Economic assessments of intervention strategies in the prevention of frailty for elderly of 60 years and over living at home: a systematic review

Gilles Kehoua (gilles.kehoua@unilim.fr)
University of Limoges, IFR GEIST, UR Vie-Santé (Aging, Frailty, Prevention, E-Health) Faculty of Medicine of Limoges; University Hospital, Clinical Gerontology HU Pole, F-87042 Limoges

Myriam Le Goff
ITM Atlantique, LATIM (INSERM 1101), M@rsouin, Brest

Caroline Gayot
University of Limoges, IFR GEIST, UR Vie-Santé (Aging, Frailty, Prevention, E-Health) Faculty of Medicine of Limoges; University Hospital, Clinical Gerontology HU Pole, F-87042 Limoges

Marie-Laure Laroche
University of Limoges, IFR GEIST, UR Vie-Santé (Aging, Frailty, Prevention, E-Health) Faculty of Medicine of Limoges; Center for Pharmacovigilance, Pharmacoepidemiology and Drug Information, F-87042

Michel Druet-Cabanac
University of Limoges, IFR GEIST, UR Vie-Santé (Aging, Frailty, Prevention, E-Health) Faculty of Medicine of Limoges; University Hospital, Clinical Gerontology HU Pole, F-87042 Limoges

Achille Tchalla
University of Limoges, IFR GEIST, UR Vie-Santé (Aging, Frailty, Prevention, E-Health) Faculty of Medicine of Limoges; University Hospital, Clinical Gerontology HU Pole, F-87042 Limoges

Research Article

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Abstract

Introduction: The objective was to conduct a systematic review of economic assessment of interventional strategies, in the prevention of frailty in elderly of 60 years and over living at home.

Methods: The keywords were searched in databases such as Pubmed, ScienceDirect, Google Scholar and Embase. Articles published in English and French between 31/10/2010 and 31/12/2021 were included. The CHEERS statement reading grid was used to assess the quality of the studies in terms of economic assessments.

Results: The search had identified nine relevant research studies, including seven randomised controlled trials and two quasi-experimental studies. Of these studies, we classified them into three programs: five studies on frailty screening, three studies on falls prevention and one study on the analysis of drugs and treatments prescribed and delivered. According to the cost-effectiveness plan of these programs, four studies had no conclusion on economic results, two studies had a dominant strategy, less expensive and more efficient, and three studies had a dominated strategy, more expensive and not efficient. Only 40% of the studies were of good quality.

Conclusion: Only two multidimensional and interdisciplinary intervention strategies were highly efficient, cost-effective and improved the quality of life of elderly. Economic results were more mixed. Many methodological weaknesses were present in these studies.

Background

A demographic revolution is underway in the world. According to the World Health Organization (WHO), the absolute number of people aged 60 and over is expected to increase from 901 million in 2015, to 1.4 billion in 2030 and 2.1 billion in 2050, and could reach 3.2 billion in 2100 [1]. Today, a person aged 60 can expect to live, on average, 22 years longer, although there are considerable differences in longevity depending on the social and economic group to which the older people belongs. Worldwide, as in France, aging has a cost and today represents three quarters of social protection expenditure [2]. As people age, there is the appearance of poly medication and geriatric syndromes, malnutrition, memory problems, depression, mental confusion, pressure sores, incontinence, repeated falls and frailty [3, 4]. According to the French Society of Geriatrics and Gerontology, frailty is a clinical syndrome. It reflects a decrease in physiological reserve capacity which alters the mechanisms of adaptation to stress. Its clinical expression is modulated by comorbidities and psychological, social, economic and behavioural factors. The frailty syndrome is a risk marker for mortality and pejorative events, including disabilities, falls, hospitalization and institutionalisation. Age is a major determinant of frailty but does not in itself explain this syndrome [5]. In the absence of a consensual definition, it is measured mainly by two models: the Fried phenotype and the Rockwood index. Fried's phenotype, considered a specific indicator of frailty, is a conceptual model or cycle of frailty, linking together its five dimensions and positioning frailty in relation to disease, functional deficits and external influences [6]. In contrast, the Rockwood model, considered as a global indicator of the health of the elderly, is the accumulation of deficits, and is based on the idea that frailty is measured by the number of age-related health problems, regardless of their nature and severity [7]. Considered as a major challenge of the 21st century, the interest of frailty is based on its roles as indicators of the risk of unfavorable evolution and possible loss of functional independence [8, 9]. Taking charge of the determinants of frailty can reduce or delay its consequences. Thus, the observation of a spontaneous reversibility of frailty, in particular at an early stage, opens a real perspective of preventive interventions, individual or collective, with the objectives of slowing down the evolution towards a polypathological cascade that can lead to death. There are multi-domain frailty prevention programs: cognitive stimulation through games [10, 11], the reduction of falls at home by the effectiveness of technology combined with a monitoring assistance center [12, 13], management and optimization of medications using a connected device for dispensing medication [14] and the WHO program with the launch of the digital application, Integrated Care for Older People whose aim is healthy aging and the prevention of loss of autonomy [15]. Many of these programs evaluated as effective are in the developmental stages, and further research is needed to assess the cost-effectiveness and financial implications. The aim was to perform a systematic review of economic assessment of intervention strategies in the prevention of frailty in elderly of 60 years and over living at home.

Main Text

The process of the systematic review of the literature was based on the approach Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [16], adapted to the systematic review of the literature on economic assessments and structured around three main steps.

Step 1: Patients/Population, Intervention, Comparaison and Outcome (PICO) [17]

We identified the population of interest as the elderly of 60 years and over living at home. Interventional strategies for the intervention group can be interdisciplinary in the prevention of frailty, by a personalized care plan or by adapted digital tools or mixed, compared to usual care for

the comparator group. The different global geriatric assessments were used followed by comprehensive economic assessments.

Research strategies

We have used all the terms associated with the PICO elements. The keywords were: « frailty » AND « qaly » OR « cost-effectiveness analysis » OR « cost-utility analysis » OR « personalized care plan » OR « e-health » OR « elderly » OR « community-dwelling » OR « intervention ». The research strategy was carried out from 31/10/2010 to 31/12/2021 on the databases: Pubmed, ScienceDirect, Google Scholar and Embase. The lower limit of 2010 was chosen in consultation with the authors. We manually searched the references of all identified systematic reviews, as well as the included studies to identify other potentially relevant articles.

Inclusion criteria

The studies included should meet the following criteria: elderly of 60 years and over living at home, prevention of frailty, identification of an interventional strategy to optimise the use of adapted digital tools (allowing to measure or transmit parameters remotely, organizational solution for data analysis for remote medical monitoring of the elderly as well as the organization and management of alerts and interactive system for personalized interactions between health professionals and the elderly), or support through a personalized or mixed care plan and complete economic assessments. Cost-effectiveness assessment methods for estimating efficiency, as well as analyzes for estimating a cost differential and a health outcome differential between several compared interventions were included. Original articles published in French and English (the languages spoken and understood by the authors), and mainly randomized controlled trials (RCT), quasi-experimental studies and cohort studies were included. These studies were chosen to avoid bias, based on their levels of scientific proof in the literature. A grade A recommendation was based on scientific proof established by studies with a high level of proof. In contrast, a grade B recommendation was based on a scientific presumption provided by studies of intermediate level of proof. Only grade C recommendation studies based on lower level of proof studies were excluded.

Non-inclusion criteria

Elderly under of 60 years and not living at home (accommodation establishments for the dependent elderly are nursing homes and these residents need help and care everyday) were excluded. Studies without clear and precise interventional strategies were excluded. Lack of complete economic assessments, economic assessments based on grade C recommendation studies and economic assessments based exclusively on cost studies without comparison were excluded. The use of adapted digital tools in health that were not in the domain of frailty prevention was excluded. Studies of low methodological quality were excluded.

Selection of studies

The first phase was to identify the articles to be included for a complete review. First, one of the authors (KG) removed all duplicates from the list. Then, fine authors analyzed the titles and abstracts (CG, MLL, MLG, MDC and AT). Finally, each author indicated if an article should be included or excluded using the criteria defined above. In case of discrepancies, the authors worked together to reach a consensus on the list of articles. The second phase allowed the authors to read the articles in their entirety and independently to validate their inclusion. If, after complete reading, the article met any of the non-inclusion criteria, it was immediately excluded and deleted, and then the reason for this exclusion was noted. If it happened that several articles covered the same intervention, we selected the most relevant according to the study objectives, inclusion and non-inclusion criteria, and was generally the most recent. For systematic reviews and included articles, we manually went through the reference list.

Step 2: Assessment of the quality of the studies according to the recommendations: Consolidated Health Economic Evaluation Reporting Standards (CHEERS) Statement

The CHEERS reading grid was used to assess the quality of the studies in terms of economic assessments [18]. This grid is composed of 24 items and identifies four levels of quality (Jiang, Ming, and You 2019), excellent quality level (score of 100%), good quality level (score from 76–99%), moderate quality level (score from 51–75%) and low-quality level (score ≤ 50%). Three authors (GK, MLG and AT) independently assessed each article. Disagreements on score levels were discussed and validated. Study quality scores were calculated for all published economic assessments according to the CHEERS statement. The distribution of study quality assessments was presented in Table 1.

Table 1
Study quality scores according to the CHEERS statement

Quality level	Number of studies	% of items meeting the criteria for an economic assessments study
Excellent quality (100%)	0	0
Good quality (76%-99%)	4	40%
Moderate quality (51%-75%)	5	50%
Low quality (≤ 50%)	1	10%
Total	10	100%

Step 3: Synthesis of the extraction of the results of the selected studies

Data extraction

One of the authors (KG) proposed to all authors (MLG, CG, MLL, MDC and AT) a list of categories containing variables extracted from the studies.

For overall study characteristics, we extracted: first author, country, year of publication, country, study design, intervention group and comparator sample sizes, intervention group and the comparator descriptions, outcomes and measures. For the complete economic assessments data, we extracted: time horizon, perspective, cost assessment, incremental cost-effectiveness ratios (ICER), economic methods, economic results and sensitivity analysis.

Quality control

The three steps described above have been independently double-checked by KG and MLG.

Results

Assessment according to CHEERS statement

No study met all 24 items of the CHEERS. Of the ten studies included in our review (Fig. 1), four studies (40%) were considered to be of good quality [19–22], five studies (50%) considered to be of moderate quality [23–27] and one study (10%) considered to be of low quality [28]. The latter was not included in this systematic literature review. So we included nine studies in our review (Table 1).

Overall characteristics of the studies

Of the nine included studies, seven studies were RCT and two quasi-experimental studies. They were carried out in Europe, including three in the United Kingdom, one in Finland, four in the Netherlands and one in Spain. Sample sizes ranged from a minimum of 191 participants to a maximum of 12,488 participants. Of these studies, five mentioned having no conflict of interest, and four did not mention any. For three studies, their funding sources were public funding (public enterprises), two studies had public-private funding and one study was funded by the European Union. In contrast, three studies did not mention their funding. According to the publication dates of the studies, three studies were published in 2019, four studies of which two were published in 2010 and two in 2017, one study published in 2018 and one study published in 2020. The interventional strategies identified in each of the studies allowed us to classify them into three programs. Frailty screening included five studies [19, 22, 24, 25, 27]. Frailty screening predicted the risk of loss of autonomy, falls, institutionalization, death and hospitalization of elderly of 60 years and over, within 1 to 3 years. The prevention of falls included three studies [20, 23, 26]. Accidental fall is defined as falling to the ground unexpectedly uncontrolled by will. Many extrinsic, behavioural or environmental factors are involved in the genesis of a fall and its possible traumatic consequences. Standard fall prevention measures must always be personalized, taking into account the dangers of the environment, the behaviour and the reaction capabilities of the person concerned. The analysis of drugs and treatments prescribed and dispensed included a study [21]. Prescription analysis is a structured and continuous expertise of the patient's therapeutics, their modalities of use and the patient's knowledge and practices. Its objective was to obtain an optimization of the efficacy and safety of therapeutics, as well as a costs minimization and optimal pharmacoadherence. All three programmes were carried out with multidimensional and interdisciplinary approaches. The multidimensional approach aimed to assess all the physical, affective and social functions as well as the environment of the elderly. On the other hand, the interdisciplinary approach took advantage of the specific skills of the various health professionals, physiotherapists, occupational therapists, nurses (at home, in the general practitioner's office and with geriatric expertise), social workers, general practitioners (GPs), geriatricians and pharmacists, implying close and coordinated collaboration

with the aim of achieving the common objectives co-established with the elderly and her entourage. The overall characteristics of included studies are in Table 2.

Table 2
Overall characteristics of included studies

First author, year of publication, country	Design study /Sample size	Intervention group (IG)	Comparator group (CG)	CHEERS (%)
Irvine et al. [23]. United Kingdom	Pragmatic RCT. n = 364 (IG = 181 vs CG = 183).	Multidisciplinary falls prevention program, including physiotherapy, occupational therapy, nurse, medical review and referral to other specialists.	Usual care	71
Kehusmaa et al. [27]. Finland	RCT. n = 741 (IG = 376 vs CG = 365). 86% of women.	Geriatric rehabilitation program among olders with progressively decreasing functional ability, and risk of institutionalization within 2 years. Comprehensive geriatric assessment + received an individualized plan in order to support their capacity for independent living, by a multidisciplinary team (physician, physiotherapist, social worker, occupational therapist).	Usual care	69
Vestjens et al. [19]. The Netherlands	Quasi-experimental design. n = 464 (IG = 232 vs CG = 232). 72.4% of women.	Finding and Follow-up of Frail older persons (FFF) integrated primary care approach : proactive frailty screening, multidisciplinary consultation (General practitioner “GP”, practice nurse, homecare nurse, elderly care physician, geriatric nurse, frequently involved physiotherapist, occupational therapist and/or social worker), individualized care plan (practice nurse, geriatric nurse, or homecare nurse), medication review (GP, pharmacist, or elderly care physician) and multidisciplinary follow-up.	Care as usual	83
Xin et al. [20]. United Kingdom	RCT. n = 474 (IG = 238 vs CG = 236).	PDSAFE is an individually-tailored, physiotherapist-delivered, balance, strength and strategy training program aimed at preventing falls among elderly with Parkinson’s.	Usual care	83
Van der Heijden et al. [21]. The Netherlands	Cluster-RCT. n = 216 (IG = 106 with 48.1% of women vs CG = 110 with 56.4% of women).	Pharmacists were instructed to conduct a clinical medication review: a medication analysis, treatment analysis, patient interview and counseling, listing all drugs prescribed and dispensed during the 6 months preceding the date of discharge (including those prescribed by the hospital and used at discharge) were printed.	Usual care	79
Turner et al. [24]. United Kingdom	Two-arm RCT. n = 12,483 women (IG = 6233 vs CG = 6250).	SCOOP is an evaluation of screening, via their GPs, aimed at identifying older women at increased risk of frailty fractures.	Usual care	73
Suijker et al. [22]. The Netherlands	Cluster RCT. n = 2283 (IG = 1209 vs CG = 1074). 65.2% of women.	To identify and treat geriatric problems (on somatic, psychological, functional and social domains), including a physical examination and performance tests to identify conditions such as urinary incontinence, memory problems, increased risk of falling, and loneliness) in an early stage. Comprehensive geriatric assessment, an individually tailored care and treatment plan consisting of multifactorial interventions, and nurse-led care coordination with multiple follow-up home visits.	Usual care	81
Bleijenberg et al. [25]. The Netherlands	Single-blind, 3-armed, cluster-RCT. n = 3092 Arm 1 = 790; Arm 2 = 1446; Arm 3 = 856). 55.3% of women.	Arms 1 (Frailty Screening + GP Care): frailty screening by of a software application to identify patients at risk for frailty with routine electronic medical record (EMR). Arms 2 (Frailty + Nurse-Led Care): frailty screening for patients, who were identified as frail, was followed by the nurse-led care intervention, trained to deliver this proactive: a home-based Comprehensive Geriatric Assessment, followed by evidence-based care planning, care coordination and follow-up.	Arms 3 (Usual Care)	73

First author, year of publication, country	Design study /Sample size	Intervention group (IG)	Comparator group (CG)	CHEERS (%)
Alhambra-Borrás, Durá-Ferrandis, and Ferrando-García [26]. Spain	Quasi-experimental design. n = 191 (IG = 55 vs CG = 136). 73.2% of women.	The physical exercise program was a multicomponent intervention including both balance and strength training to prevent falls and frailty by individual assessments carried out at each participant's home.	Usual care	73

Economic assessments

The methodological choices of complete economic assessments have made it possible to compare the differentials in costs and health outcomes of one or more health intervention strategies. Cost-effectiveness analysis (CEA) was implemented in four studies [21, 23, 26, 27]. Cost-utility analysis (CUA) was implemented in two studies [20, 24]. CEAs and CUAs were implemented in three [19, 22, 25]. Regarding the perspective of the assessment, it was mostly restricted to institutions in charge of funding the health system for five studies. The time horizon of the assessment implemented was approximately one year for seven studies, nine months for one study and 5 years for another study. For one study, the costs and results have been actualized (≥ 12 months). The cost-effectiveness plans of these three programs described above classified the studies as dominant strategies or dominated strategies. Four studies had no conclusion on economic results: screening for frailty in elderly women at increased risk of frailty fractures [24], analysis of drugs and treatments prescribed and dispensed [21], fall prevention with balance and strength training in elderly with Parkinson's disease [20], and fall prevention among elderly at high risk of falling [23]. Two studies had a dominant strategy, less expensive and more effective: screening for frailty among elderly at risk of frailty using the routine electronic medical record [25] and fall prevention through balance and strength training physical exercises [26]. Three studies had a dominated strategy, more expensive and not efficient: screening for frailty in elderly with progressively declining functional capacity who are at risk of being institutionalized within two years [27], screening and follow-up for frail elderly [19] and multi-domain frailty screening to treat geriatric problems (in the somatic, psychological, functional and social domains) [22]. The economics results are in Table 3.

Table 3
Economic assessments characteristics

First author, year of publication, country	Time horizon	Perspective	Costs	Outcomes and measures	ICER	Economic methods	Economic results	Sensitivity analysis
Irvine et al. [23]. United Kingdom	12 months	National Health Service (NHS) and personal social services.	IG = £ 1,495 (£ 278–9,015) vs CG = £1,045 (£ 16–5,667).	Modified version of the FRA Tool [29].	ICER incremental cost per fall averted = £ 3,118.	CEA	No conclusion on economic results	Bootstrapping
Kehusmaa et al. [27]. Finlande	12 months	Social Insurance Institution of Finland	IG = 13486 € (95%CI 12281 to 1469) vs CG = 10375 € (95%CI 8917 to 11834).	HRQol using the 15D score [30], FIM ™ [31].	ICER (FIM™) = 3,457 € CI Empirical estimate for CI based on bootstrapped data (650–12,340). ICER (HRQoL 15D) = −3,111,000 with ICER CI Empirical estimate for CI based on bootstrapped data (3,269,000 to 3,576,000).	CEA	Dominated strategy, more expensive and not efficient.	Bootstrapping
Vestjens et al. [19]. The Netherlands	12 months	Health care system in the Netherlands	IG = 9182.42 € ± 11,754.75 vs CG = 7717.72 € ± 9824.92.	EQ-5D health states using the Dutch EQ-5D tariffs [42–44], SPF-ILs [45], TFI [33, 34].	Using the imputed dataset, estimated differences in effectiveness and costs were both in favor of usual care, producing an ICER of −14,788 euros per SPF-ILs point and an ICUR of −126,711 euros per QALY.	CEA / CUA	Dominated strategy, more expensive and not efficient.	Nonparametric bootstrapping (percentile method).
Xin et al. [20]. United Kingdom	12 months	UK NHS and Personal Social Service	IG = £ 4020 (95%CI £ 3531 to £ 4510) vs CG = £ 3095 (95%CI £ 2694 to £ 3496) with an incremental cost of £ 925 (95%CI £ 428 to £ 1422).	EQ-5D-3L instrument [43] and QALY where the change between the two assessment points was assumed to be linear [41].	ICER was £ 120,659 per QALY gained.	CUA	No conclusion on economic results	Bootstrap and the probabilities.
Van der Heijden et al. [21]. The Netherlands	12 months	Societal	IG = 5450 € ± 1035 vs CG = 3796 € ± 437, Δ costs 1654 € (95% CI -520 to 3828).	DRPs using the Pharmaceutical Care Network Europe DRP - score form [32].	ICER for improvement in DRP = 8270 €.	CEA	No conclusion on economic results	Bootstrapping

First author, year of publication, country	Time horizon	Perspective	Costs	Outcomes and measures	ICER	Economic methods	Economic results	Sensitivity analysis
Turner et al. [24]. United Kingdom	5-year time period	UK NHS	With whole sample, IG = £ 968 vs CG = £ 900, difference 68 (95%CI -21 to 157). With complete case analysis, IG = £ 833 vs CG = £ 728, difference 104 (95% CI 8 to 201).	QALY assessed using the 3-level EQ-5D [42].	ICER (cost per QALY - Imputed) = £2,772 with incremental effect of 0.0237; ICER (osteoporotic fracture prevented) = £4,478 with incremental effect of 0.0146; ICER (hip Fracture prevented) = £7,694 with incremental effect of 0.0085.	CUA	No conclusion on economic results	ICERs estimated were more than double those estimated from the full data sets.
Suijker et al. [22]. The Netherlands	12 months	Healthcare	IG = 7012 € ± 508 vs CG = 5609 € ± 364 with unadjusted mean difference in costs 1338 € (95% CI 332 to 2514).	Modified Katz-ADL index score [46], EQ-5D-3L [42], the Dutch EQ-5D-3L tariff which was based on a sample of the Dutch general population [44] and ISAR-PC [47].	CEA: ICER for the modified Katz-ADL index was 21,884 €; CUA: ICER for QALYs was 287,879 €.	CEA / CUA	Dominated strategy, more expensive and not efficient.	Bootstrapping
Bleijenberg et al. [25]. The Netherlands	12 months	Societal	Frailty screening plus standard GP care arm = 6651 € ± 14,686 frailty screening plus nurse-led care arm = 6825 € ± 11,452 and usual care = 7601 € ± 15,717.	GFI [48] and EQ-5D instrument (application of Dutch EQ-5D tariff to calculate mean utility values for the different health states derived from the EQ-5D responses) [43, 49].	Frailty screening intervention followed by standard GP care resulted in a cost saving of 951 € (95%CI -2545 to 477) and a QALY loss of 0.0047 (95% CI -0.0266 to 0.0162) compared to CG. Frailty screening plus nurse-led care intervention was compared to CG, cost savings of 776 € (95%CI -2025 to 350) and a QALY gain of 0.0063 (-0.0112 to 0.0243) were generated.	CEA/CUA	Dominant strategy, less expensive and more efficient.	Bootstrapping

First author, year of publication, country	Time horizon	Perspective	Costs	Outcomes and measures	ICER	Economic methods	Economic results	Sensitivity analysis
Alhambra-Borrás, Durá-Ferrandis, and Ferrando-García [26]. Spain	9 months	Healthcare	IG = 1615.02 € vs CG = 1630.22 €. While for those in deteriorated state: IG = 3130.96 € vs CG = 9030.13 €.	TFI [33, 34], GARS [35], Spanish version ASA-R [36], FES-I [37], SF-12 Health Survey [38] and SPPB [39].	Incremental costs (Healthcare) = − 44,832.92 €; Incremental effects = 0.513.	CEA	Dominant strategy, less expensive and more efficient.	None

Effectiveness assessments

In CEA, health outcomes were assessed on the basis of different specific criteria, modified version of the Falls Risk Assessment (FRA) Tool [29] for the work of Irvine et al. [23], Health-Related quality of life (HRQol) using the 15D score [30], Functional Independence Measure (FIM ™) [31] for the work of Kehusmaa et al. [27], Drug-Related Problems (DRPs) were categorized using the Pharmaceutical Care Network Europe DRP-score form [32] for the work of van der Heijden et al. [21] and Tilburg Frailty Indicator (TFI) [33, 34], Groningen Activity Restriction Scale (GARS) [35], Spanish version Appraisal of Self-care Agency Scale-Revised (ASA-R) [36], Falls Efficacy Scale-International (FES-I) [37], Short Form-12 (SF-12) Health Survey [38], Short Physical Performance Battery (SPPB) [39] for the work of Alhambra-Borrás, Durá-Ferrandis, and Ferrando-García [26]. In CUA, health outcomes were assessed on the basis of different specific criteria, EQ-5D-3L instrument [40] and Quality-adjuted life year (QALY) where the change between the two assessment points was assumed to be linear [41] for the work of Xin et al. [20] and QALY assessed using the 3-level EQ-5D [42] for the work of Turner et al. [24]. In CEA and CUA, health outcomes were assessed on the basis of different specific criteria, EQ-5D utility scores using the Dutch EQ-5D tariffs [42–44], Social Production Function Instrument for the Level of well-being short (SPF-IIs) [45]; TFI [33, 34] for the work of Vestjens et al. [19], modified Katz-Activities of Daily Living (ADL) index score [46], EQ-5D-3L [42], the Dutch EQ-5D-3L tariff which was based on a sample of the Dutch general population [44], Identification of Seniors At Risk-Primary Care (ISAR-PC) [47] for the work of Suijker et al. [22] and Groningen Frailty Indicator (GFI) [48], EQ-5D instrument [40, 49] for the work of Bleijenberg et al. [25].

Discussion

In this systematic review of the literature, ten studies were included. After the exclusion of one of them on the basis of a low quality (≤ 50%) according to the CHEERS statement reading grid [18], only nine studies remained. The objective of this review was to identify efficient interventional strategies for the prevention of frailty in elderly of 60 years and over living at home. By grouping the interventional strategies from these studies, we identified three frailty prevention programs. These were the programs frailty screening, falls prevention and analysis of drugs and treatments prescribed and delivered. Several research works have been the subject of economic assessments in terms of cost-effectiveness on geriatric syndromes such as frailty and falls. In the aging population, falls are frequent, thus a significant frailty. At least one-third of elderly over 65 fall at least once a year. Geriatric syndrome, like frailty, falls can be intrinsic and extrinsic multifactorial [12, 50, 51]. Elderly who have fallen have an impact on their quality of life, leading to increased morbidity, health care utilization, with direct consequences on the quite significant increase of health care costs [52–54]. The identification of precipitating factors and the performance of complete geriatric assessments, by an interdisciplinary team with geriatric expertise, have made it possible to detect at an early stage geriatric syndromes, then treated them. The combined cost-effectiveness and cost-utility analysis with retained effectiveness criteria were carried out from an institutional and societal perspective, which implies that all costs and outcomes were considered as far as possible. We find similar results in the literature of less expensive and more efficient strategies [25, 26, 55, 56]. Thus, frailty would be both a state of weakness and a reversible process of frailization on which it would be possible to act in a preventive perspective. It is presented as a state of unstable equilibrium between two bounds qualified in a variable way [57]. The choice to include frail elderly, or those at increased risk of functional decline, or having required formal and regular home help or home care or informal home assistance from the outset of a study would already be a major risk factor for frequent decompensation in poly-pathological cascades. The reversibility of the change in phenotypic profile from fragile to pre-fragile or even robust would require significant medical, paramedical and rehabilitation resources as well as requests to hospital services for their care without any guarantee of recuperation. Evidence of cost-effectiveness is limited [27, 28, 58, 59]. Several reasons may explain this limitation: it is possible that the 12-month follow-up was too short to see preventive effects appear and the modified versions of some efficacy outcomes and QALYs measurements would not be sensitive enough to detect clinically relevant change. Poly-medication is defined as the presence of 5 or more drugs, with an increased risk of adverse effects, hospitalization and cognitive impairment. Several

studies have documented that taking 4 or more drugs was positively correlated with the occurrence of adverse drug events [14]. The regular analysis of the prescription has a positive impact on daily life, and would improve the quality of life of frail and polypathological elderly [60]. The strengths of the studies included in this review were: an appreciation and acceptability of the study by the elderly, effectiveness of the interventional strategies demonstrated with savings made in terms of costs, reduction in the number of falls, reduction direct medical costs, reduction direct non-medical costs and improving the quality of life of elderly. The weak points of the studies were: lack of characterization of heterogeneity and uncertainty, lack of description of all the methods of statistical analysis (management of missing data, grouping of data, extrapolation of data), weakness of discussion, lack of information on the type of study funding and conflict of interest for some studies. This systematic review was limited by the search approach. No studies on adapted digital tools were included in the review over the chosen inclusin period, due to the lack of complete economic assessments.

Conclusions

This literature review, carried out in four databases and over a period of 11 years, had the objective to identify efficient interventional strategies, combined with an economic assessment, in the prevention of frailty in elderly of 60 years and over living at home. Only two multidimensional and interdisciplinary intervention strategies were highly efficient, cost-effective and improved the quality of life of elderly. Economic results were more mixed. Many methodological weaknesses were present in these studies.

Abbreviations

WHO: World Health Organization

PICO: Patients/Population, Intervention, Comparaison and Outcome

CHEERS: Consolidated Health Economic Evaluation Reporting Standards

ICER: Incremental Cost-Effectiveness Ratio

CEA: Cost-Effectiveness Analysis

FRA: Falls Risk Assessment

FIM ^{TM}: Functional Independence Measure

TFI: Tilburg Frailty Indicator

GARS: Groningen Activity Restriction Scale

ASA-R: Appraisal of Self-care Agency Scale-Revised

FES-I: Falls Efficacy Scale-International

SPPB: Short Physical Performance Battery

CUA: Cost-Utility Analysis

SPF-IIs: Social Production Function Instrument for the Level of well-being short

ADL: Activities of Daily Living

ISAR-PC: Identification of Seniors At Risk—Primary Care

GFI: Groningen Frailty Indicator

IG: Intervention Group

CG: Comparator Group

RCT: Randomized Controlled Trial

DRP: Drug-Related Problems

GP: General practitioner

QALY: Qaulity-adjuted life year

CI: Confidence Interval

KG : Kehoua Gilles

MLL : Myriam Le Goff-Pronost

CG : Caroline Gayot

MLL : Marie-Laure Laroche

MDC: Michel Druet-Cabanac

AT: Achille Tchalla

Declarations

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

“Not applicable” in this section.

CONSENT FOR PUBLICATION

“Not applicable” in this section.

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AUTHORS' CONTRIBUTIONS

KG had removed all duplicates from the list.

CG, MLL, MLG, MDC and AT have analyzed the titles and abstracts.

KG proposed to all authors MLG, CG, MLL, MDC and AT a list of categories containing variables extracted from the studies.

KG and MLG have been independently double-checked of all data.

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Figures

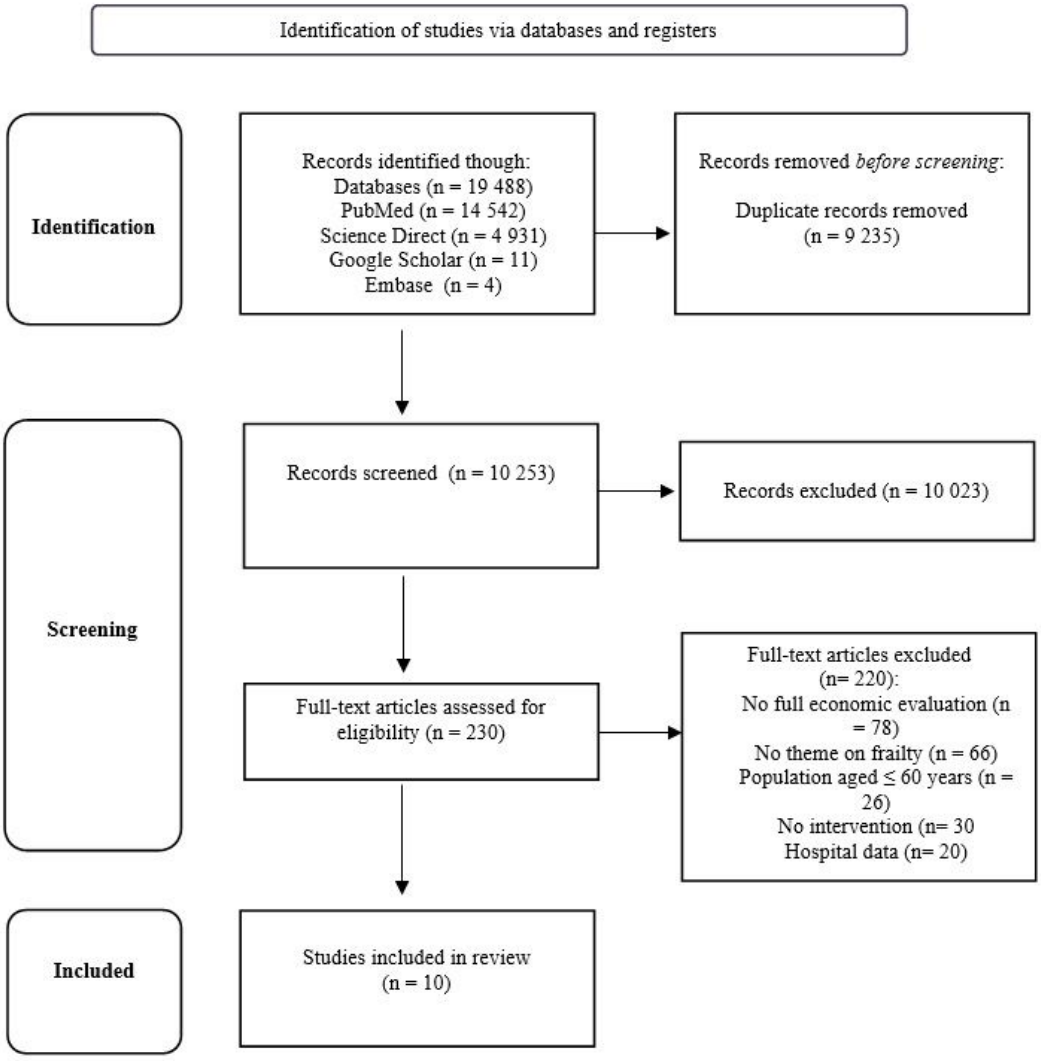

Figure 1

Flow diagram for screening and selection processes, PRISMA [16].

Supplementary Files

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