an individualised programme delivered in the home and via phone calls. Compared to the control group, significant increases in dietary habits and nutritional knowledge were observed in the intervention group, in conjunction with significant increases in blood levels of protein, iron, and vitamins A and C.

Huang *et al.* (2004) evaluated the efficacy of a home-based nursing programme in the diabetes management of older people living alone in Taipei. Availability was assessed by comparing two different intensities of home-based nursing care visitations (daily and weekly) with a control group. Both the daily and weekly visits showed significant reductions in fasting blood sugar, post-meal blood sugar, haemoglobin A1c, total cholesterol and low-density lipoprotein compared to the control. Although those having daily visits had a significantly greater weight reduction than those with weekly visits, there was no significant difference in diabetes knowledge, depression level or quality of life. Given the results, the authors recommended that although the implementation of daily visits is optimal, given the weekly visits still performed better than the control group, this may be an initial step in improving health and wellbeing in this group where staffing may be limited.

Toien *et al.* (2018) assessed the perceived benefits and opinions of preventive health visits (PHVs) to older people in Norway. These annual visits were designed

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to address multiple dimensions of access; as they were delivered free of charge (affordability) and involved assessing older people's health status and life situation, then providing personalised support (acceptability) including information and referrals to services (awareness). PHVs added to individual's feelings of safety; supported them to live at home and have a good life; and had high ratings of satisfaction and were perceived to be important. Interestingly, those who lived alone felt less supported to stay at home, and felt the service was less important than those living with others, with the authors identifying supporting this group as an area of improvement for the service.

Home-delivered meals. Through investigation of how home-delivered meals are perceived in older adults living alone compared to those living with others, Lee and Raiz (2015) evaluated the accessibility, acceptability and affordability dimensions of access. Both groups identified that benefits of the service included food security, better nutrition and the convenience of home delivery. Accessibility (driven by transportation problems), financial benefits (cost covered by the programme) and support provided by the programme were more important to those living alone than to those living with others. Those living alone provided more varied recommendations to improve the service, including greater variety in meals and meals appropriate for specialised diets.

Adult Day Health Centres. Schmitt *et al.* (2010) investigated the impact of Adult Day Health Centre participation on health-related quality of life. Overall, physical and emotional role scores as measured by the SF-36 (Ware, 1997) improved significantly. Living alone status contributed to physical functioning and mental health at six months, although adjusting for living alone as a factor in predicting quality of life may not completely capture the influence of living alone on this domain. No dimensions of access were addressed in the design or evaluation of the intervention.

At-risk populations. Two studies evaluated the Independent Living Program for Older Individuals Who Are Blind (Moore *et al.*, 2001, 2006), addressing the acceptability and availability dimension of access by examining programme satisfaction and functional outcomes for those living alone or with others.

Moore *et al.* (2006) found that regardless of living situation, participants were similarly satisfied with the quality, timeliness (getting services when needed) and goal achievement resulting from the services. Additionally, differences in living situation had minimal impact on functional outcomes, with those living alone having greater perceived ability to prepare meals and manage housekeeping tasks, while those living with others could access reading materials better.

Examining a different cohort with the same questions, Moore *et al.* (2001) found that those living alone rated the services higher than those living with others, including feeling better able to move confidently around their house, apartment or yard, better able to prepare meals for themselves, better able to manage housekeeping tasks and more in control of making decisions important in their life.

Safe plans. Ganong *et al.* (2013) evaluated an intervention to help older adults remain and enhance their ability to live safely in their home, through training

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their family or friends. Having these support network members use vignettes to help older people develop safe plans led to plans that were safer than the control group. Participants in the intervention group created more 'extremely safe' plans, which included considering their schedules and who would notice any changes, availability and contact with support network, and utilisation of both personal and technological resources. Additionally, significantly more behavioural changes were made by older adults in the intervention group. No dimensions of access were addressed in the design or evaluation of the intervention.

Village membership. Three studies examined the Village model (Graham *et al.*, 2014, 2017, 2018), a consumer-directed, social support, membership organisation that promotes ageing in place and independence. The Village model is designed to be accessible (highly community based), and promote awareness of services through information, advice and referrals.

A retrospective cross-sectional survey of five Californian Villages (Graham *et al.*, 2014) aimed to assess the perceived impact of Village membership on factors associated with the likelihood of ageing in place. The greatest impact was on encouraging social engagement and facilitating access to services. Living status did not affect the impact of the Village on members' social engagement, perceived service and health-care access, perceived health and wellbeing, or self-efficacy and independence.

A 12-month longitudinal analysis of data from seven Californian Villages (Graham *et al.*, 2018) supported these findings, with members reporting significantly greater confidence ageing in place, perceived social support and less intention to relocate after one year in the Village. This was amplified for those living alone, with those living alone significantly more likely to feel they could get the help they needed to stay in their current residence.

Results from a larger cross-sectional survey (Graham *et al.*, 2017) of active Village members from 28 Villages across the USA also identified the greatest impact of membership being social connection and support. Those who lived alone were also significantly more likely to perceive an increase in access to medical care, improved quality of life and improved ability to get to places they need or want to go.

Combined, the accessibility of Villages was seen to be particularly impactful for those living alone.

Assistive technology

Four of the 17 studies addressing ageing safely in place utilised assistive technology and included service robots (N = 1), medical alert devices (N = 1), home monitoring (N = 1) and eHealth monitoring (N = 1). All studies were pilots or trials to establish feasibility, usability, acceptability and functionality of these technology-based interventions with older people.

Service robots. One small study examined the usability and feasibility of developing and implementing a domestic help robot. Pripfl *et al.* (2016) addressed the accessibility, acceptability and affordability dimensions of access by running a three-week trial with their 'HOBBIT' robot. Although the potential functions of the

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robot were positively received by the seven older participants, the reliability and speed of functions resulted in negative views of the usability of the robot. This included lack of complexity of tasks performed, errors, lack of adaptability and responsiveness. Additionally, in part due to these limitations, the robot was seen as a novel toy by many participants. At the current pricing, users in the trial reported a preference for the more affordable option of human home care.

Medical alert devices. Morgenstern *et al.* (2015) investigated the feasibility, acceptability and potential benefits of using medical alert devices on health-related quality of life in older women living alone. The trial could not establish feasibility, due to the inability to recruit sufficient numbers. This was attributed to a lack of adequacy, with participants not having a land-line telephone (a necessity for system installation), or already having a medical alert device. Acceptability was limited. Of the 133 women using the medical alert device, only one intentionally used the device, with nine utilising emergency services without the device. Half wore the device almost all of the time, with 12 per cent never wearing the device. Additionally, the cost of the device was prohibitive for many of the participants, with only 17 per cent planning to keep the device if they had to pay for it. There was no significant improvement in health-related quality of life, anxiety, depression or perceived isolation in the intervention group compared to control.

Home monitoring systems. Mahoney *et al.* (2009) addressed several dimensions of access in a mixed-methods examination of the implementation of remote residential monitoring in Independent Living Residences. The system was designed based on feedback from older residents, relatives, building managers and nurses, taking into account considerations relating to accessibility, availability, acceptability and adequacy. After the four-month trial period, the participants expressed that the system addressed their needs, was not intrusive, but could not be a substitute for care staff. However, compared to pre-intervention, they reported that the system made them feel less secure (strongly agree to somewhat agree). The authors attributed this to the initial positive expectations of participants, coupled with the lack of visual component in the monitoring system. Although the health and wellbeing of the resident participants did not improve and they felt less secure with the system, the family member participants reported being less concerned about the resident's safety around the house after the intervention. Potential price points and associated features were also explored. Overall, the system was positively viewed, however, some felt the system would be more useful for those with poorer health or concerning behaviours.

eHealth monitoring. Jung and Lee (2017) conducted a pilot examining the impact of eHealth self-management for older Koreans living alone. As participants did not have computers or internet at home and spent most of the day at the community centre, the pilot was designed to address accessibility and availability through use of a community-based computer to collect eHealth information, in conjunction with four weeks of in-class education and monthly telephone counselling for 24 weeks. The age and level of adoption of technology were also considered in the design of the intervention, drawing on concerns around acceptability and awareness. The

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eHealth participants showed significant improvement in systolic blood pressure, self-efficacy, self-care behaviours and social support when compared to the control participants.

Psychological and social wellbeing

This category includes interventions designed to address psychological and social wellbeing, including depression, social isolation loneliness and life satisfaction. Interventions included visitor and befriending services (N = 4), group activities (N = 4), online technology (N = 1), case management (N = 1) and reminiscence therapy (N = 1).

Visiting and befriending interventions

Four studies evaluated the impact of visitor and befriending services on older people living alone, with varied findings. Like the services designed to assist individuals to age safely in place, these interventions all were designed to address accessibility by being provided in the homes of participants.

Calsyn *et al.* (1984) compared various modes of weekly friendly visitor programmes on life satisfaction, in a two-part study. Firstly, in comparing face-to-face visiting, phone visiting and no treatment, no differences were found in life satisfaction, with participants' living situation (alone or with others) also having no impact. Although included as a more cost-effective alternative, the phone visiting intervention was found to lack adequacy, with four participants dropping out. The second part of the study looked at two styles of face-to-face visiting, one focusing on engaging with the participant's past personal history and the other being a present-oriented, companionship style. Again, no significant difference was found between these two styles, although a significant effect of living condition was observed, with individuals living with someone increasing their life satisfaction more than those living alone.

In contrast, Cheung and Ngan (2000) found that a six-month volunteer visiting and networking intervention did have a positive impact on older isolated and frail seniors in Hong Kong. Participation in the intervention resulted in a significant decrease in anxiety and significant increase in community knowledge. Additionally, regression analysis identified that having more contact with a volunteer (availability) significantly reduced anxiety, and increased social integration and knowledge about community services; with the perceived helpfulness of the volunteer (acceptability) also increasing social integration and knowledge. However, the intervention did not achieve its aim of improving participant's physical health, which was attributed to volunteers not being trained or skilled in offering medical advice or assistance.

McHugh Power *et al.* (2016) addressed the accessibility and affordability dimensions of access by investigating a novel application of the friendly visitor concept. Peers visited older people who were living alone and socially isolated, to prepare and share a low-cost weekly meal in their home. This parallel RCT assessed self-efficacy, food enjoyment and energy intake, finding that only the improvement in food enjoyment across all four time-points (baseline, 8-, 12- and 26-week follow-up) was significant between groups.

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The remaining study examined befriending services using qualitative methods. Andrews *et al.* (2003) explored the views of older people living alone who used a local home-visiting befriending service. This study addressed the most dimensions of access of all studies included in this review, addressing accessibility, acceptability, adequacy and awareness. Older people primarily became aware of the service and were referred through female relatives, neighbours or health professionals. Although the befriending service was often only one of many received by the older people, it was seen as more acceptable and having the greatest social impact due to the voluntary nature and focus on building relationships. Adequacy and availability of the service were raised as being important to participants, with the reliability of the befrienders, compatibility and reciprocity in the relationship key. Duration and frequency of visits was an important issue. Overall, users felt that the befriending service did ameliorate the effects of social isolation.

Group activities

Interventions utilising group activities were another means of improving social isolation and engagement. Three out of the four interventions in this category targeted only female participants; these studies will be discussed first.

Andersson (1985) investigated the impact of small, accessible, neighbourhood group meetings in older women living alone. Significant increases in social contacts and participation in leisure activities were found, as well as a significant decrease in systolic blood pressure in the intervention group when compared to the control group. However, the decrease in blood pressure was determined by the author to be related to trust developed in the intervention, not a reduction in loneliness.

Bidonde *et al.* (2009) also focused on participation of nine older women through a group fitness programme. One particular theme arising from the qualitative data, 'It's our programme' addressed multiple dimensions of access, outlining how participants took pride, responsibility and ownership of the programme to meet their needs. This included the accessibility of the programme, in that their participation was tied to car access; affordability, with the need for the programme to be financially accessible to people on fixed incomes (annual membership of US $5 and nominal drop-in fee); acceptability in relation to ability- and age-appropriate activities; and adequacy, with the programme taken over by the participants part-way through.

The final female-focused intervention by Stevens (2001) addressed the acceptability and awareness dimensions of access through an educational friendship enrichment programme. The programme was deemed successful by the author in its awareness dimension, managing to attract the intended cohort of lonely women. The majority of participants had made new friends, both close and activity-based friendships. Additionally, the women reported an increased variety of friendships as well as more intimate, trusted friendships. Overall, there was a significant reduction in average loneliness during the year after the intervention. This did not differ significantly based on marital or living status.

In the only group activity study to include both women and men, Zingmark *et al.* (2014) examined three occupation-focused interventions designed to increase leisure engagement and ability in activities of daily living. The three interventions – individual, activity group and discussion group – were compared to a control group.

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Although participants in all groups experienced a decline in activities of daily living and leisure engagement, those involved in the individual intervention and discussion group experienced a decline to a lesser extent at both three and 12 months. However, all effect sizes were small. No dimensions of access were addressed in the design or evaluation of the intervention.

Online technology

Fokkema and Knipscheer (2007) investigated the impact of a three-year, internet-at-home intervention in a population of housebound older adults living alone. A significantly greater reduction in loneliness over time was found for the intervention group compared to the control group. This reduction was particularly evident for emotional loneliness. The internet allowed social connection despite poor health, increased self-confidence through new computer competencies and allowed participants to distract from their loneliness by meaningfully passing time on the internet. Designed to be accessible and affordable through free internet and computer services being provided at home, the intervention was deemed successful at selecting very lonely seniors (awareness), and examining benefits for those with different education levels and consequently different digital sensitivities (adequacy).

Case management

Clarke *et al.* (1992) delivered a case worker-driven intervention in the home to support accessibility, with social support packages tailored to the need of each individual to enhance acceptability. Self-perceived health status was the only outcome measure to show a significantly greater improvement in the intervention group. The authors did note that half the older people in the intervention group declined multiple offers of assistance. This group were more independent, having greater social contact and greater self-perceived health status.

Reminiscence therapy

The remaining study, by Liu *et al.* (2007), addressed the acceptability dimension of access by exploring the effects of reminiscence group therapy for older people living alone in Taiwan. Comparing this group who received ten sessions with a control group who participated in regular group activities for ten weeks, reminiscence group therapy participants had significantly raised self-esteem, lowered loneliness and improved life satisfaction.

Risk of bias

Quantitative studies

Four-fifths of categories for studies using a quantitative design were rated as adequate, with the remaining categories rated as partially adequate, inadequate or not applicable (*see* Table 6). Only two studies considered whether the sample size was adequately powered (Moore *et al.*, 2006; Morgenstern *et al.*, 2015). However, one such study was underpowered (Morgenstern *et al.*, 2015), failing to recruit sufficient participants. In addition, one further study calculated sample size based on feasibility (McHugh Power *et al.*, 2016). Over 90 per cent of the

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Table 6. Assessment of risk of bias: quantitative

	(a)[1]	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
Ahn *et al.* (2018)	++	++	+	++	++	–	NA	NA	+	NS	++	++	–	++	++
Andersson (1985)	+	++	++	++	+	–	+	–	+	NS	++	–	++	++	+
Bly and Kissick (1994)	++	+	+	++	–	NA	NA	NA	+	NS	–	–	–	–	++
Calsyn *et al.* (1984)	+	++	++	–	++	++	–	–	++	NS	++	++	++	++	++
Cheung and Ngan (2000)	++	++	+	++	+	NA	NA	NA	++	NS	+	–	++	+	++
Clarke *et al.* (1992)	++	++	++	+	+	++	++	NA	+	NS	++	+	++	+	++
Fokkema and Knipscheer (2007)[2]	++	++	++	++	++	NA	NA	NA	++	NS	++	++	++	++	++
Ganong *et al.* (2013)[2]	++	+	++	++	++	+	NA	NA	++	NS	+	–	++	++	++
Graham *et al.* (2018)	++	++	++	+	+	NA	NA	NA	++	+	++	–	+	+	++
Graham *et al.* (2017)	++	++	++	+	+	NA	NA	NA	++	NS	++	++	++	++	++
Graham *et al.* (2014)	++	++	++	+	+	NA	NA	NA	++	NS	++	–	++	+	++
Huang *et al.* (2004)	++	++	++	++	++	+	–	NA	++	NS	++	++	+	++	++
Jung and Lee (2017)	++	++	++	++	++	NA	NA	NA	++	NS	++	++	–	++	++
Liu *et al.* (2007)	++	++	++	++	++	+	NA	NA	++	NS	++	++	++	++	++
McHugh Power *et al.* (2016)	++	++	++	++	++	++	++	–	++	Note 3	++	++	++	++	++
Mahoney *et al.* (2009)	++	++	++	++	++	NA	NA	NA	+	NS	–	–	–	+	+
Moore *et al.* (2006)	++	++	++	++	+	NA	NA	NA	+	++	++	++	+	++	++
Moore *et al.* (2001)	++	++	++	++	+	NA	NA	NA	+	NS	++	++	++	++	++
Morgenstern *et al.* (2015)	++	++	++	++	++	++	–	NA	++	–	++	++	++	++	++

Table 6. (*Continued.*)

	(a)[1]	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
Pripfl *et al.* (2016)[2]	++	++	+	+	++	NA	NA	NA	++	NS	++	–	–	+	++
Schmitt *et al.* (2010)	++	++	++	++	++	NA	NA	NA	++	NS	++	++	++	++	++
Stevens (2001)[2]	++	++	+	++	++	NA	NA	NA	++	NS	++	++	+	++	++
Toien *et al.* (2018)	++	++	++	++	++	NA	NA	NA	+	NS	++	++	++	++	++
Zingmark *et al.* (2014)	++	++	++	++	++	++	+	–	++	NS	++	++	++	++	++

Notes: 1. (a) Question/objective sufficiently described? (b) Study design evident and appropriate? (c) Method of subject/comparison group selection or source of information/input variables described and appropriate? (d) Subject and comparison group characteristics sufficiently described. (e) Intervention (description, duration) adequately described. (f) If interventional and random allocation was possible, was it described? (g) If interventional and blinding of investigators was possible, was it reported? (h) If interventional and blinding of subjects was possible, was it reported? (i) Outcome and exposure measured well defined and robust to measurement/misclassification bias? Means of assessment reported? (j) Sample size appropriate? (k) Analytic methods described/justified and appropriate? (l) Estimate of variance. (m) Controlled for confounding? (n) Results reported in sufficient detail. (o) Conclusions supported by the results. 2. Indicates mixed methods. 3. Sample size based on feasibility. ++: yes. +: partial. –: no. NA: not applicable. NS: not stated.
Source: Criteria adapted from Kmet *et al.* (2004).

studies adequately described the research question, had appropriate and evident study design, and had conclusions adequately supported by the results. Approximately three-quarters had appropriate description and processes of subject selection and characteristics, with two-thirds adequately describing the intervention itself with sufficiently defined and robust measures. Only five studies adequately described random allocation (Calsyn *et al.*, 1984; Clarke *et al.*, 1992; Zingmark *et al.*, 2014; Morgenstern *et al.*, 2015; McHugh Power *et al.*, 2016), two had blinding of investigators (Clarke *et al.*, 1992; McHugh Power *et al.*, 2016) and none had adequate blinding of subjects; which is to be expected given the breath of study designs included, the preliminary scope of many studies and the difficulty of blinding to non-pharmacological interventions.

Qualitative studies

Almost two-thirds of the risk of bias categories for qualitative studies were rated as adequate (Table 7). All qualitative studies provided a clear definition of the question and context, which was appropriate for the nominated qualitative study design. All but one connected the study to a theoretical framework or wider body of knowledge (Lee and Raiz, 2015). Nine had an adequate sampling strategy; seven had systematic data collection. All except one study (Ganong *et al.*, 2013) that was mixed-methods particularly lacked rigour in their qualitative components, evident in the systematic data collection and analysis components. All presented conclusions supported by results. Four adequately used verification procedures including multiple data sources (Bidonde *et al.*, 2009), discussion, peer review or multiple coding within the research team (Andrews *et al.*, 2003; Bidonde *et al.*, 2009; Cattan *et al.*, 2011; Ganong *et al.*, 2013) and triangulation of findings (Rose, 2006; Bidonde *et al.*, 2009). Overall, the majority of studies lacked reflexivity, with only one adequately addressing (Rose, 2006) and one partially addressing (Bidonde *et al.*, 2009) this category.

Discussion

Numerous interventions have been developed to optimise health, wellbeing, quality of life and independence for older people living alone in the community; with two key foci, to age safely in place and to enhance psychological and social wellbeing. However, few interventions addressed dimensions of accessibility. This is the first study, to our knowledge, to synthesise the evidence for effectiveness and accessibility of such interventions. To date, research has focused on ageing in place, and psychological and social wellbeing, without explicitly addressing all dimensions of accessibility to services as described by the Theory of Access (Penchansky and Thomas, 1981; Saurman, 2015). These dimensions must be considered alongside the needs and preferences of this population during design, implementation and evaluation of interventions to assist individuals to age in place. Of particular note was the observation that studies of higher quality tended to perform poorly on dimensions of access. This is likely a result of high-quality studies such as RCTs, by their very nature, being restrictive in both their sampling and outcomes examined. The most common types of study included were pilot and feasibility trials, resulting in the low sample sizes and overall poor study quality.

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Table 7. Assessment of risk of bias: qualitative

	(a)[1]	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Andrews *et al.* (2003)	++	++	++	++	++	++	++	++	++	++	–
Bidonde *et al.* (2009)	++	++	++	++	++	++	++	++	++	++	+
Cattan *et al.* (2011)	++	++	+	++	++	++	++	++	++	++	–
Fokkema and Knipscheer (2007)[2]	++	++	++	++	++	+	–	–	–	++	–
Ganong *et al.* (2013)[2]	++	++	++	++	++	++	++	++	++	++	–
Gross *et al.* (2015)[2]	++	++	++	++	++	+	–	+	–	++	–
Lee and Raiz (2015)	++	++	++	+	++	++	++	++	+	++	–
Mahoney *et al.* (2009)[2]	++	–	++	++	++	–	–	–	–	+	–
Pripfl *et al.* (2016)[2]	++	++	+	++	–	+	–	+	–	++	–
Rose (2006)	++	++	++	++	++	++	++	++	++	++	++
Stevens (2001)[2]	++	++	++	++	+	+	+	–	–	++	–

Notes: 1. (a) Question/objective clearly described? (b) Design evident and appropriate to answer study question? (c) Context for the study is clear? (d) Connection to a theoretical framework/wider body of knowledge? (e) Sampling strategy described, relevant and justified? (f) Data collection methods clearly described and systematic? (g) Interview schedule described? (h) Data analysis clearly described, complete and systematic? (i) Use of verification procedure(s) to establish credibility of the study? (j) Conclusions supported by the results? (k) Reflexivity of the account? ++: yes. +: partial. –: no. 2. Indicates mixed methods.
Source: Criteria adapted from Kmet *et al.* (2004).

Two overarching themes emerged from the studies: ageing safely in place, and psychological and social wellbeing. Studies falling under ageing safely in place focused primarily on providing services to individuals living in their homes, and technology aimed at monitoring and assisting individuals who live by themselves. The second theme, psychological and social wellbeing, included a range of interventions involving visiting or befriending, group activities, case management and reminiscence therapies. This theme also included an emphasis on technology through online communication. Although the concepts of living alone, social isolation and loneliness are often used interchangeably throughout the literature (Yeh and Lo, 2004), they are not synonymous, and experiencing one does not necessarily mean the others will occur (Klinenberg, 2016). Evidently, many factors may impact the health, wellbeing and quality of life of those living alone, and consequently their ability to remain living independently in the community.

Despite being a population for which service access is a particular issue, the included studies performed poorly in both design and evaluation of the dimensions of access. The majority of studies addressed only one or two dimensions of access, and focused on the 'user' or 'person' characteristics such as accessibility, acceptability and affordability; almost no studies addressed the 'organisation' characteristics such as adequacy, availability and awareness. This emphasis seemingly suggests an attitude which places the lack of access to services on the individual rather than organisational level, which may exacerbate poor access for vulnerable populations, including older individuals who live alone. This also hampers sustainability of these programmes beyond the research project, as no consideration is given to how the successful interventions and knowledge can be successfully translated into practice within organisations. Of particular concern to successful implementation or rollout is the lack of focus on awareness of services. If the end-users do not know a service exists, despite being a successful evidence-based programme, it is unlikely to make a difference to the target group (Strain and Blandford, 2002; Tang and Pickard, 2008).

Accessibility, in the form of transport, is a significant issue for individuals as they age (Goins *et al.*, 2005; Greaves and Rogers-Clark, 2009; Andonian and MacRae, 2011; Bacsu *et al.*, 2014; Orellano-Colón *et al.*, 2015), however, the only way in which transport was addressed by the included studies was to remove it entirely from the equation by bringing the services or interventions into the home. While this is an admirable way to ensure housebound individuals receive the services they require, some of these individuals would be able to leave the house with assistance. It also raises the question of service providers prioritising accessibility (*i.e.* delivering programmes in the home) over acceptability (*i.e.* is it what the older individuals would prefer?). Further interventions which facilitate appropriate individuals to leave the house should be considered, in line with a wellness and reablement (Department of Social Services, 2015) or intrinsic capacity (World Health Organization, 2017) approach. In addition, assisting individuals to maintain function before becoming housebound is also worth pursuing.

There was a significant emphasis on technology in the included studies. However, there are many barriers to access that were not addressed, such as technical skill, physical limitations, privacy concerns and cost (Coelho and Duarte, 2015; Ofei-Dodoo *et al.*, 2015). This lack of emphasis may be due to the early

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nature of the research that was particularly characteristic of the technological studies, and may improve as the field matures. However, participants in these studies did identify these barriers as reasons why the interventions, such as service robots or home monitoring, were not feasible, usable or accessible in their current state. In addition, while technology provides exciting new opportunities to assist individuals to age in place, we must be mindful of the group for which these interventions are intended, and ensure that they meet the needs, wishes and skills of this group, whilst remaining affordable.

While one-third of the studies used either a qualitative or mixed-methods approach which allowed for the perceptions and experiences of individuals to be explored, and dimensions of access to be more easily evaluated, there was limited evidence of similar participant-focused principles used in the design of interventions. Involving end-users in the design of new services and interventions is vital to ensure that the intervention meets the access needs of users and service providers (Greenhalgh *et al.*, 2016), with one such approach being co-design. Studies which did not consider dimensions of access in the design stage often identified access problems in the evaluation stage, which could have been addressed and prevented before roll-out. The insights about accessibility (or lack thereof) provided by the included qualitative approaches is evidence of the importance of conducting qualitative, observation and multi-level evaluations alongside high-quality quantitative trials, to ensure that there is a meaningful translation of research evidence into practice (Rychetnik *et al.*, 2002). Further, while intervention outcome measures important to service providers are necessary, those receiving the intervention also need to be involved in deciding the measures of success that are important to them. In this way, providers can be sure that they are measuring whether the intervention is actually meeting the needs of the target group. Therefore, further high-quality studies using co-design processes are recommended in this area.

The average age of participants was in the mid-seventies; given increasing life expectancies individuals are living at home for longer (Australian Bureau of Statistics, 2017), necessitating further studies to be conducted in older cohorts, particularly the 'oldest-old' to ascertain if their needs and preferences differ from the younger individuals. In addition, the studies tended to include more women than men – indeed some studies focused only on women – this may be due to higher proportions of women living alone in older age due to factors such as higher life expectancy, alongside social factors such as widowhood and divorce (de Vaus and Qu, 2015*a*). However, the majority of these studies were not designed specifically with or for women despite the overwhelming population.

Conclusion

Older people comprise an increasing proportion of the global population, and generally wish to age in place in the community. This trend will contribute to increasing numbers of older people living alone in the community, for which appropriate services and supports must be available and accessible to maintain independence and optimise wellbeing. Access to services is a considerable issue in this age group, hence the dimensions of access should be used to guide service development. Likewise, end-users should be engaged in service development and

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evaluation. Recommendations for future studies include considering the dimensions of access and incorporating co-creation principles into the service design process for each service to ensure that it is meeting the needs not only of older people living alone, but also the service providers. Finally, robust evaluations built in to such service developments are also strongly recommended.

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