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Korean frailty and aging cohort study (KFACS): cohort profile

Chang Won Won,[1,2] Seoyoon Lee ,[1,3] Jinhee Kim,[4] Doukyoung Chon,[5] Sunyoung Kim,[2] Chang-O Kim,[6] Mi Kyung Kim,[7] Belong Cho,[8] Kyung Mook Choi,[9] Eun Roh,[9] Hak Chul Jang,[10] Sang Joon Son,[11] Jin-Hee Lee,[12] Yong Soon Park,[13] Sam-Gyu Lee,[14] Bong Jo Kim,[15] Hyeon Ju Kim ,[16] Jaekyung Choi,[17] Hyuk Ga,[18] Kee Jae Lee,[19] Yunhwan Lee ,[4] Miji Kim [20]

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CWW and SL are joint first authors.

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For numbered affiliations see end of article.

Correspondence to
Dr Yunhwan Lee; yhlee@ajou.ac.kr and Dr Miji Kim; mijiak@khu.ac.kr

ABSTRACT

Purpose The purpose of the Korean Frailty and Aging Cohort Study (KFACS) is to initiate a nationwide, population-based prospective cohort study of older adults living in the community to assess their frailty status and explore transitions between frailty states over time in Korea.

Participants The KFACS is a multicentre longitudinal study with the baseline survey conducted from May 2016 to November 2017. Each centre recruited participants using quota sampling stratified by age and sex. The number of participants recruited through 2 years of baseline study from 10 centres was 3014, with each site accounting for approximately 300 participants. The inclusion criteria were: having an age of 70–84 years, currently living in the community, having no plans to move out in the next 2 years, having no problems with communication and no prior dementia diagnosis.

Findings to date To define physical frailty, the KFACS used a modified version of the Fried Frailty Phenotype (FFP) consisting of five components of frailty: unintended weight loss, weakness, self-reported exhaustion, slowness and low physical activity. In the baseline study of 2016–2017, 2907 of 3014 individuals fulfilled all five components of FFP. The results indicated that 7.8% of the participants (n=228) were frail, 47.0% (n=1366) were prefrail and 45.2% (n=1313) were robust. The prevalence of frailty increased with age in both sexes; in the group aged 70–74 years, 1.8% of men and 3.7% of women were frail, whereas in the 80–84 years age group, 14.9% of men and 16.7% of women were frail. Women tended to exhibit a higher prevalence of frailty than men in all age groups.

Future plans The KFACS plans to identify outcomes and risk factors associated with frailty by conducting a 10-year cohort study, with a follow-up every 2 years, using 3014 baseline participants.

Strengths and limitations of this study

- The main strengths of the Korean Frailty and Aging Cohort Study (KFACS) are the inclusion of a nationwide population of community-dwelling Korean older adults.
- The KFACS has a comprehensive scope of assessments, with the inclusion of physical examinations, health assessments, a neuropsychological battery for cognitive function, in-depth social function surveys, dental radiography, blood tests and banking, and most importantly, a diverse range of frailty and sarcopenia assessments.
- All the data are available and open to all researchers.
- The KFACS includes two subcohort studies, that is, a survey of social frailty involving bimonthly interviews and a nutrition survey involving home visits.
- One weakness of the study is that the participants had to be ambulatory to visit the 10 centres in the baseline survey, and home-bound disabled or institutionalised persons could not participate.

INTRODUCTION

The population of Korea is ageing rapidly, with more than 14% of the total population in Korea consisting of people older than 65 years according to the 2018 Aged Population Report created by the Korean Statistical Information Service. The proportion of the aged in the population is projected to increase to 24.5% by 2030 and 41.0% by 2060.[1] The percentage of the population older than 75 years is estimated to reach 10.0% by 2030 and 25.9% by 2060, with the percentage of the population aged 85 years and older predicted to increase to 2.8% and 11.2% by these dates, respectively.[1 2] Ageing of the population is accompanied by increased rates of multimorbidity along with increased need for social support, as well as increased burden on families and public health medical expenditure.[3 4] Many recent studies increasingly identify frailty as a major threat to healthy ageing, as frailty prevalence increases with age.[5–7] An increasing proportion of community-dwelling older adults present frailty, a status of extreme vulnerability to endogenous and exogenous stressors exposing the individual to increased risk of negative health-related outcomes.[5] Therefore, it is becoming increasingly important to develop means of identifying frailty, which represents a transition

phase between healthy ageing and disability, as well as develop interventions to prevent adverse outcomes.[7]

Although many Korean cohort studies on age-related health conditions for older adults have been reported, such as the Korean Longitudinal Study on Health and Aging,[8] Korean Urban and Rural Elderly cohort study[9] and Aging Study of Pyeongchang Rural Area,[10] none focused on frailty in older adults on a nationwide scale. With a focus on evidence-based diagnosis and management methods of frailty in community-dwelling older adults, the Korean Frailty and Aging Cohort Study (KFACS) was instigated with funding from the Ministry of Health and Welfare in December 2015.[6] Because the KFACS will be the first study to examine frailty specifically in a cohort of Korean subjects, it has several important implications for older Korean adults. First, the KFACS will provide the natural history of frailty in Korea, which has never been studied. Second, the KFACS was constructed with in-depth considerations of the demographic characteristics of Korean adults—one of the fastest growing ageing populations in the world. The KFACS specifically takes into account the rapid trend of increasing life expectancy and the corresponding increase in supportive care expenditures.[11] Moreover, several potential risk factors for frailty are also considered including: nutrition (older Korean adults have relatively poor nutritional statuses, specifically consuming lower levels of protein and calcium, and having higher sodium intakes),[12] physical function (sedentary lifestyle)[11] and social aspects (high poverty and depression rates, and low social activity and participation rates).[11 13 14] The purpose of KFACS is to initiate a nationwide, population-based prospective cohort study of older adults living in the community to assess their frailty status and explore transitions between frailty states over time. The specific aims of the study were to (1) identify risk factors involved in the transition between states of frailty and the development of adverse outcomes, such as disability, institutionalisation and mortality; (2) develop models for predicting the onset and progression of frailty; and (3) create an evidence base for developing clinical practice guidelines for the prevention and management of frailty in older adults.[6]

Cohort description

The KFACS is a multicentre longitudinal study with the baseline survey conducted from May 2016 to November 2017. The participants were recruited from among community-dwelling residents in urban and rural areas nationwide in 10 study centres across different regions covering different residential locations (urban, suburban and rural)—three from Seoul Metropolitan Area, two from Gyeonggi Province and one from each of Gangwon Province, Chungcheong-buk Province, Jeolla-nam Province, Gyeongsang-nam Province and Jeju Island in South Korea (figure 1).

Each centre recruited participants using quota sampling stratified by age (70–74, 75–79 and 80–84 years with a ratio of 6:5:4, respectively) and sex (male and female), with the aim of recruiting 1500 men and 1500 women. Participants were recruited from diverse settings (local senior welfare centres, community health centres, apartments, housing complexes and outpatient clinics) to minimise selection bias. By reference, the prevalence of frailty among adults between 65 and 70 was 3.7% based on living profiles of older people survey in 2008 in Korea. The prevalence was 7.4%, 11.6% and 15.4% on 70–74, 75–79 and 80–84,

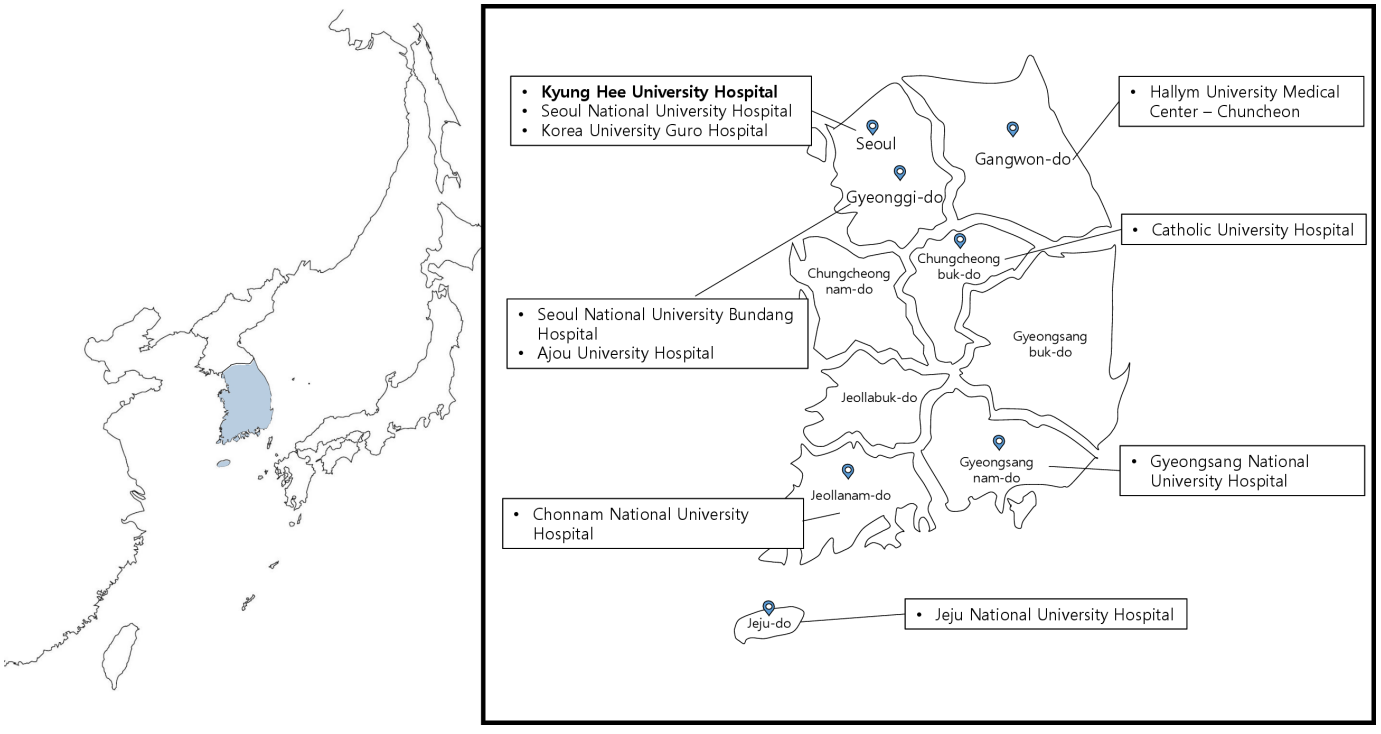

Figure 1 Locations of the 10 centres involved in the Korean Frailty and Aging Cohort Study.

respectively.[4] Due to its relatively small number, and the suggestion from the frailty consensus, which states that all persons older than 70 years should be screened for frailty, we have set the starting age from 70 to 84 for this study.[7] Persons over 85 years of age were excluded for having relatively higher difficulty in their centre visit and follow-up surveys. Additionally, the advanced age of participants over 85 has a higher probability of affecting the frailty statuses of these individuals, possibly hindering the identification of physical frailty-associated risk factors. We intentionally recruited relatively healthy community-dwelling older adults living in the community in this study by mostly recruiting participants who were able to visit the clinical sites. The inclusion criteria of KFACS participants were therefore: aged 70–84 years, currently living in the community, having no plans to move out in the next 2 years, and having no problems with communication and no prior dementia diagnosis. In this case, 'move out' refers to relocating to areas outside the three neighbouring towns above.

Of the 3014 participants, 1559 (51.7%) joined the study in 2016 and 1455 (48.3%) joined in 2017. The mean age was 76.0 years, and 1582 participants (52.5%) were female. Overall, 39.4% were aged 70–74 years, 37.4% were aged 75–79 years and 23.2% were in their 80s. The baseline survey indicated that 28% of the subjects were urban residents, 42% were suburban residents and 30% were residents of rural areas (table 1). Other general characteristics of the KFACS participants are shown in table 1.

Nutritional status was rated using the Mini-Nutritional Assessment (MNA) screening score (12–14 points, normal; 8–11 points, at risk of malnutrition; 0–7 points, malnutrition); polypharmacy indicates the use of five or more prescribed drugs.

There were no statistically significant differences between sexes except for the following variables: marriage status, whether the subject received instrumental support, whether the subject received a basic living subsidy, whether the subject received appraisal support, self-rated health, performance in word recall, performance in word recognition, weight loss status, low activity status, grip strength and gait speed.

The prospective cohort design of the KFACS included data collection every 2 years. The first wave of baseline data collection started in 2016–2017, and the follow-up (2018–2019) has been currently finished. Follow-up surveys were conducted on a 2-year basis with 4 months of allowance limitations. The follow-up rate in 2018 was 92.5%, with 88.4% visiting the clinical sites, 11% involving telephone interviews and approximately 0.5% involving home visits. The follow-up rate was 93.9% if we included findings such as entering nursing homes (four participants) or death (18 participants). The mean follow-up time range was 682.6±34.4 days. Moreover, the follow-up rate in 2019 was 94.8%, with 91.1% visiting the clinical site, 8.5% participating telephone interview and 0.2% comprising home visits. If we include findings on nursing home (one participant) or death (19 participants), the follow-up rate would be 96.2% in 2019. The mean follow-up time range was 705.1±38.0 days. Strategies promoting recruitment and retainment included enlisting caregiver assistance, providing transportation for centre visit, explaining key test results, informing participants of identified health issues, maintaining regular communication (phone calls, greeting cards for holidays and birthday), and involving proxy respondents' answer.

Field work methods

All participants visited their corresponding study centres to conduct face-to-face interviews, health examinations and laboratory tests for the baseline survey. At follow-up, participants primarily visited their centre, but we also conducted home visits, telephone interviews, and proxy interviews (in this order) if visiting the centre was not possible.

Patient and public involvement

This study was completed without participant involvement. The participants were not invited to contribute the development of the design, recruitment, questionnaires of the KFACS nor to have commitment to the results of this study. All participants were informed of the use of the data for research in this study. We have informed the participants of the main results of their blood, urine, chest X-ray, dual energy X-ray absorptiometry (DEXA), ECG and cognitive function tests. We have plans to disseminate the results of the study: (1) develop the guidelines for the prevention and management of physical frailty based on the results from the KFACS data and disclose to the public, and (2) provide printed materials on the main results of the KFACS to the participants.

Data collection and variables

The variables of the KFACS questionnaires are listed in table 2 and consisted of demographics, including socioeconomic status, living environment, lifestyle and health-related behaviours, the International Physical Activity Questionnaire (IPAQ),[15] the IPAQ environmental module,[16] dental check-up status and nutritional status using the Korean version of the MNA.[17] Health status was determined according to self-rated health conditions (12-item Short Form Survey).[18] We used a predefined list of chronic health conditions, which are based on comorbidities according to Charlson's classification to collect self-reported and physician-diagnosed chronic diseases,[19] medications, quality of life (EuroQol five-dimension scale)[20] and EuroQol Visual Analogue Scale (EQ-VAS).[21] A 15-item Korean version of the Short Form Geriatric Depression Scale,[22] activities of daily living, instrumental activities of daily living (IADL),[23] falls and fear of falling, Activities-specific Balance, Confidence scale,[24] oral health and women's health of the participants were scored, and the number of outpatient services, hospitalisation rate, number of long-term care services and health literacy were determined to measure health status. Social assessment included Practitioner Assessment of Network

Table 1 General characteristics of participants in the Korean Frailty and Aging Cohort Study baseline survey, 2016–2017

Variable	Total	Male (n=1432)			P value	Female (n=1582)			P value
		70–74	75–79	80–84		70–74	75–79	80–84	
Total baseline study participants, n (%)	3014 (100)	521 (17.3)	552 (18.3)	359 (11.9)		668 (22.2)	574 (19)	340 (11.3)	
2016, n (%)	1559 (51.7)	267 (8.9)	280 (9.3)	187 (6.2)		338 (11.2)	297 (9.9)	190 (6.3)	
2017, n (%)	1455 (48.3)	254 (8.4)	272 (9)	172 (5.7)		330 (10.9)	277 (9.2)	150 (5)	
Demographics, n (%)									
Marital status									
Single	4 (0.1)	2 (0.4)	0 (0.0)	1 (0.3)		1 (0.1)	0 (0.0)	0 (0.0)	
Married	2929 (97.3)	505 (97.1)	536 (97.3)	350 (97.5)	0.697	645 (96.6)	561 (97.7)	332 (97.9)	0.520
Divorced/widowed	78 (2.6)	13 (2.5)	15 (2.7)	8 (2.2)		22 (3.3)	13 (2.3)	7 (2.1)	
Residence area									
Urban	827 (27.6)	137 (26.5)	146 (26.6)	106 (29.5)		186 (28)	160 (28.1)	92 (27.1)	
Suburban	1262 (42.1)	211 (40.8)	223 (40.6)	140 (39)	0.877	291 (43.8)	262 (46.0)	135 (39.8)	0.224
Rural	909 (30.3)	169 (32.7)	180 (32.8)	113 (31.5)		187 (28.2)	148 (26.0)	112 (33.0)	
Education									
< Middle school	1452 (48.2)	150 (28.8)	169 (30.6)	127 (35.5)		383 (57.3)	365 (63.7)	258 (75.9)	
Middle and high school	1048 (34.8)	235 (21.1)	226 (17.6)	140 (12.3)	0.024	218 (16.2)	155 (11.9)	74 (10.9)	< 0.001
≥ College	512 (17.0)	136 (50.1)	157 (51.8)	91 (52.2)		67 (26.5)	53 (24.4)	8 (13.2)	
Receiving basic living subsidy, yes, n (%)	166 (5.5)	31 (6.0)	20 (3.6)	22 (6.1)	0.132	30 (4.5)	26 (4.5)	37 (10.9)	< 0.001
Receiving medical aid, yes, n (%)	45 (1.5)	4 (0.8)	6 (1.1)	4 (1.1)	0.829	9 (1.3)	11 (1.9)	11 (3.2)	0.124
Lifestyle characteristics									
Current drinker, n (%)	890 (41.2)	269 (56.8)	273 (54.7)	169 (52.6)	0.517	80 (19.7)	61 (21.4)	38 (21.6)	0.812
Current smoker, n (%)	174 (15.1)	61 (14.8)	56 (13.3)	41 (15.0)	0.775	2 (11.8)	4 (40.0)	10 (52.6)	0.034
Sleeping (hours/day), mean (SD)	6.24 (1.47)	6.43 (1.39)	6.54 (1.31)	6.54 (1.50)	0.354	6.06 (1.47)	5.87 (1.50)	6.08 (1.54)	0.056
Physical activity (METS/week), mean (SD)	52.45 (63.58)	71.52 (85.37)	66.08 (68.75)	46.52 (54.89)	< 0.001	51.01 (59.48)	39.5 (43.72)	32.6 (46.61)	< 0.001
Body composition, mean (SD)									
Calf circumference (cm)	33.8 (2.7)	35.2 (2.2)	34.7 (2.6)	33.7 (2.7)	< 0.001	33.7 (2.4)	32.6 (2.5)	32.3 (2.6)	< 0.001
Waist circumference (cm)	87.7 (8.6)	88.9 (8.1)	88.3 (8.7)	88.5 (9.1)	0.530	86.4 (8.0)	87.1 (8.4)	87.4 (9.4)	0.116
BMI (kg/m^2)	24.4 (3.0)	24.2 (2.8)	23.8 (3.0)	23.7 (3.0)	0.008	24.9 (2.9)	24.9 (3.1)	24.7 (3.4)	0.687
Physical function									
Timed up and go (s), mean (SD)	10.5 (2.9)	9.5 (2.7)	10.4 (2.5)	11.1 (2.7)	< 0.001	9.9 (2.2)	10.8 (3.2)	12.5 (3.5)	< 0.001

Continued

Table 1 Continued

Variable	Total	Male (n=1432)			P value	Female (n=1582)			P value
		70–74	75–79	80–84		70–74	75–79	80–84	
ADL disability, n (%)	337 (11.2)	32 (6.1)	42 (7.6)	41 (11.4)	0.016	64 (9.6)	86 (15.0)	72 (21.2)	< 0.001
IADL disability, n (%)	1148 (38.1)	311 (59.7)	303 (54.9)	219 (61.0)	0.128	101 (15.1)	107 (18.6)	107 (31.5)	< 0.001
Fall experience, yes, n (%)	612 (20.3)	67 (12.9)	96 (17.4)	65 (18.1)	0.055	136 (20.4)	160 (27.9)	88 (25.9)	0.006
SPPB, mean (SD)	3.74 (1.28)	3.32 (0.83)	3.58 (1.43)	3.92 (1.14)	< 0.001	3.54 (0.87)	3.88 (1.28)	4.58 (1.84)	< 0.001
Grip strength (kg), mean (SD)	26.2 (7.6)	34.2 (5.6)	32.2 (5.8)	28.8 (5.4)	< 0.001	22 (4.0)	20.7 (4.1)	18.9 (3.9)	< 0.001
Gait speed (m/s), mean (SD)	1.1 (0.26)	1.21 (0.25)	1.16 (0.27)	1.04 (0.24)	< 0.001	1.14 (0.23)	1.05 (0.22)	0.92 (0.22)	< 0.001
Psychological function, mean (SD)									
Self-rated health (range: 0–100)	73.9 (17.4)	77.7 (14.5)	76.2 (15.3)	72.4 (16.4)	< 0.001	74.7 (17.8)	71.8 (18.6)	67.8 (20.7)	< 0.001
GDS (range: 0–15)	3.3 (3.7)	2 (3.0)	2.5 (3.4)	3.1 (3.3)	< 0.001	3.4 (3.7)	4.1 (4.1)	4.9 (4.3)	< 0.001
EQ-5D (range: 0–1)	0.9 (0.1)	0. (0.1)	0.9 (0.1)	0.9 (0.1)	< 0.001	0.9 (0.1)	0.8 (0.1)	0.8 (0.2)	< 0.001
Cognitive function, mean (SD)									
MMSE-KC (range: 0–30)	25.5 (3.4)	26.8 (2.4)	26.1 (3.1)	25.3 (3.6)	< 0.001	25.9 (3.2)	24.8 (3.4)	23.3 (3.8)	< 0.001
Word list: memory (range: 0–30)	16.6 (4.4)	17.8 (3.7)	16.2 (4.0)	14.4 (4.2)	< 0.001	18.1 (4.1)	16.6 (4.5)	14.6 (4.7)	< 0.001
Word list: recall (range: 0–10)	5.5 (2.1)	6.1 (1.9)	5.3 (2.0)	4.6 (2.1)	< 0.001	6.1 (2.0)	5.3 (2.1)	4.5 (2.2)	< 0.001
Word list: recognition (range: 0–10)	8.5 (1.9)	8.9 (1.4)	8.5 (1.9)	8.2 (2.2)	< 0.001	8.9 (1.6)	8.4 (1.9)	8 (2.4)	< 0.001
FAB (range: 0–18)	13.4 (3.1)	14.6 (2.4)	14 (2.7)	13.3 (3.2)	< 0.001	13.4 (2.9)	12.7 (3.1)	11.4 (3.3)	< 0.001
Nutritional status, n (%)									
Normal	2519 (83.8)	450 (86.5)	457 (82.9)	297 (82.7)		576 (86.2)	464 (81.3)	275 (81.4)	
At risk of malnutrition	457 (15.2)	68 (13.1)	88 (16.0)	53 (14.8)	0.037	89 (13.3)	103 (18.0)	56 (16.6)	0.013
Malnutrition, yes, n (%)	31 (1.0)	2 (0.4)	6 (1.1)	9 (2.5)		3 (0.4)	4 (0.7)	7 (2.1)	
Social function, n (%)									
Social network type									
Contact with others more than once a week	2502 (83.0)	420 (80.6)	449 (81.3)	287 (79.9)	0.870	574 (85.9)	486 (84.7)	286 (84.1)	0.704
Attending religious gatherings at least once a month regularly	1272 (42.2)	161 (30.9)	177 (32.1)	126 (35.1)	0.513	355 (53.1)	289 (50.3)	164 (48.2)	0.521
Social capital									
Participating in more than two social gatherings	1632 (54.1)	273 (52.4)	265 (48.0)	172 (47.9)	0.272	423 (63.3)	327 (57.0)	172 (50.6)	< 0.001
Social support									
Receiving instrumental support	2212 (73.4)	380 (72.9)	408 (73.9)	261 (72.7)	0.903	496 (74.3)	424 (73.9)	243 (71.5)	0.621

Continued

Table 1 Continued

Variable	Total	Male (n=1432) 70–74	75–79	80–84	P value	Female (n=1582) 70–74	75–79	80–84	P value
Receiving informational support	2345 (77.8)	392 (75.2)	424 (76.8)	273 (76)	0.834	542 (81.1)	452 (78.7)	262 (77.1)	0.283
Receiving appraisal support	2351 (78.0)	392 (75.2)	433 (78.4)	271 (75.5)	0.402	540 (80.8)	455 (79.3)	260 (76.5)	0.269
Medical conditions, n (%)									
Hypertension	1746 (57.9)	263 (50.5)	302 (54.7)	211 (58.8)	0.108	369 (55.2)	354 (61.7)	247 (72.6)	< 0.001
Diabetes mellitus	663 (22)	117 (22.5)	136 (24.6)	86 (24.0)	0.722	126 (18.9)	116 (20.2)	82 (24.1)	0.136
Arthritis	761 (25.2)	62 (11.9)	77 (13.9)	56 (15.6)	0.439	205 (30.7)	220 (38.3)	141 (41.5)	0.007
Osteoporosis	483 (16.0)	8 (1.5)	22 (4.0)	19 (5.3)	0.004	158 (23.7)	172 (30.0)	104 (30.6)	0.001
Depression	87 (2.9)	5 (1.0)	15 (2.7)	8 (2.2)	0.112	21 (3.1)	26 (4.5)	12 (3.5)	0.427
Heart disease	251 (8.5)	53 (10.2)	61 (11.2)	38 (10.8)	0.874	31 (4.8)	36 (6.4)	32 (9.8)	0.010
Polypharmacy	891 (32.8)	174 (28.2)	148 (37.6)	86 (44.4)	< 0.001	231 (24.2)	175 (30.0)	77 (42.0)	< 0.001

Participants were sorted into three age groups (70–74, 75–79 and 80–84 years).
ADL, activities of daily living; BMI, body mass index; EQ-5D, EuroQol five-dimension scale; FAB, Frontal Assessment Battery; GDS, Geriatric Depression Scale; IADL, instrumental activities of daily living; MMSE, Mini-Mental State Examination; SPPB, Short Physical Performance Battery.

Table 2 Summary of variables collected from the Korean Frailty and Aging Cohort Study (KFACS) at baseline (2016–2017) and the first follow-up period (2019–2020)

Variable	Baseline	Follow-up	Proxy interviews
Demographics			
Age, sex, education	O	O	
Marital status, family structure	O	O	O
Work/employment	O	O	
Household income	O	O	O
Living environment (rural, suburban, urban)	O	O	
Health behaviour			
Smoking, alcohol drinking	O	O	O
Sleep, physical activity (IPAQ)	O	O	O
IPAQ environmental module	O		
Oral hygiene, dental check-up	O	O	
Health check-up	O	O	
Nutritional risk (MNA)	O	O	O
Eating behaviour	O	O	
Food security	O		
Simplified Nutritional Appetite Questionnaire (SNAQ)		O	
Health status			
Self-rated health (SF-12), comorbidity, polypharmacy	O	O	
Constipation		O	
Quality of life (EQ-5D)	O	O	
EuroQol Visual Analogue Scale	O	O	
Depressive symptoms (GDS-SF)	O	O	
K-ADL	O	O	
K-IADL	O	O	O
Physical resilience		O	
Experience of falls, recent injury, fear of falling	O	O	O
Activities-specific Balance, Confidence scale	O	O	
Oral health: mastication, pronunciation difficulties	O	O	
Women's health	O		
Healthcare			
Outpatient visits, hospitalisation, unmet needs	O	O	

Continued

Table 2 Continued

Variable	Baseline	Follow-up	Proxy interviews
Healthcare costs, long-term care services	O	O	
Health literacy	O	O	
Social function			
Social network: PANT	O	O	
Social capital: Participation in social activities	O	O	O
Social support: ENRICHD	O	O	
Cognitive function (CERAD-K, FAB)			
Global cognition: MMSE	O	O	
Executive function: FAB	O	O	
Processing speed: Trail Making Test A	O	O	
Memory: word list memory, recall, recognition	O	O	
Attention: digit span forward/digit span backward	O	O	
Korean version of Alzheimer's disease survey			O
Anthropometry			
Body weight, height	O	O	O
Body weight last year	O	O	O
Head circumference, waist circumference	O	O	
Leg length	O	O	
Upper arm circumference, calf circumference	O	O	
Physical function			
Hand-grip strength	O	O	
4 m usual gait speed	O	O	
SPPB—item 3: standing balance, item 5: chair-stand time, usual gait speed, timed up-and-go test	O	O	
Health assessments			
Vital signs: blood pressure, heart rate	O	O	
Visual acuity: Snellen chart (corrected vision)	O	O	
Hearing: pure tone audiometry (500, 1000, 2000, 3000 and 4000 Hz)	O	O	
ECG	O	O	
Chest X-ray	O	O	
Body composition			
Dual energy X-ray absorptiometry (DEXA): KFACS at eight medical centres (2016–2017)	O	O	
Ultrasound: muscle quality (Kyung Hee University only)	O	O	
Bioelectric impedance analysis: KFACS at two medical centres	O	O	
Joint replacement (identifiable from DEXA images)		O	
Panoramic radiography			
Periodontitis, upper and lower jaw bones (bone mineral density)	O	O	
Supernumerary, missing, impacted teeth, and so on	O	O	
Frailty and sarcopenia assessment			
CHS (Fried phenotype): unintentional weight loss, hand grip strength, self-reported exhaustion, physical activity, gait speed	O	O	
KLoSHA frailty index: SPPB, K-IADL, K-ADL, MMSE, albumin	O	O	
FRAIL questionnaire: fatigue, resistance, ambulation, illness, loss of weight	O	O	O
Korean Frailty Index: eight items (hospitalisation, self-rated health, polypharmacy, weight loss, depressed mood, incontinence, TUG, hearing/vision impairment)	O	O	
Frailty scale: weakness, exhaustion, isolation	O	O	
SOF index: chair-stand, energy (GDS), loss of weight	O	O	
SARC-F: five items (strength, assistance with walking, rising from a chair, climbing stairs, falls)	O	O	

Continued

Table 2 Continued

Variable	Baseline	Follow-up	Proxy interviews

Health literacy was assessed based on the capacity to obtain, process, understand, and use health information.
CERAD, Consortium to Establish a Registry for Alzheimer's disease; CHS, Cardiovascular Health Study; ENRICHD, Enhancing Recovery in Coronary Artery Disease; EQ-5D, EuroQol five-dimension scale; FAB, Frontal Assessment Battery; GDS, Geriatric Depression Scale; IPAQ, International Physical Activity Questionnaire; K-ADL, Korean Activities of Daily Living; K-IADL, Korean Instrumental Activities of Daily Living; KLoSHA, Korean Longitudinal Study on Health and Aging; MMSE, Mini-Mental State Examination; MNA, Mini-Nutritional Assessment; PANT, Practitioner Assessment of Network Type; SF-12, 12-item Short Form Survey; SOF, Study of Osteoporotic Fracture; SPPB, Short Physical Performance Battery; TUG, timed up and go.

Type,[25] social participation and activities, and the Enhancing Recovery in Coronary Artery Disease Social Support Instrument.[26 27] For cognitive function, assessments were made using the Mini-Mental State Examination; Trail Making Test A; word list memory, recall, and recognition; digit span[28] in the Consortium to Establish a Registry for Alzheimer's disease[29]; and Frontal Assessment Battery.[30] We included anthropometric measurements of body weight, height, head circumference, waist circumference, leg length and upper arm circumference. Physical function was assessed based on grip strength, gait speed, the Short Physical Performance Battery and timed up-and-go test. Health assessments, such as those for blood pressure, heart rate, visual acuity and hearing (pure tone audiometry), as well as ECGs and chest X-rays were carried out. To determine body composition, DEXA was performed at eight centres and bioelectrical impedance analysis (BIA) was performed at two centres. Panoramic radiography was carried out to assess dental status. Blood samples after an 8 hours fast were taken at around 08:00 to ensure the reliability of hormone tests (Box 1). All blood and urine samples from the participants at 10 centres were brought to a commercial laboratory and used for the tests. An extra 10 mL of blood was collected from each participant and sent to Kyung Hee University Medical Center for storage in deep freezers.

Frailty assessment

To define physical frailty, the KFACS used a modified version of the Fried Frailty Phenotype (FFP) consisting of five components of frailty: unintended weight loss, weakness, self-reported exhaustion, slowness and low physical activity.[31]

- Unintentional weight loss: defined as a 'yes' response to the question: 'In the last year, have you lost more than 4.5 kg unintentionally?'
- Weakness: defined as the lower 20th percentile of grip strength (maximal grip strength in kg after measuring twice for each hand using a hand grip dynamometer (T.K.K.5401; Takei Scientific Instruments Co, Tokyo, Japan)) stratified by sex and body mass index (BMI) quartiles based on the KFACS baseline survey.

Box 1 List of laboratory test variables collected during the Korean Frailty and Aging Cohort Study baseline survey (2016–2017)

2016–2017
Laboratory tests (taken at 08:00 after 8 hours of fasting)

- Haematology: complete blood count (white blood cell, red blood cell, haemoglobin, haematocrit test, mean corpuscular volume, mean corpuscular haemoglobin concentration, platelet)
- Biochemistry: aspartate aminotransferase test, alanine aminotransferase test, gamma-glutamyl transferase, total protein, albumin, total bilirubin, alkaline phosphatase, creatine kinase, blood urea nitrogen, creatinine, sodium, potassium, chloride, cystatin C, hepatitis B virus surface antigen
- Metabolic parameters: FBS level (fasting blood sugar), calcium, phosphorus (Pi), magnesium, haemoglobin A1c, total cholesterol, low-density lipoprotein-C, high-density lipoprotein-C, triglyceride, 25 (OH) vitamin D, vitamin B_{12}
- Hormone and tumour markers: free T4, thyroid-stimulating hormone, insulin, cortisol (S), free testosterone, **dehydroepiandrosterone, insulin-like growth factor 1**
- Inflammation markers: high-sensitivity C-reactive protein, **growth/differentiation factor 15**
- Genetic and muscle: **myostatin,** Adenosine monophosphate-activated protein kinase(AMPK) (phenotype)
- Urine test: urine 10 (stick), urine microscopic

※ Variables in bold text were added in 2017

Weakness	
Men	Women
BMI<22.0…≤25.4 kg	BMI<23.0…≤16.8 kg
BMI 22.0–23.9…≤27.1 kg	BMI 23.0–24.9…≤17.6 kg
BMI 24.0–25.9…≤27.8 kg	BMI 25.0–26.9…≤17.8 kg
BMI≥26.0…≤28.5 kg	BMI≥27.0…≤17.7 kg

- Self-reported exhaustion: defined as a yes response to either of the following statements from the Center for Epidemiological Studies-Depression scale on 3 or more days per week: 'I felt that everything I did was an effort' and 'I could not get going'.
- Slowness: walking speed over 4 m was measured using an automatic timer (Gaitspeedometer; Dynamicphysiology, Daejeon, Korea), with acceleration and deceleration phases of 1.5 m. The mean values were selected after measuring twice. The lowest 20% of gait speed stratified by sex and height based on KFACS data was suggested as a cut-off.

Slowness	
Men	Women
Height≤165.0 cm…≤0.93 m/s	Height≤152.0 cm…≤0.85 m/s
Height>165.0 cm…≤0.98 m/s	Height>152.0 cm…≤0.93 m/s

- Low physical activity: energy expenditure estimates (kcal/week) were calculated using the IPAQ and metabolic equivalent scores were derived from vigorous, moderate and mild activities in the questionnaire. Low physical activity level was defined as <494.65 kcal for men and <283.50 kcal for women, corresponding to the lowest 20% of the total energy consumed in a population-based Korean survey of older adults from among the general population.[4]

Total frailty scores (range: 0–5) were calculated by assigning a score of 1 to positive responses on each of the above five components. Participants with a score of 0 were classified as 'robust', a score of 1–2 as 'prefrail', and a score of 3–5 as 'frail'.

Subcohorts

The KFACS is unique because it is a cohort study of community-dwelling older adults, and it includes two subcohort studies: a survey of social frailty and a nutrition survey.

The social frailty survey is a bimonthly telephone survey of a subgroup within the KFACS cohort who participated in the second round of the 2017 KFACS baseline survey. From September 2017 to February 2019, 582 older adults provided additional informed consent to participate in the bimonthly telephone interviews. Among the 582 participants, 433 completed the seventh survey (74.4% follow-up). The variables in this survey included: health-related events (ie, restricted activity), healthcare utilisation (ie, hospitalisation, emergency room visits and medical expenses), disability (ie, physical functioning and IADL activity) and frailty (Tilburg Frailty Indicator), and social relationships (social network size and social activity participation). Through the KFACS social subcohort, we expect to identify social factors that determine and contribute to the physical frailty of older adults, and also to help more accurately define social frailty.

To establish the nutritional subcohort, 1002 participants who gave informed consent were selected from among the first round KFACS participants according to sampling criteria (ie, the ratios of age and sex). The 24 hours dietary recall method was used to assess dietary factors during home-visit personal interviews. Of the 1002 subjects from the first-round baseline (2016) KFACS cohort who participated in 2016–2017, 522 participants completed the 2-year follow-up survey conducted in 2018–2019. Numerous studies have reported the effects of proper nutrition in older adults, which lowers the prevalence of frailty.[32 33] Including the nutrition subcohort will enable us to develop protein intake guidelines and nutritional intervention programs to prevent frailty, as one of the significant risk factors.

Data quality assurance

The study procedures were carried out by two clinical research investigators from each of the 10 centres, for a total of 20 clinical investigators who carried the study procedures. The research investigators had been trained at Kyung Hee University Medical Center by KFACS staff members every year and had taken tests to ensure standardised quality. In addition, KFACS staff members visit the centres annually and monitor the investigators' performance based on the protocol, manual and examination guidebook created by the KFACS group.

All data obtained from the questionnaires were sent to Kyung Hee University Medical Center and managed by one medical record administrator.

Findings to date

In the baseline study (2016–2017), a total of 2907 out of 3014 individuals fulfilled all five components of FFP. The results indicated that 7.8% of the participants (n=228) were frail, 47.0% (n=1366) were prefrail and 45.2% (n=1313) were robust (table 3). The prevalence of frailty increased with age in both sexes; in the group aged 70–74 years, 1.8% of men and 3.7% of women were frail, whereas in the 80–84 years age group, 14.9% of men and 16.7% of women were frail. Women tended to exhibit a higher prevalence of frailty than men in all age groups (table 3).

Publications and findings using KFACS data

Among the social factors, the risk of frailty increased significantly when the frequency of contact with friends decreased.[34] Nutritional status (especially anorexia) was shown to increase the risk of frailty,[35] the average daily intake of nutrients (adjusted for sex and age) was shown to decrease significantly with increasing severity of frailty, and frail subjects had significantly lower levels of protein, vitamin E, vitamin C and calcium intake than robust subjects and subjects in the prefrail stage.[36] Frailty was associated with long sleep latency in elderly male subjects and with sleeping for more than 8 hours in elderly female subjects.[37] Moreover, our previous study showed that moderate hearing loss was strongly associated with social frailty.[38] The prevalence of frailty was reported to increase with a daily sodium intake of>3575 mg.[39] The self-administered health assessment tool, the EQ-VAS, was deemed appropriate as a frailty screening tool,[40] and low calf circumference (<32 cm) was shown to be strongly related to cognitive frailty in men.[41]

Brief analysis plans

Using longitudinal KFACS data, both cross-sectional and longitudinal relationships between demographic characteristics, health behaviours, health statuses and physical frailty will be characterised in a specifically Korean sample. In addition to identifying the risk factors and predictors of frailty by examining cohorts of community-dwelling older Korean adults on the national scale, we will provide the basis for developing future evaluation guidelines and screening tools for the prevention and management of physical frailty.

Strengths and limitations

The main strengths of the KFACS are (1) the inclusion of a nationwide population of community-dwelling Korean older adults; (2) the attainment of over 90%

Table 3 Characteristics of participants of the Korean Frailty and Aging Cohort Study baseline survey, 2016–2017 according to Fried's frailty phenotype (n=2907)

Variable	Total (n=2907)	Male (n=1383)	Female (n=1524)	Male 70–74 (n=506)	Male 75–79 (n=529)	Male 80–84 (n=348)	P value	Female 70–74 (n=649)	Female 75–79 (n=551)	Female 80–84 (n=324)	P value
Frailty status according to Fried's phenotype, n (%)											
Robust	1313 (45.2)	695 (50.3)	618 (40.6)	308 (60.9)	278 (52.6)	109 (31.3)		318 (49.0)	223 (40.5)	77 (23.8)	
Prefrail	1366 (47.0)	590 (42.7)	776 (50.9)	189 (37.4)	214 (40.5)	187 (53.7)	< 0.001	307 (47.3)	276 (50.1)	193 (59.6)	< 0.001
Frail	228 (7.8)	98 (7.1)	130 (8.5)	9 (1.8)	37 (7.0)	52 (14.9)		24 (3.7)	52 (9.4)	54 (16.7)	
Frailty phenotype, *n* (%)											
Unintentional weight loss (>4.5 kg)	142 (4.9)	75 (5.4)	67 (4.4)	18 (3.6)	34 (6.4)	23 (6.6)	0.062	22 (3.4)	26 (4.7)	19 (5.9)	0.181
Low grip strength	602 (20.7)	283 (20.5)	319 (20.9)	53 (10.5)	92 (17.4)	138 (39.7)	< 0.001	85 (13.1)	119 (21.6)	115 (35.5)	< 0.001
Self-reported exhaustion	971 (33.4)	323 (23.4)	648 (42.5)	95 (18.8)	128 (24.2)	100 (28.7)	0.004	239 (36.8)	229 (41.6)	180 (55.6)	< 0.001
Slowness	625 (21.5)	297 (21.5)	328 (21.5)	67 (13.2)	101 (19.1)	129 (37.1)	< 0.001	75 (11.6)	124 (22.5)	129 (39.8)	< 0.001
Low physical activity	325 (11.2)	155 (11.2)	170 (11.2)	37 (7.3)	53 (10.0)	65 (18.7)	< 0.001	46 (7.1)	59 (10.7)	65 (20.1)	< 0.001

Participants were sorted into three age groups (70–74, 75–79 and 80–84 years).

of follow-up rate both in 2018 (92.4%) and in 2019 (94.8%) of the baseline data collected in 2016–2017; (3) a comprehensive scope of assessments, with the inclusion of physical examinations, health assessments, a neuropsychological battery for cognitive function, in-depth social function surveys, dental radiography, blood tests and banking, and most importantly, a diverse range of frailty and sarcopenia assessments; and most importantly all the data are available and open to all researchers; and (4) the inclusion of two subcohort studies, that is, a survey of social frailty involving bimonthly interviews and a nutrition survey involving home visits.

One weakness of the study is that the participants had to be ambulatory to visit the 10 centres in the baseline survey, and home-bound disabled or institutionalised persons could not participate. In addition, patients with dementia with problems in communication were excluded. Second, the participants were not selected through probability sampling due to the strengthened data privacy laws that prevented researchers from acquiring the personal information of people living in the communities around the 10 centres. However, the distribution of sample characteristics (age, sex, education, place of residence) of KFACS participants was similar to the estimates of the older (70–84 years) population drawn from the national census.

Author affiliations

[1]Elderly Frailty Research Center, Department of Family Medicine, College of Medicine, Kyung Hee University, Seoul, Republic of Korea
[2]Department of Family Medicine, Kyung Hee University Medical Center, Seoul, Republic of Korea
[3]Graduate School of Social Welfare, Yonsei University, Seoul, Republic of Korea
[4]Department of Preventive Medicine and Public Health, Ajou University School of Medicine, Suwon, Republic of Korea
[5]Department of Preventive Medicine, Korea University College of Medicine, Seoul, Republic of Korea
[6]Institute of Social Welfare, Sungkonghoe University, Seoul, Republic of Korea
[7]Department of Preventive Medicine, Hanyang University College of Medicine, Seoul, Republic of Korea
[8]Department of Family Medicine, Center for Health Promotion and Optimal Aging, Seoul National University College of Medicine & Hospital, Seoul, Republic of Korea
[9]Division of Endocrinology and Metabolism, Department of Internal Medicine, Korea University, Seoul, Republic of Korea
[10]Department of Internal Medicine, Seoul National University Bundang Hospital, Seoul National University, College of Medicine, Seongnam, Republic of Korea
[11]Department of Psychiatry, Ajou University School of Medicine, Suwon, Republic of Korea
[12]Catholic institute of U-healthcare, The Catholic University of Korea, Seoul, Republic of Korea
[13]Department of Family Medicine, Hallym University Chuncheon Sacred Heart Hospital, Chuncheon, Republic of Korea
[14]Department of Physical & Rehabilitation Medicine, Chonnam National University Medical School, Gwangju, Republic of Korea
[15]Department of Psychiatry, College of Medicine, Gyeongsang National University, Jinju, Republic of Korea
[16]Department of Family Medicine, Jeju National University School of Medicine, Jeju, Republic of Korea
[17]Department of Family Medicine, Research Institute of Medical Science, Konkuk University Medical Center, Konkuk University School of Medicine, Seoul, Republic of Korea
[18]Institute of Geriatric Medicine, Incheon Eun-Hye Hospital, Incheon, Republic of Korea

[19]Department of Information and Statistics, Korea National Open University, Seoul, Republic of Korea
[20]Department of Biomedical Science and Technology, College of Medicine, East-West Medical Research Institute, Kyung Hee University, Seoul, Republic of Korea

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Competing interests None declared.

Patient and public involvement This study was completed without participant involvement. The participants were not invited to contribute the development of the design, recruitment, questionnaires of the KFACS nor to have commitment to the results of this study. All participants were informed of the use of the data for research in this study. We have informed the participants of the main results of their blood, urine, chest X-ray, dual energy X-ray absorptiometry (DEXA), ECG and cognitive function tests. We have plans to disseminate the results of the study: (1) develop the guidelines for the prevention and management of physical frailty based on the results from the KFACS data and disclose to the public, and (2) provide printed materials on the main results of the KFACS to the participants.

Patient consent for publication Not required.

Ethics approval The KFACS protocol was approved by the institutional review boards (IRBs) of the clinical research ethics committees of all 10 participating centers (Kyung Hee University, Seoul National University Hospital, Korea University Guro Hospital, Hallym University Medical Center–Chuncheon, Seoul National University Bundang Hospital, Ajou University Hospital, Gyeongsang National University Hospital, Chonnam National University Hospital, and Jeju National University Hospital), including the coordinating center, Kyung Hee University Hospital, Seoul, Korea (IRB number: 2015-12-103). All participants provided written informed consent. This report was exempted from approval by the IRB of the Clinical Research Ethics Committee of Kyung Hee University Hospital (IRB number: 2019-08-072).

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Data availability statement Data are available upon reasonable request. All data relevant to the study are included in the article or uploaded as supplementary information. All published articles and news articles using the KFACS database, data provision manuals and contact information are available at the KFACS website (http://www.kfacs.kr). The KFACS cohort database and blood samples are available to researchers, and the authors anticipate collaboration even with international researchers, although approval from the Kyung Hee University Hospital IRB is required to share the dataset or banked blood samples for all the researchers.

ORCID iDs
Seoyoon Lee http://orcid.org/0000-0003-4013-7987
Hyeon Ju Kim http://orcid.org/0000-0002-9103-3275
Yunhwan Lee http://orcid.org/0000-0001-8484-4750
Miji Kim http://orcid.org/0000-0002-0852-8825

REFERENCES

1 Korean Statistical Information Service. *Korean statistical information service (KOSIS) reports: 2018 the aged population panel*. KOSIS, 2018.
2 Son JH, Kim SY, Won CW, *et al*. Physical frailty predicts medical expenses in community-dwelling, elderly patients: three-year prospective findings from living profiles of older people surveys in Korea. *Eur Geriatr Med* 2015;6:412–6.
3 Ministry of Health and Welfare. *The survey of living conditions and welfare needs of Korean older persons*. 2008. Seoul: Korean Institute for Health and Social Affairs, Ministry of Health and Welfare, 2017.
4 Ministry of Health and Welfare. *Living profiles of older people survey in Korea*. 2008. Seoul: Korean Institute for Health and Social Affairs, Ministry of Health and Welfare, 2008.
5 Cesari M, Prince M, Thiyagarajan JA, *et al*. Frailty: an emerging public health priority. *J Am Med Dir Assoc* 2016;17:188–92.
6 Won CW, Lee Y, Choi J, *et al*. Starting construction of frailty cohort for elderly and intervention study. *Annals of Geriatric Medicine and Research* 2016;20:114–7.
7 Morley JE, Vellas B, van Kan GA, *et al*. Frailty consensus: a call to action. *J Am Med Dir Assoc* 2013;14:392–7.
8 Park J, Lim S, Lim JY, *et al*. An overview of the Korean longitudinal study on health and aging. *Psychiatry Investigation* 2007;4:84–95.
9 Lee EY, Kim HC, Rhee Y, *et al*. The Korean urban rural elderly cohort study: study design and protocol. *BMC Geriatr* 2014;14:33.
10 Jung H-W, Jang I-Y, Lee YS, *et al*. Prevalence of frailty and aging-related health conditions in older Koreans in rural communities: a cross-sectional analysis of the aging study of Pyeongchang rural area. *J Korean Med Sci* 2016;31:345–52.
11 Chung K. Changes in the living profiles of older persons and policy issues. *Health and welfare policy forum* 2014;216:7–17.
12 Han G, Yang E. Evaluation of dietary habit and nutritional intake of Korean elderly: data from Korea National health and nutrition examination survey 2013–2015. *Journal of the East Asian Society of Dietary Life* 2018;28:258–71.
13 Korean Statistical Information Service. *Participation in community activities. Korean statistical information service*. KOSIS, 2015.
14 Kim T, Lee J, Jung Poverty J. J. Elderly poverty and depression: focusing on the multidimensional concept of poverty. *Health and Social Welfare Review* 2015;35:71–102.
15 JY O, Yang YJ, Kim BS, *et al*. Validity and reliability of Korean version of international physical activity questionnaire (IPAQ) short form. *Journal of the Korean Academy of Family Medicine* 2007;28:532–41.
16 Alexander A, Bergman P, Hagströmer M, *et al*. IPAQ environmental module; reliability testing. *J Public Health* 2006;14:76–80.
17 Nestlé Nutrition Institute. *Mini nutritional assessment (MNA)*. Switzerland: Nestlé Nutrition Institute, 2009.
18 Kim S-H, Jo M-W, Ahn J, *et al*. Assessment of psychometric properties of the Korean SF-12 V2 in the general population. *BMC Public Health* 2014;14:1086.
19 Charlson ME, Pompei P, Ales KL, *et al*. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1987;40:373–83.
20 Kim M-H, Cho Y-S, Uhm W-S, *et al*. Cross-Cultural adaptation and validation of the Korean version of the EQ-5D in patients with rheumatic diseases. *Qual Life Res* 2005;14:1401–6.
21 EuroQol Group. EuroQol--a new facility for the measurement of health-related quality of life. *Health Policy* 1990;16:199–208.
22 Bae JN, Cho MJ. Development of the Korean version of the geriatric depression scale and its short form among elderly psychiatric patients. *J Psychosom Res* 2004;57:297–305.
23 Won CW, Yang KY, Rho YG, *et al*. The development of Korean activities of daily living (K-ADL) and Korean instrumental activities of daily living (K-IADL) scale. *Journal of the Korean Geriatrics Society* 2002;6:107–20.
24 Jang SN, Cho SI, SW O, *et al*. The validity and reliability of Korean fall efficacy scale (FeS) and Activities-specific balance confidence scale (ABC). *Journal of the Korean Geriatrics Society* 2003;7:255–68.
25 Wenger GC, Tucker I. Using network variation in practice: identification of support network type. *Health Soc Care Community* 2002;10:28–35.
26 Mitchell PH, Powell L, Blumenthal J, *et al*. A short social support measure for patients recovering from myocardial infarction: the ENRICHD social support inventory. *J Cardiopulm Rehabil* 2003;23:398–403.
27 Shin N, Kang Y. The relationships among health locus of control and resilience, social support and health promoting behavior in patients with newly diagnosed coronary artery diseases. *Korean Journal of Adult Nursing* 2015;27:294–303.
28 Ahn H-J, Chin J, Park A, *et al*. Seoul neuropsychological screening Battery-dementia version (SNSB-D): a useful tool for assessing and

monitoring cognitive impairments in dementia patients. *J Korean Med Sci* 2010;25:1071.
29 Lee DY, Lee KU, Lee JH, *et al*. A normative study of the CERAD neuropsychological assessment battery in the Korean elderly. *J Int Neuropsychol Soc* 2004;10:72–81.
30 Kim TH, Huh Y, Choe JY, *et al*. Korean version of frontal assessment battery: psychometric properties and normative data. *Dement Geriatr Cogn Disord* 2010;29:363–70.
31 Fried LP, Tangen CM, Walston J, *et al*. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001;56:M146–57.
32 Cameron ID, Fairhall N, Langron C, *et al*. A multifactorial interdisciplinary intervention reduces frailty in older people: randomized trial. *BMC Med* 2013;11:65.
33 Ng TP, Feng L, Nyunt MSZ, *et al*. Nutritional, physical, cognitive, and combination interventions and frailty reversal among older adults: a randomized controlled trial. *Am J Med* 2015;128:1225–36.
34 Chon D, Lee Y, Kim J, *et al*. The association between frequency of social contact and frailty in older people: Korean frailty and aging cohort study (KFACS). *J Korean Med Sci* 2018;33:e332.
35 Kim J, Lee Y, Won CW, *et al*. Nutritional status and frailty in community-dwelling older Korean adults: the Korean frailty and aging cohort study. *J Nutr Health Aging* 2018;22:774–8.
36 Park Y, Lee Y. Association between protein intake and frailty in the Korean elderly of KFACS. *Annals of Nutrition & Metabolism* 2017;71:616.
37 Kang I, Kim S, Kim BS, *et al*. Sleep latency in men and sleep duration in women can be frailty markers in community-dwelling older adults: the Korean frailty and aging cohort study (KFACS). *J Nutr Health Aging* 2019;23:63–7.
38 Yoo M, Kim S, Kim BS, *et al*. Moderate hearing loss is related with social frailty in a community-dwelling older adults: the Korean frailty and aging cohort study (KFACS). *Arch Gerontol Geriatr* 2019;83:126–30.
39 Kim S, Kim M, Min J, *et al*. How much intake of sodium is good for frailty?: the Korean frailty and aging cohort study (KFACS). *J Nutr Health Aging* 2019;23:503–8.
40 Kim S, Won CW, Kim BS, *et al*. EuroQol visual analogue scale (EQ-VAS) as a predicting tool for frailty in older Korean adults: the Korean frailty an aging cohort study (KFACS). *J Nutr Health Aging* 2018;22:1275–80.
41 Kim M, Jeong M, Yoo J, *et al*. Calf circumference as a screening tool for cognitive frailty in community-dwelling older adults: the Korean frailty and aging cohort study (KFACS). *J Clin Med* 2018;7:332.