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The effect of complex interventions on supporting self-care among community-dwelling older adults: A systematic review and meta-analysis

Abstract

Background: Self-care is critical to enable community-dwelling older adults to live independently. Complex interventions have emerged as a strategy to support self-care, but their effectiveness is unknown. Our objective was to systematically review their effectiveness on both positive (increased scores in self-rated health, ADL, IADL, quality of life) and negative aspects (increased incidence of falls, fear of falling, hospital and nursing home admission, enhanced depression score), and to determine which intervention components explain the observed effects.

Methods: CINAHL, MEDLINE, British Nursing Index, PsycInfo and Cochrane CENTRAL were searched from January 2006 to October 2016. Randomized controlled trials providing at least two of these components: individual assessment, care planning or provision of information were reviewed. Outcomes were pooled by random effects meta-analysis.

Results: Twenty-two trials with 14364 participants were included with a low risk of bias. Pooled effects showed significant benefits on positive aspects including self-rated health (standardized mean difference [SMD] 0.09, 95% CI 0.01-0.17) and mental subscale of quality of life (SMD 0.44, 95% CI 0.09-0.80) as well as negative aspect of incidence of falls (odds ratio [OR] 0.60, 95%CI 0.46-0.79). There was no significant improvement in ADL, IADL, overall quality of life, fear of falling, reduction in health service utilization, or depression levels. Meta-regression and

subgroup analysis did not identify any specific component or characteristic in complex interventions which explained these effects.

Conclusion: Based on current evidence, supporting self-care in community-dwelling older adults using complex interventions effectively increases the self-rated health, falls, and mental subscale of quality of life.

Keywords: community, older adults, complex interventions, meta-analysis, self-care

Key points:

- Complex interventions can improve the self-rated health, mental subscale of quality of life and fall rate of older adults.
- It is difficult to identify the effective components in complex interventions.
- Further research is required to explore factors that determine adherence to self-care behavior in older adults.

Introduction

Self-care has been defined as an activity that individuals undertake on their own behalf in staying fit, maintaining good health and functioning, and preventing illness, with or without assistance [1-2]. Previous studies have demonstrated that people who were less engaged in self-care tended to have unnecessary health services utilization and psychological distress, such as depression [3-5]. When people are engaged in self-care, and are supported to do so, they are more likely to maintain functional status, improve quality of life, and reduce negative outcomes such as increased disability and hospitalization [3].

Supporting self-care requires a comprehensive approach [3, 6]. Complex interventions, described as containing a combination of several interacting components, can support self-care through identification of physical, psychosocial and environmental problems, development of individual care plans, and provision of information and education [8-12].

Multiple systematic reviews have evaluated the effects of these interventions on the physical functioning of older adults [13-16]; however, the trials included in these reviews are either disease- or hospital-based, and the main focus is on the curative rather than the maintenance aspects of care. Relatively healthy older adults are often excluded from clinical trials and review.

The goal of this review is to answer: 1, what are the effects of community-based complex interventions on maintaining ADL, IADL, quality of life, and preventing fall, fear of falling and subsequent hospitalization in comparison with usual care among community-dwelling older adults? and 2, which study and intervention characteristics explain the observed effects?

Methods

Search strategy

Protocol of this systematic review is available from the authors upon request. We searched CINAHL, MEDLINE, British Nursing Index (BNI), PsycInfo and the Cochrane Central Register of Controlled Trials (CENTRAL) from January 2006 to October 2016. The search strategy used is shown in appendix 1. The online search was supplemented by an extensive hand search of the literature through references identified from retrieved articles.

Selection criteria and outcome measures

Inclusion and exclusion criteria

This review considered randomized controlled trials that intended to support self-care among community-dwelling older adults by using complex interventions in comparison with usual care. The definition of self-care used in this review was associated with concepts of an activity in which individuals take action on their own behalf to promote or maintain health and functioning [1-2]. Studies that focused on disease-specific self-management were outside the scope of this review, since these programs involved disease-specific skill-based training and the support is often delivered after hospital discharge. A complex intervention is defined as containing a combination of several interacting components that include at least two of these components: individual assessment, care planning, or provision of information.

Studies were reviewed that included older adults aged 65 years or over, living independently in their own home, male or female, and with or without chronic diseases. Studies that focused on cognitively or functionally impaired older adults who were unable to perform self-care were excluded.

Outcomes

The outcome measures of interest were divided into positive and negative aspects. For positive aspects, self-rated health, ADL, IADL, and quality of life were measured. For negative aspects,

health service utilization (hospital and nursing home admission), fall (incidence and fear of falling) and depression level were measured. Articles that included at least one of these outcomes were included.

Data extraction and quality assessment

Two authors (KW, JY) worked independently in selecting trials, assessing quality and extracting data. Identified studies were assessed for relevance according to abstract, title and body text. Those identified in the hand search were assessed for relevance on title only. A full report of each relevant study was then retrieved and read in detail to assess whether or not it met the inclusion criteria. Disagreements regarding the extracted data were resolved through discussion.

For each article included in the review, information about the methods (study design, ethics and informed consent), participants (setting, country, reason provided for selection of the intervention community, total number of participants, age, inclusion and exclusion criteria), interventions (name of the intervention, theory, provider, intervention group, control group, duration), and outcomes (outcome, time point, data collector, measurement tool) were extracted. This information was then compared and analyzed.

The potential risk of bias in the included studies was assessed by Cochrane Collaboration's tool for assessing risk of bias according to the Cochrane Handbook for Systematic Reviews of Interventions [17]. Discrepancies were resolved through the discussion between two authors or

consultation with a third author. Contacting the principal researchers to identify and clarify missing information was one way to deal with missing data.

Statistical analysis

Meta-analyses were conducted using Review Manager (version 5.3). We decided to use random-effects meta-analysis a priori due to the foreseeable complexity and multi-component nature of complex interventions. In order to ensure that it was the correct method, the presence of heterogeneity was tested by the standard χ^2 test and the inconsistency index (I^2>50%). The standardized mean differences and their 95% confidence intervals were calculated from post-intervention outcomes for continuous data, while the odds ratio was obtained for dichotomous data. Pooled odds ratios (95% confidence interval) were calculated and a 2-sided *p*-value<0.1 was considered to indicate statistical significance [17].

Publication bias was checked using a funnel plot if there were at least 10 studies reporting the same outcome [17]. Sensitivity analysis was used to test the robustness of the results of the review. The effect of including or excluding trials that showed an unclear or ambiguous definition of interventions or outcomes was examined.

Meta-regression was performed using R (version i386 3.3.2). The factors that were used to explain the between-trial heterogeneity were age, duration, delivery format (home visit, telephone follow-up, both home visit and telephone follow-up, group training, and community center follow-up), provider (single-discipline or multi-disciplinary team), and components of

complex interventions (individual assessment, care planning, provision of information) when the number of trials included was greater than 10 [17].

Results

Results of the search

We identified 22132 publications in our literature search after removing duplicates. 21908 publications were excluded based on title and brief abstract evaluation. 224 publications were assessed for eligibility, 22 of which met our inclusion criteria and were included in our meta-analysis (Figure 1). Consensus between the two independent reviewers was reached in 92% of publications.

Study characteristics

Among the 22 studies, 14364 participants were included, ranging from 40 [37] to 3326 [21], with a median sample size of 320 per study. The mean age of the participants in years ranged from 71 [20] to 86 [39]. Studies were conducted in a mix of countries between 2007 and 2016.

Studies used varying channels, numbers of visits, durations and providers to deliver interventions to community-dwelling older adults. Regarding the delivery channel, 11 (50%) trials used home visits only, 7 (32%) used home visits and telephone follow-up, 2 (9%) used home visits and group training, 1 (4.5%) used group training, and 1 (4.5%) provided visits at a

community center. Participants received an average of 7.7 visits per study. Two studies provided 1 visit per participant [35, 39], and one study provided an average of 49 visits per participant over two years [20]. The duration of the intervention period was reported to be between 6 months and 2 years. 12 (55%) reported an intervention period of 1 year or less, 10 (45%) reported an intervention period of more than 1 year. All of the complex interventions were professionally led. The nurse was the main care provider in 8 studies (36.4%); 7 studies (31.8%) had two providers, and 1 study had a total of five health-care providers, including a nurse, a geriatrician, a dietician, a physiotherapist, and an occupational therapist [22]. A summary of the study characteristics is displayed in table 1 (the full table is available in Age and Ageing online).

Risk of bias in included studies

Agreement between the two independent reviewers was higher than 90% on all aspects of quality assessment of the studies. The identified studies were heterogeneous in quality, though most had low risk of bias. Most studies described the randomization sequence adequately. Three studies [28, 35, 37] did not report the sequence generation, which may have resulted in selection bias.

The most common methodological limitation of these studies was the issue of blinding of participants and the personnel who obtained the outcome measures. Three studies [21, 27, 29] did not blind the participants or the personnel involved in collecting data, but the impact of non-blinding was unclear. Two studies [19, 26] did not provide information on whether the

participants or outcome assessors were blinded. However, presence of fall and health service utilization were not likely to be affected by the subjective reporting of outcome assessors, if any. Biased reporting or assessment may be more influential for outcomes such as activities of daily living and quality of life of participants.

Most studies reported the attrition rate and the method of handling missing data. Five studies [20, 23, 25, 32, 35] reported the drop-out rate but did not mention how to handle missing data. One study [37] used modified intention-to-treat analysis, which excludes participants who are not available for follow-up. All other studies performed intention-to-treat analysis to handle missing data.

The protocol was not found in one study [29]. It is unclear whether all pre-specified outcomes in this study were reported. About half of the studies (41%) were not reported in sufficient detail to judge the risk of other biases. No evidence of publication bias or small study effects was revealed using funnel plots. Sensitivity analysis revealed that the finding was not affected after excluding studies that had higher risk of result bias. Details can be found in table 2.

Quantitative synthesis

The effects of complex interventions on outcomes are shown in Supplementary figure S1 (available in Age and Ageing online).

Positive aspects

Self-rated health

Seven studies (32%) involving 5684 participants included the outcome of self-rated health. The heterogeneity test indicated use of the random effects model (I^2=44%, *p*=0.11). Data showed an overall benefit for community-dwelling older adults in receipt of complex interventions (SMD 0.09, 95% CI 0.01, 0.17, *p*=0.03).

Activities of daily living

Eleven studies (50%), including 4218 participants, evaluated their activities of daily living (ADL) status before –and -after the implementation of complex interventions. These eleven studies were found to be significantly heterogeneous (Chi^2=20.43, I^2=51%, *p*=0.03), thus a random effect model was adopted. A funnel plot did not give any indication of small study effect or publication bias in the studies included in the analysis. The results showed the difference was not statistically significant (SMD 0.04, 95% CI -0.05, 0.14, *p*=0.39). Meta-regression did not identify any effects for age, duration of study, number of visits, delivery modes, settings or providers.

Instrumental activities of daily living

Six studies (27%) out of 22 reported the instrumental activities of daily living status of community-dwelling older adults. As with the previous outcomes, the results of instrumental

activities of daily living were heterogeneous (Chi^2=7.81, I^2=36%, *p*=0.17), and the standardized mean difference was not statistically significant (SMD 0.02, 95% CI -0.09, 0.12, *p*=0.76).

Quality of life

The majority of studies (n=6) used SF-36 to measure quality of life. In a meta-analysis of ten studies (46%) with 7124 participants, the pooled standardized mean difference of the overall score for quality of life was not significantly different (SMD 0.52, 95% CI -0.16, 1.21, *p*=0.13). The results were found to be significantly heterogeneous (Chi^2=147.03, I^2=97%, *p*<0.001), thus sensitivity analysis was used. We excluded two studies [25, 33] from the meta-analysis to eliminate the risk of their direction and magnitude affecting the pooled estimation. The results showed no significant difference between the intervention and control groups (SMD=-0.02, 95% CI -0.17, 0.12, *p*=0.76).

No significant difference was found in the physical subscale (SMD 0.26, 95% CI -0.02, 0.53, *p*=0.06). Inconsistency across studies was high (Chi^2=45.83, I^2=89%, *p*<0.001). A significant standardized mean difference of 0.44 (95%CI 0.09, 0.80, *p*=0.01) was obtained for the mental subscale. High inconsistency was also indicated in this subscale (Chi^2=107.17, I^2=94%, *p*<0.001). For the social functioning subscale, it did not significantly differ between groups (SMD -0.01, 95%CI -0.17, 0.15, *p*=0.89). The I^2 statistics reflected homogeneity among the studies (Chi^2=1.77, I^2=0%, *p*=0.41).

Negative aspects

Falls incidence

Two studies (9%) examined the number of older adults who fell, with one reported a fall rate of 6.2% (intervention, n=562) vs 9.0% (control, n=1300) and the other 32.0% (intervention, n=231) vs 46.5% (control, n=230). The pooled summary statistics were observed as OR=0.60 (95% CI 0.46, 0.79, p<0.001), indicating a significant reduction of 40% in falls in the intervention groups in which complex interventions were used. These two studies had a low risk of bias overall.

Fear of falling

Three studies, including 845 participants, reported fear of falling using the short fall efficacy scale. Fear of falling measures concern about falling in older adults when they have to perform different daily activities, such as bathing and dressing [40]. Consistency across studies was low, with I2=87% (p<0.001). The overall improvement in fear of falling was modest and not statistically significant, with a standardized mean difference of -0.2 (95% CI -0.66, 0.26, p=0.40).

Health service utilization

Hospital admissions

Hospital admissions were reported as the outcome in eight studies (67%), with 4497 participants. Moderate heterogeneity was found among these studies (Chi^2=13.75, I^2=49%,

p=0.06). The number of hospital admissions in complex interventions group and control group participants was 1,038 of 2,273 (45.7%) and 1,044 of 2,224 (46.9%), respectively. No significant difference was found for the number of hospital admissions between groups (OR 0.97, 95% CI 0.80, 1.18, *p*=0.79).

Nursing home admissions

Five studies (23%), including 4188 participants, reported nursing home admissions. This result showed that number of hospital admissions was not statistically different between groups after complex interventions (OR=0.89, 95% CI 0.64, 1.24, *p*=0.49).

Depression

In a meta-analysis of four studies with 1190 participants, the overall depression score in the intervention groups was not significantly different from the control group (SMD=-0.02, 95% CI -0.14, 0.09, *p*=0.72).

Discussion

Based on the findings, it was apparent that complex interventions were potentially effective and beneficial to help prevent negative outcomes such as the incidence of falls, and to increase

positive outcomes such as the self-rated health and mental subscale of quality of life. However, this meta-analysis provided limited evidence of effectiveness in improving ADL, IADL, overall quality of life, fear of falling, and reducing health service utilization and depression levels.

Recent reviews have provided inconsistent findings on the effects of preventive health programs to older adults [41-43]. Interventions that included comprehensive assessment and corresponding health education to community-dwelling older adults did not have significant effect on both positive and negative outcomes including quality of life, mortality, morbidity, and institutionalization [41-42]. In contrast to these findings, negative outcomes such as hospital admission and fall were prevented when the same interventions were applied to older adults who are at risk for hospital admission or in great need of health services [43]. There is evidence that frailty and functional disabilities may benefit more from the potential value of preventive health programs [43].

Our results are similar to those of previous studies, but they differ in some ways. We confirmed that preventive health programs targeting older adults who live in the community but are not necessarily at high risk or who have multi-morbidities do not have significant effects on negative outcomes such as hospitalization. However, since the aim of our review was to examine trials that support self-care for community-dwelling older adults, we stringently included interventions that promoted active engagement in a range of daily activities, such as developing an action plan with concrete activities and strategies, and monitoring adherence to recommendations. This might explain our positive findings in terms of incidence of fall and quality of life.

Although no statistically significant effects were found in terms of physical functioning and hospital utilization, the beneficial effects of self-rated health, the number of falls, and the mental subscale of quality of life were obvious. Our review differed from others in which we selected studies that targeted the positive aspects such as self-rated health and the mental subscale of quality of life, which were not presented in previous reviews. There is evidence to show that poor self-rated health and mental quality of life are associated with functional decline [44-45], increased depression level [46] and mortality rate [47-48]. Individuals with unfavorable measures of these associated factors tend to use less preventive health services [49] and with a higher chance of institutionalization and health care expenses [50]. On the contrary, positive findings of self-rated health and mental quality of life contribute to building confidence in a person to task accomplishment [51]. It has been argued that confidence in self-care behaviors is one of the key factors determining adherence to and compliance with self-care [41, 52]. It is uncertain whether self-care behavior can be maintained when interventions cease. However, studies have shown that interventions can have a sustained effect on self-efficacy, that is, the confidence in one's ability to manage one's own health [53]. Future studies may extend our knowledge of the effectiveness of complex interventions by further analysis of these outcomes, such as self-efficacy, self-competence, and activation level.

One major strength of our review is that we specifically address the care needs of relatively healthy older adults. Many systematic reviews and meta-analyses have targeted frail older adults in the community [54], older adults at risk of hospital admission [16], and those just discharged from hospital [13-15]. The older adults in this review may have had no specific medical problems but encountered health and social issues in the community. Supporting self-

care can eventually help them to age in place. Also, this review showed the beneficial effect of providing complex interventions to these older adults.

Limitations

Because of the limited number of included trials, meta-regression was not performed in most of the outcomes. It was unclear from the included trials which characteristics in the complex interventions were more effective than others to a specific outcome to support self-care in community-dwelling older adults.

Conclusion

Complex interventions are now commonly used and will continue to be promoted as a mechanism for supporting self-care for community-dwelling older adults. Based on the current evidence, these interventions can effectively increase the positive outcomes including self-rated health and mental subscale of quality of life, and reduce negative outcome of fall.

Conflicts of interest

None declared

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Appendix 1 MEDLINE (Ovid) search strategy

Concept 1:

1. exp aged/
2. geriatrics/
3. ((old or older) adj (adult* or people or person* or over 65 or male* or female* or m?n or wom?n or population* or citizen*)).tw.
4. (elder* or old age or ag?ing or advanced age or aged-related or late* life or senior* or geriatr* or retired or gerontology*).tw.
5. health services for the aged/

6. or/ 1-5

Concept 2:

1. (community adj (dwelling or living)).tw.
2. independent living/
3. primary care/
4. primary health care/
5. home care service/
6. community-based.mp.
7. preventive health service/
8. (primary adj (care or service* or clinic*)).tw.
9. or/ 1-8

Concept 3:

1. (health adj (promotion or education)).tw.
2. (Education or participation).hw. or education.tw.
3. (self adj (care or manag*)).tw.

4. exp self care/
5. empower*.tw.
6. geriatric assessment/
7. needs assessment/
8. risk assessment/
9. exp “Outcome and Process assessment (health care)”/
10. or/ 1-11

Concept 4:

1. randomized controlled trial.pt.
2. controlled clinical trial.pt.
3. randomized.ab.
4. (pre test or pretest or (posttest or post test)).tw.
5. random allocation/
6. comparative studies/
7. or/ 1-10

CINAHL & PsycINFO & BNI

Concept 1:

1. aged or geriatrics or older adults or elderly or seniors

Concept 2:

2. community dwelling OR community living OR independent OR primary care OR primary health OR home care services OR home health care OR community based OR preventive health services

Concept 3:

3. health promotion OR health education OR self care OR self manage* OR empower* OR geriatric assessment OR need assessment OR risk assessment OR outcome OR process assessment

Concept 4:

4. randomized controlled trial OR controlled clinical trial OR pretest OR posttest OR random allocation OR comparative stud*

Cochrane Library

community AND assessment AND self care

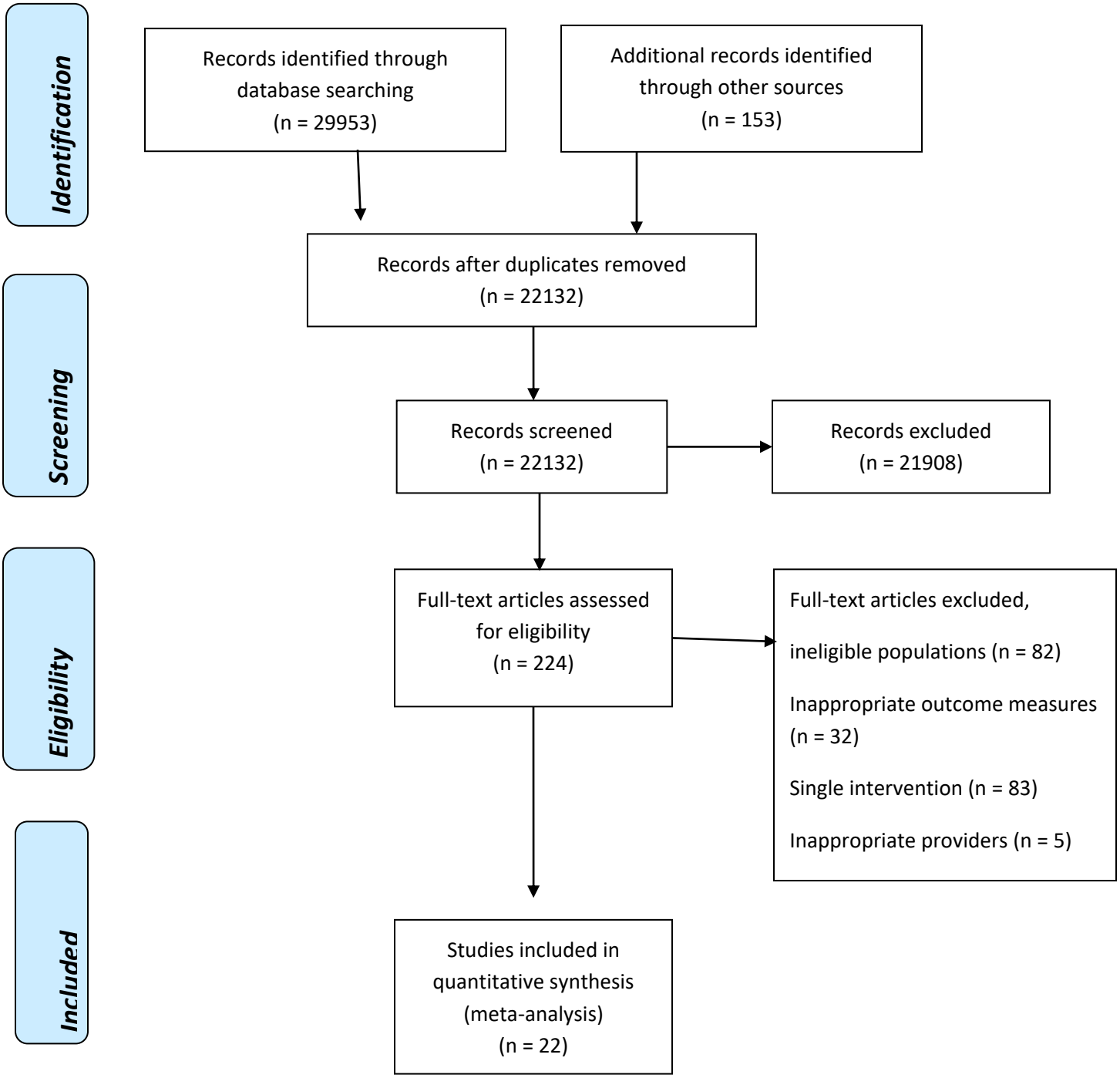


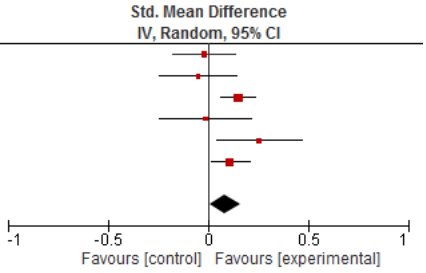
Figure 1 Search result (PRISMA)

Positive aspects

2.1 Self-rated health

Study or Subgroup	Std. Mean Difference	SE	Experimental Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
17 Ploeg 2010	-0.0189	0.0792	328	310	15.9%	-0.02 [-0.17, 0.14]
18 Sherman 2016	-0.0482	0.0985	173	255	11.9%	-0.05 [-0.24, 0.14]
19 Stuck 2015	0.152	0.0444	827	1320	27.3%	0.15 [0.06, 0.24]
2 Bouman 2008	-0.0126	0.117	139	154	9.2%	-0.01 [-0.24, 0.22]
23 Ziden 2014	0.2565	0.1084	345	114	10.4%	0.26 [0.04, 0.47]
4 Dapp 2011	0.1108	0.0497	580	1352	25.2%	0.11 [0.01, 0.21]
Total (95% CI)			**2392**	**3505**	**100.0%**	**0.09 [0.01, 0.17]**

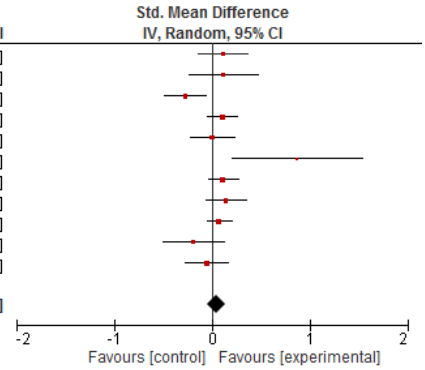
Heterogeneity: Tau² = 0.00; Chi² = 8.94, df = 5 (P = 0.11); I² = 44%
Test for overall effect: Z = 2.13 (P = 0.03)



2.2 Activities of daily living

Study or Subgroup	Std. Mean Difference	SE	Favours [control] Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
11 Li 2010	0.1134	0.1314	131	104	8.0%	0.11 [-0.14, 0.37]
13 Melis 2008	0.1218	0.1822	74	51	5.2%	0.12 [-0.24, 0.48]
14 Metzelthin 2013	-0.2727	0.1087	193	153	9.8%	-0.27 [-0.49, -0.06]
17 Ploeg 2010	0.1061	0.0793	328	310	12.8%	0.11 [-0.05, 0.26]
2 Bouman 2008	0.0044	0.117	139	154	9.1%	0.00 [-0.22, 0.23]
20 Szanton 2011	0.8721	0.3387	24	16	1.8%	0.87 [0.21, 1.54]
22 van Hout 2010	0.1147	0.0785	331	320	12.9%	0.11 [-0.04, 0.27]
23 Ziden 2014	0.1457	0.1081	345	114	9.9%	0.15 [-0.07, 0.36]
3 Counsell 2007	0.074	0.0649	474	477	14.5%	0.07 [-0.05, 0.20]
8 King 2012	-0.189	0.1601	76	81	6.2%	-0.19 [-0.50, 0.12]
9 Kono 2012	-0.0534	0.1113	161	162	9.6%	-0.05 [-0.27, 0.16]
Total (95% CI)			**2276**	**1942**	**100.0%**	**0.04 [-0.05, 0.14]**

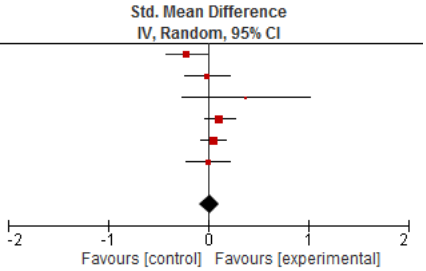
Heterogeneity: Tau² = 0.01; Chi² = 20.43, df = 10 (P = 0.03); I² = 51%
Test for overall effect: Z = 0.86 (P = 0.39)



2.3 Instrumental activities of daily living

Study or Subgroup	Std. Mean Difference	SE	Experimental Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
14 Metzelthin 2013	-0.2132	0.1069	193	162	16.2%	-0.21 [-0.42, -0.00]
2 Bouman 2008	-0.0084	0.117	139	154	14.3%	-0.01 [-0.24, 0.22]
20 Szanton 2011	0.3759	0.3258	24	16	2.5%	0.38 [-0.26, 1.01]
22 van Hout 2010	0.1147	0.0785	331	320	23.5%	0.11 [-0.04, 0.27]
3 Counsell 2007	0.0571	0.0649	474	477	28.1%	0.06 [-0.07, 0.18]
9 Kono 2012	0	0.1113	161	162	15.4%	0.00 [-0.22, 0.22]
Total (95% CI)			**1322**	**1291**	**100.0%**	**0.02 [-0.09, 0.12]**

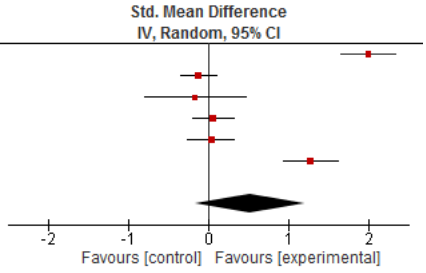
Heterogeneity: Tau² = 0.01; Chi² = 7.81, df = 5 (P = 0.17); I² = 36%
Test for overall effect: Z = 0.31 (P = 0.76)



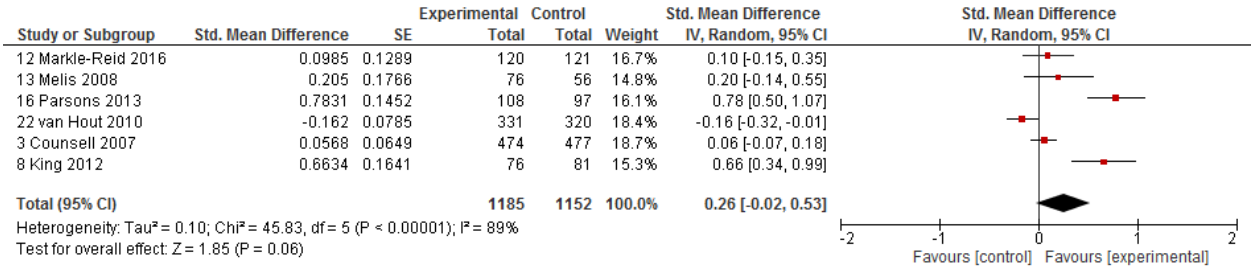
2.4.1 Overall quality of life

Study or Subgroup	Std. Mean Difference	SE	Experimental Total	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
16 Parsons 2013	2.0032	0.1719	108	97	16.8%	2.00 [1.67, 2.34]
2 Bouman 2008	-0.1175	0.1171	139	154	17.2%	-0.12 [-0.35, 0.11]
20 Szanton 2011	-0.1591	0.3233	24	16	15.2%	-0.16 [-0.79, 0.47]
5 Ekdahl 2015	0.0665	0.1291	144	103	17.1%	0.07 [-0.19, 0.32]
6 Godwin 2016	0.041	0.1489	95	86	17.0%	0.04 [-0.25, 0.33]
8 King 2012	1.2795	0.1756	76	81	16.8%	1.28 [0.94, 1.62]
Total (95% CI)			**586**	**537**	**100.0%**	**0.52 [-0.16, 1.21]**

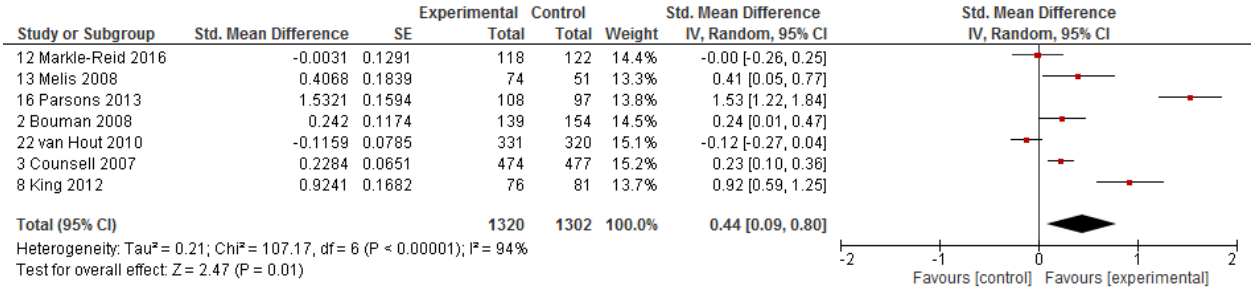
Heterogeneity: Tau² = 0.70; Chi² = 147.03, df = 5 (P < 0.00001); I² = 97%
Test for overall effect: Z = 1.50 (P = 0.13)



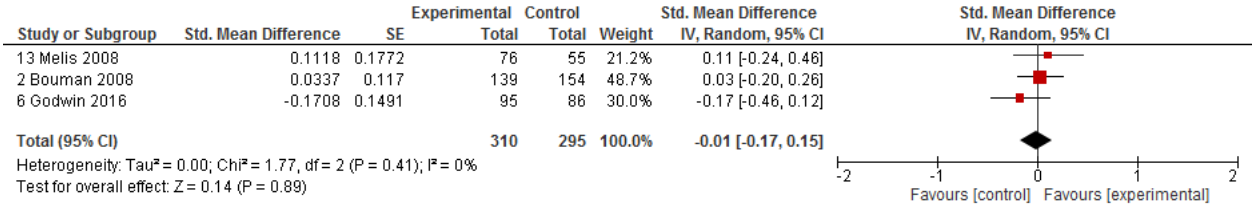
2.4.2 Physical component of quality of life



2.4.3 Mental component of quality of life

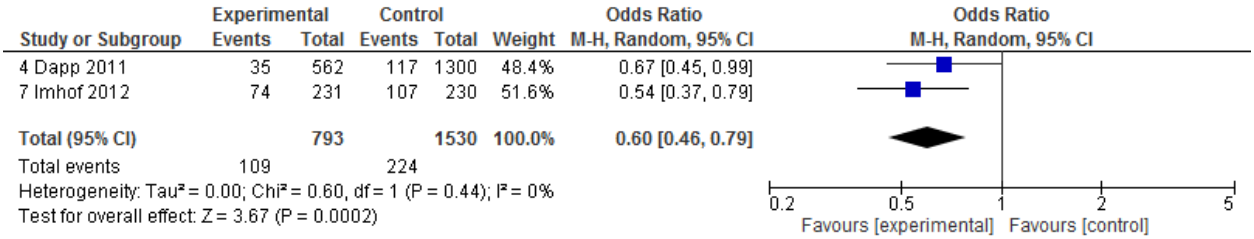


2.4.4 Social component of quality of life

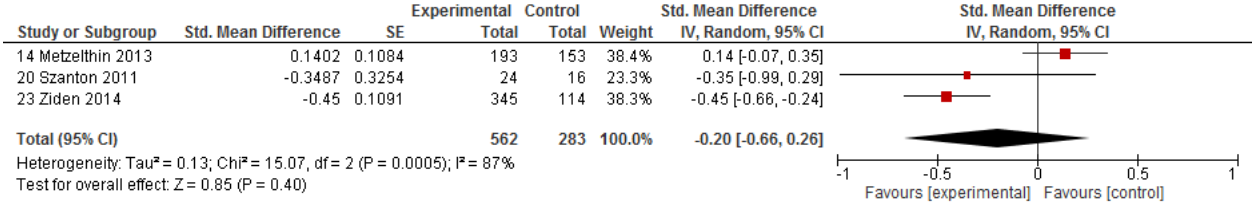


Negative aspects

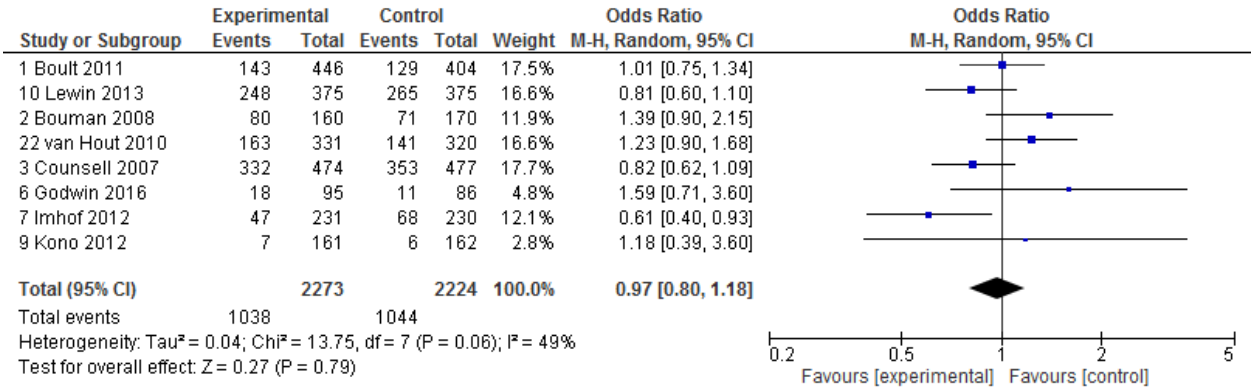
2.5.1 Falls incidence



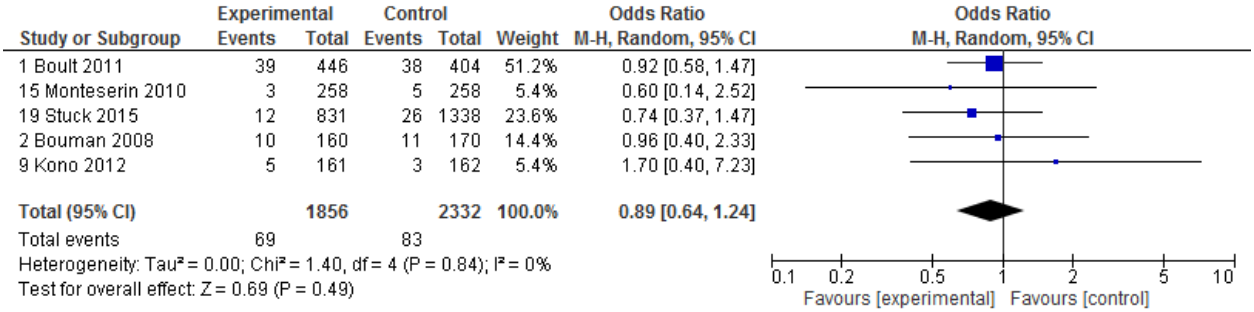
2.5.2 Fear of falling



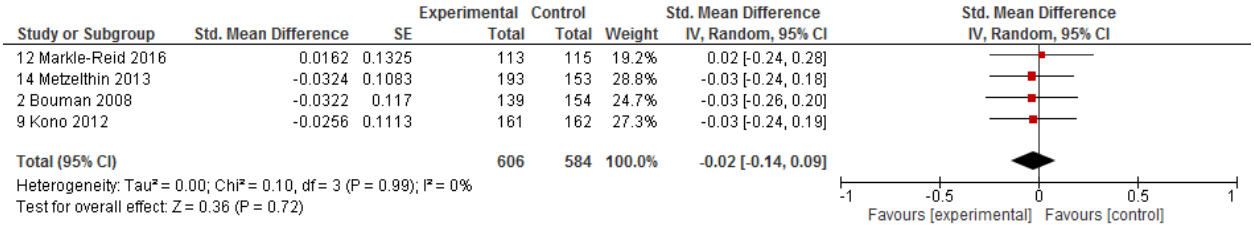
2.6.1 Hospital admission



2.6.2 Nursing home admission



2.7 Depression



Supplementary figure S1 Forest plots showing the effect of complex interventions on different outcomes

Study	Country	Participants	Inclusion/ exclusion criteria	Intervention components	Control group	Providers	Duration	Outcome measures	Results
Boult *et al.* [18]	US	N=904 (I:485, C:419) Mean age: 78	Inclusion: aged 65 and older Exclusion: not mentioned	Assessment, create care plan, promote self-management, case management	Usual care	Registered nurses	2 years	Hospital admission	OR 1.01 (0.75-1.34)
								Nursing home admission	OR 0.92 (0.58-1.47)
Bouman *et al.* [19]	The Netherlands	N=330 (I:160, C:170) Mean age: 76	Inclusion: aged 70-84, home living Exclusion: already received home nursing care, on waiting list for admission to a nursing home	Assess health problems and risks by interview, advice given, case management	Usual care	Home nurses, public health nurse	18 months	Self-rated health	SMD -0.01 (-0.24-0.22)
								ADL	SMD 0.00 (-0.22-0.23)
								IADL	SMD -.01 (-0.24-0.22)
								QOL	SMD -0.12 (-0.35-0.11)
								Mental component of QOL	SMD 0.24 (0.01-0.47)[a]
								Social component of QOL	SMD 0.03 (-0.20-0.26)
								Depression	SMD-

									0.03 (-0.26-0.20)
								Hospital admission	OR 1.39 (0.90-2.15)
								Nursing home admission	OR 0.96 (0.40-2.33)
Counsell *et al.* [20]	US	N=951 (I:474, C:477) Mean age: 72	Inclusion: aged 65 or older, income less than 200% of the federal poverty level Exclusion: residence in a nursing home, severe cognitive impairment	Comprehensive geriatric assessment, develop individualized care plan, case management	Usual care	Nurse practitioner and clinical social worker	2 years	Physical component of QOL	SMD 0.06 (-0.07-0318)
								Mental component of QOL	SMD 0.23 (0.10-0.36)[a]
								ADL	SMD 0.07 (-0.05-0.20)
								IADL	SMD 0.06 (-0.07-0.18)
								Hospital admission	OR 0.82 (0.62-1.09)
Dapp *et al.* [21]	Germany	N=3326 (I:878, C:2448) Mean age: 72	Inclusion: aged 60 years or above Exclusion: not independent, receiving nursing care, cognitive	Comprehensive assessment, computer-generated feedback, check adherence to the	Usual care	Geriatrician, nutritionist, physiotherapist, social worker,	9 months	Self-rated health	SMD 0.11 (0.01-0.21)[a]
								Fall	OR 0.67 (0.45-

			impairment, terminal disease	recommendations		nurses			0.99)[a]
Ekdahl *et al.* [22]	Sweden	N=382 (I:208, C:174) Mean age: 83	Inclusion: 75 years or older, community-dwelling, had 3 or more concomitant medical diagnoses Exclusion: not mentioned	Comprehensive geriatric assessment, home or ambulatory visits, telephone calls, training programs	Usual care	Nurse, geriatrician/ resident physician, municipal care manager, occupational therapist, physiotherapist, dietician, administrative assistant	2 years	Overall QOL	SMD 0.07 (-0.19, 0.32)
Godwin *et al.* [23]	Canada	N=236 (I:121, C:115) Mean age: 86	Inclusion: 80 years or older, cognitively functioning, living independently Exclusion: living in nursing home	Assessment, develop plan with goals, assist in meeting goals	Usual care	Primary care nurse specialist	12 months	Overall QOL Social component of QOL Hospital admission	SMD 0.04 (-0.25, 0.33) SMD -0.17 (-0.46-0.12) OR 1.59 (0.71-3.6)
Imhof *et al.* [24]	Switzerland	N=461 (I:231, C:230) Mean age: 85	Inclusion: aged 80 and older, cognitively competent Exclusion: persons at the end of life or with a major	Comprehensive assessment, develop action plan with concrete activities and strategies	Usual care	Advanced practice nurses	9 months	Fall Hospital admission	OR 0.54 (0.46-0.79)[a] OR 0.61 (0.40-0.93)[a]

			psychiatric diagnosis						
King *et al.* [25]	New Zealand	N=186 (I:93, C:93) Mean age: 80	Inclusion: aged 65 or older Exclusion: severe physical or mental health	Comprehensive assessment set goals, develop individualized support plan	Usual care	Registered nurse	12 months	Overall QOL	SMD 1.28 (0.94-1.62)[a]
								Physical component of QOL	SMD 0.66 (0.34-0.99)[a]
								Mental component of QOL	SMD 0.92 (0.59-1.25)[a]
								ADL	SMD -0.19 (-0.50-0.12)
Kono *et al.* [26]	Japan	N=323 (I:161, C:162) Mean age: 80	Inclusion: aged 65 and older, home living Exclusion: utilize formal long-term care services	Structured multi-dimensional assessments, recommendations given)	Usual care	Community health nurses, care managers, or social workers	2 years	ADL	SMD -0.05 (-0.27-0.16)
								IADL	SMD 0.00 (-0.22-0.22)
								Hospital admission	OR 1.18 (0.39-3.60)
								Nursing home admission	OR 1.70 (0.40-7.23)
								Depression	SMD -0.03 (-

									0.24-0.19)
Lewin *et al.* [27]	Australia	N=750 (I:375, C:375) Mean age: 82	Inclusion: 65 years or older, home living Exclusion: diagnosis of dementia or other neurological disorders, or receiving palliative care, people with complex care needs	Promotion of active engagement in a range of daily activities	Usual care	Physiotherapists, occupational therapists, registered nurses	1 year	Hospital admission	OR 0.81 (0.60-1.10)
Li *et al.* [28]	Taiwan	N=310 (I:152, C:158) Mean age: 79	Inclusion: aged 65 and older Exclusion: bedridden, receiving home care	Comprehensive geriatric assessment, followed by intervention program based on assessment results	Screening evaluation	Nurses, geriatricians	6 months	ADL	SMD 0.11 (-0.14-0.37)
Markle-Reid *et al.* [29]	Canada	N=288 (I:144, C:144) Mean age: 84	Inclusion: aged 75 and older Exclusion: unable to understand English	Health assessment, identifying and managing risk factors for functional decline, providing health education case management	Usual care	Registered nurses	6 months	Physical component of QOL	SMD 0.10 (-0.15-0.35)
								Mental component of QOL	SMD 0.00 (-0.26-0.25)
								Depression	SMD 0.02 (-0.24-0.28)

Melis *et al.* [30]	The Netherlands	N=155 (I:88, C:67) Mean age: 82	Inclusion: aged 70 and older, lives independently Exclusion: cognitive impairment, receiving other related programmes	Nursing assessment, coordination of care, therapeutic monitoring	Usual care	Primary care physician, geriatric specialist nurse	6 months	Physical component of QOL Mental component of QOL ADL	SMD 0.20 (-0.14-0.55) SMD 0.41 (0.05-0.77)[a] SMD 0.12 (-0.24-0.48)
Metzelthin *et al.* [31]	The Netherlands	N=346 (I:193, C:153) Mean age: 77	Inclusion: aged 70 and older, frailty Exclusion: terminally ill, confined to bed, severe cognitive or psychological impairments	Multi-dimensional assessment, treatment plan, motivational interviewing	Usual care	General practitioner and practice nurse, occupational and physical therapists	2 years	Fear of falling ADL IADL Depression	SMD 0.14 (-0.07-0.35) SMD -0.27 (-0.49-0.06) SMD -0.21 (-0.42-0.00) SMD -0.03 (-0.24-0.18)
Montesrin *et al.* [32]	Spain	N=620 (I:308, C:312) Mean age: 80	Inclusion: aged 75 or older Exclusion: concurrent inclusion in	Health promotion, develop individual care plan, disease	Usual care	Nurse	18 months	Nursing home admission	OR 0.60 (0.14-2.52)

			another study, diagnosis of a terminal disease, institutionalization, severe cognitive impairment	prevention and self-care					
Parsons *et al.* [33]	New Zealand	N=205 (I:108, C:97) Mean age: 78	Inclusion: aged 65 and older Exclusion: severe cognitive impairment, living in nursing home	Assessment, goal-setting, develop support plan	Assessment	Home care aides, registered nurses	6 months	Overall QOL Physical component of QOL Mental component of QOL	SMD 2.00 (1.67-2.34)[a] SMD 0.78 (0.50-1.07)[a] SMD 1.53 (1.22-1.84)[a]
Ploeg *et al.* [34]	Canada	N=719 (I:361, C:358) Mean age: 81	Inclusion: aged 75 and older, home living Exclusion: living in nursing home, palliative care	Comprehensive assessment, collaborative care planning, health promotion, and referral to community health and social support services	Usual care	Home care nurses	12 months	Self-rated health ADL	SMD -0.02 (-0.17-0.14) SMD 0.11 (-0.05-0.26)
Sherman *et al.* [35]	Sweden	N=438 (I:176, C:262) Mean age: 75	Inclusion: aged 75 and older Exclusion: not mentioned	Assessment of health, planning, diagnosis of health needs, nursing intervention and	Usual care	District nurses	12 months	Self-rated health	SMD -0.05 (-0.24-0.14)

				evaluation of nursing care					
Stuck *et al.* [36]	Switzerland	N=2284 (I:874, C:1410) Mean age: 75	Inclusion: aged 65 and older Exclusion: disability, cognitive impairment, terminal disease	Health risk assessment, individualized computer-generated feedback reports, nurses and primary care physician counselling	Usual care	Primary care physician, nurse counsellors	2 years	Self-rated health Nursing home admission	SMD 0.15 (0.06-0.24)[a] OR 0.74 (0.37-1.47)
Szanton *et al.* [37]	US	N=40 (I:24, C:16) Mean age: 78	Inclusion: aged 65 and older, cognitively competent Exclusion: currently receiving in-home rehabilitation	Assessment, education, interactive identification of barriers to function with joint discussion of possible retraining and solutions	Reminiscence and sedentary activities of their choice	Occupational therapist, registered nurse, and handyman	6 months	Overall QOL Fear of falling ADL IADL	SMD -0.16 (-0.79-0.47) SMD -0.35 (-0.99-0.29) SMD 0.87 (0.21-1.54)[a] SMD 0.38 (-0.26-1.01)
Van Hout *et al.* [38]	The Netherlands	N=651 (I:331, C:320) Mean age: 81	Inclusion: aged 75 and older, living at home, frail Exclusion: terminally ill, cognitively	Assessment, tailored care plan, nurse visits	Usual care	Community nurses	18 months	Physical component of QOL Mental component	SMD -0.16 (-0.32--0.01)[a] SMD -0.12 (-

			incompetent, living in residential homes, participating in other research projects					of QOL ADL IADL Hospital admission	0.27-0.04) SMD 0.11 (-0.04-0.27) SMD 0.11 (-0.04-0.27) OR 1.23 (0.90-1.68)
Ziden *et al.* [39]	Sweden	N=459 (I:174, C:285) Mean age: 86	Inclusion: aged 80 and older, independent home living, cognitively intact Exclusion: on municipal home help service	Assessed health problems, offered information, health promotion	Usual care	Occupational therapist, physical therapist, nurse (RN), social worker	2 years	Self-rated health Fear of falling ADL	SMD 0.26 (0.04-0.47)[a] SMD -0.45 (-0.66--0.24)[a] SMD 0.15 (-0.07-0.36)

QOL=quality of life, I=intervention group, C=control group, a=statistically significant

Supplementary table 1 Summary of included studies

Study	Participants	Intervention components	Control group	Providers	Duration	Outcome measures
Boult *et al.* [18]	N=904 (I:485, C:419) Mean age: 78	Assessment, create care plan, promote self-management, case management	Usual care	Registered nurses	2 years	Hospital admission Nursing home admission
Bouman *et al.* [19]	N=330 (I:160, C:170) Mean age: 76	Assess health problems and risks by interview, advice given), case management	Usual care	Home nurses, public health nurse	18 months	Self-rated health ADL IADL QOL Mental component of QOL Social component of QOL Depression Hospital admission Nursing home admission
Counsell *et al.* [20]	N=951 (I:474, C:477) Mean age: 72	Comprehensive geriatric assessment, develop individualized care plan, case management	Usual care	Nurse practitioner and clinical social worker	2 years	Physical component of QOL Mental component of QOL ADL IADL Hospital admission
Dapp *et al.* [21]	N=3326 (I:878, C:2448) Mean age: 72	Comprehensive assessment, computer-generated feedback, check adherence to the recommendations	Usual care	Geriatrician, nutritionist, physiotherapist, social worker, nurses	9 months	Self-rated health Falls
Ekdahl *et al.* [22]	N=382 (I:208, C:174) Mean age: 83	Comprehensive geriatric assessment, home or ambulatory visits, telephone calls, training programs	Usual care	Nurse, geriatrician/resident physician, municipal care manager, occupational therapist, physiotherapist, dietician, administrative assistant	2 years	Overall QOL
Godwin *et al.* [23]	N=236 (I:121, C:115) Mean age: 86	Assessment, develop plan with goals, assist in meeting goals	Usual care	Primary care nurse specialist	12 months	Overall QOL Social component of QOL Hospital admission
Imhof *et al.* [24]	N=461 (I:231, C:230) Mean age: 85	Comprehensive assessment, develop action plan with concrete activities and strategies	Usual care	Advanced practice nurses	9 months	Falls Hospital admission
King *et al.* [25]	N=186 (I:93, C:93) Mean age: 80	Comprehensive assessment set goals, develop individualized support plan	Usual care	Registered nurses	12 months	Overall QOL Physical component of QOL Mental component of QOL ADL
Kono *et al.* [26]	N=323 (I:161, C:162) Mean age: 80	Structured multi-dimensional assessments, recommendations given)	Usual care	Community health nurses, care managers, or social workers	2 years	ADL IADL Hospital admission Nursing home admission Depression
Lewin *et al.* [27]	N=750 (I:375, C:375) Mean age: 82	Promotion of active engagement in a range of daily activities	Usual care	Physiotherapists, occupational therapists, registered nurses	1 year	Hospital admission
Li *et al.* [28]	N=310 (I:152, C:158) Mean age: 79	Comprehensive geriatric assessment, followed by intervention program based on	Screening evaluation	Nurses, geriatricians	6 months	ADL

		assessment results				
Markle-Reid *et al.* [29]	N=288 (I:144, C:144) Mean age: 84	Health assessment, identifying and managing risk factors for functional decline, providing health education case management	Usual care	Registered nurses	6 months	Physical component of QOL Mental component of QOL Depression
Melis *et al.* [30]	N=155 (I:88, C:67) Mean age: 82	Nursing assessment, coordination of care, therapeutic monitoring	Usual care	Primary care physician, geriatric specialist nurse	6 months	Physical component of QOL Mental component of QOL ADL
Metzelthin *et al.* [31]	N=346 (I:193, C:153) Mean age: 77	Multi-dimensional assessment, treatment plan, motivational interviewing	Usual care	General practitioner and practice nurse, occupational and physical therapists	2 years	Fear of falling ADL IADL Depression
Monteserin *et al.* [32]	N=620 (I:308, C:312) Mean age: 80	Health promotion, develop individual care plan, disease prevention and self-care	Usual care	Nurse	18 months	Nursing home admission
Parsons *et al.* [33]	N=205 (I:108, C:97) Mean age: 78	Assessment, goal-setting, develop support plan	Assessment	Home care aides, registered nurses	6 months	Overall QOL Physical component of QOL Mental component of QOL
Ploeg *et al.* [34]	N=719 (I:361, C:358) Mean age: 81	Comprehensive assessment, collaborative care planning, health promotion, and referral to community health and social support services	Usual care	Home care nurses	12 months	Self-rated health ADL
Sherman *et al.* [35]	N=438 (I:176, C:262) Mean age: 75	Assessment of health, planning, diagnosis of health needs, nursing interventions and evaluation of nursing care	Usual care	District nurses	12 months	Self-rated health
Stuck *et al.* [36]	N=2284 (I:874, C:1410) Mean age: 75	Health risk assessment, individualized computer-generated feedback reports, nurses and primary care physician counselling	Usual care	Primary care physician, nurse counsellors	2 years	Self-rated health Nursing home admission
Szanton *et al.* [37]	N=40 (I:24, C:16) Mean age: 78	Assessment, education, interactive identification of barriers to function with joint discussion of possible retraining and solutions	Reminiscence and sedentary activities of their choice	Occupational therapist, registered nurse, and handyman	6 months	Overall QOL Fear of falling ADL IADL
Van Hout *et al.* [38]	N=651 (I:331, C:320) Mean age: 81	Assessment, tailored care plan, nurse visits	Usual care	Community nurses	18 months	Physical component of QOL Mental component of QOL ADL IADL Hospital admission
Ziden *et al.* [39]	N=459 (I:174, C:285) Mean age: 86	Assessed health problems, offered information, Health promotion	Usual care	Occupational therapist, physical therapist, nurse (RN), social worker	2 years	Self-rated health Fear of falling ADL

QOL=quality of life, I=intervention group, C=control group, a=statistically significant

Table 1 Summary of included studies

Study	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Boult *et al.* [18]	Low	Low	Low	Low	Low	Low	High
Bouman *et al.* [19]	Low	Unclear	Unclear	Unclear	Low	Low	High
Counsell *et al.* [20]	Low	Unclear	Low	Low	Unclear	Low	unclear
Dapp *et al.* [21]	Low	Low	Unclear	Unclear	Low	Low	High
Ekdahl *et al.* [22]	Low	Low	Low	Low	Low	Low	High
Godwin *et al.* [23]	Unclear	Unclear	Low	Low	Unclear	Low	Unclear
Imhof *et al.* [24]	Low	Low	Low	Low	Low	Low	High
King *et al.* [25]	Low	Low	Low	Low	Unclear	Low	Low
Kono *et al.* [26]	Low	Unclear	Unclear	Unclear	Low	Low	High
Lewin *et al.* [27]	Low	Low	High	High	Low	Low	Unclear
Li *et al.* [28]	Unclear	Unclear	Low	Low	Low	Low	Unclear
Markle-Reid *et al.* [29]	Low	Unclear	High	High	High	Unclear	Unclear
Melis *et al.* [30]	High	Unclear	Low	Low	Low	Low	Low
Metzelthin *et al.* [31]	Low	Unclear	Low	Low	Low	Low	Unclear

Montesserin *et al.* [32]	Low	Low	Low	Low	Unclear	Low	High
Parsons *et al.* [33]	Low	Low	Low	Low	Low	Low	High
Ploeg *et al.* [34]	Low	Low	Low	Low	Low	Low	High
Sherman *et al.* [35]	Unclear	Low	Low	Low	Unclear	Low	Unclear
Stuck *et al.* [36]	Low	Unclear	Low	Low	Low	Low	Low
Szanton *et al.* [37]	Unclear	Low	Low	Low	High	Low	Unclear
Van Hout *et al.* [38]	Low	Low	Low	Low	Low	Low	Unclear
Ziden *et al.* [39]	Low	Low	Low	Low	Low	Low	Low

Table 2 Risk of bias in included studies