

Article

Agreement of Pre-Frailty Classification Based on Subjective Motor Ability with the Revised Japanese Cardiovascular Health Study Criteria in Community-Dwelling Older Adults

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Abstract

Subjective grip strength and subjective walking speed may reflect actual grip strength and walking speed, respectively, in older adults. We examined whether pre-frailty could be identified using subjective motor ability. This cross-sectional observational study included 367 community-dwelling older adults who participated in physical fitness sessions in 2023. Frailty status was assessed using the revised Japanese Cardiovascular Health Study (J-CHS) criteria. A modified J-CHS classification was constructed by replacing the grip strength and walking speed components of the revised J-CHS criteria with subjective grip strength and subjective walking speed, respectively. Physical function was compared between the robust and pre-frail groups using analysis of covariance. Agreement between the revised J-CHS criteria and the modified J-CHS classification using the “disagree only” threshold was 79.0%, with a weighted kappa coefficient of 0.692. Subjective grip strength showed moderate discriminative performance for identifying objective low grip strength, whereas subjective walking speed showed lower discriminative performance for identifying objective slow walking speed. Comparisons of physical function revealed significantly lower physical function in the pre-frail group than in the robust group for both classifications. These findings suggest that subjective motor ability may help screen for pre-frailty in community-dwelling older adults.

Keywords: community-dwelling older adults; physical function; pre-frailty; subjective grip strength; subjective walking speed



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1. Introduction

Frailty is defined as “a state of increased vulnerability to health problems due to various age-related functional changes and loss of reserve capacity” [1] and is a risk factor for various adverse health outcomes in older adults [2–4]. Pre-frailty, the intermediate stage preceding frailty, is associated with a higher risk of falling [5], greater decline in activities

of daily living (ADLs) and instrumental ADLs [5,6], and increased likelihood of requiring nursing care [7], compared with non-frailty. The prevalence of frailty and pre-frailty among community-dwelling older adults in Japan is 7.4% and 48.1%, respectively [8], indicating that approximately half of this population is at risk of pre-frailty. However, frailty and pre-frailty are potentially reversible conditions, with a 2.5-year follow-up study reporting improvement rates of 6.5% among individuals with frailty and 32.5% among those with pre-frailty [9]. Given these findings, older adults with frailty or pre-frailty should be prioritized for care prevention measures, with early detection playing a crucial role in achieving this goal.

The Cardiovascular Health Study (CHS) criteria proposed by Fried et al. [10] are widely used internationally to identify frailty. This method assesses physical frailty based on five components: weight loss, muscle weakness, fatigue, walking speed, and physical activity. In Japan, the revised Japanese CHS (J-CHS) criteria have been adapted for use in older Japanese adults [11]. The revised J-CHS criteria retain the same five components as the original CHS criteria. The revised J-CHS criteria differ from the original CHS criteria in that the cutoff values for physical performance components, including grip strength and walking speed, are adapted for older Japanese adults. Additionally, from a practical standpoint, several questionnaire-based approaches have been developed to assess frailty. The Kihon Checklist, commonly used in Japanese long-term care prevention programs, is a valuable tool for evaluating frailty [12]. However, as it contains 25 items, it may impose a considerable burden on respondents. The Frailty Screening Index and FRAIL Scale offer simpler assessments, each consisting of five questions corresponding to the CHS criteria [13,14]. Nevertheless, these methods substitute items related to physical function with those assessing cognitive function, functional limitations, and comorbidities, which may reduce their ability to capture the physical characteristics of frailty as defined by the CHS criteria.

Self-reported assessments by older adults may serve as practical alternatives to performance-based measures, as they are associated with objective physical function and are predictive of future functional decline [15,16]. Recent studies have shown that subjective grip strength and subjective walking speed correspond closely to objectively measured values [17–19]. The assessment of subjective motor ability provides a simple means to identify older adults with declining physical function [18–20]. Consequently, questionnaire-based assessments could evaluate frailty components analogous to the CHS criteria by substituting objective measures of grip strength and walking speed with subjective grip strength and subjective walking speed, respectively. Such an approach offers advantages in terms of simplicity and cost-effectiveness compared with existing tools and is particularly suitable for large-scale or non-face-to-face health surveys. This method enables the screening of a larger population of older adults than would be feasible with more resource-intensive assessments, facilitating early detection and intervention for frailty and potentially reducing the associated health risks. Furthermore, it may contribute to lowering the human and time costs of community-based care prevention initiatives.

Therefore, this study aimed to examine whether pre-frailty could be identified using subjective indicators alone among community-dwelling older adults by assessing the agreement between the revised J-CHS criteria and a modified J-CHS classification.

2. Materials and Methods

2.1. Study Design and Participants

This cross-sectional observational study included 424 community-dwelling older residents who participated in physical fitness sessions held in three cities between September and November 2023 and provided consent to participate in the study. The exclusion criteria

were as follows: (1) age < 65 years, (2) Mini-Mental State Examination (MMSE) score < 24, and (3) inability to perform all measurements.

2.2. Measurements

Age, sex, height, and weight were recorded as basic attributes. The body mass index (BMI) was calculated from height and weight. Subjective grip strength and subjective walking speed were assessed using questionnaires based on previous studies [17,18,20]. Frailty was assessed using the revised J-CHS criteria. In addition, the modified J-CHS classification was constructed by replacing the grip strength and walking speed components of the revised J-CHS criteria with subjective grip strength and subjective walking speed, respectively. Cognitive function was evaluated using the MMSE, and depressive symptoms were assessed with the 5-item Geriatric Depression Scale (GDS-5). Physical function was measured using quadriceps muscle strength as an indicator of lower limb strength, the 30-s chair stand test (CS-30) as an indicator of muscle endurance, one-leg standing time as an indicator of static balance, and the timed up and go test (TUG) as an indicator of dynamic balance, in addition to grip strength and walking speed.

2.2.1. Assessment of Subjective Grip Strength and Subjective Walking Speed

Subjective grip strength and subjective walking speed were assessed using questionnaire items adapted from previous studies [17,18,20]. Participants were asked the questions, “Do you think your grip is stronger than that of other people of the same sex and age?” and “Do you think your walking speed is faster than that of other people of the same sex and age?” Four response options were provided: “agree,” “moderately agree,” “moderately disagree,” and “disagree.” No additional explanation was provided beyond the question wording and response options.

2.2.2. Determination of Frailty and Pre-Frailty

The revised J-CHS criteria were used to determine frailty and pre-frailty [11]. The five items evaluated were as follows: (1) weight loss (>2 kg in 6 months), (2) muscle weakness (male: grip strength < 28 kg, female: grip strength < 18 kg), (3) fatigue (feeling tired without reason for the past 2 weeks), (4) slow walking speed (normal walking speed < 1.0 m/s), and (5) physical activity (no light exercise/exercise, no regular exercise/sports). Participants with 0, 1–2, and ≥ 3 positive items were classified as robust, pre-frail, and frail, respectively [11]. For the modified J-CHS classification, only the muscle weakness and slow walking speed components of the revised J-CHS criteria were replaced with subjective grip strength and subjective walking speed, respectively; the remaining three components were assessed using the same criteria as the revised J-CHS criteria. Participants were classified as robust, pre-frail, and frail using the same positive-item counts as the revised J-CHS criteria.

2.2.3. Assessment of Cognitive Function

Cognitive function was assessed using the MMSE [21]. The MMSE is a widely used screening test for dementia. It is a 30-point test comprising 11 questions. A higher score indicates better cognitive function, whereas a score of <24 points indicates suspected dementia [22].

2.2.4. Assessment of Depressive Symptoms

Depressive symptoms were assessed using the GDS-5, a simplified version of the GDS [23]. The GDS-5 consists of five questions answered with “Yes” or “No.” Specifically, 1 point was assigned for each response indicating depressive symptoms, and the total

score, ranging from 0 to 5 points, was used to evaluate symptom severity. This 5-item scale assigns higher scores to greater depressive symptomatology.

2.2.5. Measurement of Grip Strength

Grip strength was measured using a new physical fitness test in Japan [24]. A digital grip strength meter (T.K.K. 5401; Takei Kiki Kogyo Co., Niigata, Japan) was used for the measurements, and the grip width of the grip strength meter was adjusted such that the second joint of the index finger was at a right angle. Measurements were performed in the standing position, with participants instructed to grip the grip strength meter with maximal effort. Care was taken to ensure that the device did not touch the body or clothing. Each side was measured twice, and the highest value was recorded as the representative grip strength.

2.2.6. Measurement of Walking Speed

Walking speed was measured using a sheet-type foot pressure ground footprint measuring device (WalkWay MW-1000; Anima Co., Tokyo, Japan) [25]. A 6.4-m walking path was used for the measurements, consisting of a 2-m acceleration zone, a 2.4-m measurement section, and a 2-m deceleration zone. Participants were barefoot during testing, and their normal and maximum walking speeds were recorded. Prior to the measurement, they were instructed to “walk at your usual pace” and then to “walk as fast as possible without running,” in that order. Each measurement was performed twice, and the fastest value for each measurement was used as the representative walking speed.

2.2.7. Measurement of Other Physical Functions

Quadriceps muscle strength was measured using a single-leg muscle force-measuring table (T.K.K. 5715; Takei Kiki Kogyo Co., Niigata, Japan) and a tension meter (T.K.K. 5710 (e); Takei Kiki Kogyo Co., Niigata, Japan) [26]. Measurements were conducted with participants in a seated position on the muscle force-measuring table, with both arms crossed in front of the chest. The distal lower leg and tension meter were secured with a belt, and participants were instructed to extend the knee joint with maximal effort. Measurements were performed twice on each side, and the highest value was used as the representative value.

CS-30 performance was assessed using the method described by Jones et al. [27]. Participants began in a seated position on a 40-cm-high chair without armrests, with their arms crossed in front of the chest. They were instructed to repeatedly stand up and sit down as many times as possible within 30 s, exerting maximal effort. The test was performed once, and the total number of completed repetitions within 30 s was recorded as the measurement value.

One-leg standing time was measured using the protocol outlined in the New Physical Fitness Test in Japan [24]. Participants stood on one leg, raising the opposite leg forward, with both hands placed on the hips. Timing began when the participant assumed the correct posture and ended when the raised leg touched the supporting leg or floor, the supporting leg shifted position, or either hand left the hip. The maximum measurement time was 120 s. The test was performed twice on each side, and the longest duration was used as the representative value.

The TUG was conducted according to the method described by Wada et al. [28]. Participants began seated on a 40-cm-high chair without armrests. Upon a starting signal, they stood up, walked around a cone placed 3 m ahead, and returned to sit on the chair. The total time required to complete the task was measured using a stopwatch. Participants were instructed to perform the movements with maximal effort. The test was performed twice, and the fastest time was used as the representative value.

2.3. Statistical Analysis

Agreement in frailty classification between the revised J-CHS criteria and the modified J-CHS classification was evaluated using the weighted kappa coefficient (weighted κ) and % agreement. For subjective grip strength and subjective walking speed, two threshold definitions were examined: “moderately disagree or disagree” and “disagree only.” The “disagree only” threshold was used as the stricter definition of subjective weakness or slowness, whereas the “moderately disagree or disagree” threshold was examined to assess whether agreement changed according to the threshold used for subjective motor ability.

As supplementary analyses, the discriminative performance of subjective grip strength for identifying objective low grip strength and subjective walking speed for identifying objective slow walking speed was evaluated using sensitivity, specificity, the positive predictive value (PPV), the negative predictive value (NPV), accuracy, balanced accuracy, Cohen’s κ value, the prevalence-adjusted bias-adjusted kappa (PABAK), and the area under the receiver operating characteristic curve (AUC). These supplementary analyses were performed to evaluate the substituted subjective components independently of the three components shared by the revised J-CHS criteria and the modified J-CHS classification.

The required sample size for comparisons of physical function among the robust, pre-frail, and frail groups was estimated using G*Power 3.1.9.7 (University of Düsseldorf, Düsseldorf, Germany) [29]. For a one-way analysis of variance with three groups, assuming a Cohen’s f of 0.25, an alpha error probability of 0.05, and a power of 0.80, the required total sample size was 159 participants, corresponding to 53 participants per group. Although the total sample size of the present study exceeded this requirement, the number of participants classified as frail was below the required number per group. Therefore, comparisons of physical function were limited to the robust and pre-frail groups.

Physical function was compared between the robust and pre-frail groups for each classification by analysis of covariance using a generalized linear model, with age, sex, BMI, MMSE score, and GDS-5 score as covariates. This analysis was performed to examine whether older adults classified as pre-frail by each classification showed poorer physical function than those classified as robust. Age, sex, and BMI were included as covariates to adjust for basic participant characteristics. The MMSE and GDS-5 scores were also included because cognitive and psychological factors may influence self-reported assessments [30,31]. Adjusted means, standard errors, adjusted mean ratios, and 95% confidence intervals (CIs) are reported to describe the magnitude and direction of group differences. All statistical analyses were conducted using SPSS Statistics (version 30.0; IBM Corp., Armonk, NY, USA), with the significance level set at 5%.

3. Results

After excluding those who met the exclusion criteria, 367 participants were included in the final analysis (Figure 1). The descriptive characteristics of the participants are presented in Table 1. According to the revised J-CHS criteria, 180 participants (49.0%) were classified as robust, 172 (46.9%) as pre-frail, and 15 (4.1%) as frail. In the modified J-CHS classification using the “moderately disagree or disagree” threshold for subjective grip strength and subjective walking speed, 73 participants (19.9%) were classified as robust, 236 (64.3%) as pre-frail, and 58 (15.8%) as frail. The percent agreement with the revised J-CHS criteria was 53.7%, and the weighted κ was 0.456 (95% CI: 0.398–0.515, $p < 0.001$). When the “disagree only” threshold was applied, 166 participants (45.2%) were classified as robust, 181 (49.3%) as pre-frail, and 20 (5.4%) as frail. The percent agreement with the revised J-CHS criteria was 79.0%, and the weighted κ was 0.692 (95% CI: 0.631–0.753, $p < 0.001$) (Table 2).

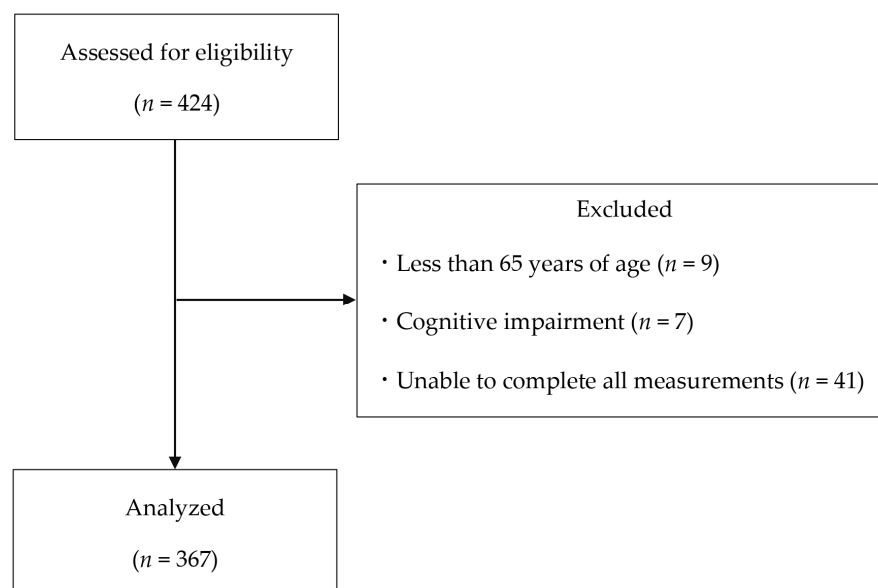


Figure 1. Flowchart of participation criteria.

Table 1. Descriptive characteristics of the participants.

	<i>n</i> = 367
Age (years)	77.0 ± 6.1
Sex	
Male (%)	79 (21.5%)
Female (%)	288 (78.5%)
BMI (kg/m ²)	22.4 ± 3.4
MMSE (score)	28.3 ± 1.8
GDS-5 (score)	0.6 ± 1.0
Grip strength (kgf)	24.6 ± 7.1
Quadriceps muscle strength (kgf)	25.6 ± 9.2
CS-30 (times)	21.5 ± 5.9
One-leg standing time (s)	30.9 ± 32.6
TUG (s)	6.2 ± 1.3
Normal walking speed (cm/s)	127.9 ± 23.2
Maximum walking speed (cm/s)	176.1 ± 32.3

Values are presented as means ± standard deviations. BMI: body mass index, MMSE: Mini-Mental State Examination, GDS-5: 5-item Geriatric Depression Scale, CS-30: 30-s chair stand test, TUG: timed up and go test.

The discriminative performance of subjective grip strength and subjective walking speed for identifying their corresponding objective criteria is shown in Tables 3 and 4. Subjective grip strength identified objective low grip strength with a sensitivity of 61.4%, specificity of 80.8%, PPV of 30.3%, NPV of 93.9%, accuracy of 78.5%, balanced accuracy of 71.1%, Cohen’s κ of 0.292, PABAK of 0.569, and AUC of 0.750 (95% CI: 0.674–0.827, $p < 0.001$). Subjective walking speed identified objective slow walking speed with a sensitivity of 19.1%, specificity of 91.3%, PPV of 24.3%, NPV of 88.5%, accuracy of 82.0%, balanced accuracy of 55.2%, Cohen’s κ of 0.114, PABAK of 0.640, and AUC of 0.635 (95% CI: 0.552–0.719, $p = 0.002$).

Because the number of participants classified as frail was limited, physical function was compared only between the robust and pre-frail groups. After adjustment for age, sex, BMI, MMSE score, and GDS-5 score, the pre-frail group classified by the revised J-CHS criteria showed poorer physical function than the robust group in grip strength ($p < 0.001$), quadriceps muscle strength ($p < 0.001$), CS-30 ($p = 0.003$), one-leg standing time ($p = 0.019$), TUG ($p < 0.001$), normal walking speed ($p < 0.001$), and maximum walking speed ($p < 0.001$).

(Table 5). A similar pattern was observed for the modified J-CHS classification: the pre-frail group showed poorer physical function than the robust group in grip strength ($p < 0.001$), quadriceps muscle strength ($p < 0.001$), CS-30 ($p = 0.010$), one-leg standing time ($p = 0.020$), TUG ($p < 0.001$), normal walking speed ($p = 0.021$), and maximum walking speed ($p < 0.001$) (Table 6).

Table 2. Agreement in frailty classification between the revised J-CHS criteria and the modified J-CHS classification.

			Revised J-CHS			
			Robust	Pre-Frail	Frail	Total
Disagree only	Modified J-CHS	Robust	145	21	0	166
		Pre-frail	35	138	8	181
		Frail	0	13	7	20
		Total	180	172	15	367
		% Agreement				79.0
Weighted κ			0.692			
Moderately disagree or disagree	Modified J-CHS	Robust	66	7	0	73
		Pre-frail	114	119	3	236
		Frail	0	46	12	58
		Total	180	172	15	367
		% Agreement				53.7
Weighted κ			0.456			

J-CHS: Japanese Cardiovascular Health Study.

Table 3. Diagnostic performance of subjective motor ability for objective impairment.

	Subjective Grip Strength	Subjective Walking Speed
Reference standard	Objective low grip strength	Objective slow walking speed
Threshold	Disagree only	Disagree only
Sensitivity (%)	61.4	19.1
Specificity (%)	80.8	91.3
PPV (%)	30.3	24.3
NPV (%)	93.9	88.5
Accuracy (%)	78.5	82.0
Balanced accuracy (%)	71.1	55.2
Cohen's κ	0.292	0.114
PABAK	0.569	0.640

PPV: positive predictive value, NPV: negative predictive value, PABAK: prevalence-adjusted bias-adjusted kappa.

Table 4. Results of the receiver operating characteristic analysis of subjective motor ability for objective impairment.

	AUC	95% CI	p-Value
Subjective grip strength	0.750	0.674–0.827	<0.001
Subjective walking speed	0.635	0.552–0.719	0.002

AUC: area under the receiver operating characteristic curve, CI: confidence interval.

Table 5. Comparison between the robust and pre-frail groups using the revised J-CHS criteria.

	Robust Group (n = 180)	Pre-Frail Group (n = 172)	Adjusted Mean Ratio	95% CI	p-Value
Grip strength (kgf)	28.5 ± 0.4	26.7 ± 0.4	1.065	1.026–1.105	<0.001
Quadriceps muscle strength (kgf)	29.6 ± 0.7	26.5 ± 0.6	1.117	1.049–1.190	<0.001
CS-30 (times)	22.5 ± 0.5	20.6 ± 0.5	1.092	1.031–1.157	0.003

Table 5. *Cont.*

	Robust Group (n = 180)	Pre-Frail Group (n = 172)	Adjusted Mean Ratio	95% CI	p-Value
One-leg standing time (s)	33.0 ± 2.2	26.4 ± 2.0	1.249	1.037–1.504	0.019
TUG (s)	5.9 ± 0.1	6.3 ± 0.1	0.933	0.902–0.966	<0.001
Normal walking speed (cm/s)	132.9 ± 1.7	123.1 ± 1.7	1.080	1.042–1.120	<0.001
Maximum walking speed (cm/s)	186.7 ± 2.3	174.3 ± 2.3	1.071	1.036–1.108	<0.001

Values are presented as adjusted means ± standard errors. These data were analyzed using covariance analysis with a generalized linear model. CS-30: 30-s chair stand test, TUG: timed up and go test, J-CHS: Japanese Cardiovascular Health Study.

Table 6. Comparison between the robust and pre-frail groups using the modified J-CHS classification.

	Robust Group (n = 166)	Pre-Frail Group (n = 181)	Adjusted Mean Ratio	95% CI	p-Value
Grip strength (kgf)	28.7 ± 0.4	26.6 ± 0.4	1.079	1.042–1.118	<0.001
Quadriceps muscle strength (kgf)	29.7 ± 0.7	26.5 ± 0.6	1.122	1.057–1.191	<0.001
CS-30 (times)	22.4 ± 0.5	20.8 ± 0.5	1.075	1.017–1.137	0.010
One-leg standing time (s)	33.1 ± 2.3	26.7 ± 1.9	1.239	1.035–1.483	0.020
TUG (s)	5.9 ± 0.1	6.2 ± 0.1	0.943	0.912–0.974	<0.001
Normal walking speed (cm/s)	130.8 ± 1.9	125.2 ± 1.8	1.044	1.007–1.083	0.021
Maximum walking speed (cm/s)	186.7 ± 2.4	174.8 ± 2.3	1.068	1.034–1.104	<0.001

Values are presented as adjusted means ± standard errors. The data were analyzed using covariance analysis with a generalized linear model. CS-30: 30-s chair stand test, TUG: timed up and go test, J-CHS: Japanese Cardiovascular Health Study.

4. Discussion

This study investigated whether pre-frailty could be identified when the grip strength and walking speed components of the revised J-CHS criteria were replaced by subjective grip strength and subjective walking speed, respectively, in community-dwelling older adults. The results showed that the modified J-CHS classification using the “disagree only” threshold had the highest agreement with frailty classification based on the revised J-CHS criteria. Furthermore, a comparison of physical function between the robust and pre-frail groups, as judged by each classification, revealed similar patterns, with both showing lower physical function in the pre-frail group than in the robust group. These findings suggest that the modified J-CHS classification based on subjective motor ability may help identify pre-frailty among community-dwelling older adults.

The degree of agreement between frailty classification based on the revised J-CHS criteria and the modified J-CHS classification was examined using weighted κ values. The highest agreement was observed when the threshold for subjective motor ability was “disagree only,” with a weighted κ of 0.692, interpreted as substantial agreement [32]. By contrast, when the threshold was “moderately disagree or disagree,” the weighted κ value was 0.456, which is below the threshold generally considered sufficient for agreement (<0.6) [33]. These findings suggest that using “disagree only” as the threshold for subjective motor ability may be appropriate for identifying pre-frailty in community-dwelling older adults. However, the number of participants classified as frail was small, limiting the power for three-group comparisons; thus, the present findings should be interpreted primarily in relation to pre-frailty identification.

Subjective grip strength showed moderate discriminative performance for identifying objective low grip strength, whereas subjective walking speed showed lower discriminative performance for identifying objective slow walking speed. Although subjective walking speed has been reported to reflect measured walking speed, the low sensitivity observed in the present study suggests that subjective walking speed may not identify all older adults who meet the objective criterion for slow walking speed. This finding supports a cautious

interpretation of subjective motor ability because performance-based measures of physical function have been shown to provide information beyond self-reported assessments [34]. Therefore, subjective motor ability should be interpreted as a simple screening approach rather than as a complete replacement for objective physical performance measurements.

Comparisons of physical function between the robust and pre-frail groups, as defined by the revised J-CHS criteria, showed that individuals with pre-frailty exhibited poorer performance across all assessed physical function measures than those classified as robust. Previous studies have reported that compared with robust individuals, those with pre-frailty exhibit weaker grip strength and lower limb muscle strength [35–37], as well as reduced balance and walking ability, corroborating the findings of our study. Older adults with poor physical function are at a higher risk for declines in ADLs and long-term care needs [38–40]. Given that pre-frailty carries a higher risk of ADL decline and certification of nursing care requirements than robustness [5–7], the lower physical function observed in the pre-frail group aligns with findings of prior research.

Physical function was compared between the robust and pre-frail groups based on the modified J-CHS classification after adjustment for basic demographic characteristics, cognitive function, and psychological status. The pre-frail group showed poorer performance across all measured physical function outcomes than the robust group, and this pattern was consistent with that observed using the revised J-CHS criteria. This finding suggests that, at the classification level, the modified J-CHS classification identified a group with physical characteristics consistent with pre-frailty. Brief or questionnaire-based frailty instruments have been evaluated not only by their agreement with established frailty assessments, but also by whether the groups identified by these tools show functional or clinically meaningful characteristics [41,42]. From this perspective, the present physical function comparisons provide supplementary evidence that the modified J-CHS classification captured a pre-frail group with lower physical function. This interpretation is also consistent with the concept of frailty as a clinically meaningful phenotype accompanied by reduced physical performance [43]. However, this classification-level interpretation should be distinguished from the component-level diagnostic performance of subjective grip strength and subjective walking speed. The present findings do not indicate that each subjective component fully identified the corresponding objective impairment. Because the present sample had generally preserved cognitive and psychological status, further studies are needed to determine whether similar findings are observed in populations with cognitive or psychological impairment.

Exercise and nutritional interventions for older adults with pre-frailty have been shown to improve physical function and prevent frailty [44,45]. Therefore, individuals identified as having pre-frailty based on subjective motor ability should be prioritized for interventions, including more detailed assessments. As the population ages, implementing efficient preventive care measures within the constraints of available resources is increasingly important. The results of this study suggest that streamlining candidate selection for long-term care prevention could support optimal resource allocation.

This study has some limitations. Because of the cross-sectional design, temporal sequence and causal relationships could not be established, and the predictive validity of the modified J-CHS classification could not be assessed. Only older adults who voluntarily participated in physical fitness tests were included; those suspected of having dementia or with missing data were excluded, introducing potential selection bias, including healthy volunteer bias, and limiting generalizability. The exclusion of cognitively impaired individuals likely biased the sample toward higher-functioning older adults, potentially overestimating the accuracy of subjective motor ability assessments. Because self-assessment of physical ability may be influenced by cognitive status, self-awareness,

and psychological factors, the accuracy of this approach may differ in more vulnerable populations, such as frail older adults or individuals requiring long-term care. Additionally, the reliability and validity of the questionnaire items for subjective motor ability were not comprehensively evaluated. Although informed by previous research, their psychometric properties, including test–retest reliability, have not been established. The questionnaire was also developed and used in a Japanese context; thus, its cultural applicability to other populations remains uncertain. Perceptions of grip strength and walking speed may vary across populations because self-assessment can be influenced by cultural background, personal expectations, and social comparison. Further, factors such as physical activity, comorbidities, social participation, and self-efficacy, which may influence subjective motor ability assessments, were not considered. Enhanced self-efficacy from regular activity or social engagement could contribute to overestimation of subjective motor ability. Other limitations include potential measurement errors inherent in self-reports and the influence of cultural or educational factors on self-assessment. The limited number of participants classified as frail also precluded detailed characterization of the physical attributes associated with frailty. Therefore, subjective motor ability should not be considered a replacement for objective frailty measurements. Future studies should evaluate the psychometric properties of the subjective motor ability questionnaire items, including test–retest reliability; examine how self-efficacy, regular physical activity, and social participation influence subjective motor ability assessments, including the potential for overestimation; assess the cultural applicability of the questionnaire; and validate this approach in larger and more diverse populations with different cognitive function levels, psychological characteristics, physical activity patterns, comorbidity burdens, socioeconomic backgrounds, social participation levels, and cultural backgrounds. In addition, because the modified J-CHS classification shared three components with the revised J-CHS criteria, the observed agreement at the classification level should be interpreted considering the influence of these shared components. Nevertheless, replacing only the grip strength and walking speed components with subjective grip strength and subjective walking speed, respectively, may provide a practical way to preserve the framework of the revised J-CHS criteria while reducing the need for performance-based measurements in initial screening. Therefore, although subjective motor ability should not be regarded as a replacement for objective frailty assessment, the present findings support its potential usefulness as a simple screening approach for identifying older adults who may require further frailty assessment in large-scale community surveys or non-face-to-face settings.

5. Conclusions

The modified J-CHS classification showed agreement with the revised J-CHS criteria, and the pre-frail group showed poorer physical function than the robust group in both classifications. These findings suggest that subjective motor ability may help identify pre-frailty in community-dwelling older adults as a simple screening approach.

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Abbreviations

The following abbreviations are used in this manuscript:

ADL	activities of daily living
AUC	area under the receiver operating characteristic curve
BMI	body mass index
CHS	Cardiovascular Health Study
CI	confidence interval
CS-30	30-s chair stand test
GDS-5	5-item Geriatric Depression Scale
J-CHS	Japanese Cardiovascular Health Study
MMSE	Mini-Mental State Examination
NPV	negative predictive value
PABAK	prevalence-adjusted bias-adjusted kappa
PPV	positive predictive value
TUG	timed up and go test

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