Frailty prevalence and screening for frailty among elderly community-dwelling, first-time seekers of formal assistance in Norway.

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Abstract

Background Detection of frailty may be essential to prevent or delay disability in home-dwelling elderly who seek formal assistance for the first time. The prevalence of frailty among elderly, first-time seekers of formal assistance in Norway, is unknown. Simple tests like Short Physical Performance Battery (SPPB) or assessment of gait speed (GS) may identify frailty. The aim of this study was to investigate the prevalence of frailty in this population, and to investigate the test accuracy of GS and SPPB to detect frailty.

Methods We conducted a cross-sectional study of 116 home dwelling elderly > 65 years seeking formal assistance for the first time. Frailty was assessed by an adapted version of Fried Frailty Phenotype (FFP), GS was measured over 4 meters, and physical function was assessed by the Norwegian version of SPPB. The test accuracy for frailty (FFP) of GS < 0.8 m/s, SPPB < 10 and SPPB < 10 were assessed.

Results 62.1%, 29.3% and 8.6% of the participants were frail, prefrail and non-frail, respectively. No association was found between age and degree of frailty. Both GS and SPPB-scores were significantly lower in the frail group than in the prefrail group, as well as significantly lower in the prefrail group than in the non-frail group (both $p < 0.001$). Numbers of criteria in FFP were significantly and inversely associated with GS ($p < 0.001$). GS ≤ 0.8 m/s showed the best test accuracy for frailty, with a sensitivity of 0.99, specificity of 0.37, positive predictive value of 0.76 and negative predictive value of 0.93.

Conclusions The present study assessed that over 90% of elderly seeking formal assistance for the first time were either frail or prefrail. This indicates that screening for frailty should be considered for this population in order to enable action to prevent or delay disability. Further, our results indicate that GS with a cut-off at ≤ 0.8 m/s may represent a feasible and easy-to-use screening tool for detecting frailty in this population.

Background

The ageing population is becoming one of the most comprehensive transformations in society worldwide (1). As the proportion of elderly increases, European countries will face mounting pressure on their public health care systems (2). According to OECD, ensuring economic sustainability and resilience in the health care system requires a reduction of wasteful spending on hospital use, and responding to the increasing need for health care in a more efficient and innovative manner. In Norway, the number of elderly recipients of formal assistance in home care settings (i.e. security alarm connected to health care, practical cleaning assistance, assistive technology for movement or sight, home care reablement and/or homecare) is increasing, although the coverage rate is decreasing slightly (3). Formal assistance is given after inquiry from the citizen. The needs are considered by a health professional, but there are no common practices for assessing health status (4).

There is a lack of knowledge of the health status among those who contact the municipality for assistance for the first time. Frailty may be a condition of special interest in this regard. The condition is a

strong predictor of increased hospital use among elderly and a major driver of health care expenditure (5). It may, however, be prevented, reversed or attenuated by interventions in early stage (6, 7). The impact of frailty may also be mitigated by a comprehensive approach (8). It is therefore suggested that early detection of frailty is essential to prevent or delay disability in home-dwelling elderly (9–12).

Frailty is a clinical state of decline in many physiological systems in late life, with an impaired response to minor stressors like acute illness or trauma. A frail elderly has thereby an increased vulnerability and a higher risk of adverse outcomes like falls, disability, delirium, hospitalization and death (13). The theoretical foundation is internationally accepted, though there are multiple diagnostic frameworks and assessment tools which define and measure frailty differently (14). In clinical settings, Comprehensive Geriatric Assessment (CGA) is endorsed as the optimal diagnostic tool and treatment regime for frail elderly (8). However, CGA is resource-intensive and less usable in research settings (15). Fried Frailty Phenotype (FFP) is one the most widely used assessment tools in research literature (16). FFP is well validated and a reliable model based on biological principles of causality, and has a predictive value on adverse outcomes and responses to therapeutic interventions (13). According to FFP, frailty is defined by meeting three or more of the following criteria; unintentional weight loss, exhaustion, low physical activity, slowness and weakness (17). Prefrailty is defined by meeting one or two of the criteria. It occurs antecedent to frailty and represent higher risk to adverse outcomes than being non-frail.

It is of interest to find even simpler tools than FFP to detect frailty in clinical settings (18). Both SPPB and GS are used as frailty assessment tools in clinical and research settings (16, 19, 20), and both are independently validated to predict adverse outcomes (21, 22). SPPB is a simple, inter-reliable and implemented base assessment tool used by clinical physical therapists in Norwegian primary care (23). It is well validated to assess physical function and to predict disability and all-cause mortality in community-dwelling elderly, and lower scores may define frailty (22, 24–26). The assessment tool consists of three components: assessment of GS, balance, and the ability to rise from a chair. Each component is scored from 0 to 4, leaving total SPPB-score to 0 to 12 points. A reduction of 1 point represents a higher risk of adverse outcomes, and is considered to be clinically significant (22, 24). A cut-off-score < 7 points is associated with an increased risk of disability and mortality, and is suggested to define frailty, and < 10 is associated with an intermediate risk of adverse outcomes, and is suggested to define prefrailty (20, 27). There is also increasing evidence that GS alone is a valid, reliable and sensitive tool for monitoring functional status and overall health for elderly, and GS < 1.0 m/s is associated with an increased risk of falls and incipient functional decline (25, 28–30). GS < 0.8 m/s may have a high sensitivity to detect frailty (FFP) in community-dwelling elderly (31).

Due to diverse settings, population, health care characteristics and frailty instrument tools in studies on community-dwelling populations in primary care settings, results demonstrate a major heterogeneity on frailty prevalence (32). Five European studies report a prevalence rate in primary care settings between 3.9–75.0% (33). We did not find any studies on prevalence of frailty among elderly seeking formal assistance for the first time. The aim of the present study was to investigate the prevalence of frailty

defined by FFP among home-dwelling elderly seeking formal assistance for the first time. Further, we aimed to examine the test accuracy of SPPB or GS to identify frailty in this population.

Methods

The present cross-sectional study used data from the *Interaction project*, a collaborative project between the coordinator office and performing physical therapy department in Drammen municipality in Norway. Drammen is an urban municipality with 70 000 residents. The project period was between week 38/2018 and week 5/2019. During the *Interaction project*-period, all elderly who contacted the coordinator office to ask for assistance for the first time were offered a home visit from a public physical therapist, which included assessment for frailty and physical functioning. Those who were assessed to be frail, prefrail or having low physical functioning were assisted to get appropriate health care. Thereafter they were invited to participate in the study. A written informed consent was obtained from all participant. The study was approved by Regional Committees for Medical and Health Research Ethics (REC, reference 2018/1344) and Norwegian Centre for Research Data (NSD, reference 496235).

The inclusion criteria were elderly > 65 years who, for the first time, asked Drammen municipality for assistance in home care settings. Persons who were not able to complete the tests, were excluded from the study. Persons with acute injuries, severe cognitive impairment, or an inability to communicate in the Norwegian language were excluded. People with severe illnesses, for example palliative cancer patients, were for ethical reasons not asked to participate in the project. The following data was collected: self-reported age, sex, height, weight and type of inquiry; a. security alarm connected to health care, b. practical cleaning assistance, c. assistive technology for movement or sight, d. physical therapy/reablement service and/or e. homecare.

Assessment of frailty, physical function and usual gait speed.

The framework of FFP was used to assess frailty. The five criteria were assessed using tools adapted to the Norwegian language and which were feasible in the participants' home. Details for assessment and cut-off scores are provided in Fig. 1. For assessment of physical activity, the translated and validated Norwegian short version of International Physical Activity Questionnaire was used and calculated as kcal/week using a standardized algorithm (34). GS was measured in meters per second over a distance of 4 meters. The participant started at a given signal, and time was measured with a stopwatch counting by centiseconds. The shortest time of two trials was registered. Physical function was assessed by the valid and reliable Norwegian version of SPPB, with outcomes scores between 0 to 12 points (23, 24). All assessments were completed by a trained physical therapist in the participants' home.

Statistical analyses

We aimed at including at least 116 participants in the study, based on an estimated prevalence of frailty of 40%, and a 95% confidence interval for the prevalence to have a maximum length of 15 percentage points (e.g., 22% – 37%). Statistical analyses were performed by using in IBM SPSS, version 25.0. Proportions were presented with 95% confidence interval [95% CI] and means were presented with standard deviation (sd). We used t-tests to explore statistically significant differences between two groups, men and women, in continuous variables having normal or subnormal distributions. We applied one-way ANOVA to detect significant association between continuous variables in three groups, frail, prefrail and non-frail group. To explore differences in proportion between groups we used Chi-square tests. To explore if GS and SPPB-score were confounding factors with the number of criteria for frailty, we used linear regression analysis. We calculated the sensitivity, specificity, positive predicting value and negative predicting value for SPPB < 10 points, SPPB 7 points and for GS < 0.8 m/s, according to the definitions presented in Fig. 2. A significance level of 5% was used in the statistical analyses.

Results

From a total of 129 elderly included in the *Interaction project*, 4 did not give consent to participate in this study. Nine were excluded due to exclusion criteria, leaving 116 included participants. Age ranged from 65 to 93 years. Descriptive characteristics of the participants are presented in table 1. 62.1 % of the participants were assessed as frail, 29.3% as prefrailty, and 8.6 % as non-frail. A larger percentage of the men were frail as compared to the women, 69.8% vs 57.5%. This difference was, however, not statistically significant. There was no significant association between chronological age and frailty. GS ranged from 0.25 m/s to 1.15 m/s, while the SPPB scores ranged from 1 to 12. A significantly greater proportion of men were assessed to have GS < 0.8 m/s. There was no significant difference in SPPB-scores or GS between men and women, and no significant association between age and GS or age and SPPB-score. Detailed characterisation of participants and results are presented in table 1.

Table 1. Characterizations of participants and results of assessment

	Total	Women	Men	p-value ¹
Characteristics of the participants				
Participants, n	116	73	43	
Proportion, %, [95 % CI]		62.9 [54.1, 71.7]	37.1 [28.3, 45.9]	
Age, mean $\pm$ sd	80.3 $\pm$ 6.7	80.3 $\pm$ 6.0	80.2 $\pm$ 7.7	0.909 ¹
Type of inquiry for formal assistance				
Security alarm connected to health care service, %	47.4	54.8	34.9	0.038 ²
Practical cleaning assistance, %	16.4	19.2	11.6	0.289 ²
Assistive technology, %	48.3	46.6	51.2	0.814 ²
Home care reablement/ active physical therapy, %	24.1	16.4	37.2	0.012 ²
Home care, %	31.0	24.7	41.9	0.053 ²
Proportions of frail, prefrail and non-frail				
Frail (filling 3 or more criteria), %	62.1	57.5	69.8	0.423 ³
Prefrail, (filling 1-2 criteria), %	29.3	32.9	23.3	0.423 ³
Non-frail, n (filling no criteria) (%),	8.6	7.0	9.6	0.423 ³
Criteria for frailty phenotype				
Un-intentional weight loss, %	35.3	34.2	37.2	0.747 ²
Self-reported exhaustion, %	54.3	56.2	51.2	0.601 ²
Low physical activity, %	50.0	45.2	58.1	0.178 ²
Slowness, %	70.7	67.1	76.7	0.272 ²
Weakness (low grip strength), %	61.2	58.9	65.1	0.507 ²
Gait speed (GS)				
GS (m/s), mean $\pm$ sd	0.66 $\pm$ 0.19	0.67 $\pm$ 0.20	0.66 $\pm$ 0.17	0.766 ¹
GS < 1.0 m/s, %	94.8	94.1	95.3	0.846 ²
GS $\leq$ 0.8 m/s, %	87.1	82.2	95.3	0.041 ²
Short physical performance Battery (SPPB), Interval 0-12				
SPPB-score, mean $\pm$ sd	7.8 $\pm$ 2.6	7.9 $\pm$ 2.7	7.8 $\pm$ 2.3	0.846 ¹
SPPB-score < 7, %	31.9	32.9	30.2	0.768 ²
SPPB-score < 10, %	68.1	64.4	74.4	0.263 ²
¹ Independent sample T Test; ² Chi Square test; ³ Chi trend test				

Associations between FFP and GS and/or SPPB-score

Both mean GS and mean SPPB-scores were significantly lower in the frail group than in the prefrail group, and significantly lower in the prefrail group than in the robust group (p<0.001). There was a significant inverse association between GS and number of criteria for frailty phenotype after adjusting for SPPB-score (p < 0.001). The association between SPPB-score and number of criteria for frailty phenotype was

not statistically significant after adjusting for GS ($p = 0.181$). Table 2 provides descriptions of GS and SPPB-scores in the frail, prefrail and non-frail groups, respectively.

Table 2. GS and SPPB-scores in frail, prefrail and non- frail group.

	Frail	Prefrail	Non-frail	P-value
<i>Number and proportion, n (%)</i>	10 (8.6)	34 (29.3)	72 (62.1)	
<i>Gait speed (GS)</i>				
<i>GS (m/s) - mean $\pm$ sd¹</i>	0.58 $\pm$ 0.13	0.75 $\pm$ 0.15	0.99 $\pm$ 0.13	< 0.001 ¹
<i>GS $\leq$ 0,8 m/s, n (%)</i>	77 (98.7)	24 (80.0)	0	< 0.001 ³
<i>Short physical performance Battery (SPPB), Interval 0-12</i>				
<i>SPPB score $\pm$ sd</i>	6.8 $\pm$ 2.3	8.9 $\pm$ 1.9	11.5 $\pm$ 0.7	< 0.002 ¹
<i>SPPB score < 10, n (%)</i>	61 (84.7)	18 (54.5)	0	< 0.001 ³
<i>SPPB score < 7, n (%)</i>	31 (41.3)	6 (18.2)	0	< 0.001 ³
¹ One-way ANOVA; ³ Chi trend test				

Test accuracy of GS < 0.8 m/s, SPPB < 10 and SPPB < 7 to detect frailty (FFP)

The test accuracy indicators of GS < 0.8 m/s, SPPB < 10 and SPPB < 7 to detect FFP are presented in table 3.

Table 3. Test accuracy indicators for GS < 0.8 m/s, SPPB < 10 and SPPB < 7 to detect frailty PFF

	<i>Sensitivity</i>	<i>Specificity</i>	<i>Positive Predictive Value</i>	<i>Negative Predictive Value</i>
<i>GS < 0.8 m/s</i>	0.99	0.37	0.76	0.93
<i>SPPB < 10</i>	0.82	0.61	0.81	0.62
<i>SPPB < 7</i>	0.40	0.84	0.84	0.40

Discussion

Among Norwegian elderly > 65 years seeking formal assistance for the first time, we found that 62.1% were frail, 29.3% were prefrail and 8.6% were non-frail according to FFP. We did not find many studies reporting on prevalence of frailty in this population. A frailty prevalence of 54% has been reported in an Irish study, using Clinical Frailty scale among elderly $\geq$ 65 years who received regular guidance from a public nurse in their home (35). Using Clinical Frailty Scale, 41.5% were found to be frail among elderly receiving low level home help (< 5 hours/week) in another Irish study (36). Finally, 89.9% were classified as frail, according to abbreviated CGA, among older home care clients in Finland (37). Although these

studies have different frailty assessment tools and designs, they indicate that the prevalence of frailty among home-dwelling elderly who receive formal assistance, is major.

The results in the present study indicate that screening for frailty should be performed when elderly seek formal assistance for the first time. Firstly, a screening program for this population will be aimed at a population with high a likelihood of being prefrail or frail. Secondly, since early stage in the frailty process can be clinically silent (13), a screening of this population may enable the public health care system to tailor person-centred interventions that may prevent, delay or reverse the condition before onset of physical and/or mental disability (6, 7, 38). This is important since frailty represents a significant burden for the person, next of kin, and the public health care system (5, 13, 17). The best therapeutic time window for preventing and treating frailty is not clear, though detection is necessary for planning and designing person-centred treatment and care plans also for advanced stages of frailty (9). Approaching frailty with comprehensive geriatric assessment (CGA), making individualized care plans based on person-centred interdisciplinary collaboration, may lessen the disability or mitigate the impact of functional impairment for frail elderly, their next of kin and the public health system (8, 39).

The ideal setting or time for frailty screening programs for elderly might be an issue for further research. Our study indicates that some elderly do not ask for formal assistance before they have developed frailty. It may be conceivable that a request for formal assistance comes as a result of decreased physical resilience or frailty development. It is suggested that frailty indicates a person's "biological age," rather than chronological age, and that it does so with a high degree of precision (40). This may explain the lack of association between frailty and chronological age in this population, even though there is a clear association between frailty and age in community studies (32). There were more women than men in our cross-sectional study, showing that more women applied for formal assistance in the project period. We assessed a not statistically significant greater proportion of the men to be frail. Frailty is, however, more frequent in women than men in community-dwelling populations (32, 41). This may indicate a behavioural difference between women and men when it comes to applying for assistance. More research is needed to explore this subject.

The second aim of this study was to examine the association between SPPB and GS and FFP. We did find a decreasing trend in both GS and SPPB from non-frail to prefrail and frail group. Associations were found between decreasing GS/SPPB and increasing numbers of criteria for frailty phenotype. The inverse association between GS and increasing numbers of criteria was also statistically significant when accounting for the impact of SPPB-score, but the inverse association between SPPB-score and increasing numbers of criteria was not significant when accounting for the impact of slow usual gait speed.

When comparing test accuracy to detect frailty for $GS < 0.8$ m/s, $SPPB < 10$ and $SPPB < 7$, respectively, we found that all three tests had acceptable positive predictive values (0.76–0.84). $GS < 0.8$ m/s had the highest sensitivity (0.99) and lowest specificity (0.37), while $SSSP < 10$ had fair sensitivity (0.82) and highest specificity (0.84).

According to our results, both GS and SPPB appear to be useful tools for screening of FFP among home-dwelling elderly seeking formal assistance for the first time. GS may be superior having higher sensitivity. Castell *et al.* (2013) found that $GS < 0.8$ m/s had 0.99 sensitivity and a 0.64 specificity to detect FFP (31). These results are the basis for the recommendation to assess GS to detect frailty in British primary care, where it is recommended that those who test positive should be followed up by a holistic medical review or CGA (12). SPPB may have fair to moderate agreement with FFP to detect frailty (42), though it is developed to assess lower-extremity function (27). It is accentuated that frailty and disability often co-occurring, even though they represent theoretically distinct domains that are not interchangeable (9, 38). Both in the present study and in previous research there are frequent co-occurrences between lower SPPB-scores and FFP, though the frail group according to FFP does not completely overlap the group having $SPPB < 7$ (20, 42). This may indicate that FFP and SPPB measure different domains. In addition to the high sensitivity of $GS < 0.8$ m/s to detect frailty, the present study found a statistically significant association between lower GS and increasing numbers of criteria for FFP ($p < 0.001$), also when adjusting for SPPB-score. This may implicate an association between lower GS and frailty. This is in line with increasing evidence that GS alone can be considered as a valid, reliable and sensitive tool for monitoring functional status and overall health for elderly (28). There is also increasing evidence that underlying causes to slowness may be related to impairment of multiple physiological systems (29, 43), a description which corresponds with the overall understanding of frailty. As both SPPB and GS are inter-reliable tests when conducted by a trained physical therapist (23, 44), the present study may implicate that involving physical therapists in screening programs to detect frailty could be reasonable.

The present study generates novel and valuable knowledge about frailty in a group of elderly that has previously not been investigated. At the individual level, the knowledge is valuable since identifying frailty enables an action to prevent or delay disability. Also, identifying frailty may provide municipalities with information about their population which enables them to better allocate their resources, planning and development of health care.

A limitation of the presents study, can be linked to a relatively small sample size, i.e. the non-frail group in this study consisted of 10 persons only. Estimates for test-accuracy to detect prefrailty in the present study would thus be inappropriate. However, the clinical implications of having a simple test to detect prefrailty, could be important in order to delay consequences of frailty. Firstly, the transition between frailty status is more common between prefrailty and non-frailty than between frailty and non-frailty (6). Secondly, prefrailty may be more useful than frailty to identify patients at risk of losing their functional capacities (45).

Conclusions

The prevalence of frailty among home-dwelling elderly who, for the first time, sought formal assistance in an urban municipality in Norway, was major. This indicates that screening for frailty may be appropriate when elderly seek formal assistance for the first time. Assessing GS with a cut-off-point at < 0.8 m/s may represent an easy and feasible screening instrument to detect frailty in this population. As the specificity

of GS to detect frailty is rather low, positive tests should be followed by additional assessments. More research is needed, however, before $GS < 0.8$ m/s could be included in clinical practice to detect frailty among first time seekers of formal assistance.

Abbreviations

SPPB

Short Physical Performance Battery

GS

Gait Speed

FFP

Frieds' Frailty Phenotype

CGA

Comprehensive Geriatric Assessment

sd

standard deviation

CI

Confidence Interval

Declarations

Ethics approval and consent to participate

This study was approved by Regional Committees for Medical and Health Research Ethics (REC, reference 2018/1344) and Norwegian Centre for Research Data (NSD, reference 496235). A written informed consent was obtained from all participant. All participants were informed oral and written before signing the consent.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors contributions

IL, LS and HO developed design and method for the study. IL performed the training for examination of participants, was responsible for data collection and was a major contributor in writing the manuscript. All authors analysed and interpreted participants data. All authors read and approved the final manuscript.

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Figures

Criterium	Tool	Cut-off
Weight loss	In the last year, have you lost weight unintentionally. What was your weight and is your weight now?	Yes > 5%
Exhaustion	Using the CES-D Depression Scale, the following two statements are read. (a) I felt that everything I did was an effort; (b) I could not get going. The question is asked "How often in the last week did you feel this way?" 0: rarely or none of the time (<1 day), 1: some or a little of the time (1–2 days), 2: a moderate amount of the time (3–4 days), or 3: most of the time (>4 days).	Subjects answering "2" or "3" to either of these questions are categorized as frail by the exhaustion criterion
Physical Activity	Based on the short version <i>International Physical Activity Questionnaire</i> . Kcals per week expended are calculated using standardized algorithms.	Kcals of physical activity per week < 383 for men, kcals of physical activity per week < 270 for women.
Usual gait speed	Assessed over 4 meters inclusive acceleration	≤ 0.67 m/s for men ≤ 173 cm and women ≤ 159 cm, ≤ 0.76 m/s for men ≥ 173 cm and women ≥ 159 cm
Grip Strength	Average from 4 assessments with Handheld Jamar® dynamometer	Depending on sex and BMI: Men; ≤ 29 kg if BMI ≤ 23, ≤ 30 kg if BMI 23.1-28, ≤ 32 if BMI > 28. Women ≤ 17 if BMI ≤ 23, ≤ 17.3 if BMI 23.1-26, ≤ 18 kg if BMI 26.1-28, ≤ 21 kg if BMI > 28.

Figure 1

Assessment tools and cut-off scores for the five criteria for FFP, inspired by Fried et al (2001).

$$\text{Sensitivity} = \frac{\text{number of frail under test cutoff} - \text{value}}{\text{number of frail}}$$

$$\text{Specificity} = \frac{\text{number of non - frail above test cutoff} - \text{value}}{\text{number of non - frail}}$$

$$\text{Positive predictive value} = \frac{\text{number under cutoff} - \text{value also being frail}}{\text{number under cutoff} - \text{value}}$$

$$\text{Negative predictive value} = \frac{\text{number above cutoff} - \text{value not being frail}}{\text{number above cutoff} - \text{value}}$$

Figure 2

Definitions and calculation method for sensitivity, specificity, positive and negative predictive value.

Supplementary Files

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- [040520STROBEchecklistLaukietal.docx](#)