Introducing Sarcopenia Cohort

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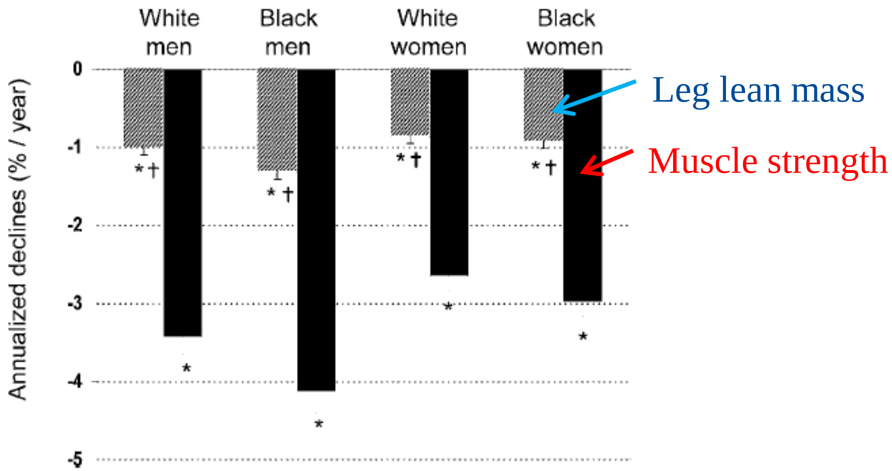
Contents

Basic knowledges

Changes in muscle with aging

1. With aging in older adults, decline in muscle strength is about 3 times as many as the loss in muscle mass



2. The loss in muscle mass and strength with aging is greater in men than women

Goodpaster et al. Journal of Gerontology 2006

Decline in muscle mass for 2 years

Towards Global Eminence

- The Loss in muscle mass in older adults is more severe in lower extremities than upper extremities

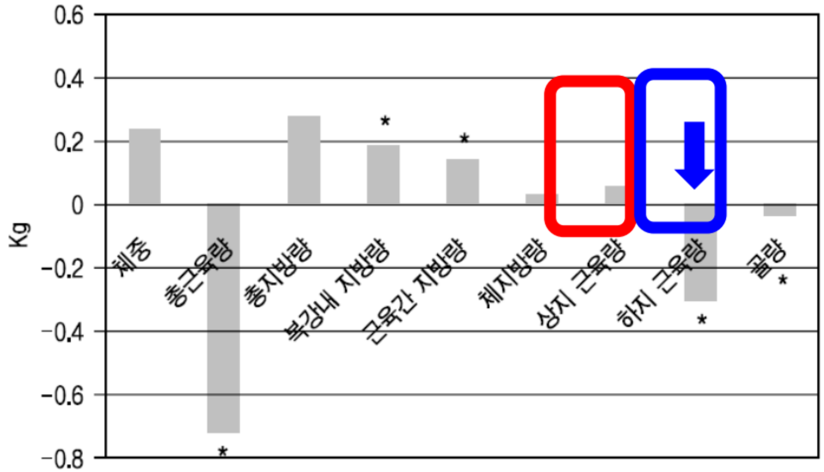


Fig. 1. Changes in body composition over 2 years in 26 African-American women older than 65 years (modified from reference 8). $^{*}p<0.05$.

Am J clin Nutr, 2004; 79: 874-80

미국 흑인 여성 (평균연령 75.5 y) whole-body magnetic resonance imaging

Muscle strength, not muscle mass (DXA), was a/w low performance 5 yrs later

Table 3 Predictors for adverse clinical outcomes of mortality and low physical performance

	Women HR or OR (95% CI)†	*P*-value	Men HR or OR (95% CI)†	*P*-value
Predictors of mortality, model 1 (normalized leg muscle strength)				
Normalized leg muscle strength	0.927 (0.080–10.788)	0.952	0.550 (0.155–1.959)	0.357
ASM/Ht^2	0.793 (0.301–2.094)	0.640	0.824 (0.493–1.375)	0.459
Percentage fat mass	0.915 (0.842–0.995)	0.038	1.015 (0.957–1.076)	0.628
Serum albumin	0.084 (0.007–0.972)	0.047	NA	
Predictors of mortality, model 2 (grip strength)				
Grip strength	0.976 (0.922–1.033)	0.397	0.987 (0.961–1.013)	0.312
ASM/Ht^2	0.878 (0.342–2.254)	0.787	0.867 (0.536–1.400)	0.559
Percentage fat mass	0.910 (0.842–0.984)	0.018	1.013 (0.961–1.067)	0.631
Serum albumin	0.068 (0.007–0.660)	0.020	NA	
Predictors of low performance, model 1 (normalized leg muscle strength)				
Normalized leg muscle strength	0.107 (0.016–0.704)	0.020	0.123 (0.018–0.821)	0.031
ASM/Ht^2	0.937 (0.448–1.961)	0.864	0.841 (0.455–1.555)	0.581
Percentage fat mass	1.036 (0.965–1.112)	0.328	1.001 (0.933–1.073)	0.984
Regular exercise	1.434 (0.600–3.430)	0.417	NA	
Predictors of low performance, model 2 (grip strength)				
Grip strength	0.998 (0.963–1.036)	0.933	0.950 (0.912–0.989)	0.012
ASM/Ht^2	0.929 (0.439–1.966)	0.847	0.956 (0.521–1.754)	0.884
Percentage fat mass	1.051 (0.980–1.126)	0.162	1.024 (0.959–1.093)	0.481
Regular exercise	1.304 (0.553–3.073)	0.545	NA	

†Hazard ratio (HR) for predictors of mortality or odds ratio (OR) for predictors of low performance. All models were adjusted for age, Mini-Mental Status Examination and Geriatric Depression Scale. ASM/Ht^2, appendicular skeletal mass divided by height squared; NA, not applicable.

KLOSHA. Korea. Geriatr Gerontol Int 2016;16:–57875

1. the modality for muscle measure matters.

Muscle strength was a/w 5-year mortality, but Leg or arm lean mass by DXA was not a/w 5-year mortality

Leg lean mass by CT was significantly a/w 5-year mortality

Muscle itself is not a problem, but the modality for muscle measure matters.

Strength	No. of Deaths	Person-Years	Crude Rate per 1000 Person-Years	Unadjusted HR (95% CI)
Men				
Quadriceps strength (per 38.0 Nm)	180	5445	33.1	1.51 (1.28–1.79)
Grip strength (per 10.7 kg)				1.36 (1.13–1.64)
Women				
Quadriceps strength (per 38.0 Nm)	106	5855	18.1	1.65 (1.19–2.30)
Grip strength (per 10.7 kg)				1.84 (1.28–2.65)
Total				
Quadriceps strength (per 38.0 Nm)	286	11300	25.3	1.54 (1.32–1.79)§
Grip strength (per 10.7 kg)				1.45 (1.23–1.71)§

Table 3. Muscle Size–Mortality Risk per Standard Deviation in Men and Women

Muscle Size Measure	HR (95% CI) Unadjusted	HR (95% CI) Multivariate Adjustment*
Men		
CT leg muscle area (per 28.1 cm^2)	1.32 (1.09–1.61)	1.26 (1.02–1.55)†
DXA leg lean (per 1.8 kg)	1.06 (0.87–1.30)	0.98 (0.75–1.28)‡
DXA arm lean (per 0.9 kg)	1.06 (0.84–1.33)	1.0 (0.76–1.33)‡ 2.0
Women		
CT leg muscle area (per 28.1 cm^2)	1.19 (0.86–1.64)	0.94 (0.66–1.35)†
DXA leg lean (per 1.8 kg)	1.16 (0.85–1.57)	0.96 (0.61–1.51)‡
DXA arm lean (per 0.9 kg)	1.12 (0.74–1.70)	1.0 (0.61–1.65)‡ 2.0
Total		
CT leg muscle area (per 28.1 cm^2)	1.29 (1.09–1.52)§	1.16 (0.97–1.39)†
DXA leg lean (per 1.8 kg)	1.09 (0.92–1.29)§	0.95 (0.76–1.20)‡
DXA arm lean (per 0.9 kg)	1.08 (0.89–1.32)§	0.99 (0.77–1.26)‡

Notes: *All multivariate models also adjusted additionally for age and other factors in stepwise model including race, height, smoking status, physical activity level, number of chronic conditions, education, log interleukin-6, and Center for Epidemiologic Studies-Depression (CES-D) scale score.

Health ABC. 70-79yr old

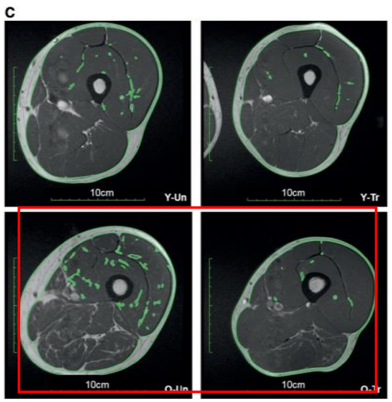
Journal of Gerontology. 2006, Vol. 61A, No. 1, 72–77

2. Aging increases noncontractile component(fat infiltration, fibrosis) in muscle

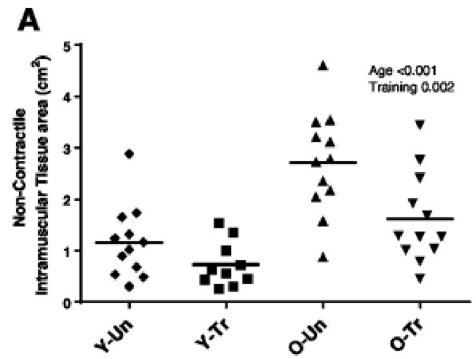
- the aging muscle not only suffers from **muscle atrophy** but also from increase **fat infiltration and fibrosis in muscle**

→ Aged muscle has Lower muscle strength compared to muscle mass volume (**low muscle quality!!**)

Y-Un: young, untrained
Y-Tr: young, trained
O-Un: old, untrained
O-Tr: old, trained



Noncontractile components(green) affected by **age and training**



Experimental Gerontology 2017; 93, Pages 54-67

3. Decrease in motor neuron unit with aging accelerates muscle strength declines

- Motor neuron (activation) is as much important for m. strength
- loss of **motor neurons** begins around the age of 50 yr

→ muscle strength is lost to a greater degree than muscle mass during aging

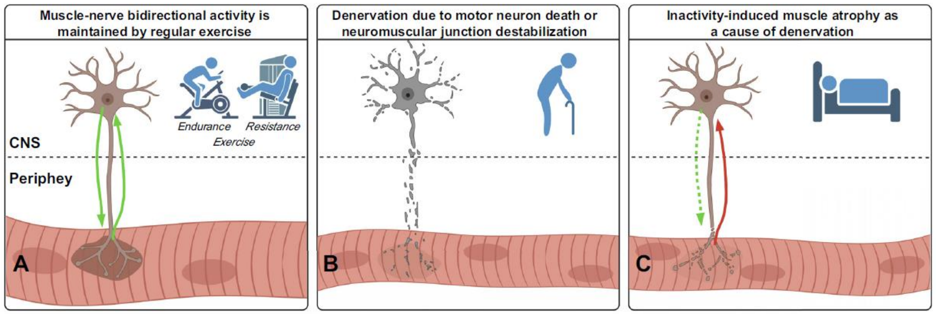


Figure 2. Bidirectional signaling between muscle fibers and motor neurons. Green and red arrows represent positive and negative signaling, respectively, between cells. *A*: exercise promotes motor neuron survival and NMJ maintenance via mutually beneficial anterograde (nerve to muscle) and retrograde (muscle to nerve) signaling between the muscle fiber and motor neuron. Heavy loading or fatigue is important for the recruitment of large and fast motor units. *B*: motor neuron death or NMJ destabilization deprives the muscle of neural input and causes muscle fiber atrophy and eventually muscle fiber death. *C*: muscle atrophy due to other factors (physical inactivity, malnutrition, and disease) alters innervation status, through a reduction in anterograde transmission and a lack of retrograde transmission of neurotrophic factors or an increase in signals hostile to the motor neuron. Created with

Am J Physiol Cell Physiol 321: C317–C329, 2021

Definition of sarcopenia

Definition of sarcopenia

- **AWGS 2019** Guideline: "age-related loss of skeletal muscle mass plus loss of muscle strength or reduced physical performance,"

'Not' diabetes, CVD

- **EWGSOP2** Guideline(2018) : a progressive and generalised skeletal muscle disorder that is associated with increased likelihood of adverse outcomes including **falls, fractures, physical disability and mortality**. Muscle strength comes to the forefront, as it is recognized that strength is better than mass in predicting adverse outcomes

JAMDA 21 (2020) 300–307

ELSEVIER

JAMDA

journal homepage: www.jamda.com

Special Article

Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment

Check for updates

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AWGS 2019 guideline

Primary care setting

Case finding

- Calf circumference (M <34 cm, F <33 cm)
or
- SARC-F questionnaire ≥4

assess

Muscle strength
- Handgrip strength M <28 kg, F <18 kg

or

Physical performance
- 5-time chair stand test ≥12 sec

'Possible sarcopenia'

Refer for confirmation

Nutrtion. exercise

Hospital setting

Process of confirmation

Confirm muscle strength
- Handgrip strength M <28 kg, F <18 kg

Confirm physical performance
6-meter galt speed <1.0 m/sec *or*
5-time chair stand test ≥12 sec *or*
short physical performance battery ≥9

ASM
DXA (M <7.0 kg/m², F <5.4 kg/m²) *or*
BIA (M <7.0 kg/m², F <5.7 kg/m²)

Sarcopenia
Low ASM + (low muscle strength *OR* low physical performance)

Severe sarcopenia
Low ASM + (low muscle strength *AND* low physical performance)

Cohorts related with sarcopenia

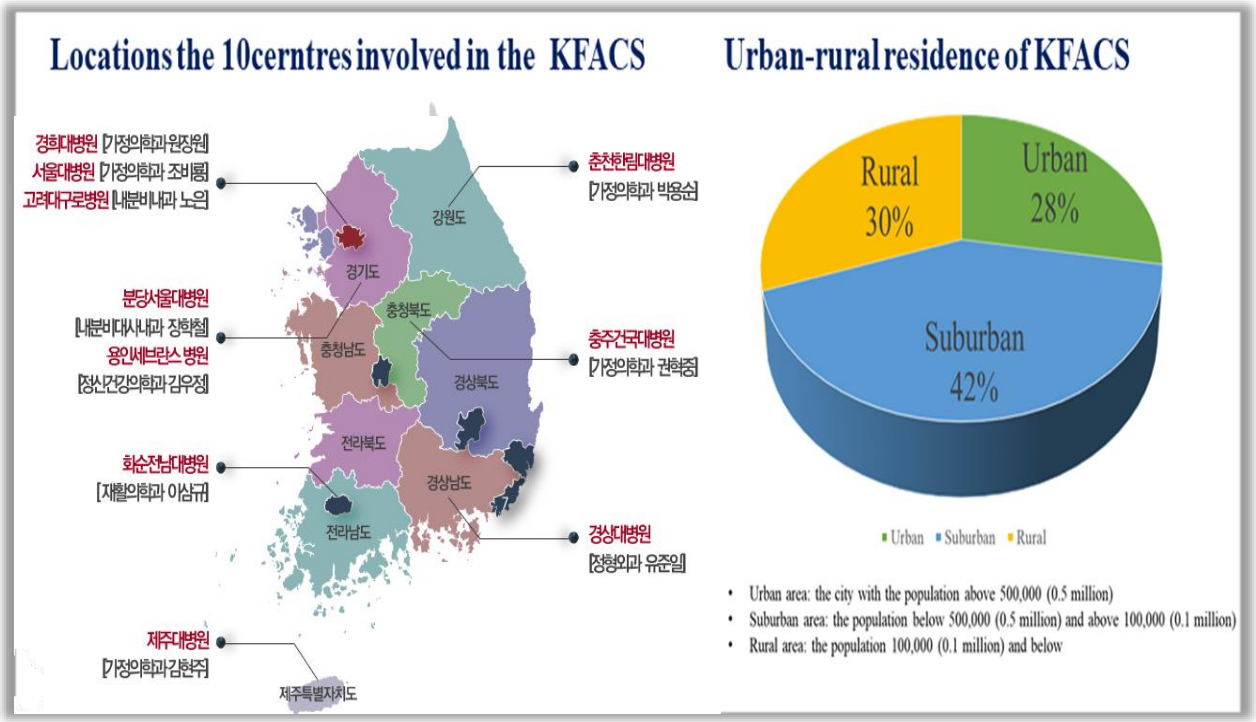
Cohorts related with sarcopenia

- Korean Frailty and Aging Cohort Study (KFACS)
- KoGES
- SOMMA
- UK BIOBANK
- NILS-LSA

Korean Frailty and Aging Cohort Study (KFACS)

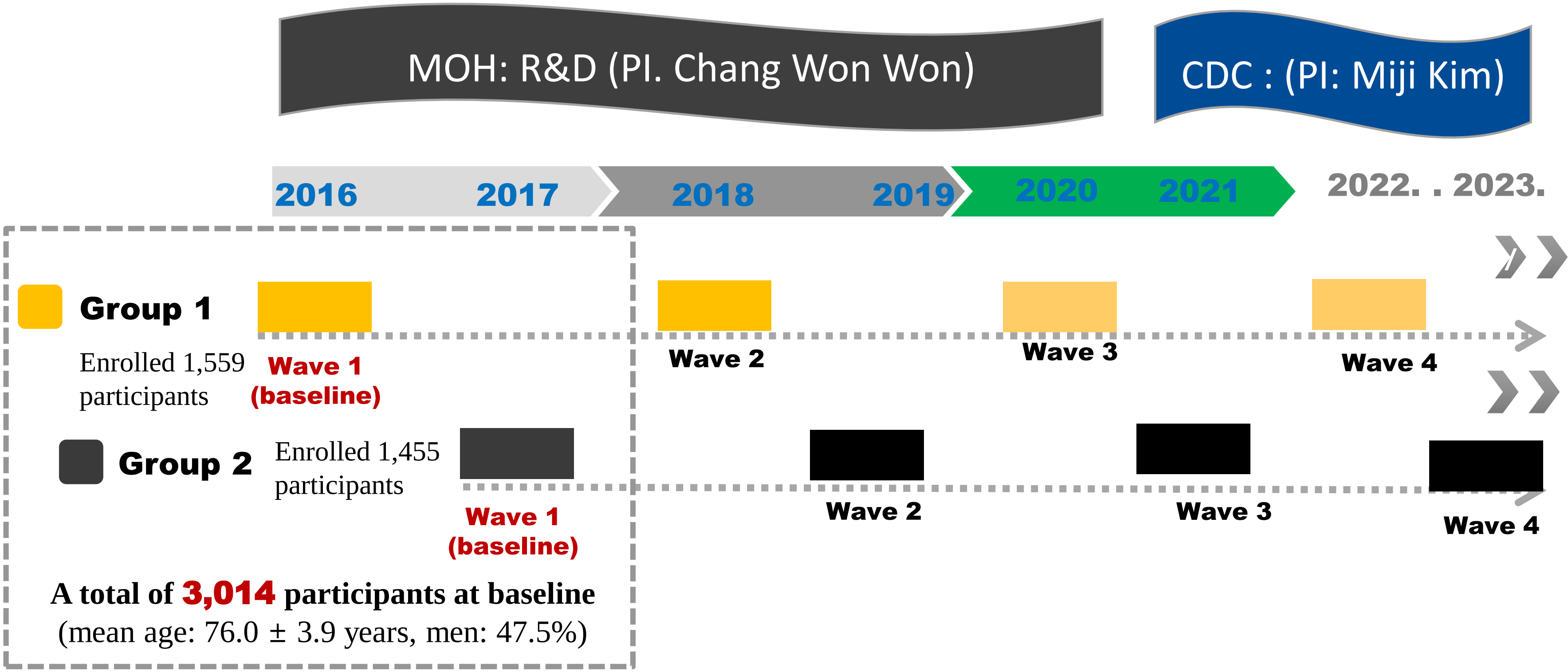
KFACS cohort

- **aged 70–84 years at baseline**
- **Community-dwelling**
- **Recruited nation-widely** at **10 centers**



KFACS scheme

Towards Global Eminence



Collected Data of KFACS

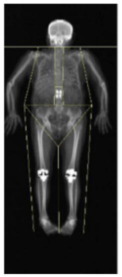
KFACS Korean Frailty and Aging Cohort Study

Body composition

Dual energy X-ray absorptiometry (DEXA):
KFCAS 8 medical centers

Bioelectrical impedance Analysis (BIA):
KFCAS 2 medical centers

Ultrasound: muscle quality
(2018, Kyung Hee University site only)



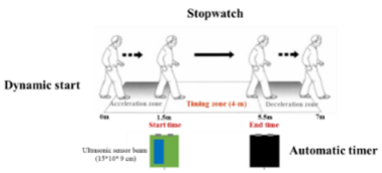
Physical function

Hand grip strength:
Digital handgrip dynamometer (T.K.K.5401, Takei Scientific Instruments Co, Ltd., Tokyo, Japan).

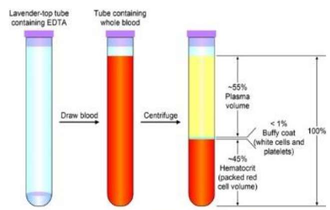
4-m usual gait speed :
Automatic timer & manual timer

Short Physical Performance Battery:
Three standing balance
Five chair-stand time
Usual gait speed

Timed up-and-go test



Contents
CBC (WBC, RBC, Hb, HCT, MCV, MCHC, platelet)
AST, ALT, GGT, Total protein, Albumin, Total bilirubin, Alk. phosphatase, Creatine kinase, BUN, Creatinine, Na, K, Cl, Urine 10 (stick), Urine microspcopic, Cystatin C, HBS Ag
Glucose (FBS), Ca, Phosphorus (Pi), Mg, HbA1c, Total cholesterol, LDL-C, HDL-C, Triglyceride, 25(OH) Vit D, Vitamin B12
Free T4, TSH, Insulin, Cortisol (S), Free testosterone, DHEA, IGF-1
hs-CRP, GDF-15
Myostatin, AMPK(phenotype)
urinalysis



Collected Data of KFACS

KFACS Korean Frailty and Aging Cohort Study

Anthropometry	Health behaviors	Health status	Cognitive function
Body weight Height	Smoking Alcohol drinking	Self-rated health (SF-12) Comorbidity Medications	**Global cognition**: Mini-Mental State Examination
Head circumference Waist circumference	Sleep Physical activity (IPAQ) IPAQ environmental module	Quality of life (EQ-5D) Depressive symptoms(GDS-SF) ADL/IADL	**Executive function:** Frontal Assessment Battery : Similarities, Lexical fluency, Fist-Edge-Palm, Conflicting instructions, Go-No-Go, Prehension behavior
Leg length	Nutritional risk (MNA) Dietary patterns Food security	Falls Experience, reason, injury, fear of falling Activities-specific Balance Confidence scale (ABC)	**Processing speed:** Trail Making Test A
Upper arm circumference Calf circumference	Oral hygiene Dental checkup	Oral health: Mastication Pronunciation difficulties	**Memory:** Word list memory/recall/ recognition
	Health checkup	Women's health : menopause, HRT	**Attention :** Digit span forward/ digit span backward
		Appetite: SNAQ (Simplified Nutritional Appetite Questionnaire) Functional constipation	Korean version of the Alzheimer disease 8 (proxy interview)
		Resilience (Brief Resilience Scale)	

※ Neuropsychological battery: the Korean Version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet (CERAD-K) and the Korean version of the Frontal Assessment Battery

Prevalence of sarcopenia, Korea

Towards Global Eminence

- older adults in community, KFACS, 70-84 yrs

M 21.3%, W 13.8%

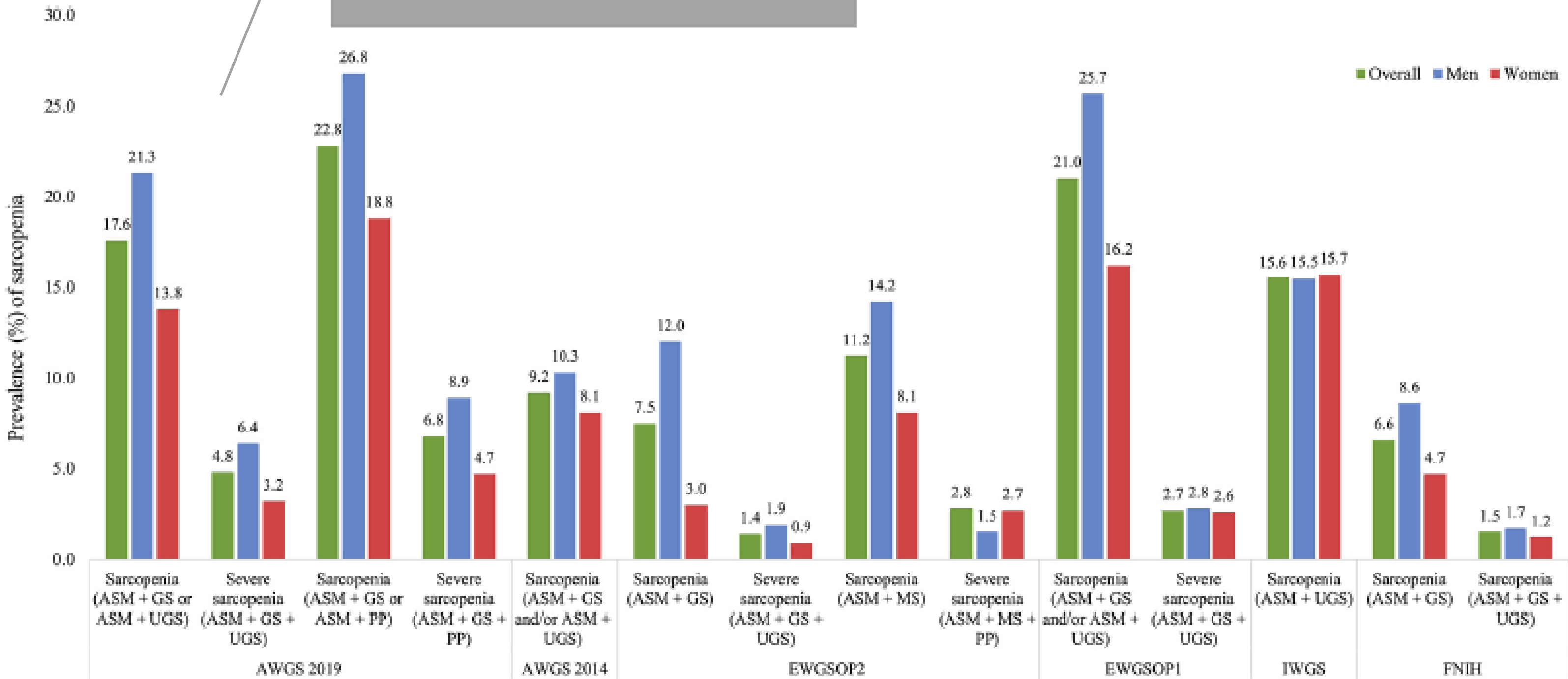


Fig. 1. Prevalence (%) of sarcopenia according to diagnostic criteria. The prevalence rates of sarcopenia as defined by the AWGS 2019, AWGS 2004, EWGSOP1, EWGSOP2, and FNIH criteria were significantly different between men and women ($P < .05$). The prevalence of severe sarcopenia as defined by the AWGS 2019 was significantly different between men and women ($P < .05$). Sarcopenia was defined as low muscle strength (MS), low ASM (expressed as ASM/height^2 or ASM/BMI), and/or low physical performance (PP). BMI, body mass index; GS, grip strength; FNIH, Foundation for the National Institutes of Health; IWGS, International Working Group on Sarcopenia; UGS, usual gait speed.

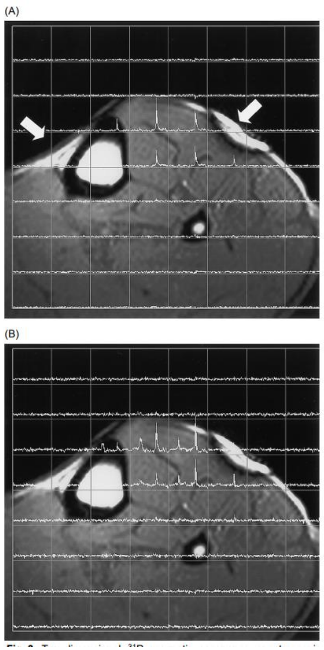
Miji Kim, Chang Won Won. JAMDA 21 (2020) 752-758

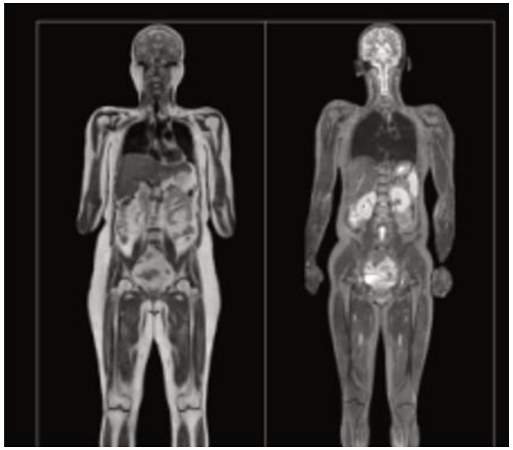
SOMMA cohort

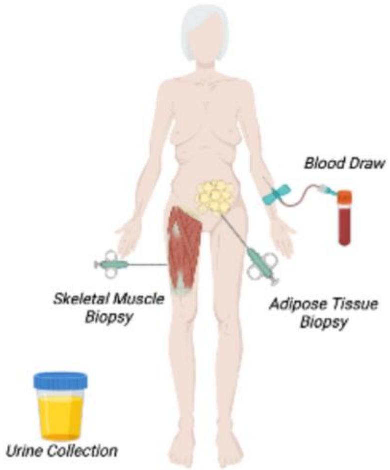
(the Study of Mobility and Muscle Aging)

To investigate

- ✓ Mitochondrial function (ATP synthesis rate) by **^{31}P MR spectroscopy**
- ✓ Muscle quality by **whole-body imaging** (MRI & CT)
- ✓ **cellular biology of aging by Muscle & fat biopsy, blood test**

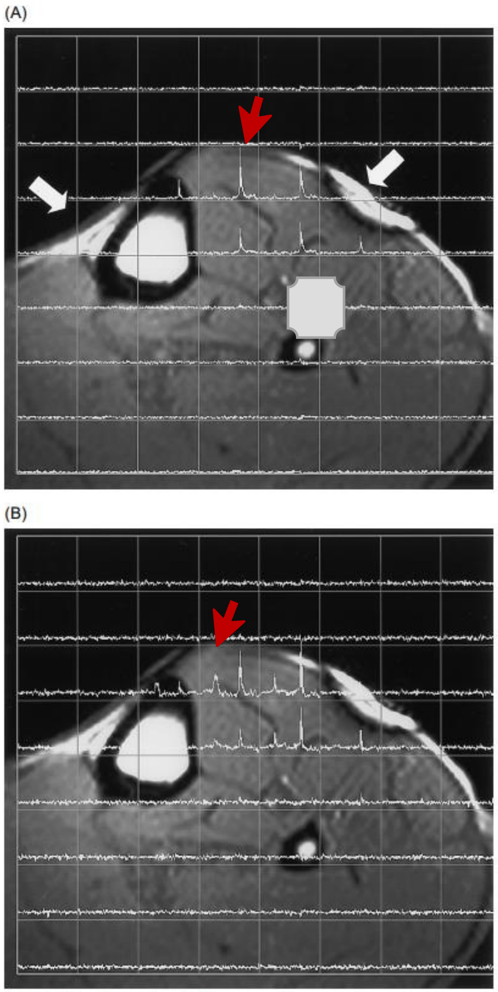


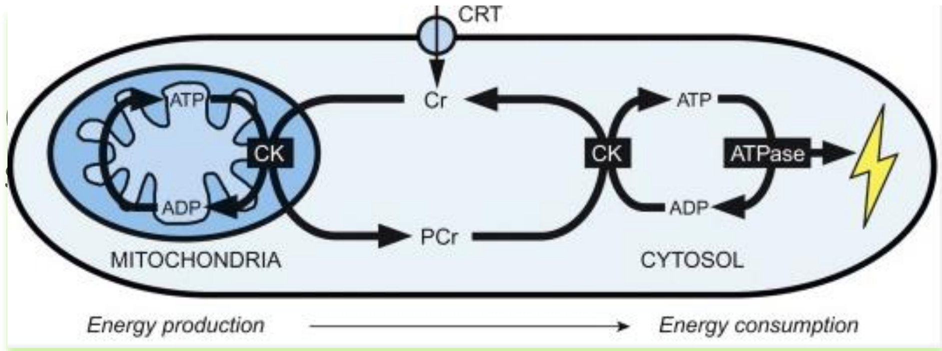




^{31}P MRS(magnetic resonance spectroscopy)

* Assess mitochondrial function (ATP synthesis rate)





inant

or.

PCr + ADP + H+ ↔ ATP + Cr phosphocreatine(PCr)

ATP + H2O → ADP + **Pi** + H+.

(B) Spectroscopic image obtained **during exercise**. Now an increased **Pi peak** is observed at the left side of the PCr peak

Proceedings of the Nutrition Society (1999), 58, 861–

SOMMA Aims

- How do cellular properties in muscle contribute to declines in mobility – strength, walking, and fitness – with aging.
- Develop an archive of resources – tissue, blood, and phenotypic data – for the study of the cellular biology of human aging.

SOMMA Design

- Measures muscle size
(MRI- muscle volume. D3Cr muscle mass)

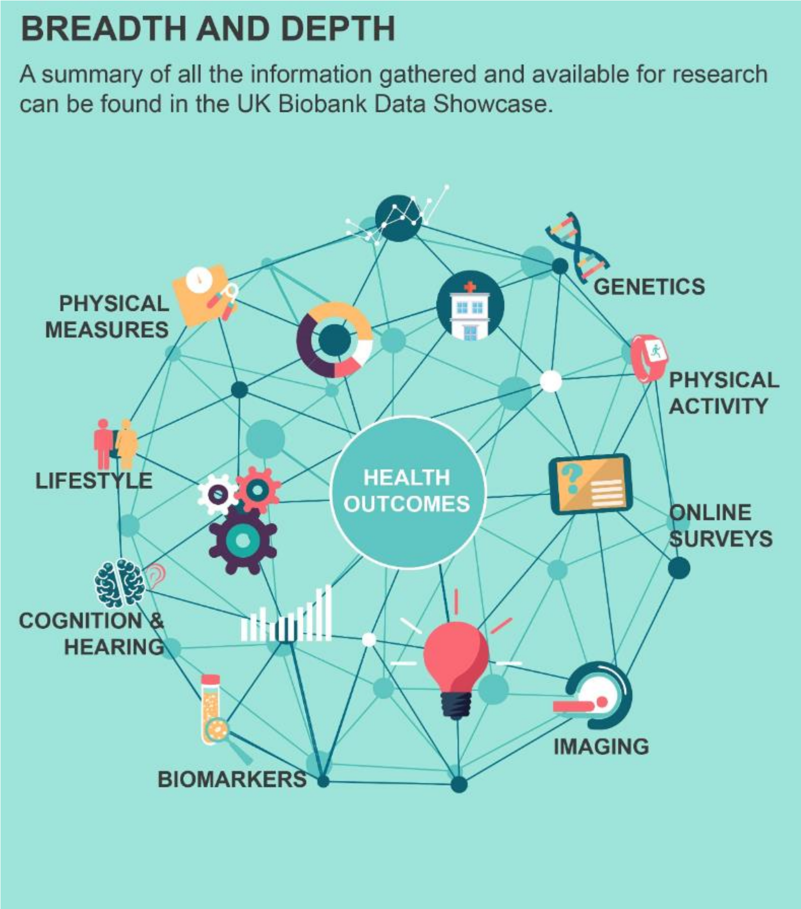
- 879 women & men age ≥ age 70
- Plus 80 participants ages 30-69
  - Communities around U. Pittsburgh and Wake Forest
  - Must walk >0.6 m/s and able to walk 400 m

- April 2019 ~ : 2 Medical sites

- Tissue biopsies & plus 2 days of examinations
  - Biopsies and biological specimens managed by Adventist Health (Translational Sciences Institute)
- Annual follow-up for 3 years
- In the 3rd year, we repeat some key baseline assessments

SOMMA
STUDY OF MUSCLE, MOBILITY AND AGING

UK Biobank



- a <u>population-based</u> prospective epidemiological study
- human health data from over 500, 000 adults aged 40-69 years from the United Kingdom
- Baseline Recruitment were done in 2006-2010.
- assessment involved sociodemographic and lifestyle factors, physical measurements, blood, and urine samples.

UK Biobank

Table 2. Data collected at the baseline assessment.

Questionnaire and interview	
Sociodemographic	Social class; ethnicity; employment status; marital status; education; income; car ownership
Family history and early life exposures	Family history of major diseases; birth weight; breast feeding; maternal smoking; childhood body size; residence at birth
Psychosocial factors	Neurosis; depression (including bi-polar spectrum disorder); social support
Environmental factors	Current address; current (or last) occupation; domestic heating and cooking fuel; housing; means of travel; shift work; mobile phone use; sun exposure
Lifestyle	Smoking; alcohol consumption; physical activity; diet; sleep
Health status	Medical history; medications; disability; hearing; sight; sexual and reproductive history
Hearing threshold	Speech reception threshold*
Cognitive function	Pairs matching; reaction time; prospective memory*; fluid intelligence*; numeric memory†

Physical measures	
Blood pressure and heart rate	two automated measures, one minute apart
Grip strength	Left- and right-hand grip strength
Anthropometrics	Standing and sitting height; weight and bio-impedance; hip and waist circumference
Spirometry	Up to three measures
Bone density‡	Calcaneal ultrasound
Arterial stiffness¶	Pulse wave velocity
Eye examination§	Refractive index, intraocular pressure; acuity; retinal photograph; optical coherence tomography
Fitness test§	Cycle ergometry with electrocardiogram (ECG) heart rate monitoring

* assessed in 170,000 participants;

† assessed in 50,000 participants;

‡measured in one heel for 170,000 participants and in both heels for 320,000 participants;

¶ measured in 170,000 participants;

§ measured in 100,000 participants

UK Biobank

Towards Global Eminence

Data type	Number of participants	Details	Date of data acquisition	Date first available for research[‡]
Baseline assessment	Whole cohort	Questionnaire, physical measures, samples (see Table 2); haematological assays done on fresh blood samples	2006–2010	Q2 2012
Repeat of baseline assessment	20,000–25,000	As above every few years, to allow correction for regression dilution due to measurement error and within person fluctuations in exposure levels [12].	2013–	Q3 2013
Biochemical assays (of baseline samples)	Whole cohort	Biomarkers with known disease associations (e.g., lipids for vascular disease), diagnostic value (e.g., HbA_{1c} for diabetes), or ability to characterize phenotypes not otherwise well assessed (e.g., renal and liver function tests).	2014–2015	2015
Genotyping (of baseline samples)	Whole cohort	Dense genotyping chip with >800,000 markers including: approximately 250,000 SNPs in a whole-genome array; approximately 200,000 markers covering CNV, loss of function, insertions, deletions, and previously identified risk factor or disease associations; approximately 150,000 exome markers covering a high proportion of non-synonymous coding variants with allele frequency >0.02%.	2013–2015	2015
Dietary Web questionnaire	210,000	Automatically coded dietary recall questionnaire, providing estimates of nutrient intake. 80,000 respondents completed it ≥ three times.	2011–2012	Q2 2013
Other Web questionnaires	350,000 to be approached	Participants invited by email to provide additional information via Web questionnaires about exposures (e.g., occupation) and health outcomes (cognitive function, depression) that are not readily identified from health record linkages.	2014–	2015
Accelerometry	100,000	Wrist-worn tri-axial accelerometers record information on type, intensity, and duration of physical activity.	2013–2015	2015
Multimodal imaging	100,000	MRI brain, heart, and abdomen (for lipid distribution); ultrasound of carotid arteries; whole body DXA scan of bones and joints	Pilot phase: 2014–2015 Main phase: 2016–2019	2015
Health record linkage	Whole cohort			
Death registrations		ICD-coded cause specific mortality	2006–	Q2 2013
Cancer registrations		ICD-coded cancer diagnoses	1971–*	Q2 2013
Hospital inpatient episodes		ICD-coded diagnoses, OPCS-coded procedures	1997–*	Q4 2013
Hospital outpatient episodes		Limited ICD and OPCS coding	2003–*	2015
Primary care		Read-coded information including diagnoses, measurements, referrals, prescriptions	Variable	2015

UK Biobank

- payment of the access fee

Description	Tier 1	Tier 2	Tier 3
Core data • Questionnaire and physical measurements • Health outcome phenotypes • Linked health data • Web-based questionnaires	✓	✓	✓
Assay data and enhanced measures • Biochemical and haematological assays • Other platform based assays • Measured and imputed genotypes • Other enhancements		✓	✓
Very large datasets • Imaging data • Other large-scale assay data • Whole genome sequence data • Whole exome sequence data			✓
First 3 years - access to data with scheduled updates	£3,000	£6,000 (+£3,000 vs Tier 1)	£9,000 (+£3,000 vs Tier 2)
Additional institution fee - each additional institution added to an application	£1,000 for first 3 years (£500 p.a. extension)		
Lower income countries and student researchers	£500 for first 3 years (£175 p.a. extension)		

* reduced access fee of £500

•The application is submitted by a student or their supervisor for the sole purpose of performing the student's research project (the resulting paper must be authored by the student)

The application cannot be used to conduct research for any other purpose, nor can it be used for multiple student (or other) projects

the Korean Genome and Epidemiology Study (KoGES)

- Ansan and Anseong cohorts of the KOGES
- 40 to 69 years, began in 2001. biennially evaluated
- The Korea Biobank Array generated 500,568 SNPs for this dataset
- multi-frequency BIA machine (Inbody 330; Biospace, Seoul, Korea)

JKMS

Demographic and Genome Wide Association Analyses According to Muscle Mass Using Data of the Korean Genome and Epidemiology Study

Jeong-An Gim [1*], Sangyeob Lee [2,3*], Seung Chan Kim [4], Kyung-Wan Baek [5,6], and Jun-Il Yoo [7]

the Korean Genome and Epidemiology Study (KOGES)

- During the 6th and 7th examination cycles **(2011–2014**), brain magnetic resonance imaging (MRI) scans and handgrip strength data were acquired.
- Four years later, follow-up brain MRI scans were conducted during the 8th and 9th exams (2015–2018).

Yu *et al. BMC Geriatr* (2021) 21:622
https://doi.org/10.1186/s12877-021-02581-4
BMC Geriatrics

RESEARCH Open Access

Sarcopenia is associated with decreased gray matter volume in the parietal lobe: a longitudinal cohort study

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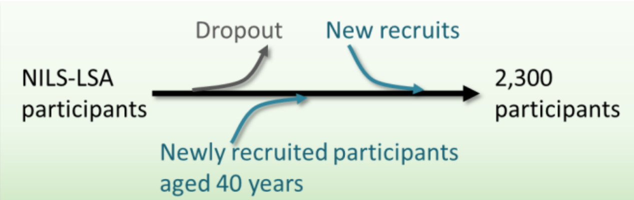
Purpose

- Systematic observation and description of the process of normal aging
- To identify factors associated with longevity

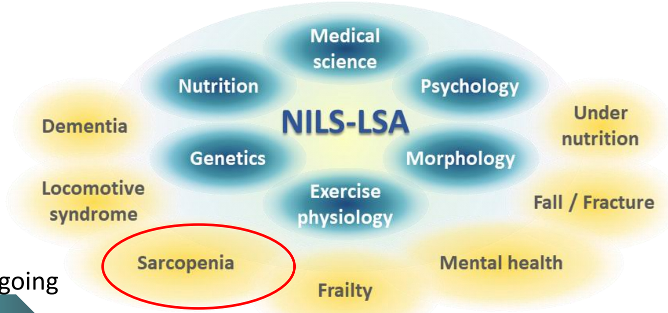
Dynamic cohort (1st–7th wave)



- **Area:** Obu and Higashiura in Aichi Prefecture, Japan
- **Participants:** Community dwellers randomly selected and stratified by age and gender
- **Age at baseline:** 40–79 years
- **1st Wave (1997–2000) Participants**

Age	Men	Women	Total
40–49	291	282	573
50–59	282	279	561
60–69	283	285	568
70–79	283	282	565
Total	1,139	1,128	2,267

National Center for Geriatrics and Gerontology



1997-	2000-	2002-	2004-	2006-	2008-	2010- 2012	2013-2016	2018- 2022	2023- Ongoing
1st wave	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
n=2,267	*n*=2,259	*n*=2,378	*n*=2,383	*n*=2,419	*n*=2,302	*n*=2,330	*n*=2,101	*n*=1,689	

Follow-up study

Shimokata et al., J Epidemiol, 2000

Some papers from KFACS, related with sarcopenia

High %BF : a/w low PP in women, not in men

Observational Study

Medicine

OPEN

Sex differences in association between body composition and frailty or physical performance in community-dwelling older adults

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- ✓ DXA
- ✓ cross-sectional, KFACS cohort, Korea
- ✓ low physical performance (SPPB ≤9)

Table 5

Univariate and multivariate logistic regression analyses of poor physical performance (SPPB score ≤ 9) and body composition.

	Male		Female	
	OR (95% CI)	*P*	OR (95% CI)	*P*
BMI				
Unadjusted	0.952 (0.894–1.014)	.129	1.046 (1.001–1.093)	*.045*[*]
Fully adjusted[†]	0.967 (0.903–1.036)	.337	1.058 (1.008–1.111)	*.022*[*]
BFP				
Unadjusted	1.017 (0.986–1.049)	.293	1.001 (0.978–1.024)	.936
Fully adjusted[†]	1.018 (0.985–1.052)	.277	1.034 (1.008–1.061)	*.010*[*]
FMI				
Unadjusted	1.113 (0.925–1.113)	.757	1.035 (0.976–1.097)	.245
Fully adjusted[†]	1.028 (0.929–1.137)	.593	1.090 (1.023–1.161)	*.008*[*]
FFMI				
Unadjusted	0.836 (0.748–0.935)	*.002*[*]	1.096 (0.996–1.207)	.062
Fully adjusted[†]	0.865 (0.767–0.974)	*.017*[*]	1.002 (0.899–1.115)	.977
TFMI				
Unadjusted	1.030 (0.898–1.180)	0.674	1.080 (0.984–1.186)	.106
Fully adjusted[†]	1.043 (0.901–1.208)	0.573	1.121 (1.014–1.240)	*.026*[*]

BFP = body fat percentage, BMI = body mass index, CI = confidence interval, FFMI = fat-free mass index, FMI = fat mass index, OR = odds ratio, SPPB = short physical performance battery, TFMI = trunk fat mass index.

Unless otherwise indicated, data are reported as relative risk (95% confidence interval).

[†] Adjusted for age, years of education, location of residence, depression, marital status, monthly income, smoking, alcohol drinking, and comorbidities, including diabetes mellitus, dyslipidemia, hypertension, osteoarthritis, and osteoporosis

[*] $P < .05$.

- “low” skeletal muscle index is negatively a/w SPPB ≤9, but trunk fat mass index is not in older men
- “high” trunk Fat Mass Index is a/w SPPB ≤9, but “low” skeletal muscle index is not in older women

FMI were calculated as the total fat mass and trunk fat mass according and TFMI to height squared, respectively (fat mass [kg]/height [m][2]).[

Medicine (Baltimore). 2021;100(4):e24400

Biomarkers of Sarcopenia, KFACS

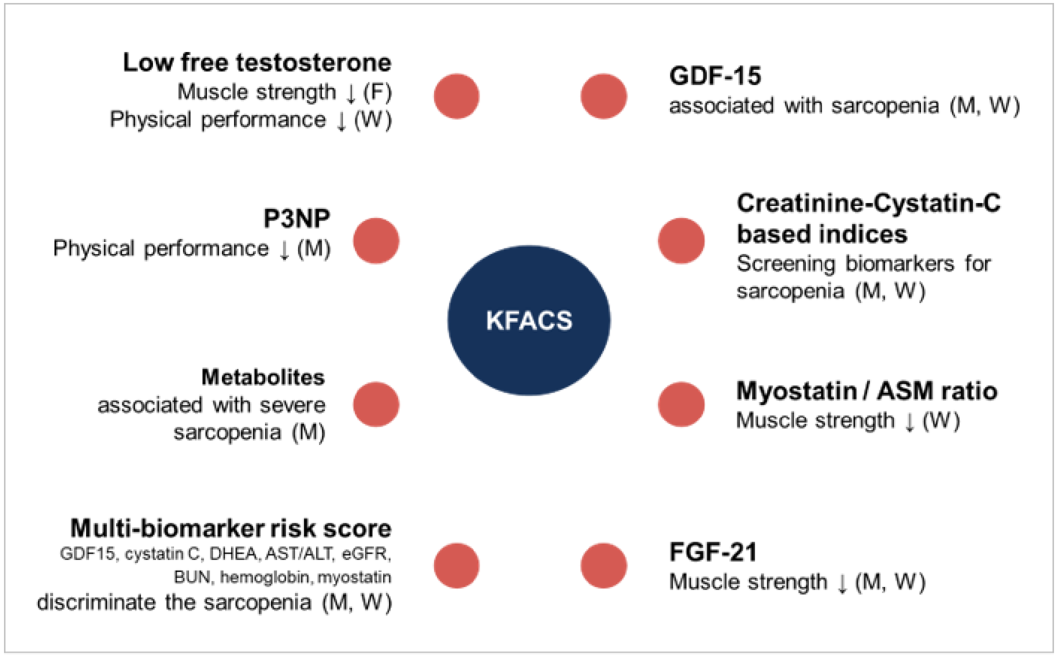

Figure 2. Blood-based biomarkers of sarcopenia: findings from the Korean Frailty and Aging Cohort Study (KFACS). " ↑ " refers to up-regulated; " ↓ " refers to down-regulated; "M" refers to men; "W" refers to women. *Abbreviations*: GDF-15, growth differentiation factor 15; P3NP, procollagen type III N-terminal peptide; FGF-21, fibroblast growth factor 21; ASM, appendicular skeletal muscle mass.

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From a solitary blood-derived biomarker to combined biomarkers of sarcopenia: Experiences from the Korean Frailty and Aging Cohort Study

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