

This is an accepted authors draft of a paper published in Journal of Family Medicine and Primary Care
Online publication complete SEP-2018
DOI: 10.4103/jfmpe.jfmpe_159_18

Home Visits: a new Screening Tool for Frailty? A Retrospective Exploratory Study

Attwood D, Stevens KN, Jones L, Harris L, Roberts F

Abstract

Introduction: The new contract for primary care mandates that all practices use a screening tool, such as the Electronic Frailty Index (EFI) to screen for frailty and apply clinical judgement, based on knowledge of the patient, to decide if they have a diagnosis of frailty. However, whilst EFI predicts hospitalisation, institutionalisation, and mortality, it has not been validated as a screening tool for frailty.

In primary care, home visits are performed when a clinician determines that a patient is housebound; they are functionally impaired to the point that it is unreasonable to expect them to attend surgery. Anecdotally, many of these patients have a diagnosis of frailty. This study assessed whether a clinician's judgement that clinical encounters could only take place by home visit could, in itself, form a new screening tool for frailty.

Method: A retrospective analysis was performed of 154 patient's medical records from 1/3/15 to 29/2/16 who were aged 65 years and over at the start of the study. Patients were divided into two groups. The first group (n=82) had received a home visit, and the second group consisted of a randomised sample of patients (n=72) with similar baseline characteristics, who had not had a home visit. Patient records were analysed by two clinicians to determine whether a frailty syndrome was present. Researchers were blinded to each other's results. An arbitrator determined the frailty status on disagreement. The data was statistically analysed to give the sensitivity, specificity, positive and negative predictive values of home visits as a screen for frailty.

Results: As a screening tool for frailty, home visits have a sensitivity of 87.23% (95% CI: 74.35% to 95.17%) and specificity of 61.68% (95% CI: 51.78 to 70.92%). Cohen's Kappa showed fair inter-observer reliability.

Conclusion: The results show home visits are a good screen for frailty. Furthermore, it does not require any additional time to perform. Knowledge of this will make clinicians undertaking home visits more alert to the possibility that the patient has a diagnosis of frailty and will speed up diagnosis and treatment.

Introduction

Frailty is a clinically recognised state of increased vulnerability, resulting from ageing and associated with a decline in physiological reserve¹. A long-term condition in its own right, patients with frailty are at dramatic risk of deterioration after seemingly minor physiological insults¹.

In the UK 18% of the population are 65 years or older 2.4% of the population are 85 years or older². Studies in the UK and the USA have shown an overall frailty prevalence of 6-

14% in 65+ year olds^{3,4}. However these studies demonstrate that the prevalence of frailty exponentially increases with age, such that in those aged 60 to 69 years the frailty prevalence is 3.2-6.5%; increasing to 25-30% in 80-89 year olds; but could be anywhere between 25-60% in those over 90 years^{3,4}. This is a problem that is set to grow, with the proportion of 65+ year olds almost doubling by 2036 in the UK².

Older people with frailty have a substantially increased risk of poor health outcomes such as falls, hospitalisation, disability, long-term care, and death^{3,4,5}. Diagnosis is crucial as it enables interventions to take place that improve outcomes such as the Comprehensive Geriatric Assessment and information sharing amongst the different providers involved in patient care¹. Furthermore, patients with frailty are much more likely to have adverse events from medical interventions, such as starting a new drug or surgery. Knowledge of frailty may make a clinician think twice about certain interventions, enabling more informed decision-making.

There are two models for identifying frailty. The first is the frailty “phenotype” model⁴ which defined frailty as with three or more out of the five characteristics: unintentional weight loss (10lb in the past year), self-reported exhaustion, weakness (grip strength), slow walking speed, and low physical activity⁴. The second model is the Cumulative deficit model proposed by Rockwood et al⁶, which is based on counting the number of clinical deficits (symptoms, signs, conditions, and biochemical values) and using certain cut offs to base a diagnosis of frailty on. Both have independently predicted falls, disability, hospitalisation, institutionalisation, and death.

However, these models are not always practical in primary care. The phenotype model is time consuming and requires equipment and trained personnel that are not found in primary care. At the time of embarking upon this study the cumulative deficit model had not been embedded into primary care IT systems, confining it to the research setting as well^{4,6}.

There is another key point to note with these models; the patients in both models were diagnosed with frailty on the grounds that they had an increased probability of falls, hospitalisation, institutionalisation and death^{4,6}. However, having an increased probability of the above outcomes does not inevitably mean the patient is frail. For example, patients with incurable cancer will all have an increased probability of falls, mortality, hospitalisation, institutionalisation and death. Some may have co-existing frailty. Many may not. There is also a dissonance in these models between the *definition* of frailty- a state of reduced physiological reserve where minor stressors trigger a dramatic deterioration in function- and the *diagnostic criteria* for frailty. One might reflect that to meet the definition for frailty the patient must suffer an acute functional decline from a minor stressor or be judged to be at high risk of an acute functional decline from minor stressors. This is different to looking at a cohort of patients in the Cardiovascular Health Study in the US⁴ and the Canadian Study of Health and Ageing⁶, applying diagnostic criteria, and evaluating if this increases probability of falls, mortality, hospitalisation, institutionalisation and death.

In 2014, the British Geriatric Society (BGS) offered a more intuitive way to think about frailty¹. They suggested five frailty syndromes, that if present (and the clinical picture fit), should make a clinician strongly consider a diagnosis of frailty. These syndromes include

recurrent falls, acute or worsening immobility, acute or worsening incontinence, delirium, and susceptibility to side effects of multiple medications¹.

To clinicians the 'syndrome approach' to frailty makes sense and is best illustrated using falls as an example. The ability of a person to remain upright is the result of complex, highly integrated feedback pathways, across multiple body systems. Massive quantities of information are relayed across different parts of the body, enabling micro-adjustments to be made to the position of body in 3D space, keeping it upright. It follows that if there are impairments in multiple body systems, the probability of falling increases. When there is a 'critical mass' of impairments, the human body will not be able to maintain its position in 3D space and a fall will result (the 'falls threshold'). Patients who are near their falls threshold clearly have reduced compensatory mechanisms across multiple systems, meaning that a minor stressor will trigger the fall. This is *the definition* of frailty. Furthermore, there are studies demonstrating outcomes of hospitalisation, institutionalisation, morbidity and mortality in older people with falls^{7,8,9}, delirium^{10,11}, incontinence¹² immobility^{13,14}, and adverse drug reactions¹⁵.

BGS also advocated screening tests for frailty. Examples include PRISMA 7 (sensitivity 83%, specificity 83%), gait speed (sensitivity 99%, specificity 64%), and timed get-up-and-go-test of 10 seconds (sensitivity 93%, specificity 62%)¹⁶. However, these tests were compared against Phenotype model as the reference test. This had a slightly lower frailty prevalence than other studies^{3,4} and, as discussed earlier, is slightly challenged in terms of diagnosing "true frailty" as per its definition. PRISMA 7, gait speed and timed-up-and-go test are seldom used in primary care due to the demands on clinician time.

In 2017, NHS England included frailty as a feature in the new primary care contract. GP surgeries were to use the Electronic frailty Index (EFI), or other validated tools, as a method to screen for frailty and code patients accordingly¹⁷. EFI is based on the Cumulative Deficit Model of frailty; as co-morbidity increases the probability of frailty increases¹⁸. There are 36 conditions (mostly diseases), each given a score of one, which is summed, then decimalised. For example, if a patient has one condition, they score 1/36. If they have three conditions they score 3/36 and so on. The scores are decimalised and if the EFI score is 0.24-0.36, the patient is said to have "**moderate frailty**." Higher than 0.36, patients are said to have "**severe frailty**"¹⁸. It should be emphasised that the terms 'moderate' or 'severe' frailty in this context are misnomers; they categorisations according to EFI rather than diagnoses of frailty.

This is recognised in the primary care contract and as a result, required general practitioners to create a list of patients in their surgeries with moderate and severe frailty and then apply clinical judgement to determine if they are actually severely frail¹⁷. However, there are problems with this model of care. EFI will only return a moderate or severe score if a patient has a certain number of deficits. Some patients with very few deficits may have severe frailty. For example, a patient with advanced dementia, in a nursing home, and dependent on care will return an EFI score of 4/36 or 0.11, and would be classified as not frail. This patient may well have coexisting frailty (as per the definition of frailty) yet not feature on the list of patients created by EFI.

Furthermore, as EFI has not been validated as a screen for frailty there is the possibility that EFI scores of frailty may not necessarily mean there is a clinical diagnosis of frailty.

There is a clear need in primary care for an easy to administer screen for frailty and in this study we investigate the possibility of using a simple solution that is routinely performed by on clinicians. In primary care, home visits are only performed when a clinician judges that a patient is housebound; they are functionally impaired to the point that it is unreasonable to expect them to attend surgery. Anecdotally, it is possible that many of these patients could have a diagnosis of frailty. This study assessed whether the need for a home visit, could in itself, form a new screening tool for frailty.

Method:

The study participants were registered at a General Practice (GP) surgery in Devon, between 1st March 2015 and 29th February 2016. The GP surgery was in the fourth more deprived decile on the Index of Multiple Deprivation (IMD) score and during this period there was approximately 3,000 registered patients, of which 470 (15%) were aged 65 years and over.

A home visit group (n=82), was identified, containing all the patients who had received a home visit during the study period. This was compared against a randomly selected sample of patients (n=72) with similar baseline characteristics who had not had a home visit. This was achieved by stratifying the home visit patients by sex (male versus female) and age cohorts. Random selection was achieved using a random numbers generator.

Two clinicians independently examined the medical records of each of the sampled patients' for the defined study period to see if one or more of the BGS frailty syndromes were present. If a frailty syndrome was found, clinical judgement was applied to determine if the patient had a diagnosis of frailty. If they did, they were recorded as such. This meant that the BGS frailty syndromes were used as the reference test.

One clinician was employed by the GP surgery and could not be blinded to whether the patient had a home visit during the study period. The second clinician was independent of the GP surgery and had no knowledge whether a patient had a home visit during the study period. If there was a disagreement between the two clinicians of the patient's frailty diagnosis, a third clinician (arbitrator), who worked at the practice, was asked to review the patient's medical records and determine their frailty diagnosis. All clinicians were blinded to each other's diagnosis of frailty.

The results were analysed using the statistical software Stata version 14¹⁹. Inter-rater reliability was assessed using Cohen's Kappa statistic. However, the 95% confidence intervals (CI) for the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated in the statistical software R²⁰ using the package *bdpv*²¹.

Due to the sampling method used in this study, it was possible that the proportion of participants who were diagnosed as frail were not representative of the actual proportion of frail patients within the practice. Therefore, to calculate the PPV and NPV we considered the prevalence estimates from the English Longitudinal Study of Aging (ELSA)³ for 65 years and over, which was 14% (95% confidence interval: 12% to 16%) based on 5450 participants.

Results:

Baseline characteristics are shown in table 1. As patients who did not have a home visit were randomly selected to ensure these groups were balanced by age and sex, there was reasonable balance in the numbers frequencies and proportions by home visit. This was also true within the clinician diagnosis of frailty, where there appeared to be reasonable agreement by age, but less by sex.

Demographics	Clinician Diagnosis		Home Visit	
	Not Frail (n = 107)	Frail (n = 47)	No (n = 72)	Yes (n = 82)
Age in years				
Mean (SD)	80 (7.9)	84 (6.8)	80 (7.2)	83 (8.2)
Gender n (%)				
• Male	29 (67.4)	14 (32.56)	21 (48.8)	22 (51.2)
• Female	78 (70.3)	33 (29.7)	51 (46.0)	60 (54.1)

Table 1: Characteristics of patients in each group

When comparing the presence of the number of frailty syndromes between the two original clinicians, the agreement was 68.2% (105 patients) with a kappa coefficient of 0.40. When comparing the binary outcome of clinical diagnosis of frailty (i.e. a patient has at least 1 frailty syndromes), the agreement was 81.2% (125 patients) and the kappa coefficient was 0.58. Essentially the evidence suggests there is fair agreement between the two clinicians.

Frequency		Home Visit		Total
		No	Yes	
Clinician Diagnosis	No	66	41	107
	Yes	6	41	47
Total		72	82	154

Table 2: A table comparing the proportion of those with a clinical diagnosis of frailty and home visits.

The results in table 2 compare the clinical diagnosis of frailty with home visits. The values in the table are based on the arbitrated scores. The sensitivity was estimated as 87.23% (95% CI: 74.35% to 95.17%) and the specificity was 61.68% (95% CI: 51.78 to 70.92%).

To estimate the PPV and NNP, we used the estimates from ELSA study³, as we believed these values were more representative of the English population where this screening tool would be applied to. Table 3 shows the estimates for the NPV and PPV for the prevalence's reported. The NPV appears to decrease as the prevalence increases, whereas the PPV increases as the prevalence increases.

ELSA Prevalence Group	NPV		PPV	
	Est.	95% CI	Est.	95% CI
60 years or over (14%)	96.7	(93.3 to 98.5)	27.0	(22.2 to 32.6)
60-69 years (6.5%)	98.6	(97.0 to 99.3)	13.7	(10.8 to 17.1)
90 years or over (65%)	72.2	(54.8 to 84.8)	80.9	(76.5 to 84.6)

Table 3: Negative and positive predictive values using the estimated prevalence from the ELSA study.

Discussion:

The results show that home visits offer an 87.2% sensitivity and 61.7% specificity, which compares favourably with other screening tools available such as PRISMA 7 (sensitivity 83%, specificity 83%), gait speed (sensitivity 99%, specificity 64%), and timed get-up-and-go-test of 10 s (sensitivity 93%, specificity 62%)⁶. Even if the lower confidence intervals (sensitivity 74% and specificity 52%) are correct, this test requires no examination, questionnaire, or scoring system and is easy to administer: the simple act of a GP making the decision to home visit a patient could automatically act as a mental prompt to evaluate for frailty. This would confer numerous benefits such as speeding up the diagnosis and initiation/referral for key interventions which are proven to improve clinical outcomes such as the Comprehensive Geriatric Assessment (CGA)¹. The population assessed in the study were representative of most of the rest of the UK.

The change in NPV and PPV would indicate that any interpretation and subsequent action by clinicians may be dependent on the patient's age. However, as the study is based on a relatively small sample of participants and the age range did not match the ELSA study, these estimates should be viewed with caution. Especially for the NPV of 90 years or over, as the 95% CI was 55 to 85%.

Using home visits as a screen for frailty is intuitive as the need for a home visit is based on a clinician's judgement that the patient has reduced physical function. Given that frailty is defined as a state of reduced physiological reserve, it seems highly probable that patients requiring a home visit have co-existing frailty.

This screen offers increased utility in a secondary care setting. For example, a GP referral that starts with "Many thanks for seeing this patient who has had three home visits in the last two months..." increases the index of suspicion for a frailty syndrome. Another example is in Orthogeriatrics, where knowledge of previous home visits might make a clinician's more wary of the potential for a dramatic deterioration following an admission for fractured neck of femur.

The study showed some variation in inter-observer reliability with a Cohen's Kappa that showed fair agreement. Two factors accounted for this. Firstly none of the patients had a coded diagnosis of frailty. This necessitated two clinicians retrospectively analysing and interpreting primary care clinician's notes and deciding whether a frailty syndrome existed. Making that judgement was sometimes challenging and is perhaps easier to accomplish prospectively rather than retrospectively. In addition, one clinician knew the patients home visiting status, which may bias results.

The study was also limited in that it only assessed for frailty during the study time period. In several subjects, frailty phenotypes had been noted in the few years prior to this but were not included in the study and discounted from analysis.

Another potential limitation was assessing for frailty using the five clinical syndromes. Frailty is defined as a state of increased vulnerability due to a decline in physiological reserve and the direct care teams felt that several patients met this definition of frailty but did not exhibit one of the five clinical syndromes. For example, one patient in the home visit group was bedbound (no falls and no new/worsening immobility as already immobile), catheterised (so no worsening/new incontinence) and did not have any other frailty syndromes. They were classified according to study criteria as not frail.

Another difference between this screen and a previous systematic review of screening tests¹⁶ is that the phenotype model⁴ was used as the reference standard. This study employed the BGS guidelines frailty syndromes as the reference standard¹.

Conclusion:

This exploratory study demonstrates that if a primary care clinician decides that a patient requires a home visit, this same judgement can be used as a screening tool for frailty, with a sensitivity and specificity that is comparable to some of the current screens for frailty. However, as this data is routinely gathered, there is no extra time burden to GP's or their computational systems needed and it also flags to patients who may require further assessment to diagnose Frailty.

Whilst the EFI score and the phenotype model have traditionally been used as reference standards for frailty, they do not actually diagnose the acute functional decline or the potential for an acute functional decline that is the defining feature of frailty. Although they do have a role in predicting outcomes such as falls, hospitalisation, institutionalisation morbidity, and mortality.

The authors would suggest that the British Geriatric Society's guideline on using frailty syndromes to diagnose frailty is intuitive. However, in addition to the five syndromes, we would suggest adding a sixth; that a clinician who has knowledge of the patient judges them to have reduced physiological reserve and is at risk of a dramatic deterioration in function.

It would strengthen the validity of the results to look across multiple GP practices to see if the study findings are generalisable, and to compare home visits against EFI as a screen for frailty. In addition it would be interesting to evaluate the BGS frailty syndromes using

similar methodology and outcomes to the phenotype and cumulative deficit model to demonstrate non-inferiority.

Acknowledgements:

The authors would like to thank our funders, Torbay Medical Research Fund.

References:

1. **Fit for Frailty part 1.** British Geriatrics Society 2014
2. **Overview of the UK population.** Office of National Statistics. July 2017
3. Gale et al, **Prevalence of Frailty and disability: Findings from the English Longitudinal Study of Ageing.** Age and Ageing 2015; Jan 44(1); pp162-5
4. Fried LP et al, **Frailty in older adults: evidence for a phenotype.** J Gerontol A Biol Sci Med Sci 2001; 56: pp M146-M156
5. Clegg et al, **Frailty in Elderly People.** The Lancet 2013; 381: pp752-762
6. Rockwood et al, **A global clinical measure of fitness and frailty in elderly people,** CMAJ 2005; 173: pp489-495
7. Tinetti et al **The effect of falls and fall injuries on functioning in community-dwelling older persons,** J Gerontol A Biol Sci Med Sci 1998; 53(2):M112
8. Kiel et al **Health care utilisation and functional status in the aged following a fall,** Med Care 1991; 29(3):221
9. Tinetti et al, **Falls, injuries due to falls, and the risk of admission to a nursing home** N Eng J Med 1997; 337(18):1279
10. Cole et al, **Prognosis of delirium in elderly hospital patients.** CMAJ 1993; 149(1):41
11. Keily DK **Persistent delirium predicts greater mortality** J Am Geriatr Soc 2009; 57(1):55
12. Campbell et al **Incontinence in the elderly: Prevalence and prognosis** Age and Ageing 1985; 14(2): 65-70
13. Brown et al **Prevalence and outcomes of low mobility in hospitalised older patients** J Am Geriatr Soc 2004; 52(8) 1263-70
14. Boyd et al **Recovery of activities of daily living in older adults after hospitalisation for acute medical illness** J Am Geriatr Soc 2008; 56(12): 1271-9
15. Davies et al **Adverse drug reactions in special populations – the elderly** Br J Clin Pharmacol 2015; 80(4):796-807
16. Clegg et al, **Diagnostic test accuracy of simple instruments for identifying frailty in community-dwelling older people: a systematic review.** Age and Ageing 2015; 44(1): pp148-52.
17. **Updated guidance on supporting routine frailty identification and frailty care through the GP Contract 2017/2018** NHS England 2017
18. Clegg et al, **Development and validation of an electronic frailty index using routine primary care electronic health record data** Age and Ageing 2016; 45(3): pp353-360
19. StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP.

20. R Core Team (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <http://www.R-project.org/>
21. Frank Schaarschmidt (2014). bdpv: Inference and design for predictive values in binary diagnostic tests. R package version 1.1. <https://CRAN.R-project.org/package=bdpv>
22. Cohen J.F. et al, **STARD 2015 guidelines for reporting diagnostic accuracy studies: explanation and elaboration** BMJ Open 2016 6:e012799