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Research article

Comparison of geriatric assessment tools for frailty among community elderly

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ABSTRACT

Background: Frailty is an important condition in elderly individuals because it increases disability, morbidity, and mortality. The definition frailty from the Cardiovascular Health Study (CHS) criteria is used worldwide and defined as fulfilling 3 out of the 5 phenotypic criteria that indicate compromised energetics: weakness, slowness, low level of physical activity, self-reported exhaustion, and unintentional weight loss.

Objective: This research aims to study the validity of 5 screening methods, e.g., Clinical Frailty Scale, simple FRAIL questionnaire, PRISMA-7 questionnaire, Time Up and Go Test (TUG), and Gérontopôle frailty screening tool (GFST), and compare those results with the definition of frailty by using the CHS criteria for screening frailty.

Methods: We conducted a cross-sectional study. The sample was 214 elderly individuals, aged ≥60 years, and living in the community. We used 5 screening tests and the Fried phenotype (CHS criteria) as a reference standard. Analysis of the sensitivity, specificity, PPV, NPV, LR+, LR-, and accuracy of each screening was compared with the Fried phenotype (CHS criteria).

Results: The prevalence of frailty of elderly individuals in the community was 11.7% when using the Fried phenotype (CHS criteria). The Clinical Frailty Scale has sensitivity 56%, specificity 98.41%, PPV 82.35%, NPV 94.42%, LR+ 35.28, LR- 0.45, and accuracy 93.46%. The simple FRAIL questionnaire has sensitivity 88%, specificity 85.71%, PPV 44.90%, NPV 98.18%, LR+ 6.61, LR- 0.14, and accuracy 85.98%. The PRISMA-7 questionnaire has sensitivity 76%, specificity 86.24%, PPV 42.22%, NPV 96.45%, LR+ 5.52, LR- 0.28, and accuracy 85.05%. TUG has sensitivity 72%, specificity 82.54%, PPV 35.29%, NPV 95.71%, LR+ 4.12, LR- 0.34, and accuracy 81.31%. The GFST has sensitivity 88%, specificity 83.56%, PPV 41.51%, NPV 98.14%, LR+ 5.37, LR- 0.14, and accuracy 84.11%.

Conclusions: The simple FRAIL questionnaire and GFST have the highest sensitivity compared with the CHS criteria. All screening tests in this study have an accuracy of more than 80% compared with the CHS criteria.

1. Introduction

Frailty is an important condition in elderly individuals because it increases disability, morbidity, and mortality. The definition of frailty is a clinical syndrome meeting 3 or more of 5 phenotypic criteria: weakness, slowness, low level of physical activity, self-reported exhaustion, and unintentional weight loss [1]. The lifelong accumulation of molecular and cellular damage in the aging process causes multiple mechanisms to be regulated by a complex maintenance and repair network influenced by genetic, environmental, and epigenetic mechanisms. The brain, endocrine system, immune system, and musculoskeletal system are intrinsically inter-related and are the organ systems in the development of frailty [2].

The definition frailty from the Cardiovascular Health Study criteria (CHS criteria) is used worldwide and defined by Fried et al. as fulfilling 3 out of the 5 phenotypic criteria that indicate compromised energetics: weakness, slowness, low level of physical activity, self-reported exhaustion, and unintentional weight loss [1]. The CHS criteria are used worldwide for screening frailty and as a reference standard by many researchers [3, 4, 5, 6]. However, the CHS criteria have a limitation in cases of limited time because the CHS has to evaluate the 5 criteria and take time for each criterion.

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This study attempts to compare the outcome of other screening tests for screening frailty conditions compare with that of the CHS criteria for screening frailty in a sample of community elderly. The screening of frailty is critical because it can decrease disability, morbidity, and mortality and improve the quality of life in elderly individuals. There are many methods to screen frailty in elderly individuals, for example, the Clinical Frailty Scale (CFS), simple FRAIL questionnaire, PRISMA-7 questionnaire, Time Up and Go Test (TUG), Gérontopôle frailty screening tool (GFST) [7, 8, 9, 10, 11, 12, 13, 14]. These tools are simple, rapid and common for frailty screening in elderly [7, 8, 9, 10, 11, 12, 13, 14, 15]. However, the different methods of screening have different outcomes. The aim of this research is to study the validity of the different screening methods and then compare that with the definition of frailty based on the CHS criteria or reference standard for screening frailty.

2. Materials and methods

2.1. Study design, setting, and sample size

We conducted this cross-sectional study at Walailak University Hospital, Nakhon Si Thammarat, Thailand, from January 13, 2020, to March 31, 2020. The sample comprised 214 participants (107 men and 107 women) aged ≥60 years and living in the studied community in the south of Thailand. The participants were recruited by using the announcement in the study setting. All the participants voluntarily participated in this research after providing informed consent. The exclusion criteria were patients who were bed-ridden, living in a nursing home, or admitted to the hospital.

The sample size (n) was calculated by using the single proportion population formula:

$$n = Z^2\, p\, (1\text{-}p) / d^2$$

where p = prevalence of the elderly from a previous study, d = precision, and Z = statistic for a level of confidence, which equals 1.96 for a 95% CI. The sample size was calculated based on the prevalence of elderly individuals, namely, 16.7% from a previous study [16], with a precision of 0.05 and a confidence level of 95%. From the calculation, at least 214 patients were required for our study. Finally, 214 participants were enrolled in this study. This study was approved by the Ethics Committee on Human Rights Related to Research Involving Human Subjects, Walailak University, Thailand (WUEC-20-004-01).

2.2. Data collection

Demographic data were collected, including age, sex, marital status, religion, education, occupation, current working status, live alone status, history of smoking, history of drinking alcohol, history of falling in the last year, history of hospital admission in the last year, underlying disease (e.g., hypertension, hyperlipidemia, diabetes mellitus, osteoarthritis of the knee, heart diseases [e.g., ischemic heart disease, heart failure, and valvular heart disease], obstructive lung disease, stroke, gout, allergic rhinitis, cancer, and renal failure), details of physical activity (e.g., frequency and duration of heavy exercise, moderate exercise, walking, and sitting, and basic activities of daily living [basic ADL]), instrumental activities of daily living (IADL), the Barthel index, and current medication. The content validity of all the questionnaires were checked and evaluated by three experts in a field of internal medicine. The information was obtained through the face-to-face review of a participant's medical history and diet pill use and the physical examination by physicians specializing in internal medicine.

Bodyweight and height were measured with the participants in a standing position and barefoot; we used an electronic digital scale and a stadiometer, respectively. Body height was recorded to the nearest 0.5 cm and body weight to the nearest 0.1 kg. Body mass index (BMI) was calculated by body weight (kg) divided by height squared (m^2) [17]. Systolic blood pressure and diastolic blood pressure were measured by an automatic sphygmomanometer with an appropriate arm cuff at heart level after the patient had been sitting quietly for 5–15 min by a community health volunteer who used the standard method [18, 19]. The participants were randomly measured by Clinical Frailty Scale, simple FRAIL questionnaire, PRISMA-7 questionnaire, Time Up and Go test and Gérontopôle screening and follow by the Fried phenotype (CHS criteria) or reference standard on the same day, respectively. The participants took a rest at the interval of 3–5 min before continuing to the next test.

2.2.1. The Fried phenotype of the CHS criteria

The Fried phenotype of the CHS is the most common frailty screening tool used worldwide. Frailty is a syndrome when 3 or more of the 5 phenotype criteria are fulfilled: weakness as measured by low grip strength, slowness based on slow walking speed, low physical activity, self-reported exhaustion, and unintentional weight loss [1]. The frailty group comprises the participants with ≥3 criteria, and the non-frailty group comprises the participants with 0–2 criteria [1, 20, 21, 22]. This study uses the frail phenotype as the reference standard to diagnose frailty.

The Fried phenotype has 5 criteria

1) Weakness

Handgrip strength is the test to evaluate weakness in the CHS criteria. The handgrip test was obtained 3 times in the sitting position by using a digital handgrip strength dynamometer (T.K.K. grip) with the dominant hand. The participants were asked about the dominant hand. If they did not know, the community health volunteer asked which hand the participants used to write. The community health volunteer explained the method to the participants. The handgrip strength was recorded 3 times to the nearest 0.1 kg. The mean of the handgrip strength was calculated in the data analysis [23, 24, 25]. The interpretation of the handgrip strength depends on sex and BMI [26].

2) Slowness

The gait speed test was the test to evaluate slowness in the CHS criteria. The gait speed test was measured by a community health volunteer. Participants walked on the floor from the starting point to the finishing line in a straight line. The distance from start to finish point was 15 feet. The community health volunteer recorded the total time required to traverse the 15 feet to the nearest 0.1 s [1, 27, 28]. The interpretation of slow gait depends on sex and height [26].

3) Low physical activity

Physical activity is the evaluation of low physical activity in the CHS criteria. The physical activity was recorded through questionnaires that inquired about the details of the respondents' physical activity, such as the frequency and duration of heavy exercise, moderate exercise, walking, and sitting. The questionnaires were administered by physicians specializing in internal medicine. The total physical activity (kcal/week) was calculated by using the metabolic equivalent (MET) score as following heavy exercise = 8 MET, moderate exercise = 4 MET, walk = 3.3 MET, sitting = 1 MET [1, 3, 29, 30].

$$\text{The total physical activity (kcal/week) [30]} = \text{activity} - \text{specific MET (kcal/ [kg/hour])} \times \text{body weight (kg)} \times \text{duration of activity (minutes/60)} \times \text{frequency per week (times/week)}$$

Low physical activity was the designation if total physical activity was <383 kcal/week in the male group and <270 kcal/week in the female group [1].

4) Self-report exhaustion

Exhaustion was evaluated by using the self-reports in 2 questions from the Center for the Epidemiological Studies-Depression Scale (CES-D).

Condition 1: I felt everything I did was an effort. If the participants answer "Yes," we evaluated that the frequency was in the past week.

Condition 2: I could not get going the frequency in the past week. If the participants answered "Yes," we evaluated that the frequency was in the past week.

The participants fulfill the exhaustion criteria if they have at least one condition for ≥3 days during the past week [21].

5) Unintentional weight loss

Unintentional weight loss was evaluated. We measured the weight by using an electronic digital scale and reviewed weight in the last year through face-to-face questions. The participants' current medication, namely, their consumption of diet pills was evaluated. The participants fulfilled the unintentional weight loss criteria if they had a loss of body weight of ≥4.5 kg in the last year [1, 26].

2.2.2. The Clinical Frailty Scale

The Clinical Frailty Scale (CFS) was assessed through a face-to-face assessment to evaluate any underlying diseases, the frequency of exercise, and basic ADL and IADL conducted physicians specializing in internal medicine. The CFS was assigned from category 1 (very fit) to category 9 (terminally ill) [7, 31]. Categories 8 and 9 were excluded by the bed-ridden criteria of this study. The male and female participants were considered in the frail group if in categories 5–7 and the non-frail group if in categories 1–4 [31].

2.2.3. The simple FRAIL questionnaire

The simple FRAIL questionnaire screening tool was assessed by using short-five questions (Yes = 1 score, No = 0 score). The maximum score was 5, and the minimum score was 0.

Fatigue – Are you fatigue?

Resistance – Cannot walk up 1 flight of stairs?

Aerobic – Cannot walk 100 m?

Illness – Do you have more than 5 underlying diseases?

Loss of weight – Have you lost more than 5% of your body weight in the past 6 months? [9, 32].

The community health volunteer asked 5 questions and recorded the total score.

The male and female participants were considered in the frail group if the total score was 3–5 and non-frail if the total score was 0–2 [9,32].

2.2.4. PRISMA-7 questionnaire

The PRISMA-7 questionnaire (PRISMA-7) was assessed by 7 questions. The community health volunteer asked the questions. The participants answered Yes = 1 or No = 0 for each question.

The maximum score was 7, and the minimum score was 0. The community health volunteer recorded the total score. The male and female participants were considered in the frail group if the total score was ≥3 and in the non-frail group if the total score was equal to 0–2 [14,33, 34].

The PRISMA-7 questionnaire comprised 7 questions:

Question 1: Are you more than 85 years old?

Question 2: Are you male?

Question 3: In general, do you have any health problems that require you limit to your activities?

Question 4: Do you need someone to help you on a regular basis?

Question 5: In general, do you have any health problems that require you to stay at home?

Question 6: In case of need, can you count on someone close to you?

Question 7: Do you regularly use a stick, walker, or wheelchair to get about? [14, 33, 34].

2.2.5. TUG

TUG was measured by a community health volunteer. Participants stood up from a seated position in a chair, walked on the floor in a straight line at a normal pace for 10 feet and then turned around and sat back down on the chair. The participants were permitted to use a walking aid if they walked with a walking aid (e.g., a walker or cane). The community health volunteer recorded the total in TUG to the nearest 0.1 s. The frailty state was designated when the total time was ≥10 s in the male and female groups [6, 13, 15].

2.2.6. Gérontopôle frailty screening tool

The GFST comprised 6 questions. The participant answered Yes = 1 or No = 0 to each question. The maximum score was 6, and the minimum score was 0. The male and female participants were considered in the frail group if the total score was ≥3 and in the non-frail group if the total score was equal to 0–2.

Question 1: Does the participant live alone?

Question 2: Has the participant involuntarily lost weight in the last 3 months?

Question 3: Has the participant had more fatigue in the last 3 months?

Question 4: Has the participant experienced increased difficulty in mobility in the last 3 months?

Question 5: Has the participant complained of memory problems?

Question 6: Does the participant present a slow gait speed (i.e., >4 s to walk 4 m)? [8, 35].

2.3. Data analysis

Statistical analysis was performed using the R environment for statistical computing. Quantitative variables were described as the mean ± standard deviation. Categorical variables were expressed as percentages and frequencies. Differences between groups were analyzed by an unpaired t test to compare the demographic data between the sex groups. The differences in frequency between groups were analyzed by the chi-square test (Fisher's exact test) to compare the positive case in screening tests between the sex groups. The sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, negative likelihood ratio, and accuracy of screening frailty tools were

Table 1. Characteristics of elderly individuals (n = 214).

Characteristics	number	(%)
Age (years)		
60–69	119	55.6
70–79	73	34.1
>80	22	10.3
Gender		
Male	107	50
Female	107	50
Marital status		
Single	8	3.7
Married	154	72
Widowed	52	24.3
Religion		
Buddhism	206	96.3
Islam	8	3.7
Underlying disease		
No	37	17.3
Yes	177	82.7
Current working status		
No	145	67.8
Yes	69	32.2
Live alone		
No	191	89.3
Yes	23	10.7
Polypharmacy*		
No	195	91.1
Yes	19	8.9
History of admission in last year		
No	148	69.2
Yes	66	30.8
History of falling in last year		
No	169	79
Yes	45	21
Smoking		
Never smokers	159	74.3
Former smokers	31	14.5
Current smokers	24	11.2
Alcohol drinking		
Never drinkers	187	87.4
Former drinkers	12	5.6
Current drinkers	15	7
Basic ADL		
Group 1	197	92.1
Group 2	17	7.9
Education		
None	8	3.7
Primary education	128	59.8
Elementary education	23	10.7
Junior high school	16	7.5
Senior high school	19	8.9
Vocational certificate/high vocational certificate	10	4.7
Bachelor's degree	10	4.7
Occupation		
Employee	61	28.5
Merchant	58	27.1
Housemaid	43	20.1
Farmer	19	8.9
Government official	19	8.9
Fishing	10	4.7
Mason	4	1.9

ADL: activities of daily living.
* Polypharmacy is defined as current medications ≥5 appropriate medications [36, 37].

analyzed as a percentage with 95% CI. The significance of data was considered when the *P* value was <0.05.

3. Results

3.1. Characteristics of the elderly individuals

The final sample comprised 214 participants (107 females and 107 males) aged ≥60 years. The maximum age was 97 years, and the minimum age 60 years. The characteristics of the elderly individuals are presented in Table 1. The highest percentage was for the group aged 60–69 years. The highest percentage for marital status was widowed. Buddhism was the most common religion. The most occupation was employee.

3.2. Demographic data: the sex groups

Table 2 shows the demographic data of the female and male groups. The mean height, handgrip strength, and duration of sitting were significantly higher in the male group than in the female group. Additionally, the mean BMI was significantly lower in the male group than in the female group. The age, weight, weight in the last year, Barthel index score, frequency of admission in the last year, total duration of admission in the last year, frequency of falling in the last year, 15-foot walk test, frequency of heavy exercise, duration of heavy exercise, frequency of walks, duration of walks, and total physical activity had no statistically significant difference between the male and female groups. Table 3 shows the percentages of the underlying disease, and the top 3 underlying diseases in elderly individuals are hypertension, hyperlipidemia, and diabetes mellitus.

3.3. Percentage of positive cases in screening geriatric tools in the sex groups

Table 4 shows that the prevalence of frailty in the community by using the CHS criteria is 11.7%. The highest positive case in screening frailty is 24.8% by using the GFST criteria, and the lowest positive case in screening frailty is 7.9% by using the CFS criteria. The positive cases in the simple FRAIL questionnaire, TUG, and GFST were significantly lower in the male group than in the female group.

3.4. The sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, negative likelihood ratio, and accuracy of the screening frailty tool

As compared with the Fried phenotype (CHS criteria) as a reference standard, the results demonstrated that simple FRAIL questionnaire and GFST have the highest sensitivity. CFS has the highest specificity (Table 5). All the tests in this study have an accuracy of more than 80%. The tests with the highest and the lowest accuracy are the CFS (93.46%) and TUG (81.31%), respectively (Table 6).

4. Discussion

The prevalence of frailty in elderly individuals in the community was 11.7% when using the CHS criteria to diagnose frailty (Fried phenotype). The prevalence of other countries varies, such as 3.9% in China by using the Fried phenotype, 26% in India by using the Fried phenotype, and 51.4% in Cuba by using Cuban frailty criteria [38]. A study in Thailand showed that the prevalence of frailty was 9.4% by using the Fried phenotype in community-dwelling elderly individuals within the knee osteoarthritis population [3]. The study demonstrated that the frailty cases in the male group were lower than that in the female group in all screening tests, which is a result similar to a study in community-dwelling elderly individuals within a knee osteoarthritis population [3]. A study in community-dwelling elderly individuals in

Table 2. Demographics stratified by sex.

Variables	Male (n = 107) Mean ± SD	Female (n = 107) Mean ± SD	*P* value
Age (years)	70.07 ± 7.15	69.28 ± 7.13	0.417
Weight (kg)	61.93 ± 10.95	60.75 ± 13.05	0.475
Height (m)	1.65 ± 0.06	1.53 ± 0.06	<0.001**
BMI (kg/m^2)	22.73 ± 3.85	26.01 ± 5.34	<0.001**
Weight in the last year (kg)	62.51 ± 10.83	60.83 ± 13.25	0.31
Barthel index score	99.35 ± 2.484	98.93 ± 2.92	0.257
Frequency of hospital admission in the last year (time/year)	0.5 ± 1.144	0.45 ± 0.849	0.684
Total duration of admission in the last year (day/year)	1.72 ± 4.03	0.93 ± 1.89	0.07
Frequency of falling in the last year (time/year)	0.27 ± 0.61	0.36 ± 0.82	0.344
Handgrip strength (kg)	28.29 ± 6.77	18.69 ± 4.66	<0.001**
15 foot walk (min)	5.78 ± 2.33	6.32 ± 2.51	0.103
Frequency of heavy exercise (day/week)	1.24 ± 2.41	1.11 ± 2.27	0.683
Duration of heavy exercise (minute/day)	23.98 ± 59.64	14.58 ± 43.38	0.189
Frequency of moderate exercise (day/week)	5.41 ± 2.21	5.48 ± 2.47	0.838
Duration of moderate exercise (minute/day)	83.27 ± 86.90	72.48 ± 78.49	0.341
Frequency of walks (day/week)	6.91 ± 0.56	6.87 ± 0.62	0.642
Duration of walks (minute/day)	100.09 ± 59.41	95.61 ± 54.15	0.564
Duration of sitting (minute/day)	145.59 ± 61.17	122.38 ± 51.15	0.003*
Total physical activity (Kcal/week)	936.07 ± 777.01	780.90 ± 571.59	0.098

*statistically significant at $P < 0.05$ **statistically significant at $P < 0.001$.

Japan demonstrated sex-related differences associated with dietary consumption. The consumption of fish, meat, vegetables, and potatoes was recommended to prevent frailty in females [39]. The difference in frailty rate might be explained by genetics, the environment, sex hormones, and nutritional status [39, 40, 41].

We showed that the CFS has the following: sensitivity 56%, specificity 98.41%, PPV 82.35%, NPV 94.42%, LR+ 35.28, LR- 0.45, and accuracy 93.46%. The CFS has the highest specificity and accuracy; this test would be useful in the diagnosis but has low sensitivity compared with the other screening tests. This outcome is similar to a study that used the CFS compared with comprehensive geriatric assessment in the emergency department in the West of Ireland and found that the CFS has the following: sensitivity 51%, specificity 94%, PPV 93%, and NPV 57% when using the cut point of frailty at ≥ 5 [42]. A study that compared CFS screening and the Edmonton Frail Scale in the perioperative department of the Royal Melbourne Hospital revealed that the CFS has a sensitivity of 80.8% and specificity of 88.6% when using a CFS at ≥ 5 and that the area under the receiver operating characteristic curve was 0.91 (95% CI, 0.86 to 0.94) [43].

This study found that the simple FRAIL questionnaire has the following: sensitivity 88%, specificity 85.71%, PPV 44.9%, NPV 98.18%, LR+ 6.61, LR- 0.14, and accuracy 85.98%. The simple FRAIL questionnaire was the highest sensitivity and that was similar to the GFST in this study. This finding suggested that the simple FRAIL questionnaire was an appropriate test for a screening test because it has a high sensitivity. The screening with 4 questions using simple FRIAL questionnaire (weight loss, aerobic capacity, fatigue, and physical resistance) compared with CHS criteria in the geriatric out-patient unit in Brazil had the following: sensitivity 85%, specificity 37%, PPV 81%, and NPV 44% when using cut-point ≥ 1 sensitivity 54%, specificity 73%, PPV 86%, and NPV 34% when using cut-point ≥ 2; and sensitivity 28%, specificity 90%, PPV 90%, and NPV 29% when using cut-point ≥ 3 [4]. A study showed the association of frailty by using 5 questions in the simple FRAIL questionnaire and a cut-point ≥ 3, the outcome of the frailty association with the next 1-year mortality in geriatric trauma patients was observed (adjust Odd ratio 1.74, $p < 0.001$) [12].

The comparison of PRISMA-7 and the Fried phenotype (CHS criteria) showed the following: sensitivity 76%, specificity 86.24%, PPV 42.22%, NPV 96.45%, LR+ 5.22, LR- 0.28, and accuracy 85.05%. A study showed the PRISMA-7 compared with a comprehensive geriatric assessment in the emergency department in the West of Ireland and demonstrated that it has the following: sensitivity 84%, specificity 78%, PPV 84%, and NPV 78% when using PRISMA-7 score ≥3 [42]. A study in community-dwelling elderly individuals living in Antalya, Turkey, used PRISMA-7 compared with CFS and found that PRISMA-7 has the following: sensitivity 87.7%, specificity 76.5%, PPV 74%, and NPV 89% when using a cut-point ≥ 3 [14]. Additionally, PRISMA-7 showed accuracy (area under the curve: AUC = 0.85) after using Fried phenotype (CHS criteria) as a reference standard [10, 14, 44].

The comparison of TUG with the Fried phenotype (CHS criteria) demonstrated that TUG has the following: sensitivity 72%, specificity 82.54%, PPV 35.29%, NPV 95.71%, LR+ 4.12, LR- 0.34, and accuracy 81.31%. A study of the older community-living population in Ireland demonstrated that TUG compared with the Fried phenotype (CHS criteria) has the following sensitivity 93%, specificity 62%, and PPV 16% when using a cut-off of 10 s; additionally, TUG can identify frail elderly individuals (AUC = 0.87) [6]. However, another study in Ireland showed the when using TUG compared with the Fried phenotype (CHS criteria), using TUG alone, frailty status was classified correctly with the mean classification accuracy of 71.82% [5].

Table 3. Percentage of underlying diseases in elderly individuals (n = 214).

Underlying disease	Number	(%)
Hypertension	111	51.9
Hyperlipidemia	75	35
Diabetes mellitus	47	22
Osteoarthritis of the knee	30	14
Heart disease	17	7.9
Obstructive lung disease	12	5.6
Stroke	11	5.1
Gout	10	4.7
Allergic rhinitis	7	3.3
Cancer	4	1.9
Renal failure	2	0.9

Table 4. Percentage of positive cases in screening geriatric tools for the sex groups (n = 214).

Screening tool	Positive Case (n,%)	Male (n = 107)	Female (n = 107)	*P* value
Fried phenotype (CHS criteria)	25 (11.7)	10	15	0.395
Clinical Frailty Scale	17 (7.9)	6	11	0.312
Simple FRAIL questionnaire	49 (22.9)	11	38	<0.001**
PRISMA-7	45 (21)	17	28	0.093
Time Up and Go Test	51 (23.8)	17	34	0.010*
Gérontopôle frailty screening tool	53 (24.8)	19	34	0.026*

*statistically significant at $P < 0.05$ **statistically significant at $P < 0.001$.

Table 5. The sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, and negative likelihood ratio of the screening frailty tool.

Screening frailty tool	Sensitivity* (95% CI)	Specificity* (95% CI)	PPV* (95% CI)	NPV* (95% CI)	LR+* (95% CI)	LR-* (95% CI)
Clinical Frailty Scale	56.00 (34.93–75.60)	98.41 (95.43–99.67)	82.35 (59.03–93.79)	94.42 (91.57–96.34)	35.28 (10.89–114.26)	0.45 (0.29–0.70)
Simple FRAIL questionnaire	88 (68.78–97.45)	85.71 (79.90–90.37)	44.90 (35.83–54.32)	98.18 (94.91–99.36)	6.61 (4.22–8.99)	0.14 (0.05–0.41)
PRISMA-7	76 (54.87–90.64)	86.24 (80.50–90.81)	42.22 (32.45–52.64)	96.45 (93.10–98.20)	5.52 (3.63–8.40)	0.28 (0.14–0.56)
Time Up and Go Test	72 (50.61–87.93)	82.54 (76.36–87.67)	35.29 (26.88–44.74)	95.71 (92.22–97.67)	4.12 (2.78–6.12)	0.34 (0.18–0.64)
Gérontopôle Frailty Screening Tool	88 (68.78–97.45)	83.6 (77.53–88.58)	41.51 (33.27–50.25)	98.14 (94.79–99.35)	5.37 (3.77–7.64)	0.14 (0.05–0.42)

PPV: positive predictive value; NPV: negative predictive value; LR: likelihood ratio.
* Compared with Fried phenotype (CHS criteria) as a reference standard.

Table 6. Accuracy of the screening geriatric tool (n = 214).

Screening frailty tool	Accuracy (%)*	95% CI
Clinical Frailty Scale	93.46	89.27–96.38
Simple FRAIL questionnaire	85.98	80.60–90.34
PRISMA-7	85.05	79.55–89.54
Time Up and Go Test	81.31	75.43–86.30
Gérontopôle frailty screening tool	84.11	78.51–88.74

* compared with Fried phenotype (CHS criteria) as a reference standard.

We showed the outcome of the GFST compared with the Fried phenotype (CHS criteria) and found that the GFST has the following: sensitivity 88%, specificity 83.6%, PPV 41.51%, NPV 98.14%, LR+ 5.37, LR- 0.14, and accuracy 84.11%. In a study by the European Union Geriatric Medicine Society, the GFST has the following—sensitivity 71.0%, specificity 70.2%, PPV 75.9%, NPV 64.7%, LR+ 2.38, and LR- 0.41—as the identification criteria of non-disabled frail elders [45]. The highest sensitivity of the GFST in this study was similar to the simple FRAIL questionnaire, but the accuracy of the GFST is lower than that of the simple FRAIL questionnaire.

Furthermore, the highest sensitivity was observed in the simple FRAIL questionnaire and GFST. This finding suggested that both screening tools contained questions directly focused on signs and symptoms of frailty whereas TUG only collected the data on physical examination with the cut point of time. In addition, CFS has the highest specificity which may result from the fact that it mainly focuses on the clinical examination of frailty.

However, all the screening tests in this study (CFS, simple FRAIL questionnaire, PRISMA-7 questionnaire, TUG, and GFST) has an accuracy of more than 80% compared with the Fried phenotype (CHS criteria).

5. Conclusions

Our findings suggest that the simple FRAIL questionnaire and GFST are the most appropriate tests to use in screening frailty in the community because they have the highest sensitivity compared with CHS criteria, as a reference standard. However, the CFS is the most appropriate to use in diagnosis because it has high specificity but low sensitivity. This study demonstrates the frailty screening tools for elderly is useful in the community and could apply in the primary care.

6. Limitations

Frailty syndrome is difficult to diagnose. However, the Fried phenotype is used as the reference standard [1, 26].

Declarations

Author contribution statement

N. Sukkriang: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

C. Punsawad: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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