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Korean version of the Fatigue, Resistance, Ambulation, Illnesses and Loss of weight questionnaire versus the Modified Kihon Checklist for Frailty Screening in Community-Dwelling Older Adults: The Aging Study of PyeongChang Rural Area

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Abstract

Aim—To compare the 5-item K-FRAIL questionnaire (Fatigue, Resistance, Ambulation, Illnesses, and Loss of weight) vs. the 28-item Kihon+3 index (the 25-item original Kihon checklist plus

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Supporting Information

See supplementary file for online publication only (Appendix I. The Kihon+3 checklist)

multimorbidity, sensory impairment, and Timed-Up-and-Go test) in identifying prefrail or frail older adults.

Methods—We conducted a cross-sectional analysis of 212 community-dwelling older adults (mean age 76 years; 41% male) in PyeongChang County, Korea. We compared C statistic, sensitivity, and specificity of the K-FRAIL questionnaire (range: 0–5; cutpoint = 1) vs. the Kihon +3 index (range: 0–31; cutpoint = 4) and the original Kihon checklist (range: 0–25; cutpoint = 4) in identifying prefrail or frail individuals according to the Cardiovascular Health Study (CHS) criteria.

Results—According to the CHS criteria, 150 individuals (70.8%) were prefrail or frail. The C statistic of the K-FRAIL questionnaire in identifying prefrail or frail individuals was lower than that of the Kihon+3 index (0.77 vs. 0.85; $p=0.022$) or that of the original Kihon checklist (0.77 vs. 0.84; $p=0.046$). However, at the a priori cutpoints, the K-FRAIL questionnaire had sensitivity (0.79 vs. 0.85; $p=0.095$) and specificity (0.69 vs. 0.69; $p=1.000$) that were not significantly different from those of the Kihon+3 index. However, the K-FRAIL questionnaire was more sensitive (0.79 vs. 0.69; $p=0.016$), but less specific (0.69 vs. 0.86, $p=0.018$) than the original Kihon checklist.

Conclusions—For frailty screening in community-dwelling older adults, the simple K-FRAIL questionnaire may not be inferior to the current standard of the Kihon+3 index, and it may be more sensitive and less specific than the original Kihon checklist.

Keywords

cross-sectional studies; frailty; geriatric assessment; public health; surveys and questionnaires

INTRODUCTION

Korea is facing a major public health challenge to ensure health and welfare of the rapidly aging population.¹ The number of older adults who reside in long-term care institutions has increased from 30,611 in 2005 to 172,809 in 2010, and the number of people who use national long-term care service has also increased from 522,293 in 2009 to 685,852 in 2013. As a result, the total long-term care cost rose exponentially from \$1.7 billion in 2009 to \$3.1 billion in 2013.^{2, 3} To slow the growth rate of long-term care costs and preserve well-being and independence in older Koreans, there is an urgent need to identify vulnerable older adults in the community who are at high risk for functional decline and institutionalization. Such vulnerability is called frailty that is a consequence of reduced physiologic reserve.^{4–6} Frailty is a strong predictor of falls, loss of independence, institutionalization, health care costs, and death.^{7, 8}

Currently, the Visiting Health Management Program of the Korean Ministry of Health and Welfare uses the “Kihon+3” index to screen for vulnerable older adults with frailty. The original Kihon checklist was first devised in Japan to evaluate functional capacity of older adults and to determine the individual’s need for assistance with daily activities.^{9,10} The Kihon+3 index consists of the 25-item Korean version of Kihon checklist, plus chronic disease, sensory impairment, and the Timed-Up-and-Go test.¹¹ While the Kihon+3 index allows a more comprehensive assessment, it is less practical as a population screening

instrument due to its length and requirement for a physical performance test. Recently, the Korean version of FRAIL questionnaire, or K-FRAIL questionnaire, which considers Fatigue, Resistance, Ambulation, Illnesses, and Loss of weight, has been proposed as a simple screening instrument for frailty in older Koreans.^{12–14} It is not established how this simple questionnaire performs in comparison with the Kihon+3 index.

We conducted a cross-sectional study to test the hypothesis that the K-FRAIL questionnaire could be used to identify vulnerable older adults without meaningful loss in sensitivity compared with the Kihon+3 index. Our rationale was that adopting a simple screening instrument would enable population screening through efficient use of time and resources.

METHODS

Study design and sample

The Aging Study of PyeongChang Rural Area (ASPRA) is a community-based, prospective cohort study of frailty and geriatric syndromes in older Koreans living in rural area.¹⁵ The design and conduct were described elsewhere.¹⁵ Briefly, we enrolled 382 older adults in 2 communities of Pyeongchang-County, Gangwon-Province, Korea, which is located 180 kilometers east of Seoul. The inclusion criteria were 1) age 65 years or older; 2) registered in the National Health Service; 3) ambulatory; and 4) living at home. Individuals were excluded if they were 1) institutionalized; 2) hospitalized at the time of assessment; or 3) bed-ridden and receiving a nursing-home level care at home.

The recruitment and baseline assessment took place between October 2014 and December 2014. The participation rate was 95% and characteristics of ASPRA participants were comparable to those of a nationally representative sample of Korean rural population, except higher proportion of ASPRA participants working in agriculture and with low formal education.¹⁵ In this study, we used data from 212 participants in Haanmi-ri community in whom both Kihon+3 index and K-FRAIL questionnaire were administered between October 2015 and November 2015. All participants provided written informed consent. The Institutional Review Board at Asan Medical Center, Seoul, Korea, approved this study.

Evaluation of frailty

Trained nurses measured frailty using the Cardiovascular Health Study (CHS) criteria for frailty phenotype, Kihon+3 index, and K-FRAIL questionnaire.

1. **CHS criteria:** This widely accepted definition was used as a reference standard.⁶ This scale assigns 1 point to each of the following 5 components: 1) exhaustion (“moderate or most of the time during the last week” to either of the following statements, “I felt that everything I did was an effort” or “I could not get going”); 2) low activity (lowest quintile in physical activity level measured using the International Physical Activity Questionnaires Short Form¹⁶); 3) slowness (usual gait speed <0.8 m/sec from the 4-meter walk test); 4) weakness (dominant hand grip strength <26 kg for men and <17 kg for women); 5) weight loss (unintentional weight loss >3kg during the previous 6 months). Individuals were

classified as robust if the score was 0 or vulnerable if ≥ 1 (prefrail if 1–2 and frail if 3–5).

2. **Kihon checklist and Kihon+3 index:** The original Kihon checklist consists of 25 items to assess daily activities (5 items), mobility (5 items), nutrition (2 items), oral health (3 items), outdoor activities (2 items), cognition (3 items), and mood (5 items) (See Supporting Information).¹⁷ Individuals were considered robust if the score was 0–3 or vulnerable if ≥ 4 .¹⁰ The Kihon+3 index includes 25 items of the original Kihon checklist and 3 additional items: chronic disease (any presence of high blood pressure, diabetes, stroke, urinary incontinence, cancer, heart disease, chronic respiratory disease), sensory impairment (visual and hearing disability affecting daily activity), and mobility impairment (Timed-Up-and-Go test ≥ 8.5 sec). This 28-item Kihon+3 index assigns 1 point to the 25 original Kihon items and 2 points to the 3 additional items. Individuals were classified as robust if the score was 0–3 or vulnerable if ≥ 4 (prefrail if 4–12 and frail if 13–31).¹⁸
3. **K-FRAIL questionnaire:** This scale has been validated in the Korean population.¹² It assigns 1 point to each of the following 5 components: 1) fatigue (response of “all of the time” or “most of the time” to the question “how much of the time during the past 4 weeks did you feel tired?”); 2) resistance (positive response to the question “by yourself and not using aids, do you have any difficulty walking up 10 steps without resting?”); 3) ambulation (positive response to the question “by yourself and not using aids, do you have any difficulty walking 300 meters?”); 4) illnesses (5 or more self-reported physician diagnoses of hypertension, diabetes, cancer excluding a minor skin cancer, chronic lung disease, heart attack, congestive heart failure, angina, asthma, arthritis, stroke, and kidney disease); 5) loss of weight (more than 5% in the past year). Individuals were classified as robust if the score is 0 or vulnerable if ≥ 1 (prefrail if 1–2 and frail if 3–5).^{12,13}

Assessment of disability

Trained nurses administered the Korean version of activities of daily living (ADL) scale to assess dependence in bathing, continence, dressing, eating, toileting, transferring, and washing face and hands; the Korean version of instrumental activities of daily living (IADL) scale to assess dependence in food preparation, housework, going out short distance, grooming, financial management, medication management, shopping, transportation, and using a telephone.¹⁹ Disability was defined as needing personal assistance to perform any of ADL or IADL activities.

Statistical analysis

The primary outcome was vulnerability defined as prefrail and frail status. We applied a priori determined cutpoints that are being used in current practice to define vulnerability, rather than searching for the cutpoints that were optimized for our sample.²⁰ For the purpose of screening, we focused on sensitivity: if the sensitivity of K-FRAIL questionnaire was not meaningfully different (i.e., <0.10) from that of the Kihon+3 index, we could adopt the K-

FRAIL questionnaire as a screening test. It was estimated that at least 191 participants would be needed to detect 0.10 difference in sensitivity between the 2 indices with type I error rate, 0.05, and type II error rate, 0.20. We compared C statistics, a measure of discriminatory ability, using the methods proposed by DeLong et al.²¹; sensitivity and specificity using McNemar test; and positive predictive value (PPV) and negative predictive value (NPV) using generalized score statistic.²² As a measure of construct validity, we evaluated the performance of each index in detecting ADL and IADL disability. As secondary analyses, we compared the K-FRAIL questionnaire vs. the original Kihon checklist, both of which were based on self-report without performance tests. Statistical analyses were performed in SPSS ver 20.0 and R ver 3.2.4. Two-sided p-value <0.05 was considered statistically significant.

RESULTS

The mean age was 75.6 years (standard deviation: 6.9) and 88 (41.5%) were male. The CHS criteria classified 62 (29.2%) as robust, 118 (55.7%) as prefrail, and 32 (15.1%) as frail. More people were frail according to the K-FRAIL questionnaire: the numbers of robust, prefrail, and frail individuals were 75 (35.4%), 86 (40.6%), and 51 (24.1%). Similarly, the corresponding numbers for the Kihon+3 index were 66 (31.1%), 95 (44.8%), and 51 (24.1%). In our sample, 178 (84.0%) participants were classified as vulnerable by at least 1 index and 108 (50.9%) were vulnerable by all 3 indices (Figure 1).

The overall discrimination for vulnerability was better with the comprehensive Kihon+3 index (C statistic: 0.85; 95% confidence interval [CI]: 0.79–0.90) than the simple K-FRAIL questionnaire (C statistic: 0.77; 95% CI: 0.71–0.84) ($p=0.022$) (Figure 2). At the currently used cutpoints, the K-FRAIL questionnaire (1 point) had sensitivity (0.79 vs. 0.85; $p=0.095$), specificity (0.69 vs. 0.69; $p=1.000$), PPV (0.86 vs. 0.87; $p=0.747$), and NPV (0.57 vs. 0.65; $p=0.133$) that were not statistically significantly different from the Kihon+3 index (4 points) (Table 1). Sensitivity, specificity, PPV, and NPV in detecting ADL and IADL disability were not statistically significantly different between the K-FRAIL questionnaire and the Kihon+3 index (Table 1). The optimal cutpoint that achieved the maximum sensitivity and specificity in our sample was 5 points for the Kihon+3 index (sensitivity: 0.79; specificity: 0.76) and 1 point for the K-FRAIL questionnaire (sensitivity: 0.79; specificity: 0.69).

In secondary analyses, the original Kihon checklist (C statistic: 0.84; 95% CI: 0.79–0.89) had better discrimination in detecting vulnerability than the K-FRAIL questionnaire (C statistic: 0.77; 95% CI: 0.71–0.84) ($p=0.046$). The currently used cutpoint for the Kihon checklist (4 points) achieved the maximum sensitivity, 0.69, and specificity, 0.86, in our sample. Compared with the Kihon checklist, the K-FRAIL questionnaire had higher sensitivity to detect vulnerability (0.79 vs. 0.69; $p=0.016$), but lower specificity (0.69 vs. 0.85; $p=0.018$) and PPV (0.86 vs. 0.92; $p=0.046$) (Table 1). For ADL disability, the K-FRAIL questionnaire showed lower specificity (0.43 vs. 0.55, $p=0.003$) than the original Kihon checklist, without statistically significant differences in sensitivity, PPV, and NPV (Table 1). For IADL disability, the K-FRAIL questionnaire had higher sensitivity (1.00 vs.

0.93, $p=0.045$) and NPV (1.00 vs. 0.96, $p=0.042$), but lower specificity (0.48 vs. 0.61, $p=0.004$) and PPV (0.42 vs. 0.47, $p=0.044$) compared with the original Kihon checklist.

DISCUSSION

A population screening is crucial to identify vulnerable older adults in frail and prefrail state who can potentially benefit from comprehensive geriatric assessment and multi-domain interventions, such as nutritional supplement and physical exercise.^{23, 24} We evaluated the performance of the validated K-FRAIL questionnaire in comparison with the Kihon+3 index that is currently used as a screening tool in the Korean National Home Visiting Program. Although C statistic of the Kihon+3 index was higher than the K-FRAIL questionnaire, there was only 6% of sensitivity difference when specificity is matched up with the current standard of the Kihon+3 index. Therefore, there may be no clinically important difference in accuracy whereas the K-FRAIL questionnaire is a briefer tool.

Since 2000, the Kihon checklist⁹ has been used in Japan to determine an older individual's need for services from the Long-Term Care Insurance in carrying out ADLs. The checklist consists of 25 yes/no items that address common geriatric problems in several domains, such as ADL and IADL disability, cognitive dysfunction, depression, nutrition, and falls. The administration time is 10 minutes or less.²⁵ Similar to the deficit-accumulation frailty index,²⁶ each item is equally weighted to calculate a summary score. Based on the total score and level of deficits in individual domains, an individual can be admitted to a long-term care hospital or receive personal care assistance at home.

The Kihon+3 index, a modified version of the Kihon checklist,^{17,18} serves as the main assessment tool to assess the need for the Long Term Care Insurance in Korea. The index includes 25 items of the original Kihon checklist and assessments of chronic conditions, sensory impairment, and the Timed-Up-and-Go test. It requires a face-to-face visit that takes more time (in our experience, it took at least 15 minutes for assessment, not taking transportation time into account), costs, resources, and additional training of assessors. While this expanded index allows a more comprehensive assessment, it may not be an efficient screening tool for population. On the other hand, the K-FRAIL questionnaire that consists of 5 items can be administered within 3 minutes, without a face-to-face visit.¹² This simple questionnaire has proven effective in screening for frailty in American,^{13, 14} European,²⁷ and Asian populations.¹² Therefore, it can be a useful population screening tool to identify vulnerable older adults in the community.⁵ Individuals who screen positive according to the K-FRAIL questionnaire can undergo a comprehensive geriatric assessment and receive resource-intensive, multi-disciplinary interventions.

We also found little difference in discriminatory ability between the original Kihon checklist (C statistic: 0.84) and the Kihon+3 index (C statistic: 0.85), which indicates that 3 additional items, including the Timed-Up-and-Go test, did not contribute meaningfully to identifying pre-frail or frail individuals. The currently used cutpoint (4) achieved higher sensitivity (0.85) and lower specificity (0.69) for the Kihon+3 index, whereas the same cutpoint achieved lower sensitivity (0.69) and higher specificity (0.86) for the Kihon checklist. Although it is commonly believed that performance-based measures are more accurate than

self-reported measures, the difference in their ability to predict mortality was minimal in a previous study.²⁸ In identifying individuals with ADL or IADL disability, performance-based measures and self-reported measures assess different aspects of functioning.^{29,30} Because an individual's ability to perform ADLs and IADLs requires not only physical capability but also psychological and health-related factors, a performance-based measure may not necessarily improve the ability to identify disability.

Nonetheless, our results do not invalidate the role of the comprehensive Kihon+3 index. The Kihon+3 index can be administered as a second step to individuals who screen positive by the K-FRAIL questionnaire. This sequential testing strategy is expected to achieve higher specificity of 0.91 and higher PPV of 0.95 than use of either index alone. By reducing false positive rate, this 2-step strategy ensures that the resource-intensive National Home Visiting Program is offered to those who are truly vulnerable. Moreover, the Kihon+3 index can reveal areas for interventions and supportive services. Alternatively, by choosing a higher cutpoint, the Kihon+3 index can be used as a confirmatory test with high specificity among those who are identified using the K-FRAIL questionnaire.

Our study has several strengths and limitations. In ASPRA cohort, we performed a standardized assessment of frailty according to several accepted definitions (CHS criteria, K-FRAIL questionnaire, and Kihon+3 index). We used a priori cutpoint to define vulnerability rather than choosing optimal cutpoint for our sample, which may not generalize to other samples. Moreover, we prespecified that the clinically important difference in sensitivity would be 10% and designed the study to have adequate statistical power. High participation rate of ASPRA cohort makes selection bias unlikely. Although this study was conducted in a small Korean rural community, we have previously shown that the demographic characteristics of ASPRA cohort are similar to those of older Koreans in rural area in the Korean National Health And Nutrition Examination Survey.¹⁵ We acknowledge that frailty assessment based on self-report (e.g., K-FRAIL questionnaire) may overestimate the presence of frailty compared with an objective assessment (e.g., CHS criteria). However, the main purpose of K-FRAIL questionnaire is to screen vulnerable individuals for a more comprehensive evaluation, rather than to diagnose frailty. Although we used the widely validated CHS criteria as the reference standard of frailty assessment, there is no consensus on how to best measure frailty. An alternative validation strategy would be to evaluate the ability to predict future adverse health outcomes, such as death, falls, hospitalizations, and institutionalization. Since our study is cross-sectional and follow-up assessment of the ASPRA cohort is underway, we were unable to examine such association in this analysis.

In conclusion, our study suggests that the K-FRAIL questionnaire may be a preferred to the Kihon+3 index for population screening of prefrail or frail older adults in the rural community, based on its short length, minimal requirement of time and resources, and comparable performance.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Number of individuals classified as prefrail or frail according to the Cardiovascular Health Study criteria, K-FRAIL questionnaire, and Kihon+3 checklist

Figure 2.

Receiver operating characteristic curve of the K-FRAIL questionnaire (solid line; C statistic: 0.77; 95% confidence interval: 0.71–0.84) and the Kihon+3 index (dashed line; C statistic: 0.85; 95% confidence interval: 0.79–0.89) in identifying prefrail or frail individuals

Table 1

Comparison of K-FRAIL questionnaire, Kihon+3 index, and Kihon checklist to identify vulnerability and disability

Outcomes	K-FRAIL (cutpoint: 1)	Kihon+3 index (cutpoint: 4)	K-FRAIL vs. Kihon+3 P-value	Kihon checklist (cutpoint: 4)	K-FRAIL vs. Kihon P-value
Vulnerability * (N=150/222)					
Sensitivity (95% CI)	0.79 (0.72–0.85)	0.85 (0.79–0.90)	0.095	0.69 (0.62–0.77)	0.018
Specificity (95% CI)	0.69 (0.58–0.81)	0.69 (0.58–0.81)	1.000	0.86 (0.77–0.94)	0.016
PPV (95% CI)	0.86 (0.80–0.92)	0.87 (0.82–0.92)	0.747	0.92 (0.87–0.97)	0.046
NPV (95% CI)	0.57 (0.46–0.69)	0.65 (0.54–0.77)	0.133	0.54 (0.44–0.63)	0.380
ADL disability (N=46/212)					
Sensitivity (95% CI)	0.91 (0.83–0.99)	0.96 (0.90–1.00)	0.317	0.83 (0.72–0.94)	0.157
Specificity (95% CI)	0.43 (0.35–0.50)	0.39 (0.31–0.46)	0.286	0.55 (0.47–0.62)	0.003
PPV (95% CI)	0.31 (0.23–0.38)	0.30 (0.23–0.38)	0.763	0.34 (0.25–0.42)	0.204
NPV (95% CI)	0.95 (0.90–1.00)	0.97 (0.93–1.00)	0.390	0.92 (0.87–0.97)	0.356
IADL disability (N=57/212)					
Sensitivity (95% CI)	1.00 (1.00–1.00)	0.98 (0.94–1.00)	0.317	0.93 (0.86–1.00)	0.045
Specificity (95% CI)	0.48 (0.41–0.56)	0.42 (0.34–0.50)	0.140	0.61 (0.54–0.69)	0.004
PPV (95% CI)	0.42 (0.33–0.50)	0.38 (0.30–0.46)	0.098	0.47 (0.38–0.56)	0.044
NPV (95% CI)	1.00 (1.00–1.00)	0.99 (0.96–1.00)	0.314	0.96 (0.92–1.00)	0.042

Abbreviations: ADL, activity of daily living; CI, confidence interval; IADL, instrumental activity of daily living; NPV, negative predictive value; PPV, positive predictive value.

* Vulnerable state includes prefrail and frail states according to the Cardiovascular Health Study criteria