



Population screening, monitoring and surveillance for frailty: three systematic reviews and a grey literature review

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Abstract

Introduction. Little is known about programmes or interventions for the screening, monitoring and surveillance of frailty at population level.

Methods. Three systematic searches and an opportunistic grey literature review from the countries participating in the ADVANTAGE Joint Action were performed.

Results. Three studies reported local interventions to screen for frailty, two of them using a two-step screening and assessment method and one including monitoring activities. Another paper reviewed both providers’ and participants’ experiences of screening activities. Three on-going European projects and population-screening programmes in primary care await evaluation. An electronic Frailty Index for use with patients’ primary care records has been recently validated. No study described systematic processes for the surveillance of frailty.

Conclusions. There is insufficient evidence for the effectiveness of population-level screening, monitoring and surveillance of frailty. Development and evaluation of community-based two-step programmes including those that incorporate electronic health records, particularly in primary care, are now needed.

Key words

- frailty
- mass screening
- epidemiological monitoring
- public health surveillance
- program development

INTRODUCTION

According to the definition proposed by the World Health Organisation, “frailty is a progressive age-related decline in physiological systems that results in decreased reserves of intrinsic capacity, which confers extreme vulnerability to stressors and increases the risk of a range of adverse health outcomes” [1]. A recent systematic review [2] suggests that the prevalence of

frailty at population-level in Europe varies by definition and setting, ranging from 2 to 60% with a median prevalence of 10.8% among community-dwellers. Frailty is strongly associated with age, so it is expected that its prevalence will increase in Europe, parallel with population ageing.

The combination of a rising prevalence and an association with important adverse health outcomes such as

disability, hospitalisation, institutionalisation and mortality, renders frailty a clear target for monitoring and surveillance activities. Frailty is not an inevitable consequence of ageing and can be prevented and potentially reversed through specific interventions such as physical exercise [3], improved nutrition [4] and appropriate drug prescribing [5]. These interventions are more effective in the early stages [3], therefore, early detection of frailty could prove useful. There are many different tools to screen for frailty [6], but the effectiveness of screening programmes is less often reported.

ADVANTAGE, the Joint Action (JA) on Frailty Prevention co-funded by the European Union (EU), aims to develop a road map to prevent and manage frailty. It involves 22 Member States and 33 organisations. One of the JA's work packages was designed to describe available approaches and interventions for the monitoring, surveillance and screening of frailty at population level that have been developed around the world through a systematic review of the literature. This paper describes the review process and its findings.

MATERIAL AND METHODS

Data sources and search strategy

We conducted three systematic searches of the literature published between January 2002 and April 2017 using PubMed, Embase, CINAHL, OpenGrey and the Cochrane Library databases. We also examined good practice, other grey literature and data from available frailty projects including EU-funded or co-funded projects, those registered on the European Innovation Partnership on Active and Healthy Ageing's Repository of innovative practices database, and information provided by ADVANTAGE JA partners about unpublished results or materials. References of papers were also searched for relevant articles. The review protocol (CRD42017071866) was published on the University of York's Prospero (Centre for Reviews and Dissemination) website [7]. This systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines [8]. Terms common to all three searches were ("Elderly" OR "Aged" OR "Older adult\$" OR "Older person\$" OR "Geriatric\$") AND ("Frailty", OR "Frail") AND ("Process\$", OR "Programme\$", OR "Program\$" OR "Intervention\$"). The following terms were then added in turn to the ones mentioned above for the sub-reviews: "Screening", "Monitoring" or "Surveillance".

Inclusion and exclusion criteria

The following inclusion criteria were applied and papers were included if they:

- 1) described data relating to frailty using any definition of frailty and irrespective of the instrument used to detect it;
- 2) included adult participants aged at least 18 years;
- 3) included population-based data on screening, monitoring or surveillance of frailty. Screening was defined as systems, programmes, processes and interventions that were specifically designed to identify frailty in a target population to intervene in order to mitigate or reduce it at population level. Surveillance was defined

as a systematic process for the collection, analysis and interpretation of health-related data on frailty needed for the planning, implementation, and evaluation of public health interventions. Monitoring was defined as the process of observing for longitudinal changes in the health status (frailty) of a population. Monitoring is related to surveillance but is not necessarily the trigger for a specific public health action. It can serve to measure the effect of an intervention on the health status of a population over time.

No restriction was applied on characteristics of the population in terms of demographics or setting, provided a population-level (but not an individual-level) approach was taken. Data were included from specific settings e.g. patients in geriatric wards, community-dwellers, and nursing homes only if there was evidence that all individuals in the population could be recruited from those settings;

4) reported data in any language of the JA Member States;

5) included original data from full articles published from the beginning of 2002 up until April 2017. Papers published before 2002 were included opportunistically if considered relevant.

Papers were excluded if they:

- a) Contained replicated data;
- b) Did not relate to the topic;
- c) Focused on individuals with specific diseases.

Data extraction

A pair of assessors reviewed all studies independently to determine if papers met the inclusion criteria with a third reviewer settling any disagreements. Data from full articles deemed suitable for inclusion were extracted for analysis. Since we were primarily interested in describing the feasibility, potential benefits and consequences of programmes rather than their quantitative results, a narrative synthesis of findings was planned rather than a meta-analysis.

Quality assessment

The Checklist for Prevalence Studies from Joanna Briggs Institute Critical Appraisal tools for use in JBI Systematic Reviews [9] was used by two critical appraisers to assess the methodological quality of extracted studies and to determine the extent to which they addressed the possibility of bias in its design, conduct and analysis. This was used mainly to signal the limitations of the possible screening alternatives and the results are presented in the synthesis and interpretation of the systematic review results.

RESULTS

Peer-reviewed literature analysis

The flowcharts for the three separate searches of the peer-reviewed literature are presented in *Figures 1-3*. Considering the three searches together, 2390 papers were screened and 94 assessed. The main reason for exclusion was that articles were unrelated to the topic. Few papers reporting on systems, programmes, processes and interventions to screen ($n = 4$) or monitor frailty ($n = 1$) met the inclusion criteria. No study

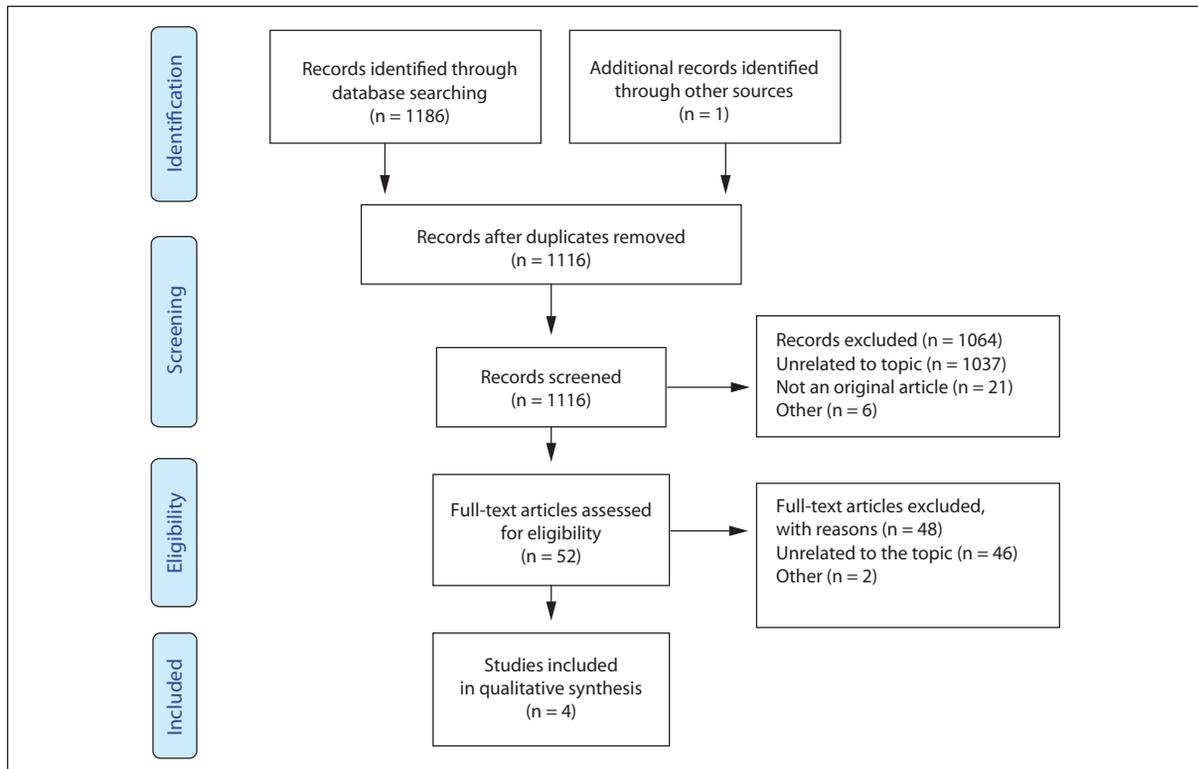


Figure 1 PRISMA flow diagram of the identification of eligible studies on screening of frailty at population level in Joint Action (JA) Member States.

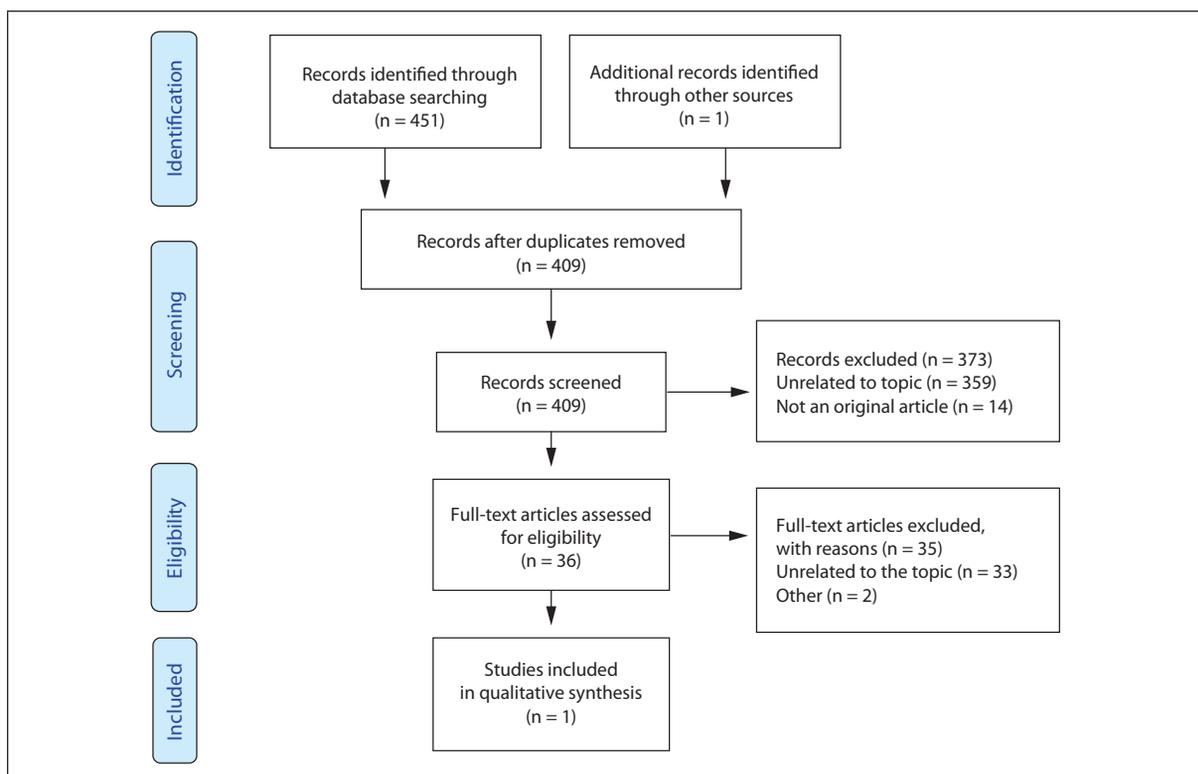


Figure 2 PRISMA flow diagram of the identification of eligible studies on monitoring of frailty at population level in Joint Action (JA) Member States.

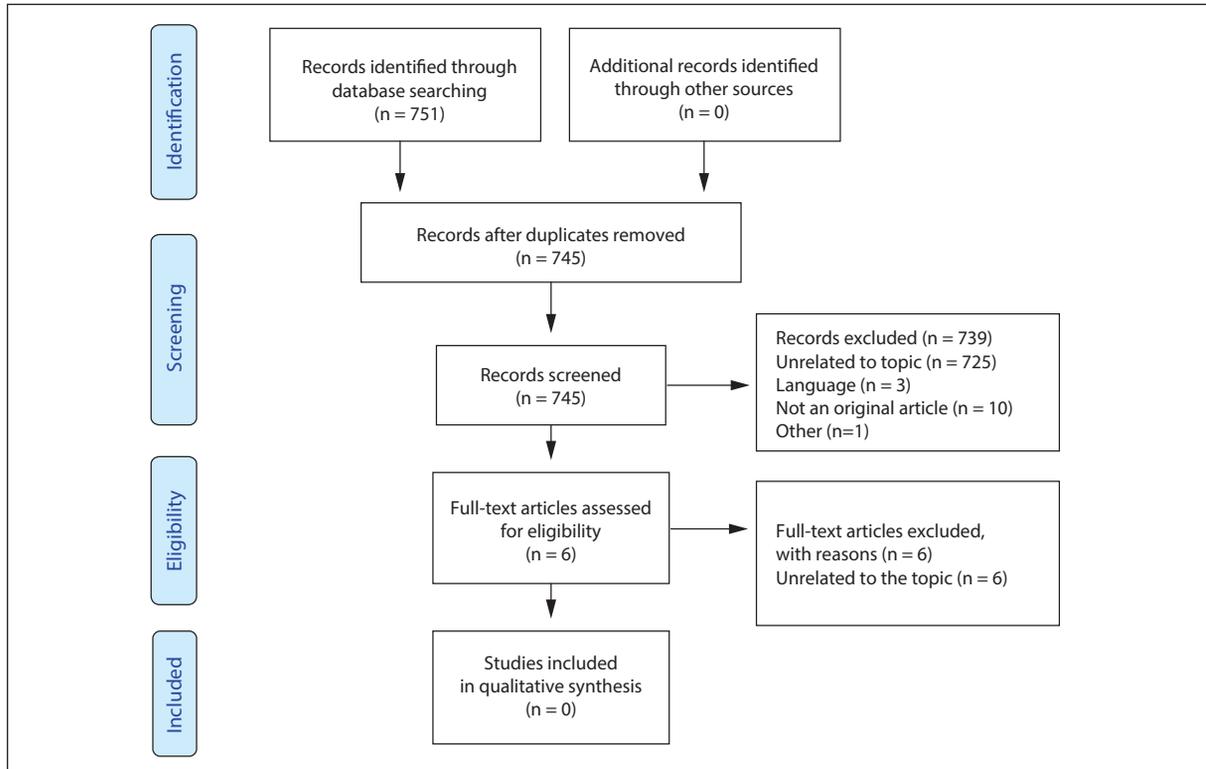


Figure 3 PRISMA flow diagram of the identification of eligible studies on surveillance of frailty at population level in Joint Action (JA) Member States.

was found reporting data on surveillance of frailty at a population level. Of the four papers on frailty screening, two provided quantitative evaluations of screening approaches, one in Italy [10] and one in The Netherlands [11]. A single study from Japan [12] described a process for both screening and monitoring of frailty. An additional qualitative study described approaches to screening for frailty in The Netherlands [13].

The three quantitative studies on screening that met inclusion criteria are summarised in *Table 1*. The two European studies screened individuals ≥ 70 years, used a very general definition of frailty and were carried out at a local level using a two-step approach. The first step in the Dutch study used a non-validated questionnaire to review patients' information in the general practitioners' clinical records. The first step in the Italian study used the validated modified Sherbrooke Postal Questionnaire [14]. The second step for both studies consisted of a clinical and social structured assessment and the intervention in subjects screened positive was not different to usual care offered to patients in both cases. The Dutch study had a limited sample size ($n = 141$) recruited from volunteering academic general practices. All patients selected at random by the general practitioners took part in the study. All individuals ($n = 6629$) living in the participating communities were contacted in the Italian study, but a large proportion (42.8%) did not return the questionnaire and out of those who responded, a third (33.7%) could not be evaluated in the second step, mainly because of death or inability to follow up by telephone. As expected, older individuals

were less likely to participate. The two studies showed that the screening intervention was feasible and reported prevalence rates of frailty up to 20%.

The Japanese paper is also based on a local intervention [12]. It is different to the approaches described because: a) it is accompanied by primary and tertiary prevention interventions, taking a public health perspective by targeting both the frail and robust populations; b) it has only one step consisting of comprehensive geriatric assessment (CGA) as part of the annual health check; c) it has been running for 10 years; and d) it reports mid-term and long-term outcomes. The overall programme including preventative approaches showed improvements in the functional status and disability rates of subjects and increases in the life expectancy at 70 years. Older and less healthy individuals participated in the CGA less often.

The final study by Lette *et al.* [13] conducted a grey literature search, followed by 12 semi-structured interviews with 17 experts with experience in preventive care for older adults, and three group interviews with a total of 21 older adults (aged 57-78 years). This study sought to identify and compare initiatives on early detection and management of frailty in The Netherlands and to explore the experiences of both participating professionals and older people. The researchers found a wide variety of approaches to frailty screening. A number of challenges were also identified by the professionals including: 1) confusion over the definition of frailty; 2) difficulty in eliciting psychological issues using questionnaires; 3) overlap in preventive initiatives between

services with many initiatives having only a weak supportive evidence; 4) insufficient follow-up of identified problems with inadequate risk assessment; and 5) too broad a target population in most initiatives to achieve a clinically significant impact. On the other hand, older people mentioned that they preferred home visits for questionnaires because of the direct personal contact. They also noted that many of the interventions appeared to be patronising or overly focused on physical health and less on psychosocial issues. In this study, the general practitioners were identified as the preferred

choice of professional to identify physical health problems and risks. The authors' main conclusions are that "more insight is needed into 'what should be done by whom, for which target group and at what moment'" and that there is a "risk current initiatives insufficiently address needs of (frail) older people".

Grey literature analysis

Three recent EU projects that aimed to establish screening strategies for frailty in European countries were found. The completed PERsonalised ICT Sup-

Table 1

Summary facts of the three papers on screening found in the systematic review. GP: General Practitioners. SD: Standard Deviation. GDS: Geriatric Depression Scale. SPPB: Short Physical Performance Battery. MNA: Mini Nutritional Assessment. SPMSQ: Short Portable Mental Status Questionnaire

Source	Region, country, Setting	Number of participants	Age. Women	Sampling method and inclusion criteria	Frailty definition	Screening process	Proposed intervention	Results
van Kempen et al [11]	Nijmegen, The Netherlands. GP practices	141	Mean 77 years ± SD 6. 62%	Random selection of 20 community dwelling patients ≥70 from 7 GP practices not selected at random	Broad definition: vulnerability based on decreased reserve capacity	Two-step: In the first step, the GP reviews the patient record and answers 14 questions about the functioning of the patient in somatic, psychological, and social domains. The patients who are judged as 'unclear' or 'frail' in the first step are eligible for the second step, where additional information is collected through a structured assessment by a primary care nurse. The GP and primary care nurse make a final frailty decision for the 'unclear' patients. The frailty decision in both steps is based on clinical reasoning, and not a numerical score	Not mentioned	Frailty prevalence 24%. One-third of the 141 individuals needed the second step. The procedure was acceptable both for the professionals and patients. Most of the professionals had too little knowledge about frailty to make a reliable final decision. Inter-observer variability could be high. The second step was time-consuming
Razzanelli et al [10]	Tuscany, Italy. Community	6629 respondents out of 11585 contacted (response rate to the questionnaire: 57.2%, less among the oldest people)	≥70 years. 58%	All residents over 70 years, but those included in social services databases with recognised disability or living in nursing homes. The additional question "can you get up from your bed without help?" in the questionnaire was used to exclude further disabled individuals	Problems in 3 or more independent predictors of loss of independence (derived from a modified version of the Sherbrook Postal Questionnaire) were considered suggestive of frailty.	Two-step: A questionnaire (modified Sherbrooke Postal Questionnaire: living alone; 4 or more medications; visual problems; falls during last year; hospital admissions during last year; memory deficits; having problems in walking for 400 metres) was sent home via postal mail. In case of non-response, two reminders were sent. Individuals with a score ≥3 were offered an in-home comprehensive assessment performed by a nurse or social worker	The information derived from the comprehensive assessment was communicated to physicians and social services with specific recommendation for possible secondary prevention intervention	Among 6629 respondents, 51.7% (n=3432) were recommended to follow the second step. 66.3% (n=2276) were evaluated. Of those, 38.1% (n=865) were not autonomous. Of the rest (n=1411), 95% had at least one problematic area and 69% at least two, showing that "the postal screening was able to identify potential patients who might benefit from further assessment and interventions for specific risk factors". The intervention did not produce special organizational difficulty, required a limited number of person-hours and seems sustainable from an economic perspective

Continues


Table 1
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Source	Region, country, Setting	Number of participants	Age. Women	Sampling method and inclusion criteria	Frailty definition	Screening process	Proposed intervention	Results
Shinkai et al. [12]	Municipality of Kusatsu, Japan. Community	Between 1737 in 2001 and 2287 in 2011	>=65 years	All inhabitants	"An age-related syndrome characterized by decreased reserve and resistance to stressors. It results from cumulative declines across multiple physiological systems, and increases vulnerability to adverse outcomes". The operational definition is not specified in the intervention	Comprehensive geriatric assessment as part of routine annual health check-ups offered by law to senior citizens in Japan	Subjects screened as frail or at high risk of frailty were encouraged to participate in long-term prevention programs, including physical, nutritional, and social activities	Participation rate in annual check-ups: 30–40% of the target population. Over 80% of the target population participated at least once during 10 years. Participants were more likely to be young, female and healthy. The complete intervention along the 10-year follow-up (2001–2011) significantly increased the functional status of subjects, delayed late-onset disability and extended healthy life expectancy at age 70 years by 1.2 years for women and 0.5 years for men

ported Service for Independent Living and Active Ageing (PERSSILAA) project [15] used a two-step strategy to identify robust, pre-frail and frail community-dwelling older adults in Italy (church groups) and in The Netherlands (primary care) [16]. Full results are not yet published. The ongoing Community Assessment of Risk Tools and Strategies (CARTS) study is testing a two-step community-dwelling screening programme for older people in Ireland, Spain and Portugal [17]. Preliminary results suggest that the screening process was able to stratify older people at risk of adverse outcomes in individual countries such as Ireland [17] and Portugal [18, 19]. The recently concluded SUNFRAIL project developed its own screening tool [20], consisting of nine questions where a positive answer elicits an alarm for the general practitioner who then clinically evaluates the patients and, if needed, may refer them to a multidisciplinary team. It was tested in 603 individuals aged ≥ 65 years in four European countries in the community, in primary care and in hospital outpatient clinics. The tool was well accepted and showed concurrent validity with physical and cognitive function and quality of life measures.

In Spain, the Ministry of Health [21], in agreement with all regional ministries and professional associations, has developed a common protocol to: a) opportunistically screen all individuals aged ≥ 70 years consulting primary care for any reason; or b) actively screen all individuals ≥ 70 already participating in specific programmes, i.e. those devoted to managing patients with chronic diseases or older adults. Frailty is detected using the Short Physical Performance Battery [22] carried out by a nurse or, alternatively, by the family physician, preferably as part of a scheduled visit. Risk of falls is also assessed through specific questionnaires. The in-

dividual detected as frail is offered a multi-dimensional (clinical-functional-cognitive-social) assessment and a multi-component physical activity (aerobic resistance, flexibility, balance and muscle strength) programme carried out in a group environment. The Spanish Region of Andalusia aligns with this strategy but screening is opportunistic in patients aged ≥ 65 years, becomes active in areas defined as in need of social intervention and uses the gait speed as the screening tool [23].

In France, since 2013, an opportunistic identification of frailty on the initiative of a health professional or a social caregiver for people aged 70 years and over is recommended. The use of the Gérontopôle Frailty Screening Tool [24] is suggested. General practitioners are in charge of initiating and following the process with the support of other primary professionals and geriatric expertise as needed. Frailty assessment has to be multi-dimensional and multidisciplinary. A personalized care plan may be developed to coordinate prevention, relating to promoting a physical activity, a balanced diet, iatrogenic drug-related risk reduction as well as occupational therapy for housing adaptation and home care services.

Neither of the two Spanish and French developments have been formally evaluated.

In the United Kingdom (UK) an electronic Frailty Index (eFI) to be used in primary care has been recently validated [25]. This eFI is automatically populated from routinely collected clinical data (symptoms, signs, diseases, disabilities and abnormal laboratory values) within the electronic health records. Similar frailty indexes using electronic hospital data that will likewise provide a validated and cost-effective means to screen for frailty among inpatients have been also developed in the UK [26, 27].



DISCUSSION

Our search of the peer-reviewed and grey literature found no description of frailty surveillance programmes, only one concerning monitoring and a few local examples of population screening initiatives, some of which have yet to be evaluated. All studies were conducted in Europe apart from one population-level study from Japan. It is not surprising that there is little evidence for surveillance/monitoring programmes since frailty is a relatively new concept that does not as yet have a specific International Classification of Diseases (ICD) code, potentially hindering the possibility of including it in national or regional monitoring or surveillance programmes. Frailty meets several criteria for considering it a high-priority health topic for surveillance [28]: a) it has high prevalence and incidence rates, which are expected to rise; b) it has often severe consequences including increased risk of mortality, hospitalisation and disability; and c) there are measures available to address frailty, particularly at its earliest stage and before onset of disability [5]. Over the last five years, some research has aimed to develop and validate models to identify individuals with frailty using electronic health data [25-27, 29-32]. All these initiatives concluded that it seems feasible to use routinely available data to obtain a valid measure of frailty. These use the Frailty Index classification based on the accumulation of deficits theory of frailty, which is the proportion of a pre-determined list of health deficits an older person has [33]. This process could easily be used internationally using standardised coding systems. It can provide data in a continuous and ongoing fashion (surveillance) or in a more intermittent or episodic way (monitoring).

Screening for frailty meets all the preliminary general criteria for a screening programme. In addition to the ones mentioned for surveillance, insights into the epidemiology and natural history of the condition are available and there are simple, safe, validated and accepted screening tests and an appropriate and accepted diagnostic and intervention approach (CGA). Based on this, an international panel of experts recommended the screening for frailty by health care providers in persons aged 70 years or older [5]. Similarly, the British Geriatrics Society in conjunction with the Royal College of General Practitioners and Age UK, in their "Fit for Frailty" guidance document, recommend that opportunistic screening be offered by health and social care professionals when they encounter older adults [34]. From October 2017, routine identification of frailty was introduced to the General Practice contract in England.

Ireland's National Clinical Programme for Older People' acknowledges the lack of supporting evidence for screening and recommends that those presenting with frailty syndromes (e.g. falls, delirium, incontinence), irrespective of setting, be screened as part of a pathway leading to CGA [35].

What is missing is data on the effectiveness, costs-effectiveness and acceptability of the screening programmes and the intervention(s) that should be offered to those identified as frail [36]. The peer-reviewed papers identified show that systematic screening would

probably be feasible and acceptable, both for patients and health care providers. The evaluation of European projects and programmes e.g. those in France and Spain, described above, should contribute much-needed data on effectiveness and costs.

Several factors need to be considered when designing population-level screening programmes. One of the most important ones is the identification of the target population. When the target is the whole population, as in the Italian study [10], one would expect a participation rate much lower than 100%. If a postal questionnaire is used for screening, one would expect an even lower participation rate among the oldest and most vulnerable, who in addition may not provide totally reliable information, particularly if a large proportion of them have cognitive problems [37]. Both factors may produce selection and information bias resulting in a lower probability of correctly detecting frailty. Furthermore, screening all community dwellers above a pre-determined age would be expensive and difficult to achieve, with healthcare professionals suggesting that targeting very broad populations reduces the possibility of obtaining accurate results [13]. An alternative approach, suggested by van Kempen [11] and the on-going Spanish and French programmes, is to target primary care users. However, this also has the potential for selection bias, though this will be less in health systems that provide extensive coverage of the whole population and could be diminished further if all those registered with a primary care centre are targeted. This last approach would take advantage of existing structures in primary care and would be less difficult to set up than a *de novo* screening, monitoring or surveillance programme. Moreover, qualitative evidence suggests that questionnaires are not the preferred screening approach for healthcare providers or older people [13]. For these reasons, primary care and the use of existing healthcare records or data may be an ideal location and strategy to develop and implement population-level epidemiological approaches to identify frailty.

Once the target population is defined, the next step would be to embark on systematic population screening, opportunistic case-finding or something between. The three quantitative papers included in this systematic review are based on population screening. The Spanish Ministry of Health protocol and the Andalusian regional government's on-going strategy combines both options as it recommends targeted screening of all individuals attending specific programmes or living in deprived areas and opportunistic screening of those who visit primary health care centres. The preferred approach may depend on the resources available.

Another aspect to consider is the screening process. With the exception of the study from Japan, all others used a two-step approach, where CGA is used to confirm frailty. There is currently no consensus as to the most suitable tool for the initial screening step. For example, scholars and healthcare professionals could suggest that the scales used in the Italian [10] and Dutch [11] studies, are not measuring frailty according to the proposed WHO definition [1]. This initial screening instrument could be derived from information contained

in the primary care electronic health records, if they are available, allowing for the construction of a frailty index, a recommended approach to classifying frailty [38]. Given the concerns expressed by healthcare professionals over the lack of evidence for screening and the overlap of initiatives [13], it is imperative to offer evidence-based interventions for those screening positive for frailty.

Future programmes including initiatives modelling those described in this review require field-testing at a larger scale, including at regional and national levels. Their aim should be to reduce the occurrence of frailty and disability, and to measure this, monitoring systems should be set in place. Shinkai *et al.*'s paper [12] provides an example of a perfect symbiosis of population-level screening combined with a monitoring programme through biennial health surveys that provides baseline and follow-up data for the evaluation of the screening intervention.

The strength of this systematic review is the search strategy employed, which included five comprehensive scientific databases along with an extensive search of the grey literature that was contributed to by researchers from several European countries. However, it is possible that we have not detected some of the programmes developed in Europe to date. However, it must be considered that most of the initiatives that appear to be missing in this review, such as the Gerontopole, are not operated as structured programmes but rather consist of referrals to a geriatric outpatient service after screening by primary care physicians as part of routine practice [39].

CONCLUSION

This systematic review reveals the current lack of programmes for the screening, monitoring and surveillance of frailty at population-level in the EU JA countries. There is a need to pilot new programmes at a larger

scale across different countries to better understand their feasibility, acceptability, costs, consequences and potential benefits. Using available data from existing cross-sectional or longitudinal studies [32] as well as primary care [25] or hospital [26, 27, 29-31] records to create a frailty index would provide a cost-effective approach to identifying frailty at population level. Monitoring and surveillance efforts would be enhanced by the creation of an ICD code for frailty as was recently approved for sarcopenia. Screening could be carried out in two phases, using a short screening test and then confirming the diagnosis using CGA. The need to provide an intervention or package of interventions for those screening positive is essential to the programme and requires more research to identify additional measures to prevent, slow or reverse frailty. Finally, the views of those performing and receiving the screening, monitoring and surveillance for frailty should be taken into account as part of an iterative process of developing such programmes; studies looking at public and patient involvement in designing frailty pathways are planned [40].

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Conflict of interest statement

There are no potential conflicts of interest or any financial or personal relationships with other people or organizations that could inappropriately bias conduct and findings of this study.

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